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Final Environmental Management Programme with annexures (EMPr)

APPENDIX 39A

ENVIRONMENTAL MANAGEMENT PROGRAMME FOR THE EXPANSION OF THE CAPE WINELANDS AIRPORT.

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ENVIRONMENTAL MANAGEMENT PROGRAMME FOR THE EXPANSION OF THE CAPE WINELANDS AIRPORT

(P10 OF FARM 724, RE OF FARM 724, P23 OF FARM 724, P7 OF FARM 942, RE OF FARM 474, P3 OF FARM 474 AND P4 OF FARM 474)

JULY 2025

PREPARED FOR
CAPEWINELANDS AERO (PTY) LTD

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PLEASE NOTE THAT ALL CHANGES TO THE DRAFT REPORT FOR COMMENT (VERSION 1) ARE UNDERLINED.

PLEASE NOTE THAT ALL CHANGES TO THE DRAFT REPORT FOR COMMENT (VERSION 2) ARE UNDERLINED & IN BLUE.

EMPR DETAILS:

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GLOSSARY OF TERMS:

Activity - An activity or operation carried out as part of the construction or operation of the runway and associated infrastructure

Airside - The part of the airport used for the take-off, landing and taxiing of aircraft, consisting of runways, taxiways and aprons, as well as adjacent terrain and buildings or portions thereof, to which access is controlled. Usually consists of high traffic with few physical barriers and wide-open space.

Apron - The airside area assigned for aircraft and aircraft handling equipment operations and parking.

Applicant– The person or legal entity that has made application to the competent authority for environmental authorizations and who will have the overall responsibility to adhere to the relevant legislation and comply with the environmental authorization.

Construction Phase - The stage of project development comprising site preparation as well as all construction activities associated with the development.

Contractor–

(i) the main or specialised contractors as engaged by the Applicant for the execution of the works, including all sub-contractors appointed by the main contractor of his own volition for the execution of parts of the works.

(ii) any other contractor from time to time engaged by the Applicant directly in connection with any part of the works which is not a nominated subcontractor or a subcontractor to the main contractor.

(iii) the main or specialised operator as engaged by the Applicant from time to time for the execution of day-to-day operation.

(iv) Any company appointed by the Applicant to undertake construction or related activities on site, and will include the main Contractor, as well as any Sub-Contractors.

Council – the local municipal authority that operates or is responsible in said area.

dB(A) - A unit of sound level - a weighted sound pressure level.

Days – the days of the week excluding Sundays and legal public holidays.

Ecosystem - The interconnected assemblage of all species populations that occupy a given area and the physical environment with which they interact.

Environmental Authorisation - The authorisation by a competent authority of a listed activity or specified activity in terms of NEMA.

Environmental Management Programme (EMPr) – this document as amended or varied from time to time, to control the implementation of the works on the site in such a way as to ensure that they do not result in undue or reasonably adverse impacts on the environment.

Environmental Control Officer (ECO) – a suitably qualified individual or site manager to be appointed by the Applicant, and his successor/s should he cease to hold such appointment for any reason, to oversee the implementation of the EMPr and environmental agreement until the completion of works on the site.

Flight paths - Aircraft take-off (departure) and landing (approach) routes. Also referred to as flight tracks.

Hazardous substance - A substance (including materials and waste) that can have a deleterious (harmful) effect on the environment and those substances declared hazardous substances in terms of the Hazardous Substances Act 15 of 1973.

Land Surveyor - (LS)

Landside - The area outside an airport terminal building where road and pedestrian movements take place. It includes the road infrastructure, car rental facilities, parking, office blocks and various other services. This area is freely accessible to the public.

Method Statement - A mandatory written submission by the Contractor to the ECO setting out the plant, materials, labour and method the Contractor proposes using to carry out an activity.

Mitigation Measures - Design or management measures that are intended to avoid and/or minimise or enhance an impact, depending on the desired effect.

Operational Phase - The stage of the project following the Construction Phase, during which the proposed development will function or be used as anticipated in the Environmental Authorisation.

Resident Engineer (RE) – the representative Engineer present on site for the works undertaken during the Construction Phase.

Site Manager – the employee of the main contractor or Applicant responsible for the day-to-day control of all activities and operation on site.

Solid waste - All solid waste including construction debris, chemical waste, broken / redundant equipment, oil filters, wrapping materials, timber, tins and cans, drums, wire, nails, food and domestic waste (e.g. plastic packets and wrappers).

Sub-Contractors - A Sub-Contractor is any individual or Contractor appointed by the main Contractor, to undertake a specific task on site.

Taxiway - A defined path, on a land aero- route to be followed by taxying aircraft, connecting the runway to parking aprons.

Terminal Building - The building in which passenger processing associated with arrivals and departures takes place.

Works – the construction operations, all related and incidental works such as, but not limited to, site works, fencing, earthworks, roads, services, buildings etc.

LIST OF ACRONYMS:

AGL	Airfield ground lighting
AIP	Alien Invasive Plant
amsl	Above mean sea level
ARFF	aircraft rescue and firefighting
ATC	Air Traffic Control
ATM	Air Traffic Movements
ATNS	Air Traffic and Navigational Services
CA	Competent Authority
CARA	Conservation Of Agricultural Resources Act 43 of 1983
CBA	Critical Biodiversity Area
CMA	Catchment Management Agency
CoCT	City of Cape Town
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CONOPS	Concept of Operations
CTIA	Cape Town International Airport
CV	Curriculum Vitae
CWA	Cape Winelands Airport
dB	Decibels
DCP	Drop-weight cone penetrometer
DEA&DP	Department of Environmental Affairs and Development Planning
DMRE	Department of Mineral Resources and Energy
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
EAPASA	Environmental Assessment Practitioners Association of South Africa
ECA	Environmental Conservation Act, Act 73 of 1989
EIA	Environmental Impact Assessment
ELU	Existing Lawful Use
EMF	Environmental Management Framework
EMPr	Environmental Management Programme
ESA	Early Stone Age
FAFK	Fisantekraal Airfield (ICAO identifier)
FATO	Final Approach and Take-off
FAWN	Cape Winelands Airport (ICAO identifier)
FBO	Fixed Base Operations
FT	feet
GA	General Authorisation
GCFR	Greater Cape Floristic Region
GEOSS	Geohydrological and Spatial Solutions International (Pty) Ltd
GG	Government Gazette
GN	Government Notice
GSE	ground support equipment
GHG	Greenhouse Gas

GVA	Gross Value Added
ha	Hectares
HWC	Heritage Western Cape
ICAO	International Civil Aviation Organization
HDPE	High-density polyethylene
ILS	Instrument Landing System
IWRM	Integrated Water Resource Management
KPAs	Key Performance Areas
LCA	Landscape Character Areas
LED	Local Economic Development
LAeq	Equivalent A-weighted sound level
Leq	Equivalent continuous sound level
LReq.d	Maximum average ambient daytime (noise)
LReq.n	Maximum average ambient night-time (noise)
LReq,T	Equivalent continuous rating level
MARS	Multiple Aircraft Ramp System
µg/m^3	Micrograms per cubic metre
mg/m^2/day	Milligrams per square metre per day
MPPA	million passengers per annum
MPRDA	Minerals and Petroleum Resources Development Act
MRO	maintenance, repair, and overhaul
NATMAP	National Transport Master Plan
NCAP	National Civil Aviation Policy
NDCR	National Dust Control Regulations
NDP	National Development Plan
NEM: BA	National Environmental Management: Biodiversity Act
NEMA	National Environmental Management Act
NEM: AQA	National Environmental Management: Air Quality Act
NEM: WA	National Environmental Management: Waste Act
NHRA	National Heritage Resources Act
NM	Nautical Miles
NO_2	Nitrogen Dioxide
NTP	National Transport Policy
NWA	National Water Act
OECD	Organisation for Economic Co-ordination and Development
OIS	Obstacle Identification Surfaces
OLS	Obstacle Limitation Surface
PBB	Passenger Boarding Bridges
PES	Present Ecological State
ppb	Parts per billion
PTB	Passenger Terminal Building
PV	Photo Voltaic
RAM	Risk Assessment Matrix
RoW	Right of Way
SABS	South African Bureau of Standards

SACAA	South African Civil Aviation Authority
SAHRA	South African Heritage Resources Act
SANBI	South African National Biodiversity Institute
SANS	South African National Standards
SCC	Species of Conservation Concern
SDF	Spatial Development Framework
SDP	Site Development Plan
SO_2	Sulphur Dioxide
SPLUMA	Spatial Planning and Land Use Management Act 16 of 2013
TIA	Traffic Impact Assessment
TMA	Terminal Manoeuvring Area
UST	Underground Storage Tank
VFR	Visual flight rules
VOR	VHF Omnidirectional Range
WAM	Wide Area Multilateration
WCPSDF	Western Cape Provincial Spatial Development Framework
WHO	World Health Organisation
WULA	Water Use License Application
WWTP/WWTW	Wastewater Treatment Plant / Works

SECTION 1: INTRODUCTION & OVERVIEW

1.1 PROJECT BACKGROUND:

An Environmental Management Plan (EMPr) describes mitigation measures in detail, and is prescriptive, identifying specific individuals or organizations responsible for undertaking specific tasks to ensure that impacts on the environment are minimized during construction, operational and related activities. As an open – ended document, information gained during on-going monitoring of procedures on site could lead to changes in the recommendations and specifications of this document. The EMPr is therefore an adaptive management plan that will constantly evolve and be improved upon during the life cycle of the project. This document forms an agreement between the Department of Environmental Affairs and Development Planning (DEA&DP) and the Applicant that the environmentally sensitive features on the site will be suitably protected during the lifespan of the activity through the implementation of the applicable mitigation measures.

This document is intended to guide and manage the construction, operation and maintenance phase of the Cape Winelands Airport. Cape Winelands Airport (CWA) with International Civil Aviation Organization (ICAO) location identifier "FAWN", was formerly known as Fisantekraal Airfield (FAFK), and was acquired in November 2020 by a group of private businessmen, who since established Cape Winelands Airport Ltd. The site is located approximately 10.5km northeast of Durbanville and 25km northeast of Cape Town International Airport (CTIA), and the current airport site is 150ha in size.

The site is bordered by the R312 and Garden Cities urban development in the South, with several agricultural activities towards the East and North. North-West is a Corobrik mine in process of closure and the Fisantekraal Wastewater Treatment Works. The Bella Riva urban development and the County Fair Laying Farms are directly West of the CWA. Further West are Dirt & Dust recreational tracks, and Braam's Voerkrale. Southwest of the site is the Fisantekraal residential area, which links with the Greenville Garden Cities development. Table 1 and Figure 1 indicates the land parcels that form part of the site with Table 2 providing a summary of the land uses. Please refer to **Annexure 2: Locality Plan**.

Table 1: Summary of the land parcels forming part of the site.

FARM NR	Surveyor General Code																				Area (Ha)
P10 of Farm 724	C	0	5	5	0	0	0	0	0	0	0	0	0	7	2	4	0	0	0	1	0	114.1516
RE of Farm 724	C	0	5	5	0	0	0	0	0	0	0	0	0	7	2	4	0	0	0	0	0	43.6026
P23 of Farm 724	C	0	5	5	0	0	0	0	0	0	0	0	0	7	2	4	0	0	0	2	3	30.8711
P7 of Farm 942	C	0	4	6	0	0	0	0	0	0	0	0	0	9	4	2	0	0	0	0	7	256.9596
RE of Farm 474	C	0	5	5	0	0	0	0	0	0	0	0	0	4	7	4	0	0	0	0	0	397.9304
P3 of Farm 474	C	0	5	5	0	0	0	0	0	0	0	0	0	4	7	4	0	0	0	0	3	0.982
P4 of Farm 474	C	0	5	5	0	0	0	0	0	0	0	0	0	4	7	4	0	0	0	0	4	36.1295

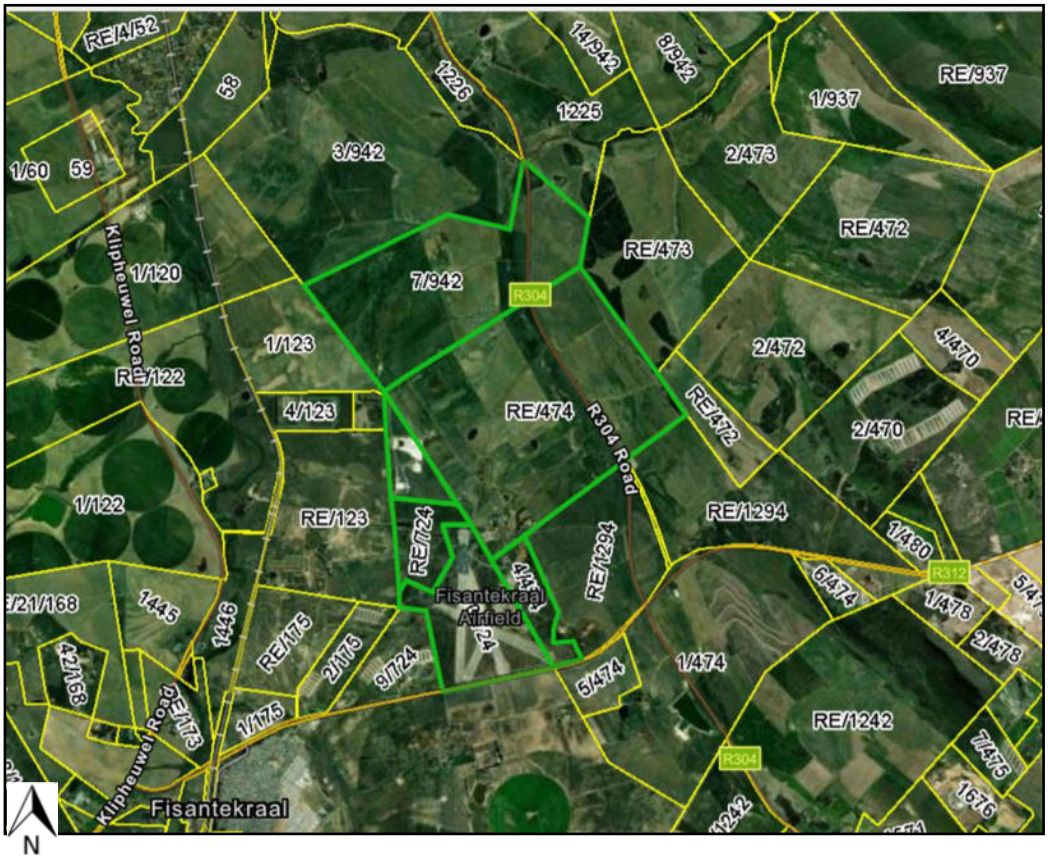


Figure 1: The site (green parcels) and adjacent land parcels (yellow) (PHS Consulting, CFM, March 2024).

Table 2: Summary of existing land uses on adjacent land parcels (Refer Figure 1).

Land portion	Description of landuse
RE/473	Agricultural – dryland wheat cultivation; some natural areas
RE/472	Agricultural – dryland wheat cultivation; some natural areas
RE/1294	Agricultural – dryland wheat cultivation; some natural areas
5/474	Agriculture; borrow area
ERF 4	Agriculture (feedlots, cultivation) and housing (Future Garden Cities)
9/724	County Fair chicken laying and rearing
RE/123	Agriculture (feedlots and cultivation) (Future Bela Riva)
RE/2/123	Feedlots (Future Bela Riva)
1/123	Agriculture cultivation
3/942	Agricultural – dryland wheat cultivation; some natural areas
1226	Agriculture cultivation
1225	Agriculture cultivation

Cape Winelands Airport has the following vision "*To be a fresh, unique, 'first of its kind' development that blends technical aviation requirements with strong commercial property development principles. The aim is to be a true catalytic legacy project, and it is envisaged to be one of the single most impactful economic drivers the region will see in decades, creating value for all stakeholders*".

The airport aims to develop into an international commercial airport and multimodal logistics hub, with excellent rail, road, and air connectivity. The airport upgrades associated with the development will deliver an airport capacity of 5,2 million passengers per annum (MPPA).

Infrastructure and facilities' sizing was appropriately matched with CWA's traffic forecast and ambitions to facilitate general aviation, domestic scheduled operations, international scheduled operations as well as positioning itself as the full reliever airport to Cape Town International Airport. The proposed development ensures that CWA can accommodate any aircraft type currently flying into Cape Town, including Code F aircraft, should airlines have to divert. The Site Development Plan (SDP) for the proposed development is provided in **Annexure 3A**.

1.2 ENVIRONMENTAL ATTRIBUTES:

1.2.1 Geology, Topography, Geohydrology and Geotechnical conditions

1.2.1.1 Topography

The **topography** of the site and surrounds is characterised by typical grass-covered low-relief rolling hills with a typical on-site elevation between 90 - 130m above mean sea level (amsl). In this region, there is a low drainage density (Stapelberg, 2009) as natural slope surfaces rarely exceed 12°. Drainage channels and small tributaries occupy the lower-lying areas between the low-relief hills.

The current CWA site is characterised by generally flat terrain with little undulation, while the northern extent of the proposed expansion area is characterised by undulous terrain with rolling hills.

1.2.1.2 Geology

The **geology** of the proposed CWA consists of shale of the Tygerberg Formation (Nt), which forms part of the Malmesbury Group and constitutes the basement rock of the area. Regionally the Malmesbury Group is overlain by different quaternary formations.

The bedrock in the region is shown to be predominantly Malmesbury Group (Nt) rocks; these are often associated with overlying ferricrete gravels/nodules. The Malmesbury Group rocks typically dip steeply to the northwest. Rapid transitions occur within this unit between easy-weathering siltstone/phyllite to more competent greywacke/sandstone. This can lead to large differences in depth of weathering/depth and development of the soil profile over relatively short distances.

Although intrusions of the Cape Granite Suite are not indicated, indications of minor intrusive, or fault-bounded bodies of granite occur in this region. These are considered extensions/satellite intrusions of the Kuilsriver–Helderberg pluton.

A regional fault system (the Colenso Fault) is mapped along the northeastern boundary of the CWA. This fault structure extends from Klapmuts in the Winelands to Langebaan on the West Coast.

1.2.1.3 Geohydrology

The **geohydrological** of the site is underlain by alluvium, colluvium, and weathered bedrock of the Malmesbury Group and Cape Granite Suite (GEOSS, 2022b). The aquifer in the area is classified as a "fractured" aquifer with potential borehole yields between 0.5 – 5.0L/s. The groundwater quality of the area, based on one laboratory sample, hydrocensus data and the NGA data indicate that the EC ranges from 19.7mS/m to 632mS/m which means the groundwater quality ranges from "ideal" to "poor" (in terms of EC). During the hydrocensus it was found that there are other existing groundwater users in the surrounding area, and that most of the users abstract groundwater from the fractured aquifer. The water levels range from shallow to deep (from 1.24mbgl to 71mbgl).

The site has a low to low/medium vulnerability classification, which means that the susceptibility of the aquifer to contamination from anthropogenic activities is low to medium. This classification is because the Malmesbury Group rock weathers to a clay. Clays are typically associated with lower permeability, retarding the migration of potential contaminants, and offering protection to potentially underlying aquifers. The clay found underlying the site, does provide some degree of protection to the underlying fractured rock aquifer.

Aquifer vulnerability increases to the north-east where the Colenso Fault system is located. This area should be considered as a sensitive area in terms of groundwater.

1.2.1.4 Geotechnical conditions

The **geotechnical conditions** of the region were mapped at 1:50 000 scale by the Council for Geoscience (CGS) in 2006 (3318DC Bellville - Geotechnical Series), refer Figure . The geotechnical series provides an indication of the likely soil conditions and construction constraints at a particular location, for example, the soil beneath the site has been classified (according to the CGS) as 'M8', indicating that "*some precautionary measures needed to overcome engineering-geological problems*". Potential problems/conditions that may be experienced with subsoils of this classification are shown in Table .

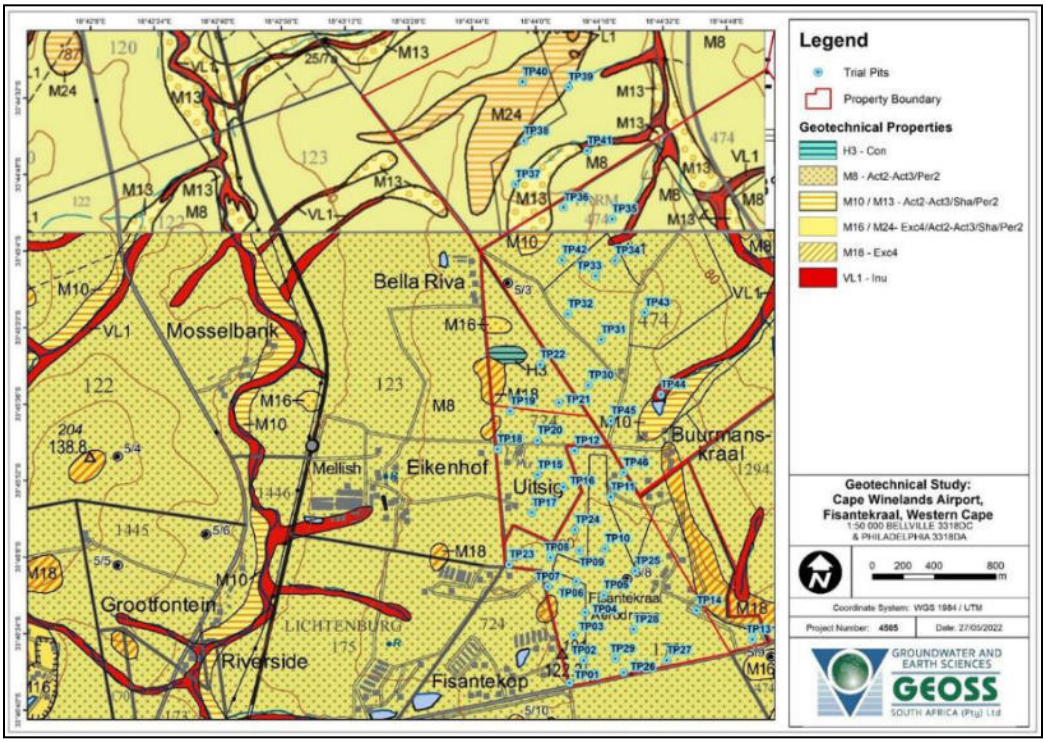


Figure 2: Large scale Geotechnical conditions of the site and surrounds showing the positions of the trial pits (3318DC – Bellville, GCS 2008) (GEOSS, Geotechnical Report, Sept 2023).

Table 3: Potential geotechnical constraints in the region of the site (after CGS, 2009) (GEOSS, Geotechnical Report, Sept 2023).

Geotechnical Condition/ Property	Description	Severity Class / Resulting Cost Implication
Permeability (Map Code: Per)	Permeability measures the flow of water through saturated soil. This is determined by the grain size and shape and the degree of compaction of the soil.	Low permeability (< 3 x 10cm/s)
Shallow water table (Map Code: Sha)	Water table occurring at shallow depth - often seasonal.	Moderate
Loose sand (consolidation) (Map Code: Con)	Material susceptible to excessive consolidation when used as foundation horizon. Non cohesive sands.	Low
Active clay (Map Code: Act2-Act3)	The degree of expansion experienced when dry clayey soils are moistened to full saturation. In addition to the activity, the clay horizon depth and thickness contribute towards determining the amount of surface movement (expansion/contraction).	The residual soils of the Tygerberg Formation may exhibit low to medium expansiveness. Medium cost implications may be incurred due to this type of material

A total of forty-six (46) trial pits were excavated and thirty-five (35) drop-weight cone penetrometer (DCP) tests were performed across the proposed CWA expansion site. Five Geotechnical Zones were delineated based on the investigation results (Figure 3):

A – Residual materials derived from granitoid sources.

B – Residual Materials derived from pelitic sources.

C – Area falling within Zones A and B with residual soils exhibiting characteristics of potentially expansive materials, and/or soils that are prone to settlement.

D - Areas of relatively deep/thick transported aeolian sand.

E – Areas of surficial ferricrete and/or silcrete.

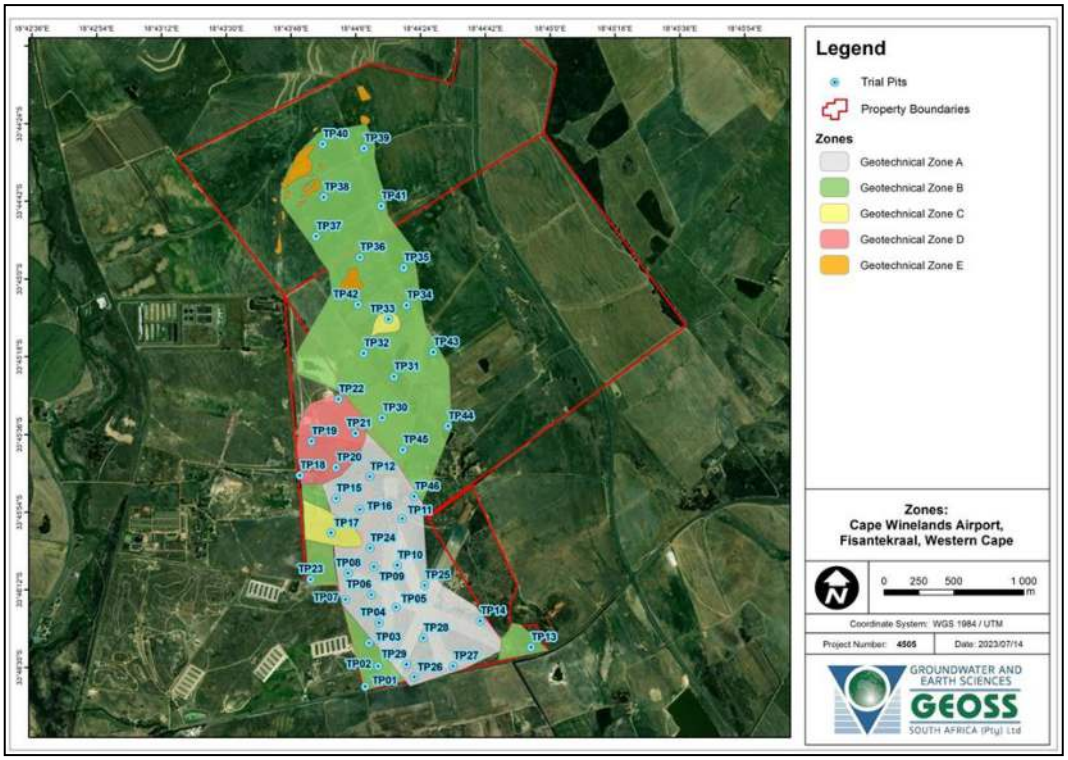


Figure 3: Aerial imagery showing interpreted Geotechnical Zone boundaries (GEOSS, Geotechnical Report, Sept 2023).

1.2.1.5 Mining

The Uitsig quarry (described as Uitsig Clay Pit) with **Mining** Licence ML17/2001 is located on P23/724 and a portion of RE/474 and has been operational since 2003. The land and the mining right/ permit is owned Corobrik (Pty) Ltd, and as part of the planned acquisition of the land for the proposed CWA expansion, a mine closure application has been lodged with DMRE by Corobrik (Pty) Ltd.

1.2.2 Climate, Ambient Air Quality and Baseline Noise

1.2.2.1 Climate

The Fisantekraal area experiences a Mediterranean **Climate** with mild wet winters and warm dry summers. Figure shows the monthly average air temperature and Figure shows the monthly median rainfall and evaporation distribution for the Fisantekraal area (Schulze, 2009). The long term (1950 – 2000) mean annual precipitation for the Fisantekraal area is approximately 532mm/annum. The rainfall typically exceeds evaporation rates in the winter months between May and August, and mists are common in winter.

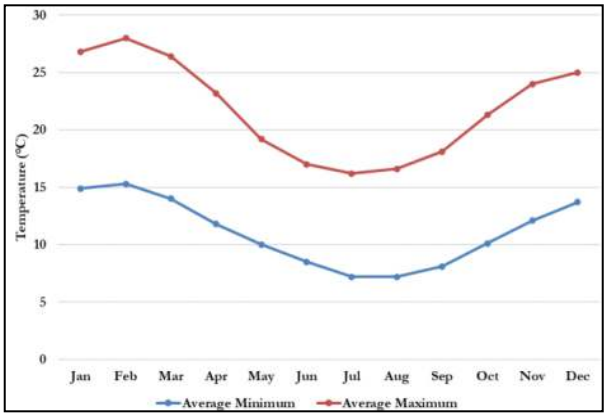


Figure 4: Monthly average air temperature for the Fisantekraal area (Schulze, 2009) (GEOSS, Geohydrological Scoping Report, Sept 2023).

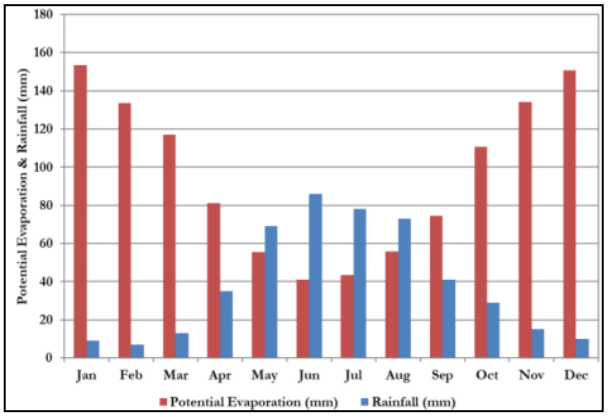


Figure 5: Monthly average air temperature for the Fisantekraal area (Schulze, 2009) (GEOSS, Geohydrological Scoping Report, Sept 2023).

At an elevation of only ±120m amsl and about 25km from the Atlantic coastline the climate is marginally maritime, i.e., mean temperature difference between hottest and coldest month is <10°C. The average annual rainfall is 532mm, of which only 94mm (<20%) is summer rain between October to March. Four years (2016-2019) of hourly local meteorological data from the CTIA weather station was obtained. The full four-year data was used for the establishment of the local wind field.

The wind characteristics are illustrated with the aid of wind roses and wind speed frequency distribution charts. The wind rose is a diagram that illustrates the frequency of the wind speeds and directions. Wind roses were generated for 16 cardinal wind directions. The wind directions are shown as from where the wind blows; the wind classes are indicated by the coloured bars; the frequencies of occurrence of the wind are indicated by the dashed circles.

Predominant winds are from the southerly direction, for both daytime and night-time. Moderate winds dominate during the daytime and light to moderate winds prevail at night-time, with average wind speeds at 6.28m/s and 4.58m/s for daytime and night-time respectively. Northerly and north-westerly winds predominate in winter, while in summer, southerly winds prevail. The wind speeds in summer are higher than that in winter - averaged wind speeds are 6.58m/s and 4.54m/s for summer and winter respectively.

1.2.2.2 Ambient Air Quality

The Western Cape Province and the City of Cape Town operate several ambient **air quality** monitoring stations in the region. The stations closest to the project site include:

- The Wallacedene Station, located in Kraaifontein, approximately 10km South of the CWA;
- The Paarl Station, which is approximately 21km East of the CWA; and
- The Stellenbosch Station, which is approximately 22km to the southeast of the CWA.

The measured average annual concentrations of SO_2, NO_2, O_3, $PM_{2.5}$ and PM_{10} were within their relevant ambient air quality standards except for PM_{10} in 2022 at the Wallacedene Station. The overall data availability was approximately 33.6%. There is no data for NO_2, O_3 and $PM_{2.5}$ in 2021.

The Paarl Station is equipped to measure the ambient concentrations of SO_2, NO_2, O_3, and CO. The measured concentrations were below their respective standards. The overall data availability was 38.5%.

SO_2, NO_2, O_3, $PM_{2.5}$ and PM_{10} were also monitored at the Stellenbosch Station. The measured average annual concentrations were all within their relevant national ambient air quality standards. It can be observed from the available data that the measured concentrations of $PM_{2.5}$ and PM_{10} were lower when compared to those from Wallacedene station. The overall data availability was 52.4% for the three years.

Existing emissions sources:

The CWA project site is located on the outskirt of the Cape Town Metropolitan. It is surrounded by farmlands. The main land uses in the area include agriculture and poultry farming, i.e., the County Fair Poultry Farm, which is located on the western border of the CWA. The existing emission sources within the study area may be grouped into three categories:

1) Industrial Sources:

Industrial emissions mainly due to combustion installations contribute to the ambient levels of the primary pollutants, e.g., SO_2, NO_2, PM_{10} and CO. Based on a desktop review of the area, the following plants / factories within 5km of the project area were identified:

- Fisantekraal Wastewater Treatment Works, which is less than 1km away from the project site to the northwest;
- County Fair Primary Processing Plant is located approximately 2km South of the CWA;
- Claytile brick factory is located approximately 4km from the CWA to the southeast; and
- Clay Industry brick factory is located approximately 5km southwest of the CWA.

The existing operations at the CWA and the onsite GA fuel tank have a very small contribution on the air pollution emissions in the area and are considered insignificant.

2) Residential Sources:

Household fuel burning, mainly used for heating and cooking in informal areas, constitutes a source of emission. The common fuels used are coal, wood, and paraffin. The main pollutants emitted are the primary pollutants, such as sulphur dioxide, carbon monoxide nitrogen oxides, particulate matter, as well as hydrocarbons and volatile organic compounds. In addition to the above-mentioned air pollutants, coal burning emits heavy metals.

The main community in the project area is Fisantekraal, which is located approximately 2.5km to the southwest of the CWA. Local dwellings and farmhouses are sparsely located in the study area.

3) Vehicular Traffic

Vehicular traffic is also a source of air pollutant emissions. These emissions include primary pollutants from the vehicle exhausts, such as carbon monoxide, sulphur oxides, nitrogen oxides, as well as hydrocarbons. Fugitive dust emissions may also occur because of vehicle-entrained dust from road surfaces. The major routes in the area include R302, R304, R312 and the local road network. Currently the existing traffic volumes on the main roads and the local road network are very small and are not expected to have a significant impact on the local air quality.

The sensitive receptors around the CWA include the local dwellings/farmhouses, the Klipheuwel community situated to the north of the airport and the Fisantekraal community towards the southwest. The Fisantekraal high school is located northeast of Fisantekraal, next to the R312 road. There are also various poultry farms around the project site. Some of the identified sensitive receptors are shown in Figure below.

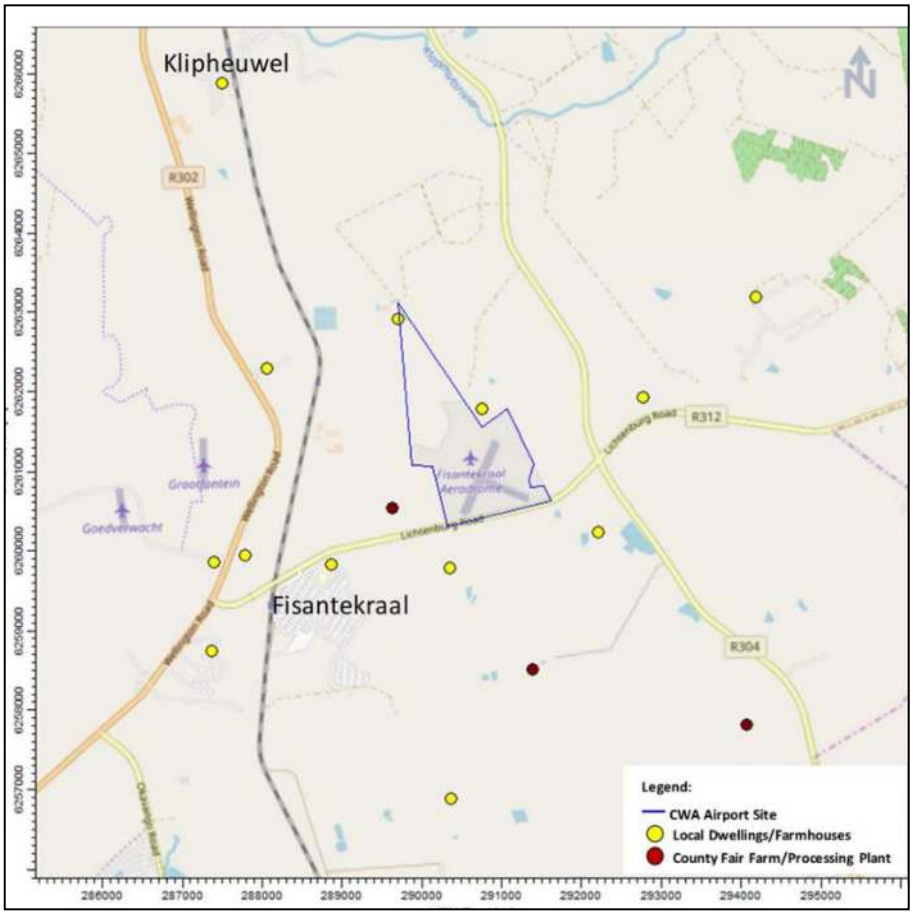


Figure 6: Sensitive Receptors identified around the CWA site (DDA, Baseline Air Quality Report, Oct 2023).

1.2.2.3 Baseline Noise

Baseline measurements were performed using two 01DB DUO sound level meters (SLM) at five selected measurement points (MP). One SLM was placed within the Fisantekraal community (MP04), and a continuous measurement was carried out from the 14th to the 22nd of April 2022. The second SLM was used to measure intermittently the **noise** levels at the remaining four locations, i.e., at MP01, MP02, MP03 and MP05. The locations of the monitoring points can be seen in Figure 7.

MP01 was located within the current CWA site, while MP02 was situated outside the County Fair Poultry Farm, which is about 1km West of MP01. Point MP03 was placed outside the Fisantekraal High School and point MP05 at the Klipheuwel community, approximately 6.3km North of the airport site. It should be noted that the community around the Mikpunt train station is also considered as part of the general Klipheuwel area.

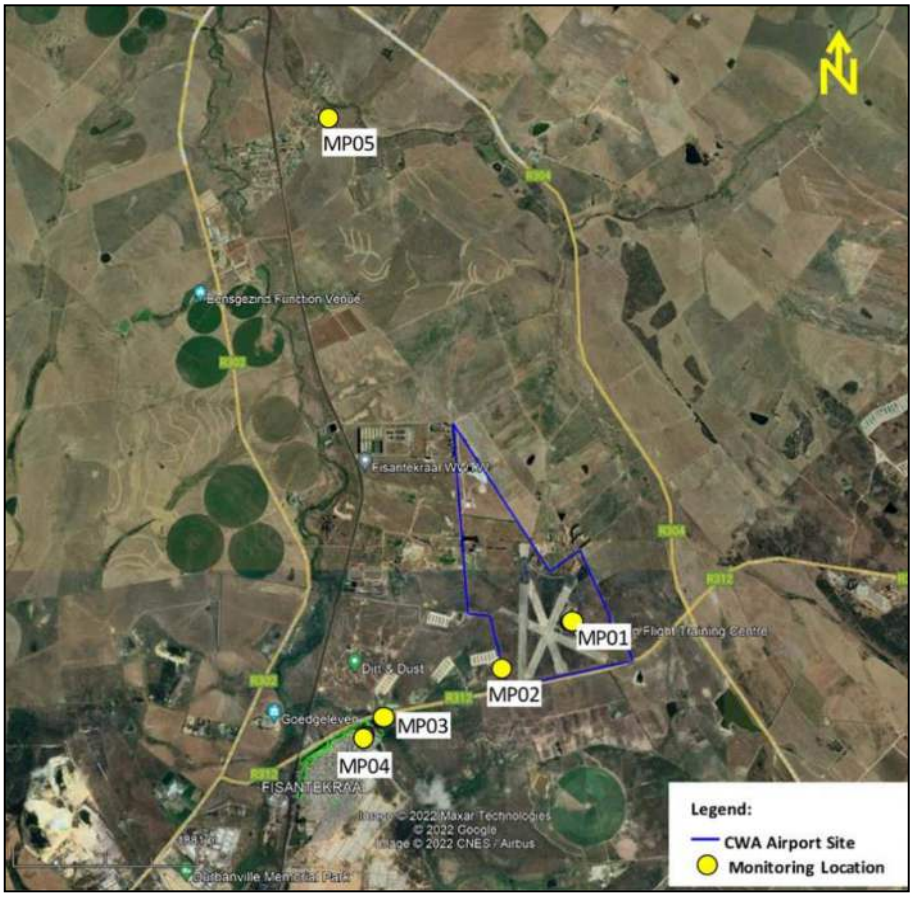


Figure 7: Noise Measurement Locations (DDA, Baseline Noise Report, Oct 2023).

The area directly west of the existing airport is designated for industrial use in the Northern District Plan. This area, north of Lichtenburg Road (R312), extends west from the airport to the railway line.

The areas west and south of the airport are marked for urban residential development and fall within the current Urban Development Edge.

The MP01, which is located within the CWA site, is considered an Industrial District, and the area at MP02 (County Fair Poultry Farm) falls under the planned industrial zones (as per the Sub-district 3 Plan in the Northern District Plan).

The points MP03, MP04 and MP05 were positioned within areas that are or have been marked for Urban developments. The monitoring point MP03 was positioned at the closest school to the CWA. Similar to MP04, the area in which the school is situated is also considered an Urban Residential District, since it is located on the border of the Fisantekraal residential area and is adjacent to the Regional Route R312.

Baseline noise monitoring established the following:

The closest residential noise-sensitive receptors to the Cape Winelands Airport operations are the two residential communities of Fisantekraal, towards the West, and Klipheuwel, towards the North.

The current noise levels at the Fisantekraal residential area exceed the SANS guideline levels for Urban Districts, with the main noise sources being human activities and vehicular traffic on the local road network. The daytime noise level was around 58dB(A) and the night-time 49dB(A).

The current noise levels at the Klipheuwel residential area only reached 41dB(A) and 38dB(A) during the day- and night-time respectively, which are well below the guideline levels for Suburban Districts with little road traffic. The main noise sources there are dogs barking, human activities, nature sounds and local vehicular traffic.

The current noise levels at the Fisantekraal High School, primarily due to the vehicular traffic on the R312 and the local road network, are currently equal to the guideline of 55dB(A) for Urban Districts.

The County Fair Poultry Farm is experiencing 54dB(A) and 39dB(A) during day- and night-time respectively on its boundary. The main noise sources at MP02 are vehicular traffic, poultry sounds, the CWA's current aircraft operations and nature sounds.

1.2.3 Natural Systems and Biodiversity

Baseline investigations on Terrestrial and Aquatic Ecology identified development constraints which inform the proposed development and the required authorisation processes. These biophysical constraints are illustrated in Figure 8.

Please refer to **Annexure 3B**, which includes a map showing the proposed activity components and associated infrastructure on the environmental sensitivities of the site including no-go areas for development.

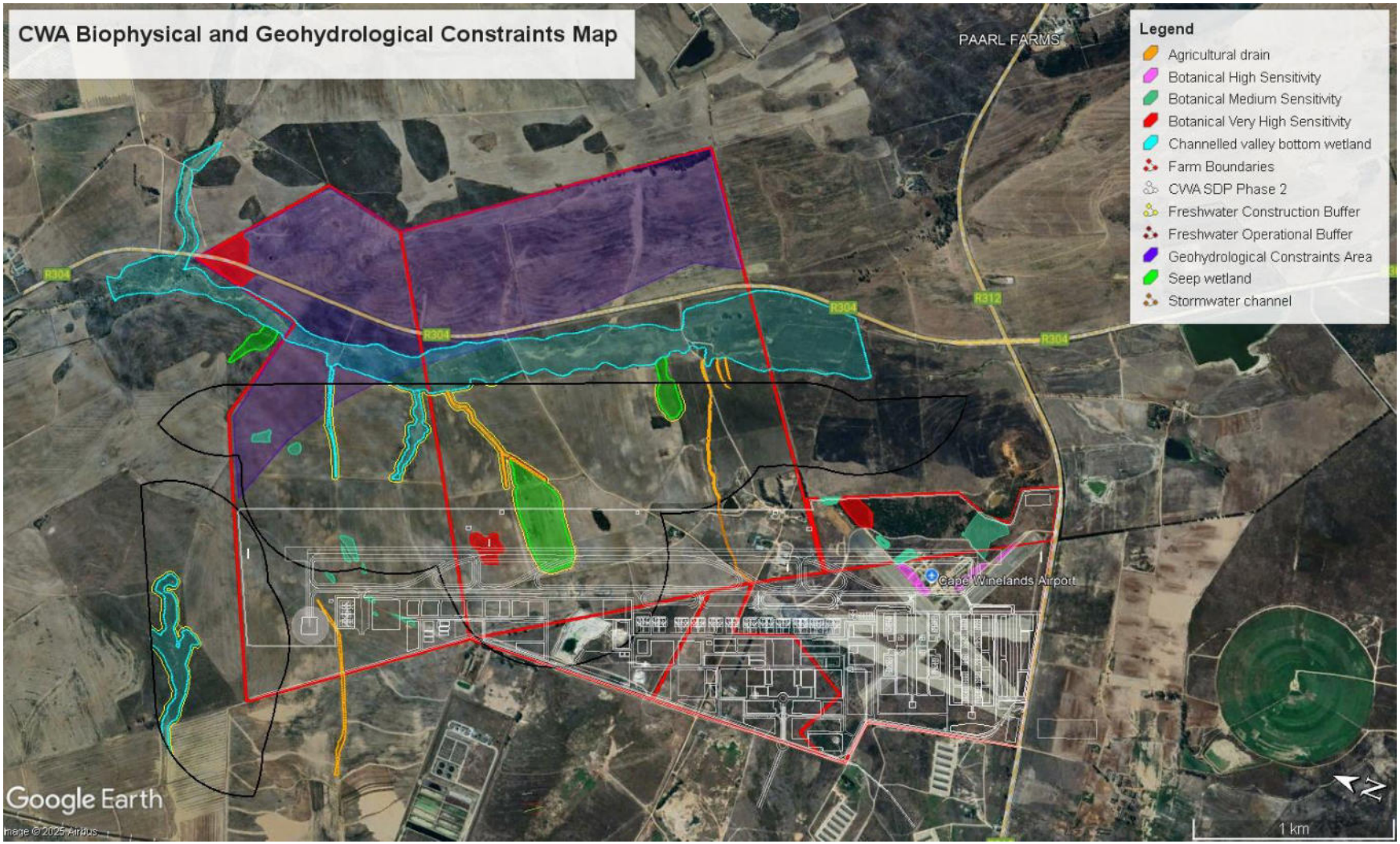


Figure 8: CWA Biophysical and Geohydrological Constraints: 15m construction and operational wetland buffer indicated by yellow outline; 500m ZoR indicated by black outline; 16m operational phase conservation buffer around seep wetland indicated by purple outline (PHS Consulting, March 2025) (Annexure 3B).

1.2.3.1 Botanical

The study area is part of the West Coast Renosterveld bioregion (Mucina & Rutherford 2006), and is part of the Fynbos biome, located within what is now known as the Core Region of the Greater Cape Floristic Region (GCFR; Manning & Goldblatt 2012). The GCFR is one of only six Floristic Regions in the world and is the only one largely confined to a single country. It is also by far the smallest floristic region, occupying only 0.2% of the world's land surface, and supporting about 11 500 plant species, over half of all the plant species in South Africa (on 12% of the land area). At least 70% of all the species in the Cape region do not occur elsewhere, and many have very small home ranges (these are known as narrow endemics). Many of the lowland habitats are under pressure from agriculture, urbanisation, and alien plants, and thus many of the range restricted species are also under severe threat of extinction, as habitat is reduced to extremely small fragments. Data from the nationwide plant Red Listing project indicate that 67% of the threatened plant species in the country occur only in the southwestern Cape, and these total over 1800 species (Raimondo et al 2009). It should thus be clear that the southwestern Cape is a major national and global conservation priority and is quite unlike anywhere else in the country in terms of the number of threatened plant species.

According to the SA Vegetation Map three different vegetation types would have occurred in the study area before human disturbance (see

Figure), although one of these (Cape Flats Sand Fynbos) would barely have been present on site.

Further to this **"Swartland Shale Renosterveld** would have covered most of the site and is regarded as **Critically Endangered** on a national (DEA 2011; Skowno et al 2019) and regional basis (Holmes et al 2008). Less than 9% of its total original extent remains intact, less than 1% is conserved, and the national conservation target is 26% (Rouget et al 2004). The unit is known to support a very large number of plant Species of Conservation Concern (Raimondo et al 2009), many of them being bulbs (geophytes) or succulents and occurs on fertile shale derived soils in the lowland region from Piketberg to Somerset West. This vegetation type needs regular fire for optimal ecological functioning (Helme & Rebelo et al 2016).

Swartland Silcrete Renosterveld would have covered about 15% of the greater study area and is also regarded as **Critically Endangered** on a national basis (DEA 2011; Skowno et al 2019) and regional basis (Holmes et al 2008). Less than 10% of its total original extent remains intact, less than 1% is conserved, and the national conservation target is 26% (Rouget et al 2004). The unit is small in total extent (even prior to human influence) and is also known to support many plant Species of Conservation Concern (Raimondo et al 2009), and occurs on ferricrete (koffieklip) and silcrete outcrops in the lowland region from Piketberg to Somerset West. This vegetation type also needs regular fire for optimal ecological functioning (Helme & Rebelo et al 2016).

Cape Flats Sand Fynbos was barely present on site originally but is also regarded as **Critically Endangered** on a national (DEA 2011; Skowno et al 2019) and regional basis (Holmes et al 2008). Less

than 19% of its total original extent remains intact, less than 1% is conserved, and the national conservation target is 30% (Mucina & Rutherford 2006). The unit is also known to support a very large number of plant Species of Conservation Concern (Raimondo et al 2009) and occurs on acid sands on the lowlands between Atlantis and False Bay.

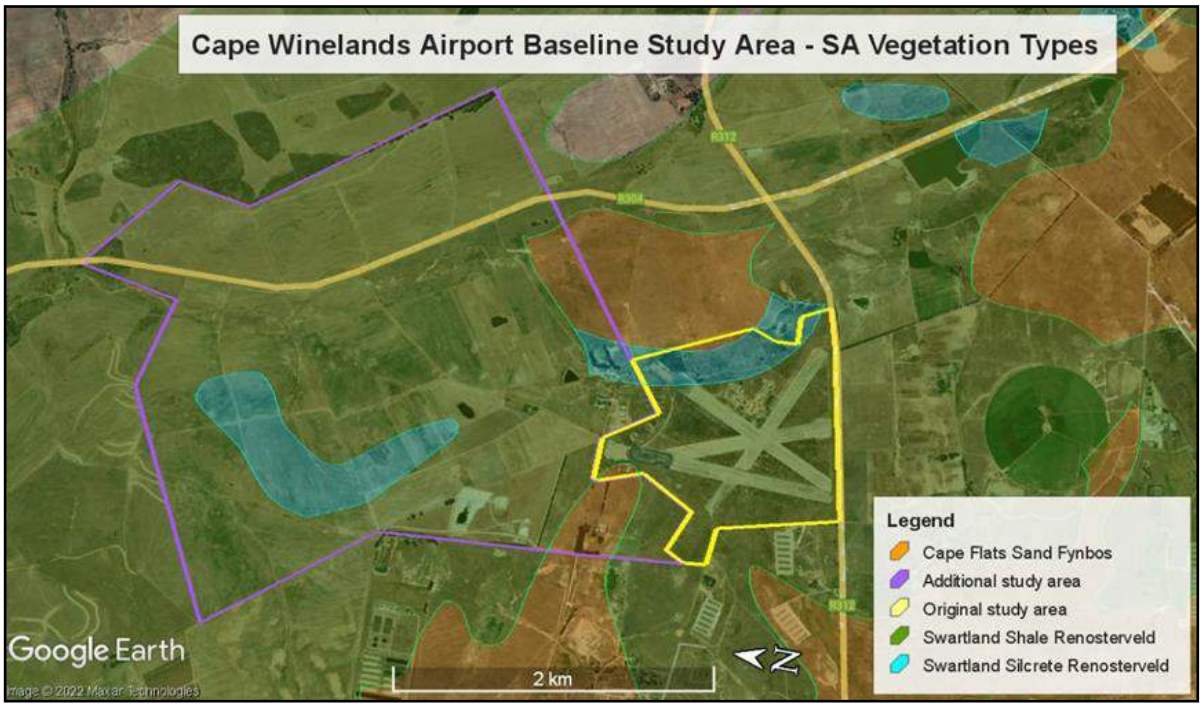


Figure 9: Extract of the SA Vegetation Map showing that three different vegetation types would originally have occurred in the study area, with Swartland Shale Renosterveld making up the bulk of the site (Nick Helme Botanical Surveys, Botanical Baseline report, August 2020).

There was (and still is, in the form of seedlings) a high to very high density of woody alien invasive vegetation in most of the original study area, comprising mostly *Acacia saligna* (Port Jackson), but also with occasional *Leptospermum laevigatum* (Australian myrtle), *Pinus* sp. (Pines) and *Eucalyptus* sp. (gums). Total woody alien invasive vegetation cover ranged from 50% to 100%, with an average overall of about 75%, prior to clearance of most of the original study area in late 2020 and early 2021. The biocontrol fungus has infected most of the Port Jackson and is reducing seed set and even killing some of the plants, but even if all above ground specimens are removed there is likely to be a massive seedbank that would germinate after fire or similar clearing (which has proven to be the case). Nearly all the dense woody alien invasive cover is a response to previous soil disturbance, which may have included cultivation, followed by ferricrete quarrying in places, and extensive disturbance associated with development and maintenance of the airport. Even the small areas seemingly not disturbed by any of the above have been invaded by aliens, simply because of seed dispersal.

As expected in such a disturbed area the understorey is also often dominated by alien invasive herbs and grasses, such as *Plantago lanceolata* (ribwort plantain), *Echium* spp. (Pattersons curse), *Erodium* spp. (cranesbill), *Lolium* spp. (ryegrass) and *Avena* (oats).

Surprisingly, most of the site has not been burnt in the last 14-25 years (as judged by the vegetation on site, and by historic satellite imagery going back to 2004), and much of the indigenous vegetation can thus be considered due or overdue for a fire, as Renosterveld is a fire driven vegetation type (Helme & Rebelo 2016), requiring fire once every 8-12 years for optimal ecological functioning. In the absence of fire for more than 15 or 20 years evident (above ground) plant species diversity can be expected to drop off quickly but can bounce back quite dramatically after a fire (from soil stored seedbanks).

There is no indigenous plant cover in the large, cultivated areas, comprising about 80% of the total study area.

Indigenous plant diversity is very low in the most disturbed parts of the original study area, and is low overall, compared to pristine Renosterveld, which would have at least 250 species in a site of this size (if pristine). However, the least disturbed areas of Medium, High and Very High sensitivity have increasingly high levels of indigenous plant diversity, with an overall total of about 50 species recorded in the original study area. An additional 30 plant species were recorded in the additional study area in March 2022, taking the site total up to about 80 plant species. Refer to Figure 10 below.

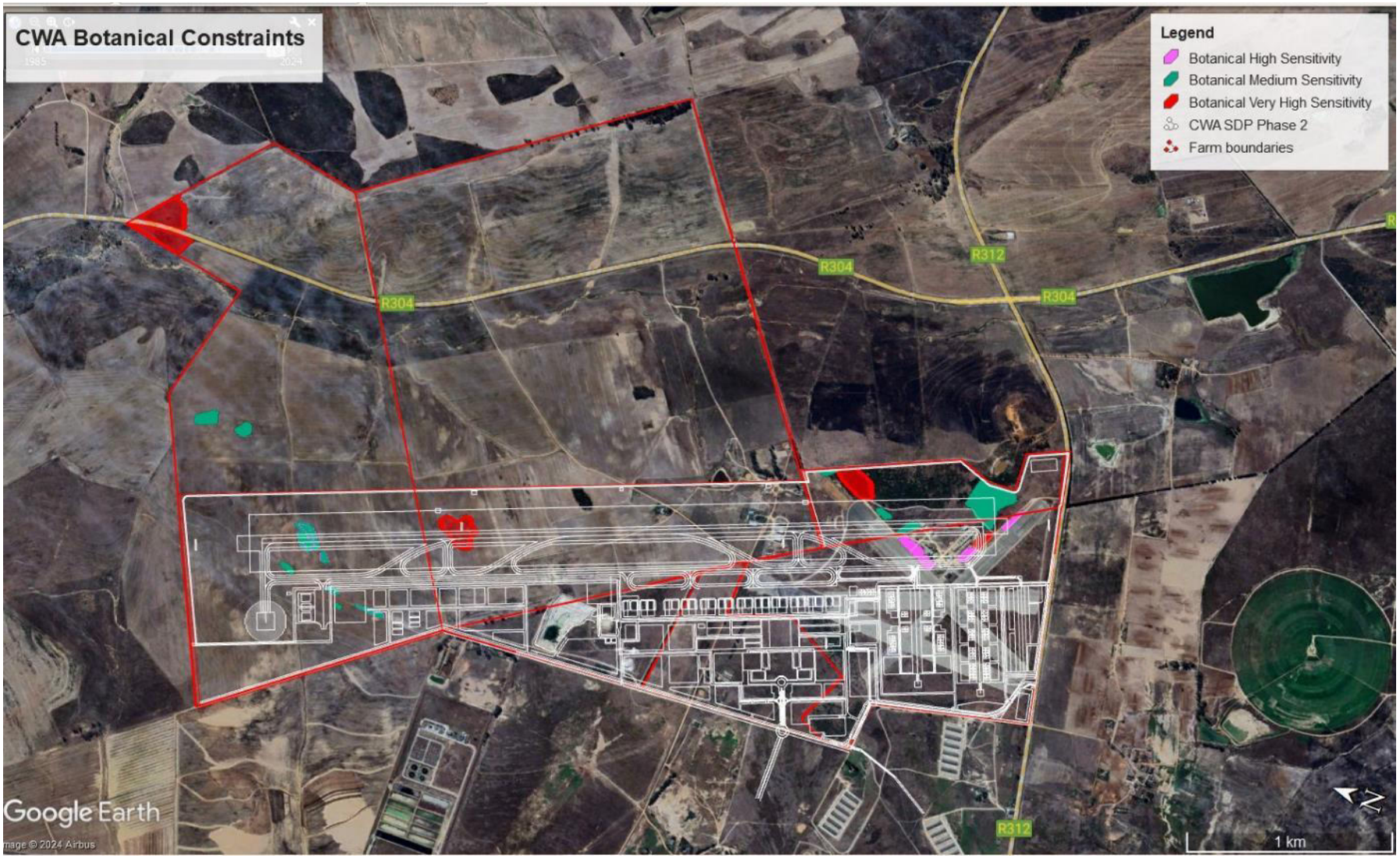


Figure 10: Botanical sensitivity map: All areas not shaded green, red or pink within the study area are of Low botanical sensitivity (PHS Consulting, October 2024).

1.2.3.2 Watercourses and Wetlands

The CWA site is located within Quaternary Catchment G21E in the Berg Water Management Area. The Mosselbank River is located West of the study area, and the Klapmutsrivier North of the site. Both rivers are considered largely modified. Refer to Figure 11 below.

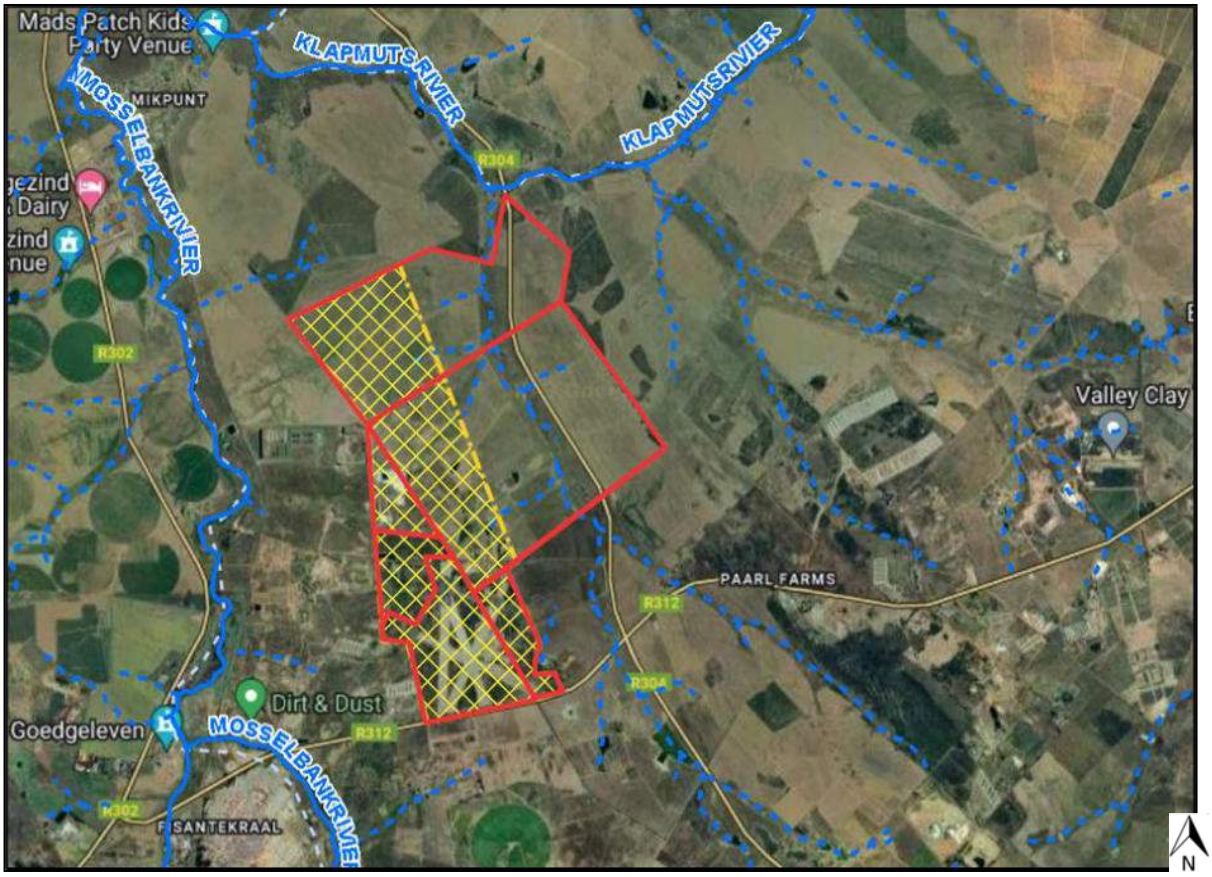


Figure 11: Development area (hatched yellow) and cadastrals (red outline) in relation to identified rivers and drainage lines in the area (PHS Consulting, CapeFarmMapper, Oct 2023).

A freshwater ecological site verification was undertaken for the site in 2022, and identified the following (Figure 12 below):

- A channelled valley bottom (CVB) wetland (hereafter referred to as CVB wetland 1) associated with the unnamed tributary of the Klapmuts River was identified bisecting the eastern portion of the study area, west of the R304;
- Two CVB wetlands (CVB wetlands 2 and 3) were identified within the northern portion of the study area and are linked to CVB wetland 1. The upper reach/western portions of the two CVB wetlands were also identified to encroach into the focus area;
- Another CVB wetland (CVB wetland 4) was identified North of the study area.

- Two seep wetlands were identified within the central western portion of the study area. One of these seep wetlands is directly linked to CVB wetland 1, while the other is indirectly linked via an agricultural drain;
- Several stormwater channels (some with concrete channels and others with excavated earth channels) and agricultural drains (usually with excavated earth channels) that convey surface water runoff (predominantly from the cultivated areas) into the identified freshwater systems, including into CVB wetland 1. It is possible that some of these agricultural drains may have functioned as natural watercourses in the past, but due to the high degree of land use transformation, agricultural activities and historical mining activities they now only function as drainage channels.
- Two artificial impoundments, one isolated and relic and the other connected to CVB wetland 1 via a stormwater channel and agricultural drain, and a quarry associated with historical open-pit clay mining activities were identified.

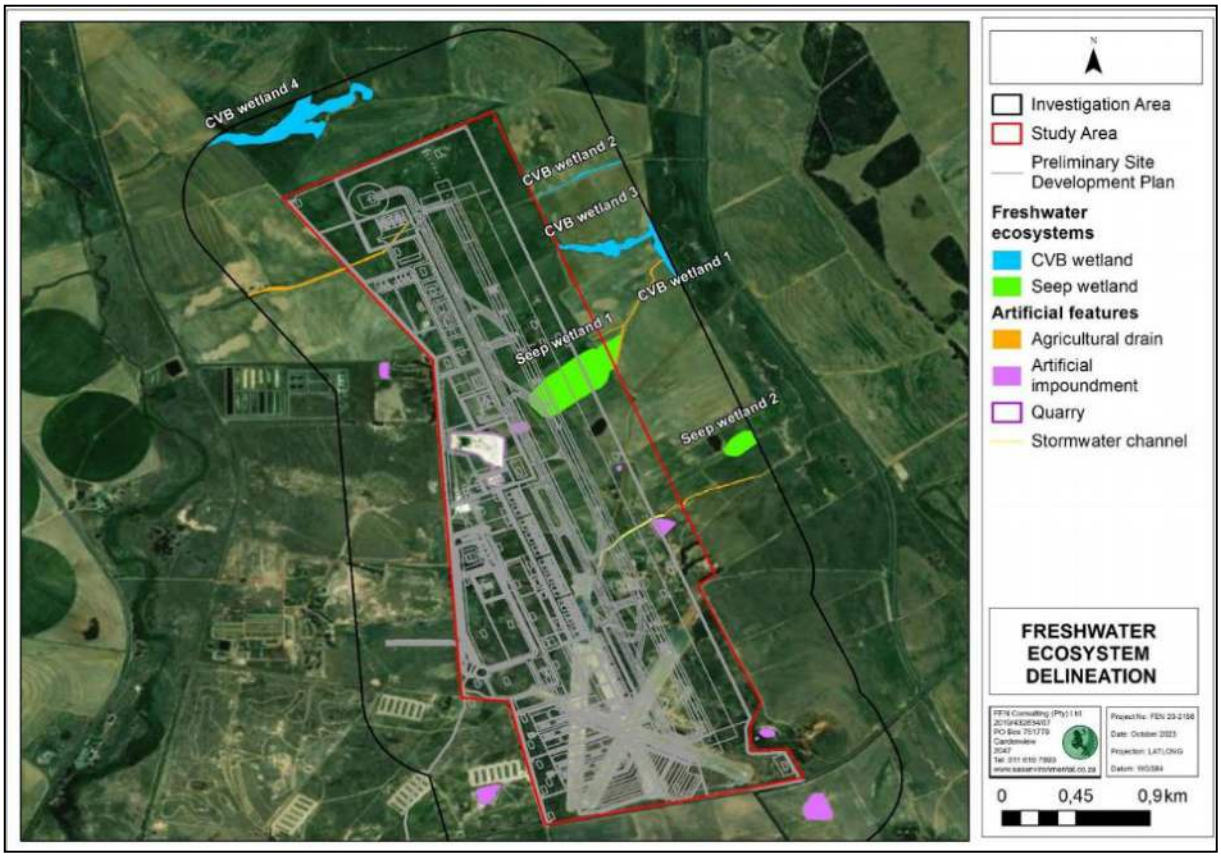


Figure 12: The delineated extent of the watercourses and artificial features associated with the study area and SDP (FEN, Freshwater Ecological Scoping Report, Sept 2023).

1.2.3.3 Hydropedology

The proposed development area is associated with a seep wetland as well as several additional watercourses which are located in close proximity to the proposed development footprint. The activities associated with the CWA development could potentially intercept subsurface flows and thus affect watercourse recharge. The proposed development site was found to be primarily underlain by soils with secondary accumulations of powdery gypsum and layers cemented by silica. These soils are usually found in very dry conditions with high evaporation rates and are often associated with calcareous soils. In these soils, water does not drain deeply but easily infiltrates the sandy surface layers. As a result, water moves upward due to evapotranspiration, leading to a very slow recharge rate. Several dominant soil types were found to coincide with the proposed development site. The dominant soil types identified within the proposed development site were grouped according to their hydropedological responses as summarised below and illustrated in Figure :

Stagnating/Recharge (Slow) Soils: These soils exhibit rapid drainage and percolation of water in the topsoil. However, the presence of cemented layers leads to stagnation and shallow water tables. The primary flow path is slow vertical movement, with excess water rarely reaching the bottom of the soil profile, making upward flux for transpiration dominant.

Responsive (Shallow) Soils: These soils have limited depth and small storage capacity. They respond quickly to rain, generating overland flow when rainfall exceeds their storage capacity.

Interflow (Soil/Bedrock) Soils: These soils have hydromorphic features which indicate occasional water accumulation at the soil/bedrock interface with slow lateral water movement. Drainage could be limited by a shallow layer of impermeable rock.

Responsive saturated (Artificial impoundments): The identified saturated features were manmade water features.

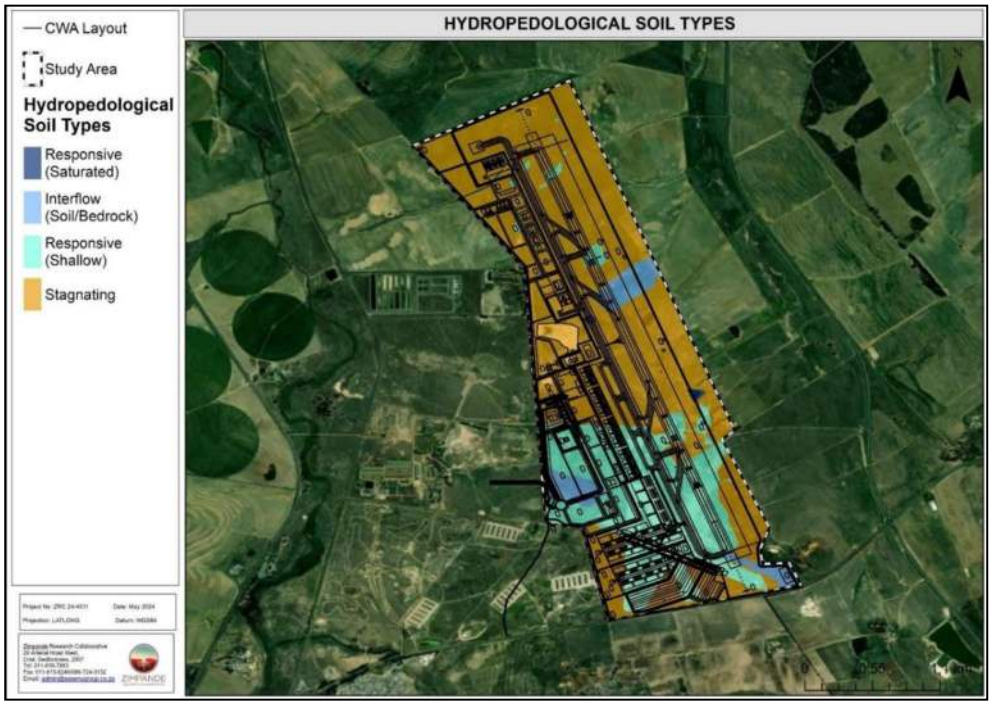


Figure 13: Map depicting hydropedological soil types associated with the study area overlain by the proposed layout outline. (Zimpande Research Collaborative, Hydropedological Assessment, June 2024).

1.2.3.4 Faunal and Avifaunal

Large portions of the proposed CWA development area fall within Endangered Swartland Granite Renosterveld, while small western and eastern portions fall within the Critically Endangered Cape Flats Sand Fynbos and a small southern portion falls within the Critically Endangered Swartland Shale Renosterveld. According to the Red List of Ecosystems dataset (2022), the southern and western portions of the study area is located within a threatened ecosystem - the Swartland Granite Renosterveld with an endangered threat status. Small, isolated patches of the study area is located within threatened ecosystems: Cape Flats Sand Fynbos (CFSF) and Swartland Shale Renosterveld (SSR), both of which are considered critically endangered.

Three broad floral habitat units were identified for the study area (Figure 14):

1) Renosterveld Habitat: Alien Invasive Plant (AIP) infestation and edge effects have reduced the habitat potential for many fauna types, but remaining fragments are still offer habitat of varied structure and floral diversity suitable for many fauna due to its floral richness.

2) Freshwater Habitat: Consists of modified wetlands, artificial impoundments, a canalised watercourse and other ephemeral drainage features, plays an important role in supporting water dependant species, provides more opportunities in terms of foraging for many fauna and is an important corridor within the largely modified landscape.

3) Modified Habitat: Includes areas where vegetation is significantly degraded or entirely absent because of agriculture, households, and mining. Some pockets of severely invaded portions (by Port Jackson) provide valuable shelter for fauna, and some areas particularly abundant in avifauna. Forage potential for fauna and avifauna is anticipated to be intermittent within the habitat because of monoculture cultivation and the homogeneity of the remaining unit.

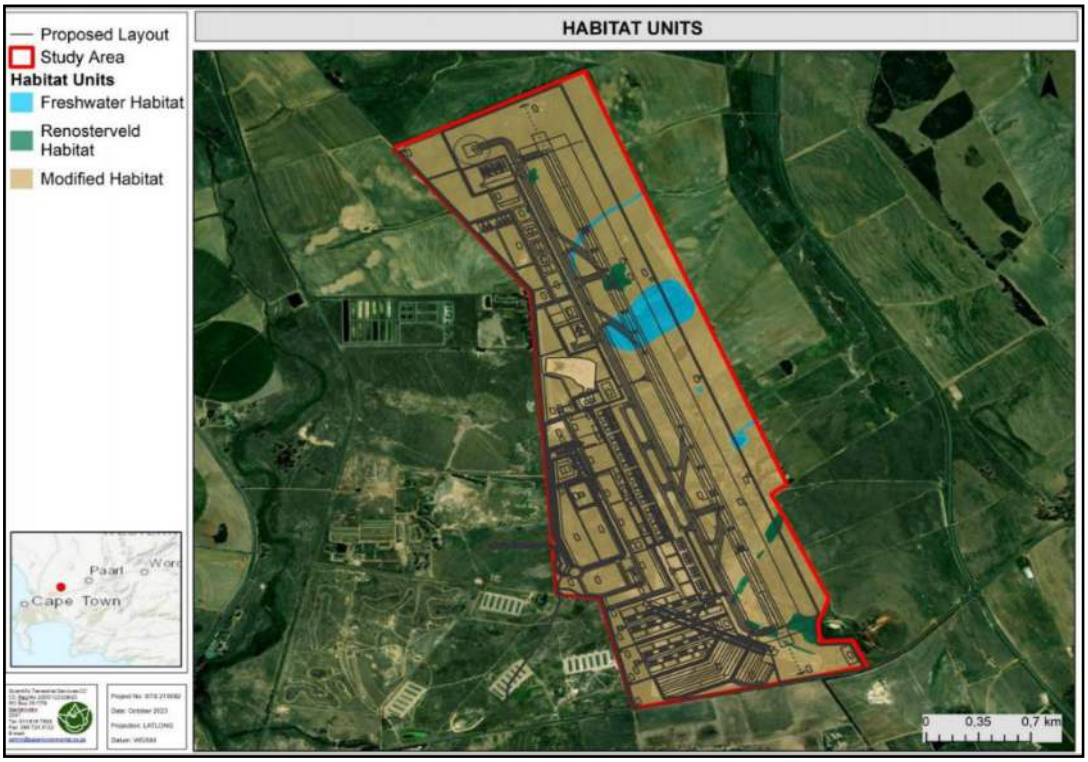


Figure 14: Habitat units encountered within the study and focus area (STS, Faunal and Avifaunal Scoping report, Oct 2023).

The following protected areas are located within 10km of the study area:

- Joostenbergskloof Conservation area,
- Joostenberg Hill Conservation area,
- Botterblom Nature Reserve,
- Durbanville Nature Reserve,
- Uitkamp Wetlad Nature Reserve,
- Joostenberg Private Nature Reserve (Informal),
- JN Briers Louw Nature Reserve (formal), and
- Cape Winelands Biosphere Reserve.

In terms of species diversity and habitat integrity mostly commonly occurring species were observed for the mammal, herpetofauna, invertebrate and avian assessment, and only SCC, *Grus paradiseus* (Blue crane) was observed. The study area is largely cultivated land with reduced primary productivity and floral richness, and most secretive and rare fauna have emigrated to areas with more suitable natural vegetation. This results in a largely intermediate to moderately low diversity of mammals, invertebrates, herpetofauna and avifauna.

The remaining portions of Renosterveld habitat provided habitat for breeding and foraging for most common fauna and is the most valuable from a faunal perspective and considered of intermediate sensitivity. The Freshwater habitat provides valuable habitat to water dependant species, and at the same time maintains ecological functions and faunal movement corridors, so is considered of intermediate sensitivity. The Modified Habitat is considered of moderately low sensitivity, however, as it makes up largest part of the site it is anticipated to be utilized for foraging by most faunal species. Refer to Figure 15 below.

According to SAS the artificial impoundments and agricultural drains mapped by FEN "*are not considered to be natural features, though the artificial impoundments will likely provide seasonal breeding localities for amphibians as well as a source of drinking water for other faunal species in the study area. The agricultural drains may be used by smaller species as movement corridors, though they are not considered of increased importance or sensitivity from a faunal perspective*."

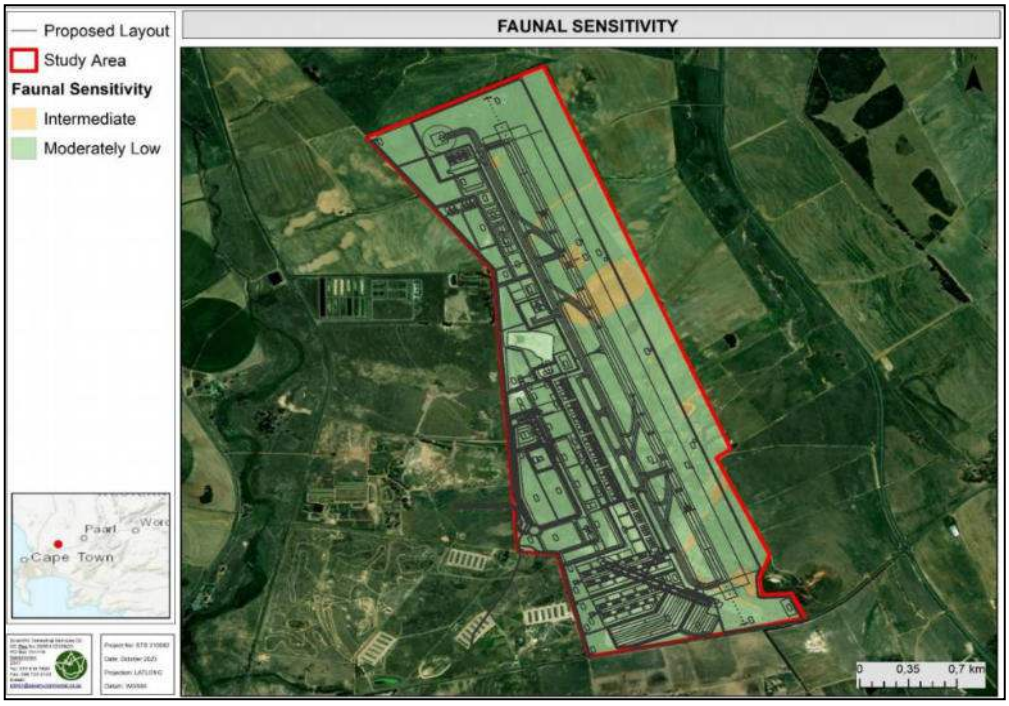


Figure 15: Faunal habitat sensitivity map for the study area (STS, Faunal and Avifaunal Scoping report, Part B, Oct 2023).

1.2.4 Socio-Economics

The CWA is in a rural area within the City of Cape Town Metro, which is the capital city of the Western Cape Province, and acts as legislative capital for South Africa. The CoCT consists of 116 wards, of which CWA is located within the Northern District's Ward 105.

1.2.4.1 Socio-Economic Overview of the City of Cape Town Municipality

The CoCT economy contributed approximately 72% to the economy of the Western Cape Province in 2020. In terms of absolute numbers, the CoCT economy generated R268 048 million in GVA at constant prices relative to R372 308 million recorded for the Western Cape Province. The GVA contribution of the CoCT economy to the Western Cape Province decreased from 72,98% in 2005 to 72% in 2020. The CoCT economy grew off a solid base by 1,65% per annum from 2005 to 2020, or 27,89% over the 15 years despite the impact of the COVID-19 pandemic.

The largest sector of the CoCT economy was Finance, Insurance, Real Estate and Business Services sector, followed by Wholesale and Retail and Manufacturing. Combined, these three sectors contributed almost 64,20% of the total GVA generated by the CoCT economy in 2020, an increase of 0,65% from 2005. The Finance, Insurance, Real Estate and Business Service sector has remained the largest contributor to the CoCT GVA over the 15 years of the analysis. The Manufacturing sector's contribution decreased from 17,26% in 2005 to 14,09% in 2020, whereas Finance, Insurance, Real Estate and Business Services increased their contribution to GVA from 30,21% in 2005 to 35,05% in 2020.

To understand whether sectors are contracting or growing, it is useful to consider the overall and annual growth rates and to compare those to the Western Cape Province within which the CoCT economy functions. The Western Cape Province and CoCT economies grew in nominal terms by 1,75% and 1,65% per annum respectively, from 2005 to 2020. The Agriculture, Hunting, Forestry and Fishing, and Community, Social and Personal Services sectors in the CoCT economy achieved higher growth rates than the province over the period 2005 to 2020.

The Agriculture, Hunting, Forestry and Fishing, Finance, Insurance, Real Estate and Business Services, and General Government sectors demonstrated the highest annual growth rates for the CoCT over the period 2005 to 2020. Although the Manufacturing sector grew only by 0,28% per annum between 2005 and 2020, its contribution to GVA declined by 18,41% from 2005 to 2020.

1.2.4.2 Sector analysis of GVA contributions

An assessment of the larger sectors suggests that the contribution of several of the sectors (such as Wholesale and Retail and Transport, Storage and Communication) declined slightly in the CoCT economy from 2005 to 2020 in favour of Finance, Insurance, Real Estate and Business Services, which increased its contribution to GVA of the CoCT economy by 16.02% over the period, and Community, Social and Personal Services, which increased its contribution by 20.69%. The Manufacturing sector showed a decline in its contribution to GVA, i.e., 17,26% (2005) compared to 14,09% (2020). The contribution of the sectors to GVA in the CoCT and the Western Cape Province remained more or less in the same proportions whether the

sector contribution increased or declined. This is to be expected since the CoCT contributes 72% to the GVA of the Western Cape Province.

A synopsis of the data suggests that three sectors increased their contribution to GVA of the CoCT economy, while seven sectors indicated a declining contribution. The trend emerging across the province is similar with only two sectors increasing their GVA contribution to the provincial economy, i.e., Finance, insurance, real estate and business services and Community, social and personal services. The concern with this trend is the reduced employment levels within the more labour-intensive sectors of the economy. A greater focus on sectors with a service orientation has emerged over the 15 years of the analysis, which are invariably low employment creators compared to construction and manufacturing.

The GVA sector contributions to the CoCT together with the annual and period growth rates for 2005 and 2020 were assessed. Among the 10 classified sectors, eight sectors indicated an annual increase in economic activity with the minor economic sectors of Mining and Quarrying and Electricity, Gas and Water Supply indicating a year-on-year decline from 2005 to 2020. The declining trend in the contribution of the Manufacturing sector to GVA (14,09% in 2020 versus 17,26% in 2005) is concerning due to the labour-intensive nature of the industries that generally form part of this sector. The analysis also demonstrates that the Manufacturing sector is declining in favour of increases in Finance, Insurance, Real Estate and Business Services and Community, Social and Personal Services, which alludes to a greater focus on service orientation.

The **primary sector** of the CoCT economy includes Agriculture, Hunting, Forestry and Fishing activity and Mining and Quarrying. The primary sector contributed 1,66% to the GVA of the CoCT economy in 2020, which is slightly up from 1,64% in 2005. Agriculture is the largest contributor to the GVA of the Primary sector with a sector contribution of 81,81% in 2005, increasing to 88,89% in 2020.

The **secondary sector** of the CoCT economy includes Manufacturing, Construction and Electricity, Gas and Water Supply. The secondary sector contributed 23,44% to the GVA of the CoCT economy in 2005, while the contribution to GVA decreased to 19,99% in 2020. The contribution of the Manufacturing sector to the secondary sector GVA decreased from 73,64% in 2005 to 73,39% in 2020.

The **tertiary sector** of the CoCT economy includes Trade, Repairs and Hospitality, Financial Institutions, Real Estate and Business Services; Community, Social and Personal Services; and Government Services. The tertiary sector contributed 74,92% to the GVA of the CoCT economy in 2005; this increased to 79,14% in 2020.

Government Services are included as part of the tertiary sector for the analysis. The analysis suggests that the contribution of Government Services to the GVA of the tertiary sector increased from 13,48% in 2005 to 15,39% in 2020.

1.2.4.3 General employment trends:

A comparison of total employment indicates that the CoCT contributed 62,58% to total employment of the Western Cape Province in 2020, while overall employment increased by 33,01% between 2001 to 2020 in the CoCT economy.

The primary, secondary and tertiary sectors contributed 2,73%, 16,81% and 80,46% to total employment in the CoCT economy respectively, in 2020, while the Western Cape Province saw employment contributions of 10,08%, 15,54% and 74,39% from the primary, secondary and tertiary sectors, respectively.

The strong growth in the tertiary sector was offset by negative and low growth in employment in the primary and secondary sectors of the CoCT economy respectively. Strong employment growth was recorded in the tertiary sector with an increase of 44,93% over the period 2001 to 2020, or an annual compounded growth of 1,97% per annum. The Western Cape Province experienced similar trends, with a decline of 27,55% recorded for the primary sector and increases of 5,56% and 52,90% for the secondary and tertiary sectors, respectively.

In terms of employment growth by sector in the CoCT and specified periods pre-2008, 2008 - 2011 and post-2011, the tertiary sector shed the fewest number of jobs with a decline of 0,39% from 2008 to 2011. The secondary sector and primary sector of the economy shed jobs with declines of 16,21% and 9,01%, respectively, over the period 2008 to 2011. Post-2011, all three sectors clawed back all or some of the lost employment in the previous period, achieving an increase in employment of 13,89%, and 8,95% over the period 2012 to 2020 for the primary and tertiary sector, respectively. However, the secondary sector had not recovered all the employment lost during the recessionary period by 2020, which is a concern as stated previously, with specific reference to the labour-intensive industries.

The CWA development will specifically benefit the secondary and tertiary sectors of the Western Cape economy. However, all economic activities associated with the development during construction and operations impact the primary, secondary and tertiary sectors of the economy with a requirement for raw materials (e.g., sand mining), construction activity (e.g., bricks, cement, etc) and business services (e.g., professional services).

1.2.5 Heritage (Cultural, Archaeological and Visual)

1.2.5.1 Cultural:

The South African Air Force established the Fisantekraal airfield in 1943, and it was used by Lockheed Ventura bombers for anti-shipping and anti-submarine search and attack. This use continued until the war ended in 1945. After that period, it operated as an airfield under state control with facilities leased for private pilot training, until it was transferred into private ownership in 1993.

There are only four old structures at the northern end of the site which were built during WWII as part of the airport's defences and which have some interest as such (three are disused and derelict, one of which is no longer roofed; and the one building still in use was converted into two workers' dwellings some years

ago). It appears that these four buildings and the landing-strips are all that remains from the initial WWII construction; these four and just one other, a large hangar at the centre of the site (removed before 1968), appear on the 1953 aerial photograph.

It was concluded that the airfield is an interesting relic of war-time need and the urgency of providing for defence of the coastline. He stated that the war-time airfield is incomplete, and the site includes only four structures and the landing-strips of that defensive infrastructure. Further, the four structures are derelict and unused; and, more importantly have no special significance or meaning; and, this historical interest apart, the landing-strips have functional significance only.

Two homesteads on the remainder of Farm 474 and on the remainder of Farm 724 was already in existence in 1953 (refer Figure).

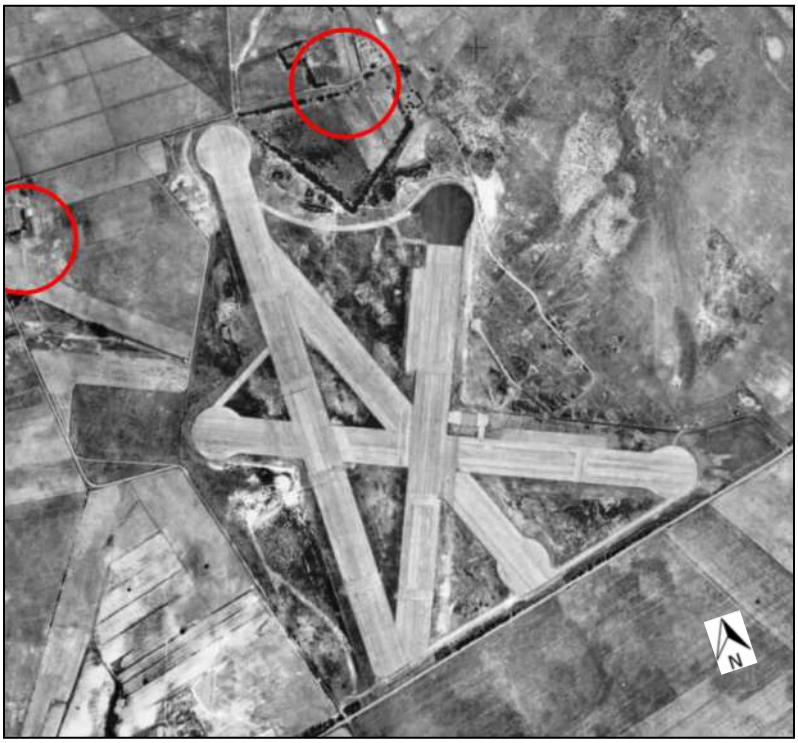


Figure 16: 1953 aerial photograph showing the two farmsteads to the north of the airfield (Aikman Associates, Heritage Baseline Study, Oct 2023).

1.2.5.2 Archaeological:

Early Stone Age (ESA), Middle Stone Age (MSA) and Later Stone Age (LSA) resources have all been recorded in the Klipheuwel, Durbanville and Joostenburg area (Halkett & Hine; Kaplan 2019, 2018, 2012, 2006a, b, 2005, 2003a, b, 2004, 2002, 2001, 2000, 1999,). The Cultural Landscape is dominated by implements assigned to the ESA (handaxes, Large Cutting Tools (LCT), angular chunks, cleavers, choppers, cores and flakes made almost exclusively on round quartzite cobbles). In some areas very few/no archaeological remains have been found (Kaplan 2003b, 2001, c, d, e, 2002b). Most surveys have been undertaken in previously disturbed farmland and transformed landscape, within and on the edges of rapidly developing urban areas and gated

estates. In every study conducted the remains have been graded as having low (Grade lllC) archaeological significance due to the isolated, disturbed and transformed context in which they have been found.

Therefore, the area identified for upgrading and development of the Cape Winelands Airfield does not constitute a sensitive archaeological landscape. Apart from the existing CWA, almost the entire surrounding farms, including the recently acquired properties, have been fundamentally transformed by agriculture and its associated infrastructure.

1.2.5.3 Visual:

The area considered as the receiving environment was delineated as approximately 8km around the proposed development site, as the receiving environment further than 8km will be negligibly affected by the proposed development in terms of visual and aesthetic considerations. The topography of the study area is characterized by shallow river valleys and gently rolling hills, most of which are under cultivation, giving way to agri-industrial land uses further south and ultimately predominantly suburban areas within the urban edge of Durbanville. Topographic relief generally increases westward towards the Durbanville hills and decreases eastward into the sloping flats of the greater Mosselbank river valley and the Agterpaarl / Paardeberg Cultural Landscape.

The receiving environment generally enjoys long views towards Paardenberg (northeast), Paarl Mountain (east), Simonsberg (southeast) and the Boland Cape Fold range running from Somerset West northward in the distance. The southern portions of the receiving environment also enjoy distant views towards Table Mountain.

The are several bulk infrastructure features present in the study area - a few Eskom servitudes containing overhead powerlines, distribution lines, sub-stations and telecommunication infrastructure. These and other infrastructural, industrial, and semi-industrial features contribute to visual clutter and discordant elements visible in the landscape, such as the masts of the Goedverwacht Radio Station, the Fisantekraal WWTW, various poultry batteries in the area (concentrated around Joostenbergkloof), the Durbanville Industrial Park, and mining-related land uses such as Apollo Bricks, industries such as Namchar and the local feedlots. These are generally concentrated along the parallel railway line and Klipheuwel road with Fisantekraal's expanding residential areas being the nearest in proximity to the subject site.

The predominant land use is agricultural, with areas of agri-industrial, peri-urban / industrial (concentrated along the Klipheuwel corridor) and urban/residential in the south (within the Fisantekraal settlement and the Durbanville urban edge). The land use mix is typical of areas at the outskirts of the Cape Town Metro and associated with the Cape Winelands landscape.

Land uses within 5km of the project site includes the following:

- Agricultural activities surrounding the site, with areas that are more exclusively under cultivation located in the hinterland and within cultural landscape areas. Vineyards and wine estates are located on the slopes of the Durbanville Hills and foothills, while grazing and grain dominate the open fields to the west, east and north.

- Schools and community facilities are located within Fisantekraal.
- To the south and east of the subject site is the Joostenberg Vlakte, a semi-agricultural area that is characterized by large plots and smallholdings, equestrian farms, various guest houses and strong landscape and settlement patterns created by tree avenues.
- Along the Klipheuwel corridor, there are industrial, agri-industrial and mining activities.

In general land use intensifies and densifies southward and southwestward, with pockets of development within the agricultural landscape (such as the Durbanville industrial park and Fisantekraal residential area).

The landscape to the north and east of the subject site is more agricultural and rural (except for a concentration of agri-industry in the Joostenbergkloof area), while areas to the west tend to be more mixed. The study area receiving environment can be described as rural agricultural, containing isolated areas with land uses of mixed density and nature, and a band of peri-urban agricultural and industrial activity in the southwestern portions of the study area that have been earmarked for extensive future development.

Natural vegetation in the area has been modified and transformed completely through cultivation of the land and urban development. Remnant natural vegetation, if any, would typically be associated with the river valley bottoms in the study area. Local vegetation patterns are not uniform throughout the study area, given the wide range of land uses. Within the agricultural areas, vineyards and paddocks are sometimes framed by avenues of mature trees (typically beefwood, pines and Eucalyptus species). These avenues are often isolated and associated with farmsteads and yards/werf areas, or entrance roads.

The proposed development must be seen within the context of an area which is currently and will in future undergo significant development, which is most likely to intensify in the short, medium, and long term and supported and/or championed by the provincial, municipal and district policy frameworks.

According to the Northern District Plan, the study area forms part of the urban periphery of CoCT where extensive low-density development is expanding the residential "hinterland". This trend has been an increasing feature in the study area for several years, with the most rapid development happening over the past 10 years.

The Northern District plan also identifies the extension of the emerging industrial area at Fisantekraal as a major opportunity in the district to reinforce service industrial areas that are in proximity to activity routes and development routes, and to respond to the urgent need for centres of employment. Future development plans include extensive urban infill within the Northeastern Growth Corridor in Sub- district 3, which is located to the southwest and south of the subject site.

The vision is to establish a growth corridor along the Malmesbury rail line which is primarily focused on higher density integrated and inclusionary housing development, where adequate employment opportunities are identified as well as the required public infrastructure being developed simultaneously.

Figure 17 shows the proposed CWA expansion site in the context of approved future developments within the study area and immediate vicinity. The proposed Bella Riva development, the Fisantekraal industrial node, the high-density residential development within the urban edge and the Greenville Garden City development across the R312 will erode the rural agricultural landscape character within these parts of the receiving environment, and impact significantly on visual quality and coherence of the scenic routes and peripheral areas of the surrounding cultural landscapes.

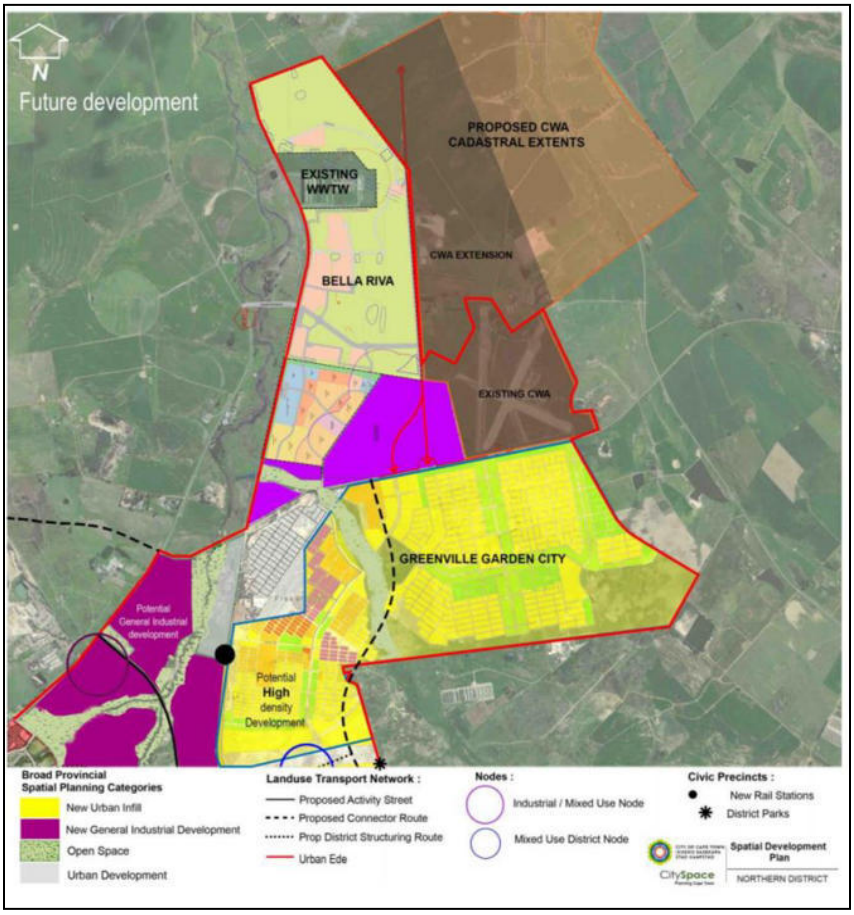


Figure 17: Map showing proposed future development in the study area (Filia Visual, Visual Scoping Report, Sept 2023).

Figure indicates the possible subsequent changes to the extents and boundaries of the cultural landscapes, based on cumulative development and conurbation (merging of suburb areas) that will result in the transformation of these landscapes.

Their delineation on a map should therefore follow along the new urban edge to portray the reality on the ground more accurately. These observations place additional emphasis on the imperative for the CWA development to demonstrate a sensitive response to the visual resources and sensitive viewers outside of the urban edge within the (reduced) Cultural Landscape areas.

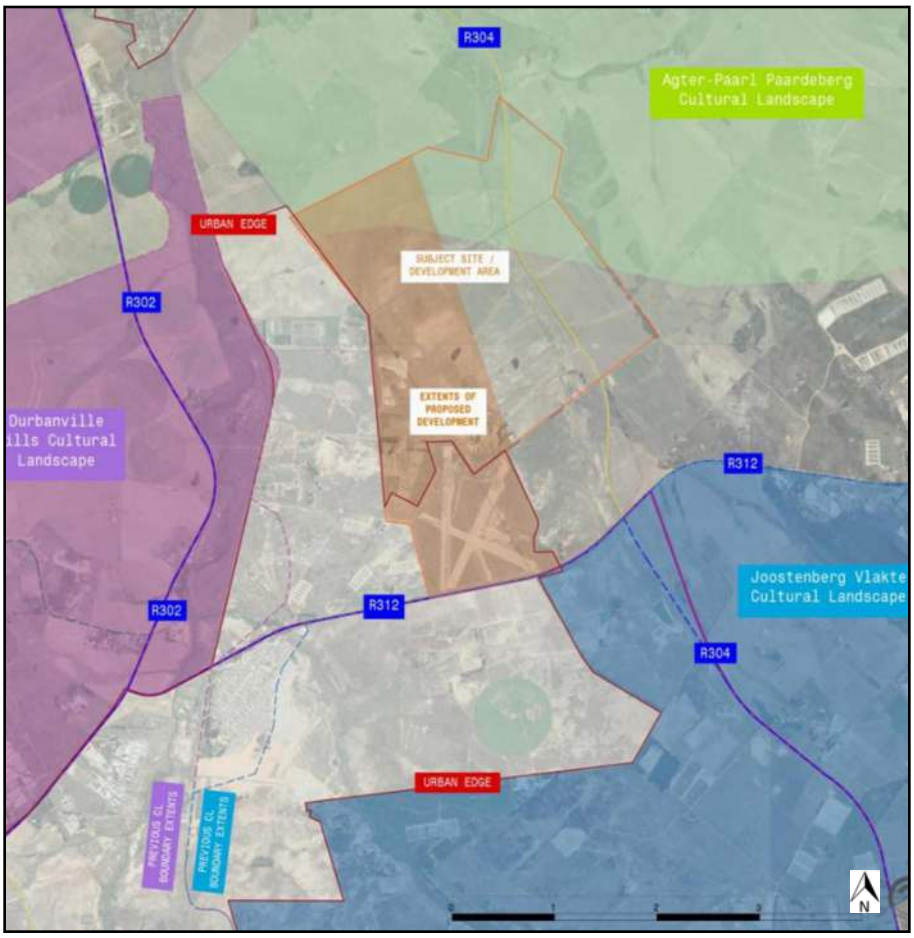


Figure 18: Possible effect of future developments on the extents of the cultural landscape layout in the study area (Filia Visual, Visual Scoping Report, Sept 2023).

Evaluation of the Visual resource in terms of Aesthetic value

Four areas were identified within the study area as areas that can be described together as **Landscape Character areas (LCA**). This was based on topography, vegetation pattern (agriculture) and land use as primary informants, along with fieldwork observations and the existing classifications of relevant policy and planning documents. Refer to Figure 19 below.

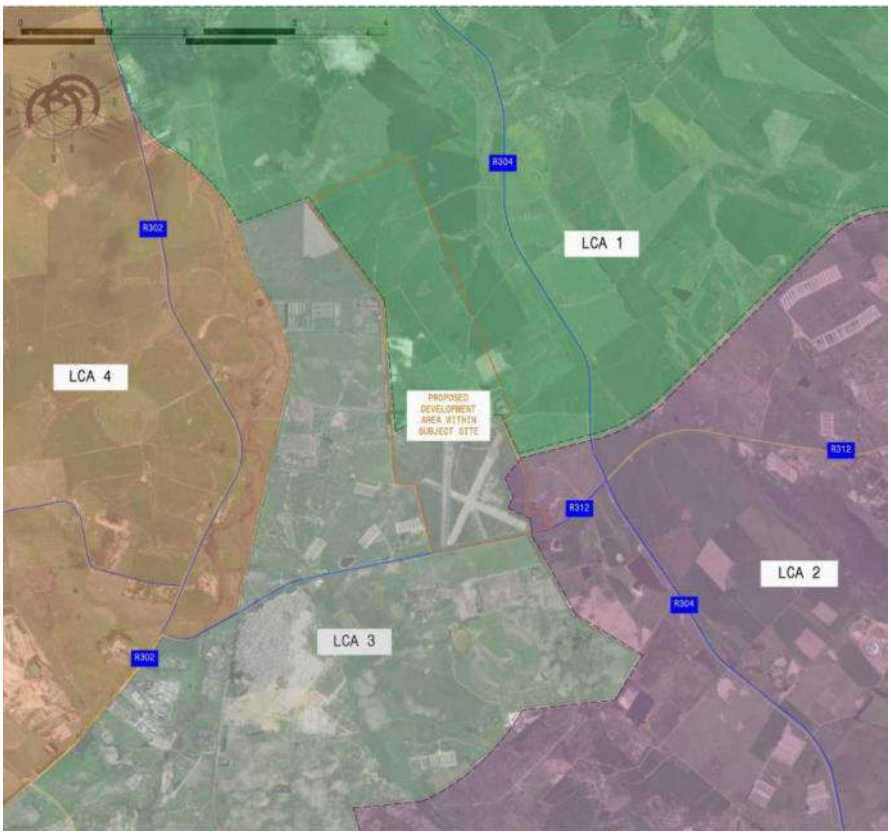


Figure 19: Graphic illustrating the Landscape Character areas in the receiving environment (Filia Visual, Visual Scoping Report, Sept 2023).

LCA 1: Landscape Character area 1 is situated to the north of the subject site and consists of a predominantly rural agricultural landscape of grazing and grain fields containing very few built elements and sparsely interspersed landscape elements (tree avenues associated with farm werf areas, property boundaries and limited copses of natural vegetation along river courses). Topographically, the LCA is comprised of low rolling hills and gently undulating fields, with long views towards the encircling mountains to the east. This LCA has a strong sense of place, being identified as the AgterPaarl/Paardeberg Cultural Landscape according to the Northern District plan.

LCA 2: The Joostenberg Vlakte Landscape character area is a semi-agricultural area characterized by large plots and smallholdings, equestrian farms, various guest houses and strong landscape and settlement patterns created by tree avenues. It is gently sloping, but generally flat topographically, with some intensification of topographical variance in the northeastern parts. Although not densely developed, views within the smallholding areas are typically near and generally limited to the foreground because of the amount of existing vegetation, buildings, and other visual obstructions. In the agricultural areas, topography becomes more variable, and elevated areas along the R304 and towards the east of the LCA open to long, dramatic vistas of the Simonsberg and Stellenbosch mountains in the south and the Peninsula Mountain range in the southwest. This LCA has a strong sense of place, being identified as a Cultural Landscape according to the Northern District plan.

LCA 3: Urban and suburban residential areas, peri-urban industrial areas (the Durbanville Industrial Park and local brick manufacturing plants), future high and medium density formal and informal residential areas and large tracts of undeveloped land are found within Landscape Character area 3. The visual quality of these areas is generally low, due to large portions being either environmentally degraded or because of the presence of discordant elements in the field of vision (including the local WWTW, Eskom transmission power line and substation infrastructure, developments under construction and industrial/semi-industrial activities along the Klipheuwel corridor and railway line).

LCA 4: Landscape Character area 4 contains the rural agricultural areas outside of the urban edge from the Groot Phesantekraal wine estate and upwards towards Spes Bona and extending to the areas east of Klipheuwel. This landscape comprises mostly of the Durbanville Hills Cultural Landscape. This area enjoys peripheral views onto the residential and industrial areas alongside in its southern parts but maintains long views over vineyards and the patchwork of crops towards the Boland Mountain range as a rule throughout. Dominated by agricultural land uses, the scenic quality of this area is notable, with pastoral agricultural scenes and an ever-changing seasonal colour palette, moving from an agricultural landscape dominated by viticulture in the south, to one of predominantly wheat and pasture in the north. Topography in this area consists of gently rolling hills and small shallow river valleys.

The study area and receiving environment can be described as having a mixed landscape character and sense of place, which are generally identifiable as consistent with the boundaries of the LCA's.

- LCA 1, 2 and 4 retain predominantly rural and agricultural characteristics,
- LCA 3 is dominated by suburban and industrial developments and other land uses that generally erode scenic quality within the context of the Cape Winelands region's peri-urban areas.

1.2.6 Agriculture

The CWA site is bordered by the R312, with several agricultural activities towards the East and North. The entire study area is situated within Land Type Db 41 with prismacutanic, pedocutanic and/or gleycutanic diagnostic horizon dominant and the B horizons normally non-red. These are soils where the non-red B-horizon (subsoil) has a strong to very strongly developed structure, usually also with a high clay content, making the soil mostly imperfectly to poorly drained and the strong structure in the subsoil places a restriction on root development. Because most of these soils have a sandier topsoil on a clay subsoil, they are usually sensitive to erosion due to poor management practices are applied (vegetation cover removed through overgrazing of natural veld or by cultivation).

According to the Land Type memoirs the distribution of soil forms per terrain unit for Land Type Db41 varies between 1, 3, 4 and 5 (refer Figure).

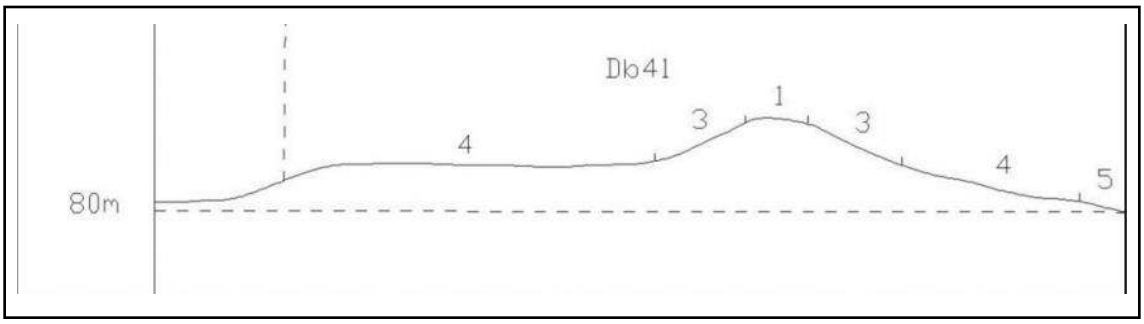


Figure 20: Typical terrain form of Land Type Db41 showing terrain units present (Agri-Informatics; Agro-Ecological Scoping Report, Sept 2023).

The reconnaissance soil survey that was conducted as part of this study (refer Figure), correlate with the Land Type information. Prismacutanic, pedocutanic and/or gleycutanic diagnostic horizons are dominant in large sections of the study area, with deep bleached or marginally yellow apedal sand also common in places.

The climate (temperate dry, hot summer; marginally maritime; average annual rainfall is 532mm) amounts to crop evaporation of 1178mm/annum (818mm during the summer months) which indicates a rainfall deficit in summer and implies that, for most perennial tree crops, irrigation of at least 5000m^3/ha will be required during summer. Wine grapes will require approximately 3 000m^3/ha.

The winter rainfall of 438mm is regarded as adequate for dry land (non-irrigated) winter cereal production, provided that the soil properties are sufficient to retain groundwater between rainfall events. The study area has very limited access to water that can be used for irrigation with most irrigation water coming from borehole supply.

The study area is situated in the southeastern corner of the Homogeneous Farming Area (HFA) known as the "High Rainfall Sowing Area" of the Swartland with a landscape almost fully converted to agriculture. Agricultural activity is mostly small grain production in combination with sheep and/or cattle farming, with no irrigation cultivation due to the limited irrigation water available in the area. Other farming activities in the vicinity includes Braam's feedlot and County Fair chicken farms.

Figure 22 illustrates the extent of the cultivated areas and other features within the study area.

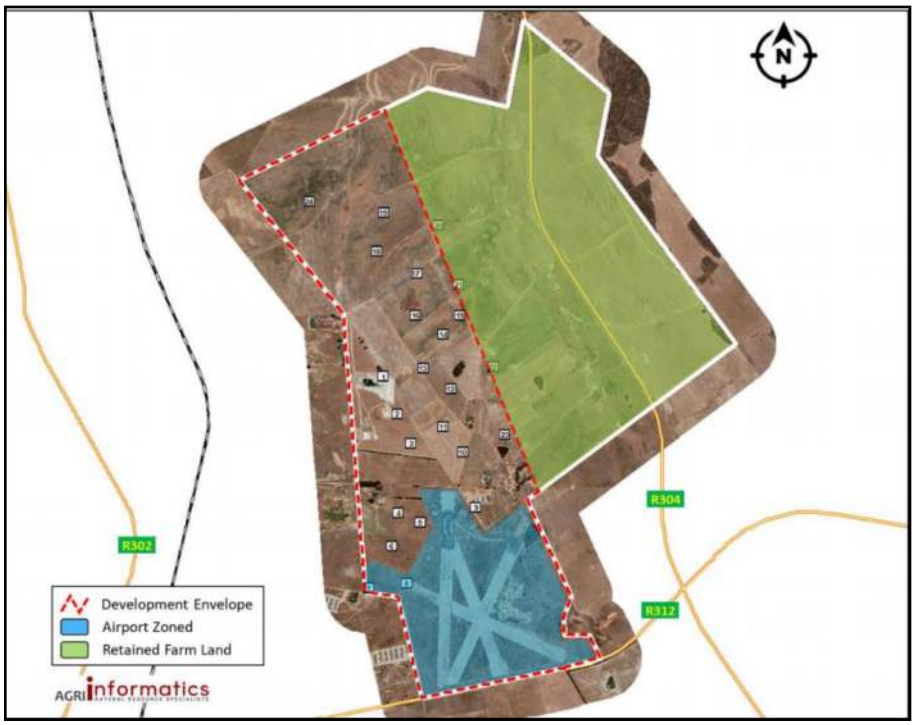


Figure 21: Soil profile pit positions used during the soil survey (Agri-Informatics; Agro-Ecological Scoping Report, Sept 2023). Note the green area will remain Agriculture.

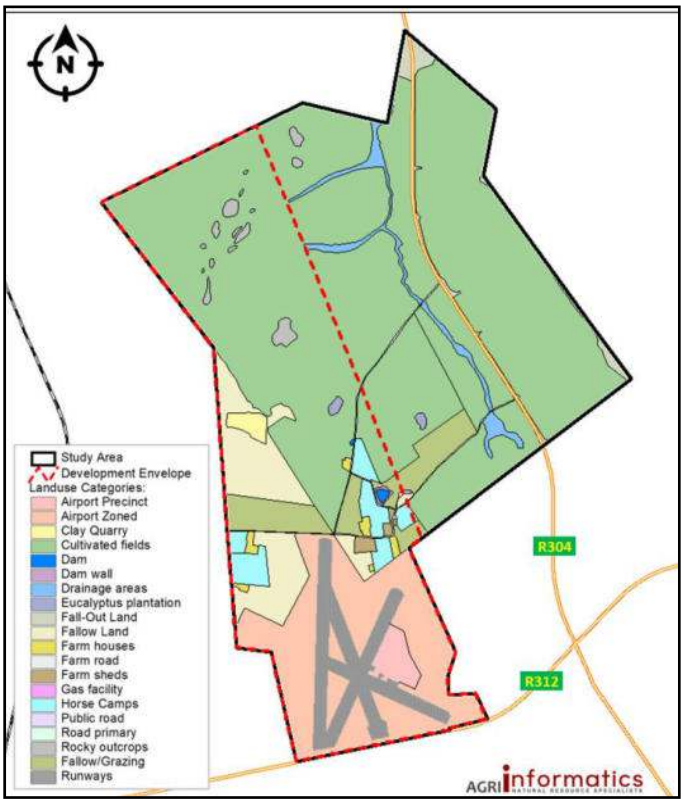


Figure 22: Land use classes of the study area (Agri-Informatics; Agro-Ecological Scoping Report, Sept 2023).

1.2.7 Civil Aviation

Current aviation activity at the airport consists of flight school operations and other unscheduled general aviation flights. These includes private owner-pilots and limited charter operations in light fixed-wing aircraft, as well as helicopters, gyrocopters, and microlights. All flights operate under visual flight rules (VFR) and make use of the runway 05-23 and 14-32 depending on wind conditions. Flight activity at the airport averages approximately 100 air traffic movements (ATM; take-offs and landings) per day, varying with weather conditions, seasons, and day of the week.

Other aviation-related activities taking place at the airport include the rental of hangar space for privately-owned aircraft and the sale of aviation gasoline (Avgas 100LL). There are currently 34 hangars on the site that are in use by various private aircraft owners, two flight schools (Cape Town Flight Training Centre and Aerosport) and small aircraft operators, such as a crop sprayer and aerial advertising firm. There are no military/defence-related activities taking place at the airport.

1.2.7.1 Meteorological conditions related to aviation

According to the Civil Aviation Report *for the purposes of airport planning and design, the aerodrome reference temperature is defined by IACO as the monthly mean of the daily maximum for the hottest month of the year, where the hottest month is the month with the highest mean temperature. Based on this the aerodrome reference temperature was calculated to be 24.1 °C.* Rainfall data was based on 13 months ending March 2022, which illustrated that the overall rainfall trend at the site is relatively like the public domain data, with May, June, July, and August being the wettest months of the year.

Wind direction and speed play an important role in the design of the runway orientation and the usability of the runway should be not less than 95%. Cross winds of a certain speeds as specified in the standards, will make the runway unusable for certain aircraft depending on their size. According to available information for the site and within the area a more common wind speed of 5 to 10m/s is experienced in the Southeast direction and slightly stronger winds in the Northwest direction on less common occasions.

1.2.7.2 Aerodromes

Most of the airstrips located within the area suggest the usage of local farmers and / or wine producers in the area. The following 24 airports/helistops/airstrips have been noted in a 20nm (+/- 37 km) radius from Cape Winelands Airport:

Table 4: Aerodromes within 20 nautical miles radius from CWA (NACO & ATNS; Civil Aviation Scoping Report, Sept 2023).

#	Airport/Airstrip/Helistop	Distance from CWA	Surface, facilities and usage	Map Identifier
1.	Grootfontein	+/- 2nm	1 x Gravel/Hanger/Local Farmer	R 021
2.	Unknown airstrip (33°50'52.23"S 18°47'54.99"E)	+/- 5nm	2 x Gravel/Building/ Local Farmer	unknown

3.	Altona	+/- 6nm	1 x Gravel/No Facilities/ Local Farmer	Altona
4.	Coutermanskloof	+/- 8nm	1 x Gravel/No Facilities/ Local Business	R 022
5.	Wintervogel Flight Park	+/- 9nm	2 x Gravel/Frequency, Hangers & Buildings/ Local Farmers & Training	R 074
6.	Morningstar (WCMC Club)	+/- 9.6nm	1 x Asphalt/Frequency, Hangers & Buildings/ Local & Training	R 020
7.	De Waal	+/- 11nm	1 x Gravel/No Facilities/ Local Farmer	De Waal
8.	Klipvlei Airfield Park	+/- 12nm	1 x Gravel/No Facilities/ Local Farmer	Klipvlei Airfield Park
9.	Good Hope INTL	+/- 12.8nm	1 x Gravel/No Facilities/ Local Farmer	Good Hope INTL
10.	Stellenbosch	+/- 13 nm	1 x Asphalt/Frequency, Hangers & Buildings/ General Aviation & Training	FASH
11.	Netcare Blaauwberg Hospital Helistop	+/- 13nm	Helipad/No Facilities/Emergency Helicopters Only	298
12.	Air Force Base Ysterplaat	+/- 14nm	1 x Asphalt/Military Facilities/Military & State usage	FAYP
13.	Cape Town International Airport – ACSA	+/- 14nm	2 x Asphalt/All Commercial Facilities/ Commercial International usage	FACT
14.	Diemerskraal	+/- 14.7nm	1 x Gravel/Hangers & Buildings/Local Farmers & Training	R 039
15.	Paarl	+/- 14.8nm	1 x Gravel/No Facilities/ Local Farmers	FAPU
16.	Delta 2000	+/- 15nm	1 x Asphalt/Hangers/ Local Farmers	FADX
17.	Black River Helistop	+/- 15nm	Helipad/No Facilities/ Local Business use	394
18.	Paardeberg	+/- 16nm	1 x Gravel/No Facilities/ Local Farmers	Paardeberg
19.	WP OES	+/- 17nm	1 x Asphalt/Hangers/ Local Farmers	WP OES
20.	V&A Waterfront Helistop	+/- 17.5nm	Helipad/No Facilities/ Local Business use	225

21.	Robben Island Airstrip	+/- 18.9nm	Airstrip is closed	
22.	Vogel	+/- 19nm	1 x Gravel/No Facilities/ Local Farmers	Vogel
23.	Craigcor	+/- 20nm	1 x Gravel/No Facilities/ Local Farmers	Craigcor
24.	Swartdam	+/- 23nm	1 x Gravel/No Facilities/ Local Farmers	Swartdam

1.2.7.3 Other civil aviation installations

Other civil aviation installations nearby the airport site include the following navigational aids and surveillance equipment. Most of these installations are located at or close to CTIA.

Table 5: Communication, Navigational and Surveillance Equipment nearby the Cape Winelands Airport site (NACO & ATNS; Civil Aviation Scoping Report, Sept 2023).

#	Communication/Navigation/Surveillance Equipment	Distance from CWA	Map Identifier	Civilian (C) or Military (M)	Source of data
1.	Navigational Aid - NDB	+/- 10.4 nm	CB	C	SA-AIP
2.	Surveillance (Radar) - Cape Town S-Band 1 MSSR (+ PSR)	+/- 13 nm	SSR_1	C	ATNS
3.	Communication – 13 x Transmitters	+/-13.1 nm	FACT TX	C	ATNS
4.	Navigational Aid - VOR/DME	+/- 13.8 nm	CTV	C	SA-AIP
5.	Surveillance (Radar) - Cape Town S-Band 2 MSSR (+ PSR)	+/- 14 nm	SSR_2	C	ATNS
6.	Communication – 13 x Receivers	+/- 14.1 nm	FACT RX	C	ATNS
7.	Communication – 6 x Local Transceivers	+/- 14.2 nm	FACT SSS	C	ATNS
8.	Communication – 7 x Local Transceivers	+/- 14.3 nm	FACT TWR	C	ATNS
9.	Surveillance - Various Multilateration sites at CTIA	13 – 14.7 nm	FACT MLAT	C	ATNS
10.	Navigational Aid - VOR/DME	+/- 18.8 nm	RIV	M	SA-AIP

Note: RIV (10) and CB (1) navigational aids have been decommissioned.

In addition to the existing installations listed in Table , the following Wide Area Multilateration (WAM) antenna sites are planned to be implemented in the near future: (GS04) Cape Town Old Radar Site; (GS05) Tygerberg; (GS07) Simonsberg; (GS08) Kanonkop; and (GS09) Hawequas.

1.3 ACTIVITY DESCRIPTION:

A detailed breakdown of the proposed development and its associated infrastructure for each of the four Precincts and Phases (Phase 1 or 2) of the development is described below:

1.3.1 Airside Precinct Development

In Phase 1, the airport will comprise of one runway, which will be at an orientation of 01-19 and a length of 3.5km and will be constructed to serve up to Code 4F instrument operations.

This runway will be shared by all operators, including scheduled commercial as well as general aviation, where intersection take-off points will be introduced on the runway to improve efficiency for general aviation operations.

The airside runway development in Phase 1 will also include, but not be limited to, airside systems such as CAT III Instrument Landing System (ILS), Precision Approach Path Indicator, Glidepath Antennas, Meteorological Systems, Airfield Ground Lighting (AGL) and Remote Digital Control Tower Systems.

The following additional developments are proposed as part of Phase 1 & 2 of the Airside Precinct:

Aircraft Parking Aprons: Passenger terminal apron; General aviation and FBO aprons; Isolation pad; Cargo apron (Phase 2); MRO apron (Phase 2).

Aircraft parking stands range from ICAO Code B up to ICAO Code F stands. As part of the Development, 11 MARS stands (21 code C equivalent stands) is foreseen. Some of these will be contact MARS stands and will be equipped with passenger boarding bridges (PBBs) and will be able to accommodate up to Code F aircraft. The other stands will be remote stands, to which passengers are bussed or can walk. In addition to this, 1 Code E cargo aircraft parking stand and 2 Code E MRO aircraft parking stands have been included.

Airside service roads will be constructed to provide access to airport assets for vehicles such as buses, ground service equipment and maintenance vehicles. An airport security fence will be erected in line with aviation security standards.

The bulk electricity supply will terminate within the CWA site in a position at a connection point comprising an Eskom local substation (final overhead pole, overhead drop-out line-fuses, medium voltage 3-core cable connection to metering substation fitted with dual outgoing feeder connections) housed in a fenced or secure enclosure (likely 5000mm by 4000mm).

1.3.2. Landside Precinct Development

The following developments are proposed as part of Phase 1 & Phase 2 of the Land Side Precinct:

Passenger Terminal Building (Phase 1): The PTB (Passenger Terminal Building) serves as the nexus of the airport's operations, connecting airside and landside areas, facilitating passenger and baggage movements, while adhering to rigorous national and international regulations. It has been designed in accordance with the latest ICAO Annexes and the IATA Airport Development Reference Manual (12th edition, May 2022),

ensuring compliance with aviation standards. The location and approximate size of the PTB have been predetermined in the airport master plan. The PTB will be a double level building with a handling capacity of 5.2MPPA and the terminal has been designed to process both domestic and international passengers.

Facilities will be designed specifically for the intended user groups and will be compliant with the relevant standards and recommended practices. These facilities will include specialised equipment and areas to facilitate check-in and bag-drop, security screening, and, in the case of international traffic, customs and emigration / immigration.

The VIP processing facility will have direct access to the airside. Government officials, VIPs and CIPs (Commercial Important Person) will be processed through the facility.

Included in the Development for Phases 1 & 2 are commercial developments, with approximately 350 000m^2 of lettable area provided for. The terminal precinct encompasses a terminal plaza with landmark hotels, and an aviation museum. Included in the aeronautical hub functions are hangars, aviation clubs, an aviation training centre, workshops, light manufacturing, logistics, warehousing, and food processing.

Additional developments proposed as part of Phase 1 & Phase 2 of the Land Side Precinct development: Petrol Service Station; Hotel; Access, egress and an internal vehicular road system; Drop and go facilities which will allow passengers to drop passengers off close to the passenger terminal building; Car rental facilities; Vehicular parking (multi-storey parking, at-grade parking); Pedestrian walkways; Substations; Billboards (indoor and outdoor, static and electronic); Droneport and vertiports; Gardens; Public transport facilities (Phase 2); Carpark/VTOL (Phase 2).

1.3.3. General Aviation Precinct

The general aviation area for Phase 1 & 2, including business aviation, is located on the south of the airport site. The FBO (Fixed Base Operators) facilities are located along a dedicated taxi lane that provides direct access to/from the main runway via the parallel taxiway. A GA (General Aviation) kerbside refuelling station for AV-gas will be developed at the furthest southern corner of the GA site. A GA clubhouse with airside views will be developed, with adjacent grass parking areas for visiting GA aircraft. The helicopter operations will be from dedicated FATOs (Final Approach and Take-off areas).

The following developments are proposed as part of Phase 1 & Phase 2 of the General Aviation Precinct: Fixed Base Operators Hangars; General Aviation Hangars; Clubhouse Area; Final Approach & Take-Off Infrastructure; AVGAS Station; Substation; Remote Digital Control Tower.

1.3.4. Services Precinct

The key airport support facilities are the aircraft rescue and firefighting (ARFF) services, airport maintenance, ground support equipment (GSE) maintenance and staging, cargo, aircraft maintenance, repair and overhaul (MRO), aircraft fuel facilities and an airport operations centre. Also included is provision for solar PV and a biodigester. Most of these facilities are located on the western side of the airport. All facilities are accessible from the secondary landside road system, accessed from the western entrance road into the airport site.

The following developments are proposed as part of Phase 1 & Phase 2 of the Services Precinct:

The fuel facilities (Phase 1) consist of a bulk fuel depot, a general aviation kerbside refuelling station and a commercial/retail service station. An underground fuel line from the bulk fuel depot to the aprons (and General Aviation area) is also provided for in Phase 2.

Aircraft Rescue and Fire Fighting (Phase 1) - The airport will be equipped to provide a level of protection corresponding with Category 9 to meet the ICAO standards. The location of the rescue and firefighting station has been positioned close to the middle of the runway and complies with the ICAO requirements considering the response times of two minutes and not exceeding three minutes, to any point of the operational runway and any other part of the movement area.

Cargo Facility (Phase 1) - The cargo facility is planned for the handling of general and specialized cargo in a dedicated facility on airside. The cargo facility is expected to handle both belly cargo (on passenger aircraft) and full freighter aircraft and is, therefore, located close to the passenger terminal building. Initially, full freighter aircraft can make use of the main apron, as aircraft stand demand is limited during off-peak hours. A single dedicated freighter aircraft stand will be provided when passenger peak traffic starts to spread out.

The airport maintenance facilities (Phase 1) are planned in the services precinct, with access on both airside and landside.

GSE staging areas (Phase 1) are included close to the main apron. Two areas have been reserved for GSE parking adjacent to the main apron.

The location of the proposed MRO facility (Phase 1), including apron and taxiway, is in the North of the airport site. This includes one widebody aircraft parking position and associated hangar. Moreover, additional space for several additional aircraft is available on the site.

Catering Building (Phase 2) - located in the northern area of the airport, with direct airside access and landside access via the northern service entrance to the airport.

Solar PV and Biodigester (Phase 1 & Phase 2) - Included in the Development is provision for solar PV and a biodigester as renewable energy sources.

Airport Operations Centre (Phase 1) - A dedicated Airport Operations Centre will provide space for several key airport support services such as airport offices, remote/digital air traffic control facilities, police services, clinic, airport staff facilities and emergency facilities, among other functions. Housed in this facility will also be a central facility for all government department officiating at the airport. It is envisaged that this Operations Centre is a multi-storey building with 5 floors with access to both landside and airside on the ground floor.

Air Traffic Control Centre (Phase 1) - The upper levels of the Airport Operations Centre will also contain an entire floor dedicated to the remote air traffic control centre.

Additional developments proposed as part of Phase 1 & Phase 2 of the Services Precinct development: Incoming potable water line from CoCT; Potable Water Reservoir; Groundwater Treatment Infrastructure; Potable Water Pump Station; Non-potable Water Storage; Solid Waste Storage; WWTW; Substation; Cargo Apron (Phase 2).

The Site Development Plan (SDP) for the proposed development is shown in Figure 23 and 24. The SDPs and detailed plans showing the four precincts separately are included in **Annexure 3A**.

Figure 23: Proposed SDP Phase 1 (Capewinelands Aero (Pty) Ltd, August 2024).

Figure 24: Proposed SDP Phase 2 (Capewinelands Aero (Pty) Ltd, January 2025).

1.4 ENVIRONMENTAL LEGISLATION:

NEMA defines the principles of sustainability and integrated environmental management forming the basis of the environmental legal framework. Various supplementary acts under the themes of land-use planning and development, resource conservation and utilisation, and waste management and pollution control add to this legal framework, and includes policies, acts, and associated regulations applicable at a National, Provincial and Local (municipal) level.

There are several regulatory requirements at local, provincial, and national level with which the proposed project must adhere to. These include:

- The Constitution of the Republic of South Africa Act 108 of 1996,
- The National Environmental Management Act 107 of 1998, as amended, and EIA Regulations,
- National Environmental Management: Air Quality Act 39 of 2004 (NEM: AQA) as amended and the South African National Air Quality Standards,
- National Water Act 36 of 1998 (NWA),
- National Environmental Management: Waste Act (NEM: WA), Act 59 of 2008 as amended,
- Environmental Conservation Act (ECA) Act 73 of 1989,
- National Environmental Management: Biodiversity (NEM: BA) Act 10 of 2004,
- National Heritage Resources Act (NHRA) No. 25 of 1999,
- Minerals and Petroleum Resources Development Act 28 of 2002 (MPRDA),
- Conservation Of Agricultural Resources Act 43 of 1983 (CARA),
- Spatial Planning and Land Use Management (SPLUMA) Act 16 of 2013,
- Western Cape Land Use Planning Act (LUPA) Act 3 of 2014
- National Development Plan 2030 (NDP 2012),
- Western Cape Provincial Spatial Development Framework (WCPSDF) 2014,
- Western Cape Biodiversity Spatial Plan (WCBSP), 2017,
- City of Cape Town Integrated Development Plan (2022-2027),
- City of Cape Town Economic Growth Strategy (2013),
- City of Cape Town Municipal Spatial Development Framework (2023),
- City of Cape Town Municipal Planning bylaw (2015 as amended in 2019)

- Northern District Plan (2023),
- Civil Aviation Act 13 of 2009 and Regulations,
- White Paper on National Civil Aviation Policy, 2017 (NCAP),
- National Airports Development Plan, 2015 (NDAP),
- White Paper on National Transport Policy, 2021 (NTP),
- National Transport Master Plan (NATMAP) 2050, 2011,
- City of Cape Town Outdoor Advertising and Signage By-Law No. 10518 of 2001, First Amendment By-Law 2013,
- City of Cape Town: Treated Effluent By-Law, 28 October 2009, promulgated 30 June 2010,
- City of Cape Town: Environmental Health By-Law, 30 June 2003,
- City of Cape Town: Stormwater Management By-law (2015),
- City of Cape Town: Management of Urban Stormwater Impacts Policy (2009).
- City of Cape Town: Water bylaw (2010) and City of Cape Town: Water Amendment bylaw (2018),
- City of Cape Town: Environmental Management Framework (EMF),
- Climate Change Policy (National and Provincial),
- National Water Resources Management Strategy (NWRMS).

Note the summary provided is not intended to be definitive or exhaustive and serves only to highlight key environmental and planning legislation and obligations. In addition to the above Acts, policies, guidelines, and other planning / framework documents applicable to the proposed development are discussed in the ensuing sections

1.4.1 National Environmental Management Act, 1998 (Act 107 of 1998), as amended ("NEMA")

NEMA makes provision for the identification and assessment of activities that are potentially detrimental to the environment, and which require authorisation from the competent authority based on the findings of an Environmental Impact Assessment (EIA). NEMA is a national act, which is enforced by the Department of Environmental Affairs (DEA). In the Western Cape, these powers are delegated to the Department of Environmental Affairs & Development Planning (DEA&DP). According to the list of activities identified under the EIA Regulations, by Listing Notice 1 (GN. R. 327), Listing Notice 2 (GN. R. 325), and Listing Notice 3 (GN. R. 324), published in Gazette No. 40772 on the 07 April 2017, the following activities are triggered and require environmental authorisation:

Table 6: Listed Activities triggered in terms of NEMA.

Listing Notice 1 (Regulation 327, GG40772 - 7 April 2017)	
Activity	**Description**
9	*The development of infrastructure exceeding 1 000 metres in length for the bulk transportation of water or storm water—* *(i) with an internal diameter of 0,36 metres or more; or* *(ii) with a peak throughput of 120 litres per second or more;* *excluding where—* *(a) such infrastructure is for bulk transportation of water or storm water or storm water drainage inside a road reserve or railway line reserve; or* *(b) where such development will occur within an urban area.*
10	*The development and related operation of infrastructure exceeding 1 000 metres in length for the bulk transportation of sewage, effluent, process water, waste water, return water, industrial discharge or slimes –* *(i) with an internal diameter of 0,36 metres or more; or* *(ii) with a peak throughput of 120 litres per second or more;* *excluding where—* *(a) such infrastructure is for the bulk transportation of sewage, effluent, process water, waste water, return water, industrial discharge or slimes inside a road reserve or railway line reserve; or* *(b) where such development will occur within an urban area*
12	*The development of—* *(i) dams or weirs, where the dam or weir, including infrastructure and water surface area, exceeds 100 square metres; or* *(ii) infrastructure or structures with a physical footprint of 100 square metres or more;* *where such development occurs—* *(a) within a watercourse;* *(b) in front of a development setback; or* *(c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse; — excluding—* *(aa) the development of infrastructure or structures within existing ports or harbours that will not increase the development footprint of the port or harbour;* *(bb) where such development activities are related to the development of a port or harbour, in which case activity 26 in Listing Notice 2 of 2014 applies;* *(cc) activities listed in activity 14 in Listing Notice 2 of 2014 or activity 14 in Listing Notice 3 of 2014, in which case that activity applies;* *(dd) where such development occurs within an urban area;* *(ee) where such development occurs within existing roads, road reserves or railway line reserves; or* *(ff) the development of temporary infrastructure or structures where such infrastructure or structures will be removed within 6 weeks of the commencement of development and where indigenous vegetation will not be cleared.*
13	*The development of facilities or infrastructure for the off-stream storage of water, including dams and reservoirs, with a combined capacity of 50 000 cubic metres or more, unless such storage falls within the ambit of activity 16 in Listing Notice 2 of 2014.*
16	*The development and related operation of facilities for the desalination of water with a design capacity to produce more than 100 cubic metres of treated water per day.*

19	*The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 10 cubic metres from a watercourse;* *but excluding where such infilling, depositing, dredging, excavation, removal or moving—* *(a) will occur behind a development setback;* *(b) is for maintenance purposes undertaken in accordance with a maintenance management plan;* *(c) falls within the ambit of activity 21 in this Notice, in which case that activity applies;* *(d) occurs within existing ports or harbours that will not increase the development footprint of the port or harbour; or* *(e) where such development is related to the development of a port or harbour, in which case activity 26 in Listing Notice 2 of 2014 applies.*
24	*The development of a road—* *(i) for which an environmental authorisation was obtained for the route determination in terms of activity 5 in Government Notice 387 of 2006 or activity 18 in Government Notice 545 of 2010; or (ii) with a reserve wider than 13,5 meters, or where no reserve exists where the road is wider than 8 metres; but excluding a road—* *(a) which is identified and included in activity 27 in Listing Notice 2 of 2014;* *(b) where the entire road falls within an urban area; or* *(c) which is 1 kilometre or shorter.*
25	*The development and related operation of facilities or infrastructure for the treatment of effluent, wastewater or sewage with a daily throughput capacity of more than 2 000 cubic metres but less than 15 000 cubic metres.*
26	*Residential, retail, recreational, tourism, commercial or institutional developments of 100m^2 or more, on land previously used for mining or heavy industrial purposes; -* *Excluding –* *(i) where such land has been remediated in terms of part 8 of the NEMA: WA (Act no59 of 2008) in which case the NEM:WA , 2008 applies; or* *(ii) where an environmental authorisation has been obtained for the decommissioning of such a mine or industry in terms of this Notice or any previous NEMA notice; or* *(iii) where a closure certificate has been issued in terms of section 43 of the Mineral and Petroleum resources Development Act, 2002 (Act no 28 of 2002) for such land.*
28	*Residential, mixed, retail, commercial, industrial or institutional developments where such land was used for agriculture, game farming, equestrian purposes or afforestation on or after 01 April 1998 and where such development:* *(i) will occur inside an urban area, where the total land to be developed is bigger than 5 hectares; or* *(ii) will occur outside an urban area, where the total land to be developed is bigger than 1 hectare;* *excluding where such land has already been developed for residential, mixed, retail, commercial, industrial or institutional purposes.*
48	*The expansion of—* *(i) infrastructure or structures where the physical footprint is expanded by 100 square metres or more; or* *(ii) dams or weirs, where the dam or weir, including infrastructure and water surface area, is expanded by 100 square metres or more;* *where such expansion occurs—* *(a) within a watercourse;* *(b) in front of a development setback; or* *(c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse;*

	excluding— *(aa) the expansion of infrastructure or structures within existing ports or harbours that will not increase the development footprint of the port or harbour;* *(bb) where such expansion activities are related to the development of a port or harbour, in which case activity 26 in Listing Notice 2 of 2014 applies;* *(cc) activities listed in activity 14 in Listing Notice 2 of 2014 or activity 14 in Listing Notice 3 of 2014, in which case that activity applies;* *(dd) where such expansion occurs within an urban area; or* *(ee) where such expansion occurs within existing roads, road reserves or railway line reserves.*
56	*The widening of a road by more than 6 metres, or the lengthening of a road by more than 1 kilometre—* *(i) where the existing reserve is wider than 13,5 meters; or* *(ii) where no reserve exists, where the existing road is wider than 8 metres; excluding where widening or lengthening occur inside urban areas.*
61	*The expansion of airports where the development footprint will be increased.*
Listing Notice 2 (Regulation 325, GG40772 - 7 April 2017)	
Activity	**Description**
1	*The development of facilities or infrastructure for the generation of electricity from a renewable resource where the electricity output is 20 megawatts or more, excluding where such development of facilities or infrastructure is for photovoltaic installations and occurs-* *(a) within an urban area; or* *(b) on existing infrastructure.*
4	*The development and related operation of facilities or infrastructure, for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of more than 500 cubic metres.*
7	*The development and related operation of facilities or infrastructure for the bulk transportation of dangerous goods—* *(i) in gas form, outside an industrial complex, using pipelines, exceeding 1 000 metres in length, with a throughput capacity of more than 700 tons per day;* *(ii) in liquid form, outside an industrial complex, using pipelines, exceeding 1 000 metres in length, with a throughput capacity of more than 50 cubic metres per day; or* *(iii) in solid form, outside an industrial complex, using funiculars or conveyors with a throughput capacity of more than 50 tons per day.*
15	*The clearance of an area of 20 hectares or more of indigenous vegetation, excluding where such clearance of indigenous vegetation is required for —* *(i) the undertaking of a linear activity; or* *(ii) maintenance purposes undertaken in accordance with a maintenance management plan.*
27	*The development of a road—* *(i) with a reserve wider than 30 metres; or* *(ii) catering for more than one lane of traffic in both directions;* *but excluding a road—* *(a) for which an environmental authorisation was obtained for the route determination in terms of activity 5 in Government Notice 387 of 2006 or activity 18 in Government Notice 545 of 2010, in which case activity 24 in Listing Notice 1 of 2014 applies;* *(b) which is 1 kilometre or shorter; or*

	(c) where the entire road falls within an urban area.
Listing Notice 3 (Regulation 324, GG40772 - 7 April 2017)	
Activity	**Description**
1	*The development of billboards exceeding 18 square metres in size outside urban areas, mining areas or industrial complexes.* *(i) Western Cape - All areas outside urban areas, mining areas or industrial complexes.*
2	*The development of reservoirs, excluding dams, with the capacity of more than 250 cubic metres.* *i. Western Cape* *i. A protected area identified in terms of NEMPAA, excluding conservancies;* *ii. In areas containing indigenous vegetation; or* *iii. Inside urban areas:* *(aa) Areas zoned for use as public open space; or* *(bb) Areas designated for conservation use in Spatial Development Frameworks adopted by the competent authority, or zoned for a conservation purpose.*
3	*The development of masts or towers of any material or type used for telecommunication broadcasting or radio transmission purposes where the mast or tower –* *a) is to be placed on a site not previously sued for this purpose; and* *b) will exceed 15m in height –* *but excluding attachments to existing buildings and masts on rooftops.* ***i Western Cape*** *i. All areas outside urban areas* *ii. Areas designated for conservation use in Spatial Development Frameworks adopted by the competent authority, or zoned for a conservation purpose, within urban areas: or* *iii. Areas zoned for use as public open space or equivalent zoning within urban areas.*
4	*The development of a road wider than 4 metres with a reserve less than 13,5 metres.* *i. Western Cape* *i. Areas zoned for use as public open space or equivalent zoning; ii. Areas outside urban areas; (aa) Areas containing indigenous vegetation; (bb) Areas on the estuary side of the development setback line or in an estuarine functional zone where no such setback line has been determined; or* *iii. Inside urban areas:* *(aa) Areas zoned for conservation use; or* *(bb) Areas designated for conservation use in Spatial Development Frameworks adopted by the competent authority.*
12	*The clearance of an area of 300 square metres or more of indigenous vegetation except where such clearance of indigenous vegetation is required for maintenance purposes undertaken in accordance with a maintenance management plan.* *Western Cape* *i. Within any critically endangered or endangered ecosystem listed in terms of section 52 of the NEMBA or prior to the publication of such a list, within an area that has been identified as critically endangered in the National Spatial Biodiversity Assessment 2004;* *ii. Within critical biodiversity areas identified in bioregional plans;* *iii. Within the littoral active zone or 100 metres inland from high water mark of the sea or an estuarine functional zone, whichever distance is the greater, excluding where such removal will occur behind the development setback line on erven in urban areas;*

	iv. On land, where, at the time of the coming into effect of this Notice or thereafter such land was zoned open space, conservation or had an equivalent zoning; or *v. On land designated for protection or conservation purposes in an Environmental Management Framework adopted in the prescribed manner, or a Spatial Development Framework adopted by the MEC or Minister.*
18	*The widening of a road by more than 4 metres, or the lengthening of a road by more than 1 kilometre.* *Western Cape* *i. Areas zoned for use as public open space or equivalent zoning;* *ii. All areas outside urban areas:* *(aa) Areas containing indigenous vegetation; (bb) Areas on the estuary side of the development setback line or in an estuarine functional zone where no such setback line has been determined; or* *iii. Inside urban areas:* *(aa) Areas zoned for conservation use; or* *(bb) Areas designated for conservation use in Spatial Development Frameworks adopted by the competent authority.*
19	*The expansion of runways or aircraft landing strips where the expanded runways or aircraft landing strips will be longer than 1,4 kilometres in length.* *Western Cape* *i. All areas outside urban areas.*

1.4.2 National Environmental Management: Air Quality Act 39 of 2004 (NEM: AQA) as amended and the South African National Air Quality Standards:

The NEM: AQA reformed legislation in terms of air quality by providing reasonable measures for the prevention of pollution, ecological degradation and to secure ecologically sustainable development while promoting justifiable economic and social development. It provides for national norms and standards regulating air quality monitoring, management, and control.

The proposed project includes a fuel storage facility which requires authorisation to obtain an Atmospheric Emission Licence (EAL) in terms of the NEM: AQA due to Category 2 and specifically Subcategory 2.4: Storage and Handling of Petroleum Products being triggered.

The Act outlines in Schedule 2 the South African air quality standards, and includes margins of tolerance, compliance time frames and permissible frequencies by which the standards may be exceeded.

With specific reference to air quality emissions - the South African National Standard 1929 of 2009, Ambient Air Quality – Limits for Common Pollutants.

An Air Emissions Licence Is Required for the Bulk Fuel Storage on site when the constructed storge volume exceeds 1000 m3. The phasing of the storage and handling facility relate to the developed capacity to exceed this threshold only in 2038. It was clarified with the competent authority that an application for an AEL should be applied for at least 6 months before the threshold is exceeded. Therefore, an application for the AEL will only take place in 2037 or sooner if the threshold exceedance is eminent.

Category 2: Petroleum Industry, the production of gaseous and liquid fuels as well as petrochemicals from crude oil, coal, gas or biomass:

Subcategory 2.4: Storage and Handling of Petroleum Products

Description: Petroleum products storage tanks and product transfer facilities

Application: All permanent immobile liquid storage tanks larger than 1 000m^3 cumulative tankage capacity at a site.

1.4.2.1 The South African National Standard 1929 of 2009, Ambient Air Quality – Limits for Common Pollutants:

The South African National Ambient Air Quality Standards were published in GG32816 on the 24th of December 2009. These standards are based on international best practices and indicate safe exposure levels for most of the population. The South African National Ambient Air Quality Standards are given in:

- The South African National Ambient Air Quality Standards (24 December 2009); and
- The National Ambient Air Quality Standard for Particulate Matter with Aerodynamic Diameter Less Than 2.5 Micron Meters (PM2.5) (29 June 2012).

1.4.2.2 Dust Fallout Guidelines:

On 1 November 2013, the Government Notice 827 - National Dust Control Regulations (NDCR) was published in terms of section 53 (O) of the National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004). The Regulations prescribe general measures for the control of dust in all areas, including residential and non-residential areas. The acceptable dust fall rates are set out in the Regulations for residential and non-residential areas.

The South African Bureau of Standards (SABS) has published dust deposition standards that are based on the cumulative dust fall levels in the South African National Standard (SANS) 1929:2011. Four bands have been developed against which dust fallout can be evaluated.

1.4.3 National Water Act (NWA) Act 36 of 1998:

The National Water Act (NWA) (Act 36 of 1998) provides the legal basis for water management in South Africa and must ensure ecological integrity, stimulate economic growth, and promote social equity when managing and using water. It is based on Integrated Water Resource Management (IWRM), which includes water quality, water quantity, pollution prevention, resource protection and protection and promotion of aquatic ecosystem quality (aquatic biota and in-stream and riparian habitat).

The overall Resource Protection and Waste Management Policy sets out the interpretation of policy and legal principles as well as functional and organisational arrangements for resource protection and waste management in South Africa. Operational policies describe the rules applicable to different categories and aspects relating to waste discharge and disposal activities.

The registration of water use authorizations is required in terms of section 26 (1) (c) and 34(2) of the National Water Act, 36 of 1998 (NWA).

A General Authorisation (GA) is an authorisation to use water without a licence, provided that the water use is within certain limits and complies with conditions set out in the Gazetted GA. This authorisation requires a registration with the Department of Water and Sanitation prior to exercising the water use(s).

The S21(a) GA has a cap of 40 000m^3/annum regardless of the size of the property based on Regulation 538 of 2016. The S21(b) GA is capped at surface storage volume of 2000m^3. In terms of S21(c) and (i) water uses the process is determined by the risk rating (L, M, H) completed by a Freshwater Ecologist. If the risk rating is LOW, it can be generally authorised. If the rating is MEDIUM or HIGH a WULA will be required. In the case of boreholes there is an exclusion in Regulation 538 of 2016 – any borehole within 500m of a wetland automatically requires a WULA even though the volume could be within the ambit of a GA.

Existing Lawful Water Use (ELU) means the use of water authorised by or under any law that took place at any time for a period of two years before the commencement of the National Water Act 1998. The qualifying period is between 1998 and 2000.

A Schedule 1 use is a water use permissible in terms of Schedule 1 of the NWA, and allows a landowner, or legal occupier of the land, a right to reasonable use of surface or groundwater on that property This '*reasonable use*' is defined as:

- '*reasonable domestic use in that person's household*';
- '*small gardening not for commercial purposes*';
- '*the watering of animals (excluding feedlots) which graze on that land within the grazing capacity of that land*'.

Schedule 1 water uses do not require any permission or registration and is over and above the other abstraction volumes on site. Water uses exceeding the provisions of a GA, that cannot be classified as a Schedule 1 use, or that does not fall under ELU, will have to be authorised through a Water Use Licence (WULA). Section 21 of the National Water 36 of 1998 identifies the water uses to be authorised in terms of the act:

(a) taking water from a water resource;

(b) storing water;

(c) impeding or diverting the flow of water in a watercourse;

(d) engaging in a streamflow reduction activity contemplated in Section 36 of the Act;

(e) engaging in a controlled activity identified as such in section 37(1) or declared under section 38(1);

(f) discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit;

(g) disposing of waste in a manner which may detrimentally impact on a water resource;

(h) disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generation process;

(i) altering the bed, banks, course or characteristics of a watercourse;

(j) removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people;

(k) using water for recreational purposes.

CWA has a responsibility to implement measures to prevent pollution of any water resources during construction and operational activities. Since construction is proposed within the regulated area of water course or other freshwater feature, and water for the site will be abstracted from boreholes on site, an application for an integrated water use licence (WUL) is required. A WULA (WU33620) has been initiated with DWS through the e-wulaa system and will run concurrent with the other authorisation processes as part of the "One Environmental System".

1.4.4 National Environmental Management: Waste Act 59 of 2008 (NEM: WA) as amended:

The NEM: WA aims to reform waste management to protect health and the environment. It provides reasonable measures for the prevention of pollution and ecological degradation and to enable ecologically sustainable development; provides for institutional arrangements and planning matters; national norms and standards for regulating the management of waste by all spheres of government; specific waste management measures; the licensing and control of waste management activities; the remediation of contaminated land; the national waste information system; compliance and enforcement; and matters connected therewith.

The proposed activities on site require the following in terms of the NEM: WA:

Category C:

(1) The storage of general waste at a facility that has the capacity to store in excess of 100m^3 of general waste at any one time, excluding the storage of waste in lagoons or temporary storage of such waste.

(6) The sorting, shredding, grinding, crushing, screening or baling of general waste at a waste facility that has an operational area that is 1 000m^2 and more.

A Norms & Standards registration in terms of the NEM: WA (Act 59 of 2008 as amended, is required for applicable waste activities pertaining to the proposed development. The following Norms and Standards are applicable to the project:

- National Norms and Standards for the Storage of Waste (GN 37088, 29 November 2013).
- National Norms and Standards for the Sorting, Shredding, Grinding, Crushing, Screening or Bailing of General Waste (GN 41175, 11 October 2017).
- National Norms and Standards for the Treatment of Organic Waste (GN 1984, 1 April 2022).
- National Norms and Standards for Organic Waste Composting" (GN.561 of 25 June 2021).

1.4.5 Environmental Conservation Act 73 of 1989 (ECA) & Noise Regulations:

Section 25 of the Environmental Conservation Act (ECA) Act 73 of 1989 promotes the development of Noise Regulations (GN R154 in Government Gazette No. 13717 dated 10 January 1992). The administration of the noise control regulations was devolved to provincial and local authorities, so in Western Cape, noise is regulated by the New Noise Control Regulations put forward in June 2013 (Provincial Gazette Number 7141 of 20 June 2013).

"Disturbing noise" means a noise, excluding the unamplified human voice, which—

a) exceeds the rating level by 7dB(A);

b) exceeds the residual noise level where the residual noise level is higher than the rating level;

c) exceeds the residual noise level by 3dB(A) where the residual noise level is lower than the rating level; or

d) in the case of low-frequency noise, exceeds the level specified in Annex B of SANS 10103;

''Noise nuisance'' means any sound which impairs or may impair the convenience or peace of a reasonable person.

In Schedule 2 of the Noise Control Regulations, 2013, it is stipulated that a person may not:

a) cause a disturbing noise; or

b) allow a disturbing noise to be caused by any person, animal, machine, device, apparatus, vehicle, vessel or model aircraft, or any combination thereof.

In Schedule 3, regarding causing a noise nuisance, a person may not: *build, make, construct, repair, rebuild, modify, operate or test a vehicle, vessel, aircraft, model aircraft or any other object, or allow it to be built, made, constructed, repaired, rebuilt, modified, operated or tested, in or near a residential area*.

In terms of Schedule 4 (1) of the Noise Control Regulations:

The local authority, or any other authority responsible for considering an application for a building plan approval, business license approval, planning approval or environmental authorization, may instruct the applicant to conduct and submit, as part of the application, a noise impact assessment in accordance with

SANS 10328 to establish whether the noise impact rating of the proposed land use or activity exceeds the appropriate rating level for a particular district as indicated in SANS 10103, or where the noise level measurements cannot be determined, an assessment, to the satisfaction of the local authority, of the noise level of the proposed land use or activity.

In terms of Schedule 4 (3) of the Noise Control Regulations:

Where the results of an assessment undertaken in terms of sub-regulation (1) indicate that the applicable noise rating levels referred to in that sub-regulation will likely be exceeded, or will not be exceeded but will likely exceed the existing residual noise levels by 5 dB(A) or more, the applicant must provide a noise management plan, clearly specifying appropriate mitigation measures to the satisfaction of the local authority, before the application is decided; and implementation of those mitigation measures may be imposed as a condition of approval of the application.

In terms of Clause 4(4) of the Noise Control Regulations:

Where an applicant has not implemented the noise management plan as contemplated in sub-regulation (3), the local authority may instruct the applicant in writing to cease any activity that does not comply with that plan or reduce the noise levels to an acceptable level to the satisfaction of the local authority.

The World Health Organisation (WHO), together with the Organisation for Economic Co-ordination and Development (OECD) have developed their assessments on the effects of exposure to environmental noise resulting in several guideline values for different time periods and situations.

The WHO recommends a standard guideline value for average outdoor noise levels of 55dB(A) be applied during normal daytime, to prevent significant interference with the normal activities of local communities. The relevant night-time noise level is 45dB(A). In addition, the WHO recommends that during the night, the maximum level of any single event should not exceed 60dB(A) to protect against sleep disruption.

Ambient noise levels have also been specified for various environments.

Table 7: WHO Guidelines for Ambient Sound Levels (Noise Scoping report, DDA, Sept 2023).

Environments	Ambient Sound Level LAeq (dB(A))			
	Daytime		Nighttime	
	Indoor	Outdoor	Indoor	Outdoor
Dwellings	50	55		
Bedrooms			30	45
Schools	35	55		

The OECD supports the levels recommended by the WHO, and in addition they suggest the following environmentally sustainable transport noise levels based on the (noise) receiving community (Table 8).

Table 8: OECD Guidelines for Ambient Sound Levels (Noise Scoping report, DDA, Sept 2023).

Land Areas	Max allowable ambient noise level	
	Daytime	Nighttime
Urban	55	45
Rural	50	40

The SANS 10103 Code of Practice provides typical ambient noise rating levels (LReq,T) in various districts (refer Table 9 according to Table 2 in SANS 10103).

Table 9: Typical Rating Levels for Ambient Noise (Noise Scoping report, DDA, Sept 2023).

Type of district	Equivalent continuous rating level ($L_{Req.T}$) for noise (dB(A))					
	Outdoors			Indoors, with open windows		
	Day-Night *L*R,dn1)	Day-time *L*Req,d2)	Night-time *L*Req,n2)	Day-Night *L*R,dn1)	Day-time *L*Req,d2)	Nighttime *L*Req,n2)
a) Rural districts	45	45	35	35	35	25
b) Suburban districts with little road traffic	50	50	40	40	40	30
c) Urban districts	55	55	45	45	45	35
d) Urban districts with one or more of the following: workshops; business premises; and main roads	60	60	50	50	50	40
e) Central business districts	65	65	55	55	55	45
f) Industrial districts	70	70	60	60	60	50

Note: Daytime: 06:00 to 22:00, Night-time: 22:00 to 06:00.

1) Equivalent continuous rating levels that include corrections for tonal character and impulsiveness of the noise and the time of day.

2) Equivalent continuous rating levels that include corrections for tonal character and impulsiveness of the noise.

The applicable SANS District for both the examined sensitive receptors is that of a Suburban Residential area with little road traffic, which has a guideline of 50dB(A) for day and 40dB(A) for night-time respectively.

1.4.6 National Environmental Management: Biodiversity Act 10 of 2004 (NEM: BA):

The Act provides for the management and conservation of South Africa's biodiversity within the framework of the National Environmental Management Act, 1998; the protection of species and ecosystems that warrant national protection; the sustainable use of indigenous biological resources; the fair and equitable sharing of benefits arising from bioprospecting involving indigenous biological resources; the establishment and functions of a South African National Biodiversity Institute (SANBI); and for matters connected therewith.

1.4.7 National Heritage Resources Act, 1999 (Act No. 25 of 1999) ("NHRA")

The NHRA, provides for the management of national heritage resources, to set norms and maintain national standards for the management of heritage resources in South Africa, and to protect heritage resources of national significance, so that heritage resources may be bequeathed to future generations.

Section 38 (1) stipulates that subject to the provisions of subsections (7), (8) and (9), any person who intends to undertake a development categorised as—

a) the construction of a road, wall, powerline, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length;

b) the construction of a bridge or similar structure exceeding 50m in length;

c) any development or other activity which will change the character of a site--

i) exceeding 5 000m^2 in extent; or

ii) involving three or more existing erven or subdivisions thereof; or

iii) involving three or more erven or divisions thereof which have been consolidated within the past five years; or

iv) the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority;

d) the re-zoning of a site exceeding 10 000m^2 in extent; or

e) any other category of development provided for in regulations by SAHRA or a provincial heritage resources authority, must at the very earliest stages of initiating such a development, notify the responsible heritage resources authority and furnish it with details regarding the location, nature and extent of the proposed development.

Final Comment is to be obtained from Heritage Western Cape (HWC) who is regarded as a commenting authority in this case.

1.4.8 Minerals and Petroleum Resources Development Act 28 of 2002 (MPRDA) as amended:

The MPRDA came into effect on 1st May 2004 and governs the acquisition, use and disposal of mineral rights within South Africa. The Uitsig quarry (described as Uitsig Clay Pit) with Mining Licence ML17/2001 on P23 of Farm 724 has an existing Mining Licence (ML17/2001) from the Department of Minerals Resources and Energy (DMRE). A mine closure application has been lodged by Corobrik (Pty) Ltd, the current holder of the Mining Licence, in terms of Section 43 of the MPRDA. The mine will be closed before the development is approved and the closure objectives is in line with the development objectives.

1.4.9 Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983) ("CARA")

The objective of this Act is to provide for the conservation of the natural agricultural resources by the maintenance of the production potential of land, by the combating and prevention of erosion and weakening or destruction of the water sources, and by the protection of the vegetation and the combating of weeds and invader plants.

The National Agriculture Department is responsible for implementing CARA, which stipulates, among other things, that:

- You can't cultivate virgin soil without written permission.
- You can't cultivate any land with a slope of more than 12% without written permission.
- You must protect cultivated land effectively against water and wind erosion.
- The veld on the farm must be effectively protected against deterioration and destruction.

The proposed expansion project entails rezoning of agricultural land for use in aviation, which will require comment from Western Cape Department of Agriculture: Land Use Planning.

1.5 THE EMPr DOCUMENT

An Environmental Management Plan (EMPr) can be defined as "*an environmental management tool used to ensure that undue or reasonably avoidable adverse impacts of the construction, operation and decommissioning of a project are prevented; and that the positive benefits of the projects are enhanced*". EMPr's are therefore important tools for ensuring that the management actions arising from

EIA processes are clearly defined and implemented through all phases of the project life cycle.

The EMPr forms part of the contract identifying and specifying the procedures to be followed by the Applicant in order to eliminate or reduce adverse impacts during the construction and operational phase. Should the owner or employee persistently fail to observe provisions of the EMPr, the Environmental Control Officer (ECO) should notify the relevant authority for a compliance audit, and possibly the prosecution of an individual or the removal of the individual from site.

The Environmental Contract ascribes legal status to the EMPr and any subsequent amendments thereto. The EMPr includes all relevant documentation within this report and/or referred to within it. The National Environmental Management Act, 1998 (Act No. 107 of 1998) ("NEMA"), and the respective Regulations are pertinent to this development. All activities on site must adhere and comply with the provisions of these Acts.

In general, the EMPr can consist of the following phases: ***planning & design***; ***pre-construction activities***; ***construction activities***; ***rehabilitation &/or decommissioning***; and lastly ***operational activities***. However, the need to include all the above phases is dependent on the scale and scope of each individual project. For the purposes of this application the following three categories are largely defined:

- **Planning, Design & Pre-construction Phase**: These measures relate to the detailed layout, planning and design of the Cape Winelands Airport and associated infrastructure and will largely be implemented by the planning and development team, prior to the commencement of any physical site activities. This section also relates to the demarcating of the proposed activity footprint areas versus conservation and no-go areas.

- **Construction Phase**: This section is applicable during site preparation and construction on the site for the proposed project and must be implemented by the relevant contractors and sub-contractors. This relates to the construction of services, infrastructure, buildings, associated infrastructure, runways, landscaping etc.

- **Operational Phase**: This section is intended to guide the operation and maintenance aspects associated with the Cape Winelands Airport relating to the proposed project, in line with relevant legislative requirements and the recommendations made by the specialist consultant (s).

Please note: The first two phases can overlap and are generally also referred to collectively as the CEMP (Construction Environmental Management Plan). The final phase can also be referred to as the OEMP (Operation Environmental Management Plan).

The EMPr will be reviewed by the ECO on an ongoing basis. Based on observations during site inspections and issues raised at site meetings, the ECO will determine whether any procedures require modification to improve the efficiency and applicability of the EMPr on site. Any such changes or updates will be registered in the ECO's monthly record, as well as being included as an annexure to this document. Annexures of this nature must be distributed to all relevant parties on site.

The following content is required in the EMPr in accordance with Annexure 4 of the EIA Regulations:

Table 10: EMPr requirements in terms of Annexure 4 of the EIA Regulations.

(1) An EMPr must comply with Section 24N of the act and include -	**Section in EMPr:**
a) details of– *(i) the EAP who prepared the EMPr; and* *(ii) the expertise of that EAP to prepare an EMPr, including a curriculum vitae;*	Page 3 & Annexure 1.
b) a detailed description of the aspects of the activity that are covered by and as identified by the project description;	Section 1.3.
c) a map at an appropriate scale which superimposes the proposed activity, its associated structures, and infrastructure on the environmental sensitivities of the preferred site, indicating any areas that should be avoided, including buffers;	Figure 8 & Annexure 3B

d) a description of the impact management outcomes, including management statements, identifying the impacts and risks that need to be avoided, managed and mitigated as identified through the environmental impact assessment process for all phases of the development including— *(i) planning and design;* *(ii) pre-construction activities;* *(iii) construction activities;* *(iv) rehabilitation of the environment after construction and where applicable post closure; &* *(v) where relevant, operation activities;*	Section 2 and 4
e) a description of proposed impact management actions, identifying the manner in which the impact management outcomes contemplated in paragraph (d) will be achieved, and must, where applicable, include actions to — *(i) avoid, modify, remedy, control or stop any action, activity or process which causes pollution or environmental degradation;* *(i) comply with any prescribed environmental management standards or practices;* *(ii) comply with any applicable provisions of the Act regarding closure, where applicable; &* *(iii) comply with any provisions of the Act regarding financial provision for rehabilitation, where applicable;*	Section 2 and 4
f) the method of monitoring the implementation of the impact management actions contemplated in paragraph (e);	Section 4 and 5
g) the frequency of monitoring the implementation of the impact management actions contemplated in paragraph (e);	Section 4 and 5
h) an indication of the persons who will be responsible for the implementation of the impact management actions;	Section 3 and 4
i) the time periods within which the impact management actions contemplated in paragraph (f) must be implemented;	Section 4 and 5
j) the mechanism for monitoring compliance with the impact management actions contemplated in paragraph (e);	Section 4 and 5

k) a program for reporting on compliance, taking into account the requirements as prescribed by the Regulations;	Section 4 and 5
l) an environmental awareness plan describing the manner in which— *(i) the applicant intends to inform his or her employees of any environmental risk which may result from their work; and* *(ii) risks must be dealt with in order to avoid pollution or the degradation of the environment; and*	Section 4.2.2 & Annexure 15
m) any specific information that may be required by the competent authority.	<u>All additions/ changes as a result of the PPP are underlined</u>

SECTION 2: ENVIRONMENTAL IMPACTS

2.1 IMPACTS:

Section 2.1 is compiled from the list of impacts as identified and listed within the relevant Specialists Studies and through the consultation process. These impacts provide the reader with the understanding and background to assist with all aspects of environmental management associated with the CWA.

2.1.1 Geohydrological Impacts:

Construction Phase

- Potential Impact on groundwater quality deterioration because of contamination by construction of the facility.
- Potential Impact on groundwater quality deterioration because of surface runoff.

Operational Phase:

- Potential impact on groundwater quality deterioration because of leaks from fuel storage and distribution.
- Potential impact on groundwater quality deterioration because of atmospheric deposition.
- Potential impact on groundwater quality deterioration because of direct release.
- Potential impact on groundwater quality deterioration because of Accidental Release.
- Potential impact on groundwater quality deterioration because of bio-digester facilities for energy generation.
- Potential impact on groundwater quality deterioration because of the operation of photovoltaic solar facilities.
- Potential impact due to the depletion of groundwater resource as a result of over-abstraction.
- Potential impact on groundwater quality as a result of over-abstraction.
- Potential impact on groundwater quality deterioration as a result wastewater storage before treatment.

2.1.2 Air Quality Impacts:

Construction Phase:

During construction, the main air pollutant of concern is dust. Dust will be generated during the land clearing, site preparations and levelling, bulk earthworks, such as cut and fill operations to the east of the existing runways, material loading and hauling, travelling on unpaved roads and wind erosion from exposed areas.

The dust is expected to settle to the ground near the sources due to gravity in a matter of a few hours and can cause a nuisance to the receptors in close proximity to the sources. The effects of dust include visual soiling of clean surfaces, such as cars, window sills and household washing. The airborne dust can also have an effect on visibility in the immediate vicinity of the source, which may affect potential aircraft operations during the construction phase.

The sensitivity in the immediate vicinity of the site is considered low, since there are no existing residential areas bordering the CWA airport site. The closest community is that of Fisantekraal, which is situated more than 1,000 m away, towards the south-west.

The exhaust emissions from the truck movements and equipment at the site are expected to marginally increase air pollution concentrations, primarily within the site. At the existing communities around the airport site, these increases are expected to be negligible. Therefore, the expected impact of the vehicle and equipment exhaust emissions during construction is considered to be insignificant.

During construction the dust deposition is expected to increase in close proximity to the various construction activites, i.e. within 300 m from the working face. Therefore, the extent of the impact was considered to be contained primarily within the site boundaries and set to local. The duration of the main construction activities may take up to 2 years, and as such was set to short-term. The total dust deposition beyond a 200m zone from the airport site is expected to be well below the DEA guideline of 600 mg/m^2/day for residential areas, such that the intensity rating was considered to be medium. The significance of the unmitigated impact is anticipated to be VERY LOW.

Even though, under hot and windy summer conditions the generated dust may blow off site, it is unlikely to create nuisance at Fisantekraal. With the implementation of the mitigation measures, the impact is expected to be INSIGNIFICANT.

Operational Phase:

The resulting air pollution levels around the Cape Winelands Airport due to the airport operations were simulated with the use of the US FAA's AEDT model, which utilises the USEPA AERMOD model for the for the dispersion calculations. The resulting air pollution contours and air quality impacts were estimated for the following scenarios:

Scenario 1: Existing runway setup under full utilisation (No-Go Alternative);

Based on the modelling results for the existing situation under full capacity (Scenario 1), the ground-level concentrations of all pollutants are expected to exceed their respective guidelines outside the CWA airport site boundaries.

It should be noted that the highest maximum 1-hr NO_2 concentrations at some small areas around the site exceeded the 1-hr guideline value. However, the frequency of exceedances was below 3 per year, which is well below the 88 times per annum permissible by the South African legislation.

Currently, the sensitivity of the area in the immediate vicinity of the site is considered low, due to the fact that the closest community, Fisantekraal, is situated more than 1,000 m away.

However, as indicted in previous sections, in the near future two residential areas are planned to be developed immediately south and towards the west of the airport. Once these communities are established, the sensitivity of the area would be considered moderate, assuming appropriate buffer zones will be established, primarily due to noise impact concerns.

Based on the modelling results for Scenario 1, the existing air pollution intensity due the airport's operations is considered to be low. The extent of the impact is mostly limited to the airport site, with two small areas extending towards the west and south of the site. The overall impact rating for Scenario 1 was found to be of VERY LOW significance.

Scenario 2: Operations on the new runway 01/19 in the operational year;

With the introduction of the new runway, the air quality impact zones during the operational year will be reduced in size, compared to Scenario 1. In addition, these zones will also follow a more north-westerly and south-easterly direction, in line with the new runway.

All of the air pollutant levels outside the airport site boundaries were found to be very low. The air pollution concentrations due to the airport operations at the Fisantekraal community, but also at the new developments west and south of the airport, are expected to be very low and well within the air quality standards.

The overall air quality impact for Scenario 2 is of VERY LOW significance.

Scenario 3: Operations on the new runway 01/19 at full capacity.

The air quality impact zones for the new runway at full capacity will extend beyond the airport site boundaries in a north-westerly and south-easterly direction. The air pollutant levels, however, will be within their respective air quality standards, except for the highest maximum 1-hr NO2 concentrations within small areas north and south of the runway.

Even though the maximum 1-hr NO2 concentrations exceeded the 1-hr standard, the frequency of exceedances was below 10 per year, which is within the allowed number of exceedances of 88 times, as specified by the South African legislation.

The air pollutant levels at the identified community receptors, including at Fisantekraal and Klipheuwel were found to be well within the standards.

The overall air quality impact for Scenario 3 is of LOW significance.

2.1.3 Noise Impacts:

Construction Phase

During construction the noise levels at the closest community receptors are not expected to exceed the SANS guidelines for Urban Residential areas.

No specific noise mitigation measures are necessary for the construction operations, other than ensuring that the equipment is in good working order and properly maintained, as well as providing training to the personnel to adhere to operational procedures that reduce the occurrence and magnitude of individual noisy events.

The significance of the unmitigated impact is anticipated to be VERY LOW. It should be noted that for a short duration, when the working face is closest to the Fisantekraal community towards the western boundary of the site, this impact may be LOW, albeit for a limited time.

With mitigation measures, the noise impact during construction is anticipated to be INSIGNIFICANT.

Operational Phase

The resulting noise levels from the Cape Winelands Airport aircraft operations were simulated with the use of the US FAA's AEDT model. Based on the noise modelling methodology and input data, the resulting noise contour levels were estimated for three (3) scenarios. The busy day operations are expected to reach 301 by the time the current runway system reaches its operational capacity (Scenario 1). For Scenario 2, the expected busy day aircraft operations per day with the new runway 01/19 will be reduced to 29. When the new airport operates at capacity the busy day operations will reach 208. Based on the modelling results in the previous sections, the impacts for the operational phase of the project are summarised below.

Scenario 1: Existing Runway System at Full Utilisation (No-Go Alternative)

For Scenario 1, the day-night noise rating level L_{Rdn} noise contour of 55 dB(A) will encompass a total area of 2.47 km^2 around the airport. A small portion of this contour extends beyond the R312 towards the south, within the Greenville Garden City and covers a zone of approximately 0.44 km^2. Within this zone it would not be recommended to establish residences, without providing additional noise mitigation measures.

The L_{Rdn} 60 dB(A) zone is completely contained within the airport site for Scenario 1.

From the day-night N70 contours, which indicate the number of aircraft movements that exceed 70 dB(A) L_{Amax} at a given location, it was found that the 30 and above events area is 8.6 km^2, and a portion of this zone extends beyond the airport site boundaries into the Bella Riva development and primarily into the Greenville Garden City. The area affected in the later development is 1.6 km^2. This is considered significant, and mitigation measures in terms of appropriate land use planning should be implemented for this zone.

No night-time aircraft operations are planned for the night-time period for this scenario.

Based on the resulting noise contours, it is evident that the existing residential areas of Fisantekraal and Klipheuwel fall outside of the above-mentioned impact zones.

In addition, the fact that the proposed residential developments of Bella Riva and the Greenville Garden City are in the design phase could provide an opportunity to consider and implement appropriate mitigation measures, taking into account the areas of impact in each development.

Based on the above, the overall impact rating without mitigation for Scenario 1 was found to be of HIGH significance. With the implementation of the mitigation measures, primarily in terms of land use planning for the proposed residential areas adjacent to the airport, the overall impact rating was found to be of MODERATE significance.

Scenario 2: New Runway 01/19 in Operational Year

With the introduction of the new runway, the noise impact zones during the operational year will be greatly reduced compared to the ones resulting from the current runway system at full capacity.

The area with LRdn 55 dB(A) during the operational year will only be 1.44 km^2 and will not extend into the proposed residential areas west and south of the airport and will be contained within the development area of the airport site.

The aircraft operations that will cause 5-10 events per day exceeding the 70 dB(A) L_{Amax}, will extend outside air airport's site boundary towards the south. However, this zone is very small, and the number of events is considered of low significance.

Based on the above, the overall impact rating for Scenario 2 was found to be of LOW significance without mitigation.

Additional noise abatement procedures for the aircraft operations are not required for the operational year of the new runway. However, consideration of such measures and operations should be initiated before the full capacity of the new runway is reached, based on the noise monitoring around the airport and noise modelling of the applicable mitigation measures.

Scenario 3: New Runway 01/19 at Full Capacity

By the time that the new airport and runway 01/19 reaches its capacity, the length of the LRdn 55 dB(A) impact zone will reach 4 km north of its northern site boundary. The Klipheuwel residential area will be

outside this impact zone. The noise level on the south-eastern part of Klipheuwel community is expected to reach 49 dB(A), which is in accordance with the SANS 10103 guideline for Urban Districts with little road traffic.

Towards the south, the 55 dB(A) noise contour will extend less, reaching a distance of 3.3 km. This zone will overlap the Greenville Garden City development and cover an area of approximately 1.02 km^2.

It should be noted that immediately south of the runway, there will also be a small zone of 0.11 km^2 within the Greenville Garden City area, where the L_{Rdn} reaches between 60 dB(A) and 63 dB(A).

Towards the Bella Riva area, the L_{Rdn} 55 dB(A) contour will extend approximately 300m from its eastern further most point of this development. The area that is covered by this contour within the Bella Riva development is 0.38 km^2.

From the N70 day-night contours it is evident that there is an area within the Greenville Garden City that will experience more than 30 events of 70 dB(A) L_{Amax}. This is considered significant, and mitigation measures in terms of appropriate land use planning should be implemented for this zone, which is approximately 1.2 km^2.

It should be noted that the above-mentioned zone that should be considered for appropriate land use planning is smaller than the relevant one for Scenario 1, which is 1.6 km^2.

The Klipheuwel residential area was found to fall within the 5-10 events contour but outside the 20-30 events.

The number of events that exceed the 70 dB(A) L_{Amax} during night-time, i.e. between 22h00 and 06h00, are expected to be only 3, and their contour is contained around the northern section of the new runway, within the airport development site.

Similarly, the number of events that exceed the 60 dB(A) L_{Amax} during night-time is 3, and its contour is primarily around the northern section of the new runway. This contour marginally extends beyond the airport site boundaries and covers a small portion of the northern Bella Riva development area. However, this is considered of low significance, since it only refers to 3 events and will take place before 11h00.

The investigation of noise abatement operational procedures should be initiated before the full capacity of the new runway is reached, taking into account the recommended noise monitoring around the airport and noise modelling of the applicable mitigation measures.

Based on the above, the unmitigated overall impact rating for Scenario 3 was found to be of HIGH significance. With the implementation of appropriate land use planning for the proposed adjacent residential areas, the overall impact rating for Scenario 3 was found to be of MEDIUM significance.

2.1.4 Botanical Impacts:

Construction Phase:

The main construction phase botanical impact of the proposed development is loss and degradation of the remaining natural and partly natural vegetation in some of the development footprints. It is likely that about 1.0ha of the 1.6ha patch of Very High sensitivity in the North will be lost, along with the two associated plant Species of Conservation Concern in this area. About 1.3ha of High sensitivity vegetation will be lost, and about 2.7ha of Medium sensitivity vegetation will be lost. Thus, a total of about 5ha of vegetation of some sensitivity will be lost, with all the rest being of Low sensitivity (generally heavily disturbed or cultivated). Only three of the 25 recorded plant Species of Conservation Concern in the study (and Agricultural Precinct) area will be lost to the proposed development footprint, one of which already seems to be extinct on the site (*Leucospermum grandiflorum).*

Operational Phase:

Operational phase impacts include reduction of the current low - moderate levels of ecological connectivity across the study area, and associated habitat fragmentation.

The airside open space areas will need to be brushcut and mown to various heights (from 200mm to 700mm), to comply with safety regulations, and also to minimise potential bird-strikes. This regular mowing will obviously have a negative physical effect on the plants, but most of them should survive, although they will remain stunted, and may not flower or set seed, depending on the timing of the mowing.

The Landscape Concept Plan indicates that a suitably low growing (depending on location) mix of indigenous annuals, vygies, herbs and low shrubs will be hydroseeded and planted in most of the airside open areas. If this is even partly successful it could actually enhance the current low indigenous plant diversity in these areas.

Some fire related changes are likely, but assessing these is difficult, as the No Go implies very infrequent fires, which may also be the case going forward, unless managed and mitigated (in the conservation worthy areas at least).

Alien invasive vegetation management already undertaken on site has had a minor positive impact and will continue. If the required environmental management of the natural areas on site is properly implemented, and if the required biodiversity offset is secured, then the proposed development could have a notable positive botanical impact on a regional scale, even taking into account the loss of patches of sensitive habitat on site.

2.1.5 Freshwater Ecological Impacts:

Construction Phase:

Modification of the seep wetland 1 and CVB wetland 2 and 3's hydrological functioning and water quality:

- Site preparation prior to construction activities, involving vehicular movement (transportation of construction materials) and associated disturbances to soil.
- Removal of topsoil and vegetation and creation of topsoil stockpiles, and increased likelihood of dust generation due to exposed soil.
- Movement of construction equipment and personnel within the seep wetland 1 and potentially CVB wetland 3.
- Earthworks involving removal of topsoil and creation of soil stockpiles for the construction of activities related to the runway and related infrastructure and service infrastructure within 32m of the delineated extent of the wetlands.
- Groundbreaking including excavation and stockpiling of soil for the construction of stormwater infrastructure within 32m of the seep wetland 1 and potentially CVB wetland 3.
- Groundbreaking: installation of service infrastructure within the 32m NEMA ZoR of the seep wetland 1 and potentially CVB wetland 2 and 3.
- Potential mixing and casting of concrete/ asphalt for runway within the 32m NEMA ZoR of the seep wetland 1.
- Construction of maintenance road and fences through the wetlands.

Changes to the geomorphological processes (sediment balance, erosion and sedimentation):

- Site preparation prior to construction activities, involving vehicular movement (transportation of construction materials) and associated disturbances to soil.
- Removal of vegetation within the development footprint and seep wetland 1 resulting in increased sediment loads into the seep and CVB wetlands and potential for headcut erosion and smothering of wetland habitat.
- Earth works involving excavation and creation of soil stockpiles for the construction service infrastructure, stormwater attenuation ponds, runway and maintenance road and fences within the 32m NEMA ZoR of the seep wetland 1 and CVB wetlands 2 and 3.

Wetland habitat loss, altered wetland habitat and impacts to biota:

- Site preparation prior to construction activities, involving vehicular movement (transportation of construction materials) and associated disturbances to soil.
- Removal of topsoil and creation of topsoil stockpiles.

- Earthworks involving excavation and creation of soil stockpiles for the construction of the runway, service infrastructure, stormwater attenuation ponds, maintenance road and fences within the 32m NEMA ZoR of the seep wetland 1 and potentially CVB wetland 3.
- Potential mixing and casting of asphalt and concrete for the runway associated with the proposed CWA development within the 32m NEMA ZoR of the seep wetland 1.
- Loss (6.74ha) of seep wetland 1 habitat and ecoservices as a result of the construction of the proposed CWA development.

Operational Phase:

- Modification of the seep wetland 1 and CVB wetland 2 and 3's hydrological functioning and water quality:
- Operation of stormwater attenuation ponds and discharge of attenuated stormwater from the proposed CWA development into the seep wetland 1 and CVB wetland 3 via stormwater attenuation ponds within the study area.
- Operation of the runway and service infrastructure potentially releasing hydrocarbons from the internal road network and runway entering the wetlands through stormwater run-off.
- Operation of the maintenance road and fences through the seep wetland 1 and CVB wetlands 2 and 3.
- Potential indiscriminate movement of vehicles within the wetlands for inspection/ maintenance.

Changes to the geomorphological processes (sediment balance, erosion and sedimentation):

- Operation of the stormwater attenuation ponds responsible for the alteration of the sediment load as a result of water and sediment release into the wetlands via stormwater releases. Hardened surfaces and diffuse stormwater runoff may also affect sediment balance in the landscape.
- Potential indiscriminate movement of vehicles within the wetlands for inspection/ maintenance.

Wetland habitat loss, altered wetland habitat and impacts to biota:

- Operation of the proposed CWA development including the related infrastructure, stormwater attenuation ponds, roads, service infrastructure and associated open space areas.
- Anthropogenic disturbance including noise and physical degradation of wetland habitat reducing available feeding, drinking, breeding and migratory habitat to biota associated with the CVB wetlands 2 and 3.
- Potential hydrocarbons from the hangars, workshops, internal road network and runway entering the wetlands through stormwater run-off.

2.1.6 Hydropedological Impacts:

Construction Phase:

The potential impacts from the proposed CWA development will likely pertain to the impacts experienced once the land is excavated during the construction of foundations for the proposed development:

- Sealed surfaces post-construction could alter the natural flow of water in the study area, potentially leading to increased erosion and sedimentation in lower-lying areas if not managed properly.
- Reduced infiltration due to sealed surfaces may necessitate the channelisation of water into stormwater structures and discharge into downstream watercourses or lower lying areas in the landscapes.
- Encroachment on interflow soils may disrupt wetland recharge mechanisms, affecting subsurface processes and ecological state.
- Downstream streams are ephemeral and likely recharged mainly by overland flow and direct precipitation over short periods. As such the contribution of interflow soils to these downstream watercourses is likely limited.

Operational Phase:

Overall, the hydropedological processes are predicted to remain largely unmodified in the post development scenario, and the functionality of the wetlands identified within the catchment area will likely remain unchanged if stormwater is managed effectively.

2.1.7 Terrestrial Ecological Impacts:

Construction Phase:

Faunal Impacts

- Loss of habitat due to vegetation clearance activities;
- Displacement of species from the footprint areas during construction activities;
- Potential increased mortalities due to human – wildlife conflict as well as faunal species collisions with construction vehicles;
- Potential poaching/snaring by staff/construction personnel;
- Loss of habitat connectivity and movement corridors within the landscape;
- Increased noise pollution from machinery during the construction phase; and
- Increased light pollution.

Avifaunal Impacts

- Direct loss of avifaunal habitat;
- Decreased avifaunal abundances and species richness;
- Increased anthropogenic movement;
- Altered avifaunal movement patterns;
- Loss of avifaunal SCC habitat and possible SCC occurrence both within the study area and in the surrounding habitats;
- Altered biotic integrity and disturbance to ecosystem function; and
- Altered water quality.

Operational Phase:

Faunal Impacts

- Potential increased mortalities due to human – wildlife conflict as well as faunal species collisions with operational vehicles;
- Potential poaching/snaring by staff;
- Loss of habitat connectivity and movement corridors within the landscape;
- Increased noise pollution from aircraft during the operational phase; and
- Increased light pollution, notably during the operational phase of the airport.

Avifaunal Impacts:

- Direct loss of avifaunal habitat;
- Decreased avifaunal abundances and species richness;
- Increased anthropogenic movement;
- Potential for bird strikes;
- Altered avifaunal movement patterns;
- Loss of avifaunal SCC habitat and possible SCC occurrence both within the study area and in the surrounding habitats;
- Altered biotic integrity and disturbance to ecosystem function; and

- Altered water quality.

The presence and abundance of high-risk bird species are primarily associated with agricultural land use and water bodies within the primary bird hazard zone surrounding the proposed CWA. The movement of birds between these habitats warrants attention.

2.1.8 Socio-economic Impacts:

Potential positive socio-economic impacts:

1. *Provision of transport infrastructure:* The proposed CWA will serve as a "reliever" airport for the CTIA in a complementary role within South Africa's network of airports and airfields. It would alleviate congestion at CTIA and make land available for future expansions at the CTIA. It would also increase the available hangarage facilities in the market and unlock the Western Cape GA market, which is currently severely constrained.

2. *Employment opportunities:* The findings of the employment analysis indicate that the project could sustain about 32 433 (direct, indirect and induced) employment opportunities during construction, including ongoing capital expenditure requirements over 22 years of initial and ongoing construction. As a result of the job opportunities created through the proposed interventions, household incomes from job opportunities could increase by R3,8 billion over the total 22 years of initial and ongoing construction.

During the initial 20 years of operations, the project could sustain about 102 732 direct, indirect and induced employment opportunities, adding R17,7 billion in household income.

3. *Economic income:* The proposed CWA expansion would contribute to the primary (raw materials, e.g., sand, stone), secondary (e.g., bricks, cement, roof tiles) and tertiary sectors (various professional services) of the local economy during the construction phase. The initial capital investment of an estimated R8,9 billion could generate R23,2 billion in new business sales during construction, referred to as the production (or output) that creates demand for business activity over the construction period. The increase in production output could add R8,8 billion (net of the import leakage) to the GGP of the CMA during construction. During an initial 20-year operational period, which includes a substantial component of maintenance expenditure, an estimated at R36,1 billion in nominal terms could generate R76,1 billion in new business sales.

4. *New business development:* The preferred alternative development plan earmarks 350 000 m^2 of GLA for commercial and general business. This will provide numerous opportunities for transport-related businesses like public transport, car hire, fuelling, and parking will attract commercial passenger traffic at the airport. Commercial developments such as retail, food & beverage, and even offices can support business traffic by providing complementary and convenient services. Once the airports become operational, the tertiary sector in particular would benefit, but the primary and secondary sectors would also continuously benefit due to the linkages between the different economic sectors.

5. *Revenue accruing to the local authorities:* The development of the CWA could contribute R3,9 billion to central government coffers over 22 years in current terms, while the City of Cape Town could obtain R2,.1 billion from rates and services based on the applied assumptions in current terms.

6. *Surrounding property values:* Properties adjacent to the site may be in demand for commercial and/or industrial developments, thus increasing the perceived value of those properties.

Potential negative socio-economic impacts:

1. *Impact on traffic flows:* A significant increase in traffic along the access routes can be expected during construction and operations, which will negatively impact surrounding land users in particular. A number of road upgrades have been recommended by the Traffic Impact Assessment; many of these are directed at background traffic related to other developments in the area.

2. *The influx of job seekers:* An influx of job seekers (mainly from the Northern District) during construction will lead to competition among local (Fisantekraal) residents for employment opportunities. Workers stranded in the area after the construction phase could also increase the demand for housing and social services over the longer term.

3. *Dust and noise (construction):* Site preparation and the introduction of services will create dust and noise that would affect nearby receptors, in particular the residents of Fisantekraal to the southwest.

4. *Construction workers* may seek the local community for leisure and social activities. This could lead to social ills impacting local families and their social structures.

5. *Increase in crime levels:* On-site activities could attract criminals, but this could be mitigated with effective security measures and access control. Crime could include on-site petty theft, theft of building material, on-selling of security information, or burglary and theft at nearby properties.

6. *Sense of place (operations):* A large airport will affect neighbouring land users who may enjoy a more rural character, with their sense of place negatively affected by the potential visual impact, aircraft noise, air pollution and increased traffic along the access routes.

7. *Nearby farming and business operations:* Noise and air pollution may negatively impact nearby farming operations and businesses in the area.

8. *Surrounding property values:* Property owners in nearby neighbourhoods may be negatively affected due to a change in the sense of place. There are no existing residential properties located within the 55 dBA noise contour identified by the Noise Impact Assessment, offering new proposed residential developments an opportunity to consider and implement appropriate mitigation measures during the planning stages.

9. *Bulk infrastructure requirements* relate to the provision of bulk infrastructure for sewerage, water and electrical supply, solid waste disposal and stormwater management. The developer is responsible for the provision of these services, but the local municipality requires sufficient capacity to meet the additional demand. The engineering reports indicate that the required services are available in the area, and that there

is sufficient capacity to accommodate the proposed CWA development if the Developer provides the necessary infrastructure and network connections.

2.1.9 Heritage Impacts (Cultural, Archaeological and Visual) Impacts:

Construction and Operational Phase

Archaeological Impacts:

The project does not pose a significant threat to local **archaeological heritage resources** and that the proposed development area is not a sensitive or threatened archaeological landscape.

Visual Impacts:

- Potential effect and/or intrusion on protected landscapes or scenic resources; and potential effect of change to the visual character of the area: Visibility of sources of light at night (for sensitive receptors) within LCA 2 & 3 (inside Urban Edge, and within Joostenburg Vlakte Cultural Landscape (CL)).

- Potential effect and/or intrusion on protected landscapes or scenic resources; and potential effect of change to the visual character of the area: Visibility of sources of light at night (for sensitive receptors) within LCA 4 (within the Durbanville Hills CL and the Koeberg/ Swartland Farms CL).

- Potential effect and/or intrusion on protected landscapes or scenic resources: and potential effect of change to the visual character of the area: Visibility of sources of light at night (for sensitive receptors) within the LCA 1 (within the Agter-Paarl Paardeberg CL).

- Potential effect and/or intrusion on protected landscapes or scenic resources and potential effect of change to the visual character of the area: Transformation of land use and site character: New buildings, structures and service infrastructure visible within previously predominantly rural agricultural landscape. Transformation of land uses within the site boundaries from an existing airfield and farmland (mostly undeveloped) into a regional airport including a commercial component (mostly developed). Total clearance of the developable areas of the subject site during construction phase (bulk earthworks).

- Potential effect on the visual amenity of Scenic routes: The R312 Lichtenburg Road Scenic Route (Route 31; SR1: Scenic drive envelope, Gateway Point and view corridors as scenic resources).

- Potential effect on the landscape character and sense of place of: the Agter-Paarl Paardeberg Cultural Landscape (LCA 1 – areas not within the property boundary). Potential effect on the scenic amenity of: the portion of the R304 Provincial Scenic Route (between the R312 Lichtenburg Road crossing and its intersection with Slent Road near Klipheuwel) that bisects the subject site, but lies eastward and outside of the portion of the CWA that is earmarked for development.

- Potential effect on the landscape character and sense of place of: The Durbanville Hills CL (extents of the Cultural Landscape as modified in Figure 18) and the Koeberg/Swartland Farms CL (both within LCA4). Potential effect on the scenic amenity of: R302 Klipheuwel road Scenic Route (Route 30b; SR1) and the Spes Bona Road.

- Potential effect on the landscape character and sense of place of: The Joostenberg Vlakte Cultural Landscape (extents of the Cultural Landscape as modified in Figure 18) also referred to as LCA 2. Potential effect on the scenic amenity of: R304 (S1: between the N1 and the crossing with the R312 Lichtenburg Road).

Cultural Impacts:

Although two of the structures in the study area are older than 60 years neither of them is of aesthetic significance nor conservation worthy. The proposed expanded airport will have an impact on the landscape character which is of some significance (Low).

The NHRA specifically refers to social and economic development. In addition, Section 38(3)(d) of the NHRA requires that the impact of the development on heritage resources relative to the sustainable social and economic benefits to be derived from the development should be evaluated.

Capital investment in the airport expansion is estimated to be of the order of R7-Billion. The proposed passenger terminal is designed to accommodate 5.2million passengers per year. The developers have stated that their aim is for the airport to be more than just an aviation hub. It will be used as a driver of regional economic development and local community inclusion.

Other developments on this site include cargo terminals, aircraft hangars, a hotel, heliport, ware housing and logistics facilities. It will reduce airline fuel costs and emissions, improve the business case for air travel, and drive economic growth in the region. It will also provide additional capacity, improve redundancy, reduce inefficiencies at Cape Town International Airport, and make air travel more affordable and accessible.

Its proximity offers airlines a more viable alternate airport for diversion planning, alleviating the need to carry an excessive amount of fuel for long-haul flights. By reducing the fuel burden by up to 10,000kg per flight, the airport will reduce fuel consumption and carbon emissions. Independent estimates suggest that the airport will collectively save airlines millions of kilograms of fuel and boost cargo-carrying capabilities, demonstrating its immense potential to promote a more environmentally responsible aviation sector. The City of Cape Town's rates income will be dramatically increased.

Given that the impact on heritage resources will be low and that the sustainable social and economic benefits will be immense it is recommended that HWC supports the development proposals.

Only mitigation regarding Visual Impacts is therefore provided in Section 2.2 below.

2.1.10 Agro-Ecosystem Impacts:

Construction and Operational Phase:

- Change in Productivity;
- Loss of productive land;
- Impact on Food Security;
- Loss of farming infrastructure;
- Change in Employment;
- A capital injection into the remainder of the farm; and
- Improved security in the area.
- Possible soil degradation by wind and/or water erosion;
- Impact on vleis, marshes, water sponges and water courses;
- Impact on the flow pattern of run-off water.

2.1.11 Civil Aviation Impacts:

The main areas of impact related to the civil aviation activities:

i. Obstacle Limitation Surfaces

ATNS Survey Team has conducted a full WGS84 Obstacle survey in and around Cape Winelands Airport to a 10km radius. The survey team consists of a professional land surveyors and registered obstacle evaluator recognized by the SACAA.

ii. Airspace

There are several (minor) civil aviation aerodromes located within 20nm of the CWA site, as well as the AFB Ysterplaat. Moreover, Cape Town International Airport and its Terminal Manoeuvring Area (TMA) are also in close proximity to the site. The proposed increase of flight activity at CWA, and particular the introduction of scheduled commercial operations, will likely affect the flight operations at the nearby aerodromes.

In order to ensure safety of operations, it is important that airspace at the airport is suitably configured, and that feasible departure and arrival procedures are put in place at the airport. Therefore, an airspace study should be conducted by aviation specialists, suitably qualified in the field of Procedures for Air Navigation Services and Aircraft Operations (PANS-OPS), to determine safe and efficient ways of operating flights in and out of CWA in relation to CTIA and other aerodromes. This study should address the need for

navigational and visual aids at the airport and identify possible impact this may have on existing (and planned) civil aviation installations in the vicinity.

***NACO* have undertaken a study on the "*Development of an Airspace Concept of Operations for the Cape Winelands Airport*" which can be seen as a master plan or scheme of the intended airspace and its operation.**

iii. Noise

Aircraft noise is generally recognized as one of the most significant negative impacts of airport development on its environment. The noise footprint of an airport depends on its airside infrastructure configuration, flight procedures, mode and time of operations, frequency of flights and aircraft types operating at the airport, amongst other factors. The impact this noise has on the airport environment further depends on prevailing weather conditions, topography, and surrounding land use, as well as socio-economic and cultural factors.

It is essential that the impact of aircraft noise associated with the proposed development is studied in detail by suitably qualified experts in noise measurement, modelling and analysis. The following ICAO documents provide the relevant frameworks for such assessments and for managing the impacts identified.

***DDA Environmental Engineers* has undertaken a complete Noise Impact Assessment. Refer to Noise Impacts and Mitigation.**

iv. Ground transportation

The envisaged increase in aviation activity at the CWA will likely result in increased ground traffic to and from the airport. Passengers, visitors, airport staff, tenants, concessionaires and related businesses will all use road access to the airport site. Currently, the main access to the airport site is off the R312 and traffic on this road is likely to increase due to the proposed development. However, other roads in the vicinity, such as the R304, R302 and even the N1, may also be affected.

In order to ensure the impact of increased ground transportation activity is managed appropriately, an assessment should be conducted that takes into account the various modes of transport and infrastructure available around the site. Such assessment should be conducted by a suitably qualified transport engineer in line with relevant national, provincial and municipal regulations and guidance material.

***ITS Consulting Engineers* has undertaken a complete Traffic Impact Assessment. Refer to Traffic Impacts and Mitigation.**

Socio-economic impact

Through the proposed development and the envisioned increase in aviation activity, the CWA will likely have a material socio-economic impact on its direct environment, the wider region and the aviation industry. The construction and development of the planned airport infrastructure and facilities will attract significant investment. This will result in substantial revenue and job creation for the local construction industry and

associated trades. Once operational, the airport itself, as well as the multitude of businesses it will support and facilitate, will present permanent employment opportunities. The connectivity the airport will enable, will support the growth and development of both trade and tourism. All this will likely encourage and attract further investment into the Fisantekraal area, and the entire growth corridor from Durbanville to Wellington and Paarl.

It is well documented that airports have a large, positive impact on employment and economic development. Benefits can be direct, indirect and catalytic and extend from the immediate local environment to the national and even international level. Further assessment by transport economists and aviation specialists can qualify and quantify the expected socio-economic impact of the CWA development in more detail.

Multi-Purpose Business Solutions **has undertaken a complete Socio-Economic Impact Assessment. Refer to Socio-Economic Impacts and Mitigation.**

2.1.12 Traffic Impacts:

The following potential impacts have been identified as part of the required design and operational reconfiguration of the proposed CWA:

- Reconfiguration of road network for access through one of three options - Option 1: Access via Melish Road / Lichtenberg Road (R312), Option 2: Access via Melish Road / Klipheuwel Road (R302), Option 3: Access via Lucullus Road extension.
- Increase in vehicles and passengers and amendment to road infrastructure.
- Amendment to public transport system in the area to link to the CWA.
- Design of public roads to accommodate increased pedestrian and bicycle movements.
- Possible linking of cargo movement to the rail infrastructure and required upgrade of rail system to accommodate this.

2.1.13 Climate Change Impacts:

2.1.13.1 Impact of Climate Change on the Project:

Risk of Wildfires:

Impact: Health and safety

- Fires may lead to injuries/hospitalisations/loss of life.
- Increased smoke and ember storms may lead to injuries and hospitalisations.
- Compromised food (i.e., due to crop loss) and water supplies may affect the nutrition and wellbeing of personnel.

- Wildfires can impact air quality by increasing emissions of particulate matter and ozone precursors, posing a risk to human health.

Impact: Operational and value chain

- Damage and/or loss of property and infrastructure due to fire, strong winds and/or lifted debris.
- Smoke from wildfires can travel long distances, and reduced visibility may impact the efficiency of air traffic operations, that could lead to economic losses.
- Electricity generation may be disrupted, which could halt operations. It should be noted that while the site is currently supplied by Eskom, sustainable energy sources including a bio-digestor plant and photo-voltaic power supplies (solar PV) are being considered. It is intended that the site will be powered by off-the-grid energy sources, with Eskom supply serving as a back-up. The accessibility of the airport may be reduced impacting goods and service delivery, arrival of staff/personnel and passengers. This could halt/delay operations leading to economic losses.

Risk of Landslides:

Impact: Health and safety

- Landslides may lead to injuries/hospitalisations/loss of life in affected areas.
- Compromised food (i.e., due to crop loss) and water supplies in affected areas may impact the nutrition and wellbeing of staff/personnel.

Impact: Operational and Value Chain

- Landslides may lead to damage and/or loss of property and infrastructure in affected areas.
- The accessibility of the airport may be reduced impacting goods and service delivery, arrival of staff/personnel and passengers. This could halt/delay operations leading to economic losses.

Risk of water scarcity

Impact: Health and safety

- Water scarcity may lead to reduced water quantity and quality on site and in adjacent areas which could create human health risks
- Drought conditions can impact food security, leading to the malnutrition of staff/personnel.

Impact: Operational and Value Chain

- Airports rely on water during construction, in daily operations, on the airfield and in terminals. Reduced water supply may impact the functioning of airport facilities, and halt/delay operations that could lead to economic losses.

- Increases in operational costs may be experienced, if the cost of water increases which may result in reduced profits.

Risk of extreme heat:

Impact: Health and safety

- Heat stress may cause staff/personnel to experience heat related illnesses, dehydration and fatigue, which consequently could impact operations on site.
- Compromised food (i.e., due to crop failure) and water supplies due to heat waves may impact the nutrition and wellbeing of staff/personnel.
- Heat waves can lead to poor air quality, as increased temperatures can lead to increased ozone concentrations (a key component of smog). Poor air quality poses a risk to human health.

Operational and Value Chain

- Heat stress may impact the health of the workforce leading to operational delays, that could result in economic losses.
- Extreme heat events may lead to equipment failures/malfunctions that could halt/delay operations.
- Heat wave can also negatively influence road and rail infrastructure causing transportation delays, that may impact goods and service delivery, arrival of staff/personnel and passengers.

Risk of flooding events:

Impact: Health and safety

- Workplace injuries and potentially loss of life
- Compromised food (i.e., due to crop failure) and water supplies due to flooding may impact the nutrition and wellbeing of staff/personnel.

Impact: Operational and Value Chain

- Flooding may result in infrastructure and property damage.
- Flooding may result is road closures, causing transportation delays, that may impact goods and service delivery, arrival of staff/personnel and passengers.

2.1.13.2 Impact of the Project on Climate Change:

The Greenhouse Gas (GHG) emissions resulting from the construction and operation of the CWA will contribute to global anthropogenic climate change. However, the expected changes in global climate cannot be specifically linked to the GHG emissions of a specific emission source or individual emitter. Direct

emissions resulting from fuel combustion and wastewater treatment are expected. There are specific indirect emissions associated with the operation/value chain of the airport such as waste generation, employee commute, passenger commute and aviation. The emissions taken into consideration are those which occur within the boundaries of South Africa (i.e., international aviation is excluded). The estimated emission from the airport is estimated to be 3.68 million tCO2e, approximately 0.097% of the South African budget of 3 380 MtCO2e. The value of 3.68 million is high to the national budget.

2.1.14 Aviation Glint and Glare Impacts:

The aim of this study was to determine the impact that solar glint and glare would have on various aviation receptors. The FAA model considered the 2-mile receptors on the approach to Runway 01/19 and The Air Traffic Control Tower. The initial modelling (Version 1) indicated that the Air Traffic Control Tower will be exposed to green and yellow glare. However, it was recommended that the southeastern portion of the Services Precinct be excluded from the installation of the Solar PV panels to eliminate the exposure to the Air Traffic Control Tower.

The remodelling conducted (Version 2), was based on the updated layout provided that incorporated the above recommendation. The results of Version 2 modelling indicate that no glare will be expected. Therefore, no further mitigation was required.

2.1.15 Major Hazard Impacts:

The study found that the proposed CWA facilities would be classified as a Low Hazard Establishment Major Hazard Installation, resulting in the risks to the general public being considered acceptable.

Bulk Fuel Tank Farm:

Pool fires and flash fires from a loss of containment at the storage and offloading installations of Jet A-1 and Avgas and subsequent fires were simulated. Tank explosions from Avgas were also simulated.

The 1% fatality for Avgas and Jet A-1 from fires, could extend a short distance over the tank farm boundary. However, these impacts would not extend to areas occupied by the general public or to the runway and airplanes.

Risks greater than 1x10-4 fatalities per person per year, are considered tolerable for industrial areas, but excessive for residential areas. The 1x10-4 fatalities per person per year did not extend into areas occupied by the general public on the proposed CWA site.

The risk of 3x10-7 fatalities per person per year isopleth indicates the extent for land-use that would be suitable for vulnerable populations, such as hospitals, retirement homes, nursery schools, prisons, large gatherings in the open, and so forth. As the risks did not extend into areas occupied by the general public, no land planning would be required. The risk from the installations after Phase 3 would be considered acceptable.

Avgas Kerbside Filling:

The kerbside filling will consist of a $9m^3$ Avgas tank with an offloading area. Pool fires form a loss of containment would extend beyond the secondary containment but would not extend to the area occupied by the general public.

Risks greater than 1x10-4 fatalities per person per year, are considered tolerable for industrial areas, but excessive for residential areas. The 1x10-4 fatalities per person per year did not extend into areas occupied by the general public on the proposed CWA site.

The risk of 3x10-7 fatalities per person per year isopleth indicates the extent for land-use that would be suitable for vulnerable populations, such as hospitals, retirement homes, nursery schools, prisons, large gatherings in the open, and so forth. As the risks did not extend into areas occupied by the general public, no land planning would be required. The risk from the kerbside filling would be considered acceptable.

Apron Pipeline:

The apron pipeline is expected to be constructed during Phase 2. The pipeline would be located in a chamber. Thus, a loss of containment will firstly fill the chamber and then overflow. For this study, the maximum area from a pool formed from a loss of containment was limited to $300m^2$.

The 1% fatality from the apron pipeline could extend 41m from the pipeline. However, the risks from the apron pipeline failure would be considered acceptable.

Impacts onto Neighbouring Properties, Residential Areas and Major Hazard Installations:

Impacts from Jet A-1 and Avgas would not extend into areas occupied by the general public.

Major Hazard Installation:

The expected MHI hazard tier for each phase of the fuel storage project is LOW.

2.1.16 Poultry Impacts:

Increased activity, dust and noise will affect poultry; Flies and rodents associated with improper waste management can transmit diseases; Light pollution as the result of road usage at night and lighting of the airport near the poultry farm may interfere with the circadian rhythm of breeder and layer birds; Loud noises (aircraft and vehicles) can disturb and stress the birds as well as decrease production.

Increase air pollution can cause respiratory issues in poultry; Contamination of ground water as a result of run-off of water used for cleaning and accidental spills; The influx of people into the area may act as fomites and transmit poultry diseases; Wild birds attracted to the area may transmit diseases if they come into contact with poultry; International waste poses a risk for disease outbreaks.

2.2 IMPACT MITIGATION:

Section 2.2 is compiled from the list of management & mitigation measures as identified and listed within the relevant Specialists Studies and through the consultation process. These management & mitigation measures provide the basis on which the Design, Construction and Operational sections within the EMPr are compiled. All the aspects below are considered and integrated throughout the Design, Construction and Operational Goals of the EMPr as set out from Section 3 – 5 below.

2.2.1 Geohydrological Mitigation:

Construction Phase:

- Vehicles must be maintained regularly and kept in a good working order, and park on hardstand areas with appropriate drainage and catchment systems, where possible.
- Dirty water should be captured, to be re-used where possible. No dirty water is allowed to be discharged into the surrounding environment.
- Implement monthly groundwater quality monitoring during construction phase.
- Drip trays to be used under stationary vehicles and machinery where possible.
- A dewatering plan to be developed prior to construction (where required). Should this be required, the dewatering plan could be devised by a professional. It is important that if the water is to be released back into the environment, it should be done under the guidance of relevant regulations and supervised/monitored by an appropriately qualified professional.

Surface runoff:

- Installation of appropriate stormwater systems with catch pits to isolate fuel and other contaminants.
- A stormwater management plan and system should address potential water quality concerns and associated water treatment. The water quality must meet relevant standards prior to discharge into the receiving environment; further the regulations indicated in the Water Act (as well as amendments) will need to be adhered to.
- An appropriate monitoring system within the stormwater reticulation could be considered, where applicable and possible, e.g. within separation/first flush chambers.
- Petrol interceptors might be considered to mitigate the risks of contaminants draining into the environment.

Operational Phase:

Leaks from fuel storage and distribution:

- Tanks must be double walled / "jacketed" i.e., possessing secondary containment to prevent tank content to release into surrounding soil and groundwater. The underground storage tank must have an internal leak detection monitoring system between the two walls to monitor for product leakage;
- Fuel lines and sumps must be secondary contained where lines are joined.
- The filling station must include the following design measures:

Fuel Containment Area

- The containment slab must be graded to drain a catch-pit that is connected to discharge to the stormwater system via an oil separator while the surrounding paved surface areas must be graded to ensure rainwater runoff to the stormwater system. No washing in this area is allowed

Forecourt Area

- The forecourt area must be provided with its own set of catch pits that is connected to discharge to the sewer via a separate oil separator. Please note that the aforesaid areas (1 & 2 above) cannot be interconnected. The surface area of the forecourt must be graded to the abovementioned catch pits while the surrounding surface area graded to drain rainwater to the stormwater system. Washing of the forecourt surface is allowed in this instance.
- Additionally, the following mitigation is required which is associated with petrol filling station Underground Storage Tank (UST) and pipework installations (applicable for the construction and operation phase):

National Standards

- All containment manholes must be regularly inspected as part of the normal management procedures at the service station.
- The installation of Underground Storage Tanks (UST's) and associated pipework must be implemented in accordance with the relevant South African National Standards (SANS), specifically (not exclusive to) the following standards:

a) SANS 10089-3 (2010): The petroleum industry Part 3: The installation, modification, and decommissioning of underground storage tanks, pumps/dispensers and pipework at service stations and consumer installations.

b) SANS 10 400TT (Fire Protection) 53 Sections 1-6 (The application of the National Building Regulations- Installation of Liquid Fuel Dispensing Pumps and Tanks);

c) SANS 10087-3 (2008): The handling, storage, distribution and maintenance of liquefied petroleum gas in domestic, commercial, and industrial installations Part 3: Liquefied petroleum gas installations involving storage vessels of individual water capacity exceeding 500L.

- The installation of the UST's and associated pipework must comply with the National Building Regulations and Standards Act No. 103 of 1977;
- The installation must comply with local authority bylaws and all procedures and equipment used must be in accordance with the Occupational Health & Safety Act (No. 85 of 1993);
- Upon completion of the UST installation, an engineer is to inspect and verify that the tanks and the associated infrastructure have been installed as per the design criteria described in the final IAR and to all required SABS/SANS standards and applicable legislation. A report thereafter, based on the engineer's findings, is to be submitted to the DEA&DP Land Management and Pollution Directorates for inspection and the City of Cape Town Municipality.
- Any repair work required is to be conducted according to SABS 1535 (Glass-reinforced polyester-coated steel tanks, including jacketed tanks, for the underground storage of hydrocarbons and oxygenated solvents and intended for burial horizontally).

Installation of Underground Storage Tanks

- The USTs must be reliable in the event of heavy rains and flooding. UST manholes shall be impermeable and resistant to fuel, they shall consist of a heavy-duty cast-iron cover, which shall prevent damage from surface traffic;
- Construction of a reinforced concrete slab over the USTs, its thickness and strength are to be determined by a qualified Engineer;
- The filler point and tank must be fitted with overfill protection. The critical level should be such that a space remains in the tank to accommodate the delivery hose volume (2%). Earthing and snap tight quick coupling is
- The USTs are to be fitted with a tank containment sump, fitted on top of the tank and a dispenser containment to be provided for loading of materials into tanks to minimise the risk of fires and prevent spillage and loss of materials; and sump must be provided, fitted underneath the dispenser as containment. A Filler spill containment must also be provided for remote filler containment purposes;
- The excavation must be protected against the ingress of surface run off water, and is to be kept reasonably free of sub-surface water by pumping out if necessary;

- The excavation must be lined with a HDPE liner or a suitable layer to prevent infiltration of product to the groundwater should a spill or leak occur (an impermeable liner);
- The UST is to be inspected before installation for damage, including factures or damage to coating work.
- Leak and pressure tests must be conducted on tanks and pipelines to ensure integrity prior to operation and the inspection authority must issue pressure test certificates.
- The UST must be buried 750mm below finished ground level in accordance with SANS 10089-3;
- The local Fire Department must be informed two (2) working days before installation commences and to be called for inspection at the following stages:
    - Installation of tank on clean sand bed before backfilling
    - Witness pressure test (delivery lines 1000kPa, tank 35kPa); and
    - Inspection of slab over tank before concreting.

Pipework

- Installation of associated pipe work. This shall include the installation of internationally approved non-corrosive pipework systems. All underground piping is to be Petrotechniks UPP Extra piping (nylon lined, 10 bar rated). Nextube Kableflex sleeving (oil industry green with a smooth internal bore) to be used as secondary containment. This is to limit the possibility of pipe failure due to corrosion; this being the most common cause of pipe failure before this system was introduced to South Africa.
- All pipeline connections are to be housed within impermeable containment chambers. A leak detector on all submersible pumps that automatically checks the integrity of the pipework on the pressure side of the pump must be provided. Pipelines must not retain product after use and no joints are to be made underground. An emergency shut-off valve must be supplied between the supply pipeline and dispenser inlet. All pipes (vent, filler and delivery) are to slope back to the USTs so that fuel does not remain in the pipes;
- Vent pipes to be fitted with "Fulcrum" vertical vent roses, or an approved equally equivalent market product replacement, that conforms to these standards. Confirmation of filler point and vent position to be made by an approved Engineer for safety distances required;
- Vent pipes above ground are to be galvanised mild steel and are to be at least 1000mm above the roof height and away from any doors, windows, chimney openings and other sources of ignition; and the tank product lines must be pressure tested prior to commissioning;

Leak detection and monitoring required

- It is required to undertake integrity testing on Underground Storage Tanks (UST's) and underground pipe integrity testing. The frequency of integrity testing should be as follows as outlined here. Tank and pipe integrity testing shall be carried out in the following instances:
- Following installation of a new UST and associated underground pipework or following repair, maintenance or upgrade of an existing UST or underground pipework (or both). Testing shall be carried out prior to burial of the installation;
- When ownership of the UST and associated underground pipework changes;
- When leak detection monitoring methods that may be in place, such as Stock Inventory Reconciliation Analysis, Automatic Tank Gauging (with a reconciliation facility) or interstitial vapour or liquid monitoring of double-walled or jacketed steel tanks, indicate the possibility of a leak. In this instance, an investigation into the possible leak, including integrity testing in the final stages of the investigation, shall be used to track the reasons for a failure to reconcile;
- Where continuous leak detection monitoring, such as Stock Inventory Reconciliation (SIR), is not carried out at a site. In this instance, UST and associated underground pipe integrity testing should be carried out every 2 years. If USTs and underground pipes do not operate with a continuous leak detection system, but do have cathodic protection installed, then this period may be extended to 10-year intervals.
- USTs are to be fitted with a monitoring tube to allow for the monitoring of leaks through the tank surface;
- Leak detectors are to be installed to the submersible pumps within UST manholes to ensure that there are no line leaks;
- A relatively inexpensive soil vapour monitoring installation must be installed which can be monitored on a frequent basis (monthly intervals) using a Photo Ionisation Detector (PID) e.g., Mini RAE 2000.
- The installation of Soil Vapour Sampling Points will require the placement of a permeable coarse clean sand layer beneath the storage tanks for a vertical depth of approximately 0.5m to 1m in order to locate the vents in the 16mm diameter monitoring pipe over portion of this depth
- The Groundwater Monitoring Action Plan must be included as an Annexure to the approved EMPr.
- Observation wells must be installed in the sand fill surrounding the underground storage tanks for regular monitoring purposes
- All containment manholes must be regularly inspected as part of the normal management procedures at the service station

- Continuous electronic monitoring (CEM) of product must be carried out. Should discrepancies occur an alarm will be triggered and site management will review the finding and take appropriate action to rectify the situation as required.
- Should a leak be found or should the groundwater in the monitoring wells be found to be contaminated with hydrocarbons, a baseline Phase 1 Contamination Assessment should be undertaken and the site remediated in consultation with a contamination remediation consultant and the Authorities.

Forecourt Dispensing Area

- Installation of pump islands in the forecourt area. The pumps are to be fitted with a Spill Containment Chamber;
- Construction of a concrete bunded reinforced graded slab over the forecourt area, with positive falls towards a centrally located catch-pit/sump. The slabs thickness and strength are to be determined by a qualified Engineer. The centrally located catch-pit/sump shall drain into a pollution containment chamber i.e., an approved oil/water separator system. Once the wash water has passed through the system, the separated oil must be collected regularly by an approved waste contractor and removed to an approved hazardous waste disposal facility.

Atmospheric deposition:

Where vehicles are required for airport operation, make use of electrical vehicles as opposed to conventional combustion engine powered vehicles. Reduce/minimise traffic requirements/ground support vehicles for aircraft operations where possible.

Direct Release:

- For routine burns and training purposes, make use of biodegradable fuels, which once burn minimise the impact on the groundwater.
- No compounds containing to PFCs are to be used on site.
- Erect bunds on which training can take place to contain the waste from the fire residue as well as the extinguishing agents.
- The discharge generated by training exercises will need to be monitored and analysed for several chemical parameters (to be established once the composition of the extinguishing agents used on site are known) and will need to be disposed of or stored appropriately in accordance with the National Water Act (DWS, 1998) (and relevant amendments).
- It is likely that disposal and/or storage of the waste from training will give rise to the need for a Water Use License (WUL), depending on the waste composition, frequency of training and planned disposal of training residue.

Accidental Release:

- Devise and design appropriate bunding for storage of chemical substances that are to be stored on site, as well as erecting the electrical infrastructure (where risk of contamination exists, i.e. substations) on appropriate bunding.
- Implement appropriate monitoring infrastructure, e.g. borehole monitoring around the sites where electrical infrastructure and chemicals are stored, to identify leakages and spillages from chemical storage facilities and electrical infrastructure.

Biodigester facilities for energy generation:

- Proper management and design of digestate application (i.e. use as fertiliser) to areas on the property and/or surrounding areas.
- Monitoring of the impacts on the groundwater will need to be implemented should this biproduct of the facility be used in this way.
- Ensure design of facility is appropriate, e.g. include bunding in high-risk areas or where applicable, instate appropriate monitoring around facility and along relevant points through the system.

Photovoltaic solar facilities:

Make use of biodegradable cleaning agents to ensure little to no impact on the quality of the groundwater is experienced.

Over-abstraction of groundwater:

- Groundwater abstraction volumes must be monitored.
- Water levels must be monitored and should not drop below the critical water level (as per yield testing reports).
- Monitoring information must be assessed regularly (suggested monthly). If the water level in the boreholes drops below the dynamic water level. i.e. 72mbgl for CWA_BH001. and 40mbgl for CWA_BH002 abstraction will immediately be reduced by 10%. This would be for normal rainfall events. If a hydrological drought persists for more than two years, the water level can drop to above the critical water level i.e. 85mgbl for CWA_BH001 and 61mbgl for CWA_BH002. Monitoring will persist for 30 days. In the event of lowered levels persisting after the initial 10% reduction, further reductions in excess of 10% must be implemented and if the low levels persist for more than 60 days, abstraction must cease until the levels have been recovered. This process will continue until the water level in the borehole is stable.
- A formal groundwater management plan needs to be designed and implemented.

Groundwater quality deterioration because of wastewater storage:

- Spillages or leakages from the WWTW could contaminate the surrounding non-perennial freshwater systems and groundwater in the area. Therefore, the effluent containment ponds should be appropriately lined to avoid discharge into the subsurface, and potentially groundwater.
- Solid waste should be stored on concrete bunded or lined surfaces and water drainage from the solid waste should be captured and returned to the WWTW.
- It is recommended that Groundwater Management Plan be implemented to ensure the groundwater quality is not affected by the operations of the WWTW.
- Monitoring of the WWTW infrastructure is required to ensure that there is no loss of water in the system; flow meters measuring influent and effluent must be installed, monitored and recorded.
- Regular internal and external inspections and auditing of the facility must take place to ensure the infrastructure is in good working order.

Groundwater quality deterioration because of brine storage:

- Spillages or leakages from the brine ponds could contaminate the groundwater in the area. Therefore, the brine containment ponds should be appropriately lined with additional bunding structures to avoid discharge into the subsurface, and potentially groundwater.
- It is recommended that a Groundwater Management Plan be implemented to ensure the groundwater quality is not affected by the operations of the brine ponds.
- Regular internal and external inspections and auditing of the facility must take place to ensure the infrastructure is in good working order.

Groundwater quality deterioration because of chemical storage associated with WWTW:

- The chemical storage areas should be appropriately lined with additional bunding structures to avoid discharge into the subsurface, and potentially groundwater.
- It is recommended that Groundwater Management Plan be implemented to ensure the groundwater quality is not affected by the operations of the WWTW.
- Monitoring of the WWTW infrastructure is required to ensure that there is no loss of water in the system; flow meters measuring influent and effluent must be installed, monitored and recorded.
- Regular internal and external inspections and auditing of the facility must take place to ensure the infrastructure is in good working order.

Groundwater quality deterioration because of result of irrigation with the treated sewage effluent:

- Contaminated water used to irrigate the demarcated fields could contaminate the groundwater in the area. The WWTW needs to ensure that the water released into the environment is within the limits of the GA.
- Monthly monitoring of the quality of the treated effluent must take place to ensure that quality objectives are reached.
- It is recommended that a Groundwater Management Plan be implemented to ensure the groundwater quality is not negatively affected by the irrigation with treated effluent

Additional:

- Due to the proximity of the Colenso Fault to the CWA, a no-go area for specific high-risk activities is proposed to the northeastern section of the study area. The precise location of the Colenso Fault is uncertain and therefore, the no-go area was drawn 500m from the closest geologically mapped fault. The 1: 250 000 (Cape Town, 3318) and the 1: 50 000 (Paarl, 3318DB) geological maps were used, and both of these maps delineate the closest fault in the same area. This no-go area does not have to apply to all activities, but only to certain high-risk activities such as the aviation fuel farm, bulk fuel storage, retail service station or other activities that are considered high risk.
- The site development should only proceed on condition that no contamination of the underlying aquifer takes place. This will require the appropriate protection, mitigation and monitoring measures, including those indicated in this report.
- In situations where it is not possible to avoid pollution because of higher operational priorities for example, the need to protect people, take all reasonably practical steps to mitigate the effects of such pollution.
- A groundwater monitoring network will be required, and will require the following:

- Regional monitoring boreholes: To monitor the regional groundwater quality, e.g. of the fractured bedrock aquifer. These boreholes should ideally be monitored prior to the commencement of construction to establish baseline conditions.
- Local monitoring boreholes: These boreholes are required specifically to monitor the groundwater surrounding high-risk facilities (e.g. firefighting training areas, fuel farms, chemical storage facilities etc). The design and position of these boreholes will need to be established once the positions of the high-risk facilities are finalised and the final site development plan is made available. Importantly, any planned development of groundwater production boreholes could be appropriately designed to serve for both groundwater production and monitoring purposes.

- The groundwater impact assessment should be updated if the final site development plan/area changes and once intricate details of the activities for each component of the facilities are known and available.
- It is recommended that all mitigation measures given in this report are to be adhered to in order to minimise the potential impacts of the development on the environment.

2.2.2 Air Quality Mitigation:

Construction Phase:

Dust suppression measures are recommended in order to reduce any possible impacts. "Good practice" dust suppression measures will be adopted, such as:

· Apply wet suppression on the main site roads.

· Implement a speed limit of 30km/hour on unpaved roads on site.

· Give preference to routes away from the western site boundary.

· Reduce the frequency of disturbance of stockpiles.

Dust monitoring along the western, southern and northern boundaries of the site is recommended to be conducted on a monthly basis during construction and to be reported quarterly to the authorities.

Operational Phase:

Scenario 1: Existing runway setup under full utilisation (No-Go Alternative);

In line with the ICAO emission reduction action plans and best practices with respect to airport-related air quality, the following "best practice" emission mitigation measures could be investigated for implementation for Scenario 1:

- Implementation of measures to decrease the queuing lines.
- Minimisation of the waiting time for parking.
- Examination of permitting aircraft taxiing at higher speeds.
- Limitation of the length of the course of taxiing.
- Utilisation of aircraft-serving equipment with "cleaner" technology.

Scenario 2: Operations on the new runway 01/19 in the operational year;

Similar to Scenario 1, a mitigation version of the impact ratings was not produced for the operational impact ratings of Scenario 2. However, the most suitable and cost-effective mitigation measures should be

investigated, and an acceptable implementation timeframe should be established before the new runway reaches its capacity.

Scenario 3: Operations on the new runway 01/19 at full capacity.

For Scenario 3, a number of mitigation measures should be considered for implementation in consultation with the various stakeholders associated with all the airport operations. In addition, in line with the noise impact recommendations, the airport-compatible land-use planning immediately south of the new runway would be recommended. As such, the identified potential mitigation measures are:

- Encourage airport-compatible land-use planning.
- Implement measures to decrease the queuing lines.
- Limit the length of the course of taxiing.
- Shutting down as many engines as possible when idling and taxiing.
- Reduce reverse thrust use during landing.
- Utilise aircraft-serving equipment with "cleaner" technology.
- Investigate the provision of electricity at terminal gates, so as to minimise use of the APUs and GSE as much as possible.

Assuming that some of the above-mentioned mitigation measures will be implemented before the airport capacity is reached, the resulting overall impact with mitigation for Scenario 3 would be expected to be slightly lower than the unmitigated one. However, the overall significance rating would not change.

It is recommended that a continuous air quality monitoring station is established at the northern CWA site boundary.

Based on the air quality modelling results, the highest concentrations occur along the runway and extending north of these runways. This is due to the strong south-easterly wind during the summer season in the Western Cape. Therefore, the existing location of the monitoring station is suitable for current and future runway operations. The concentrations measured represent the highest concentrations. The pollutants' concentrations at other locations around the airport and the surrounding communities are deemed to be much lower.

The station is equipped to measure the ambient concentrations of SO2, NO2, O3, CO and PM10. It is further recommended that the monitoring data be reported biannual basis to the City of Cape Town Air Quality Management Unit and the South African Air Quality Information System as operated by SAWS, on an ongoing basis.

2.2.3 Noise Mitigation:

Construction Phase

- Ensure that the equipment is in good working order and properly maintained;
- Providing training to the personnel to adhere to operational procedures that reduce the occurrence and magnitude of individual noisy events;
- Limit night-time construction activities; and
- Avoid night-time construction activities on the property to the west of the airport boundary (earthworks), which are closer to the Fisantekraal residential area.

Construction Monitoring Network and Monitoring Plan:

Noise monitoring will be conducted during the construction phase of the new airport and runway. This monitoring is to be carried out in accordance with the methods stipulated in the SANS 10103:2008 Code of Practice and the current Western Cape Noise Control Regulations.

Two points will be used for the noise monitoring locations, positioned on the inside of the airport boundary. These locations should cover the area close to the entry point of the trucks to the site and the community closest to the construction activities. These locations should be finalised once the construction plan and schedule are determined.

The monitoring will be conducted every three months during construction and on a monthly basis during the period when night-time construction will be taking place.

Three-monthly reports should be submitted to the authorities, including a brief assessment indicating if any construction-specific noise exceedances above baseline and SANS district guidelines are taking place. In the event of exceeding noise guidelines, appropriate site- and operation-specific noise mitigation measures should be investigated and implemented.

Operational Phase

- Encourage airport compatible land-use planning via:
    - establishing compatible land use (such as industrial and commercial) to be located around airport facilities.
    - directing incompatible land use (such as houses and schools) away from the airport environs and the runway alignments;
- Provide incentives for airlines to obtain aircraft with the latest available noise reduction technology, through for example noise-related landing charges.

- Consider the use of specific take-off or approach procedures (such as Continuous Descent Operations, or steeper landing trajectories) to minimise and optimize the distribution of noise on the ground.
- Use noise preferential routes to assist aircraft in avoiding noise-sensitive areas, such as Klipheuwel, on departure and arrival, and the use of turns to direct aircraft away from noise-sensitive areas.
- Consider approaches at slightly steeper angles. A small increase in the glide-path angle to 3.2°, rather than the standard 3.0°, may be feasible and offer scope for noise reduction.
- Establish and maintain effective communication channels with the affected public and provide real-time information on incoming and outgoing flights and their evolving noise footprints.
- Consider noise-related operating restrictions for night-time. These can be imposed on a voluntary basis by the airport, or by the Government.

In conjunction with the above-mentioned noise abatement measures, the introduction of 'passive' mitigation measures, such as noise insulation on existing residential dwellings and noise-sensitive buildings (schools, hospitals, etc.) may be considered.

Operational Monitoring Network and Monitoring Plan:

Three permanent noise monitoring terminals should be established before or by the operational year of the new airport and runway.

The first of these terminals should be established at the Klipheuwel area, preferably close to its south-eastern boundary. The second should be positioned within the Greenville Garden City Development, in line with the new runway 01/19 and the third on the eastern side of the Bella Riva development.

A summary of the noise monitoring results should be reported on a quarterly basis to the appropriate authorities. These reports should contain, but not be limited to the:

- 24-hour equivalent continuous A-weighted sound pressure level, $L_{Aeq,T}$;
- equivalent continuous day-night rating level, L_{Rdn};
- equivalent continuous day and night rating levels, L_{Rd} and L_{Rn};
- maximum A-weighted level, L_{Amax};
- percentile levels L_n;
- number of exceedances above 70 dB(A) and 60 dB(A) of the L_{Amax} and SEL.

A noise complaints registry must be established and connected with the noise monitoring system, in order to provide the capability for correlation of the complaints with the actual measured levels, as well as the aircraft-related operational data.

The complaints and relevant aircraft-related operational data should be included in the quarterly report to the authorities.

It should be noted that even though several mitigation measures have been identified in this section for the airport's operations, the identification of the most suitable and cost-effective mitigation measures, together with a realistic time schedule for their implementation, can only be a result of consultations between the various stakeholders associated with all the airport operations, and taking into consideration the safety and security requirements associated with these airport operations. Once these consultations take place and the mitigation measures, together with the implementation schedule have been determined, their effects can be quantified and the mitigated impact rating tables determined.

For this reason, the compilation of a **Noise Mitigation and Management Plan (NMMP)** will take place post authorisation.

2.2.4 Botanical Mitigation:

- All Very High, High and Medium sensitivity areas (Refer Figure 10 above) that do not fall within the authorised development (construction) footprint should be conserved as part of any redevelopment of this site (no development and no infrastructure through these areas), and ideally, they would also all be ecologically connected via rehabilitated Low sensitivity areas. From a botanical perspective most of these areas would be ecologically viable, especially if connected by ecological corridors. Key ecological management interventions required are ongoing alien invasive vegetation management (pre and post burn) and management burns in the appropriate autumn season (once every 8-12 years).

- Two of the Very High sensitivity areas are within the Agricultural Precinct, whilst the other two are within the Airside Precinct.

- All authorised hard infrastructure bordering on any of the mapped areas of Very High, High and Medium sensitivity botanical areas must be surveyed and fenced off prior to any site preparation, clearing or construction. These sensitive areas may not be disturbed in any way during the construction process. Fences should be marked with signage every 15m indicating that these are No Go areas, and all contractors must be made aware of such, starting with and including in their contract quotation requests. Where the perimeters of these areas lie within 20m of the RESA (runway clearance area) they should be buffered by an ecological buffer area at least 5m wide that is not disturbed by any earthmoving or development.

- No perimeter service road may cross or disturb the mapped area of Very High sensitivity East of the main runway.

- An EMPr (THIS DOCUMENT) for the remaining conservation worthy areas on site (all remaining areas of Very High, High and Medium botanical sensitivity, including all such areas within the Agricultural Precinct, refer Figure 10 above) should be drawn up, with input from the botanist.

- All invasive alien vegetation in the conservation areas on site must be removed within one year of any project approval, using appropriate methodology (see Martens *et al* 2021), by qualified personnel. Ongoing annual alien vegetation removal must be undertaken.
- No spraying of herbicide should be undertaken in any conservation areas.
- Once all alien invasive vegetation has been removed from the conservation areas all these areas must be subject to planned (controlled) burn regimes, as this vegetation needs fire for optimal ecological functioning. The two Very High sensitivity areas are the priority areas for ecological burns, which must be undertaken in the period February to March. These burns should be professionally managed.
- Prior to the controlled burn, firebreaks should be brushcut by hand around the perimeter of the sensitive areas (not within them) using handheld brushcutters.
- The botanically sensitive areas will need to be burnt every 8-12 years for optimum ecological functioning.
- The Very High sensitivity areas falling within the Agricultural Precinct must be fenced off and excluded from grazing and trampling by livestock (especially cattle). This must be done within 60 days of authorisation, or sooner if possible (subject to landowner negotiation).
- The condition of all Very High, High and Medium sensitivity areas (Agricultural Precinct and on site) should be monitored every year by a suitably competent botanist (or CoCT Environmental Management Dept.), and they should make recommendations for any management changes or actions (alien clearing, lack of fire, etc.) that are needed in order to achieve optimal ecological functioning in these areas.
- Most of the low and medium significance occurrences of plant SoCC within the proposed development footprint (as well as some of the high significance species) can be successfully translocated, and this should thus be done by experienced Search and Rescue contractors prior to any site development, with the assumption that the receiving areas will be properly managed in perpetuity as plant conservation areas. This must be done in consultation with the botanical specialist and can proceed prior to any authorisation (provided all necessary permits and permissions are obtained).
- A plant Search and Rescue plan should be prepared (prior to any development or site clearing) by the appointed S&R contractor, the EAP and the botanist, and should outline who needs to do the work, when seed, sods and cuttings need to be collected, how they should be stored, how much should be collected, how receiving sites should be identified and prepared, and how and when the planting out should be undertaken and who is responsible for this. Guidelines on ongoing maintenance of these areas must also be included.

- Large scale Search and Rescue of plant material from all Medium, High and Very High sensitivity areas within the development and clearing footprints must be undertaken prior to any development or disturbance of these areas and outlined as part of an EMPr for the site. Receiving areas should ideally be located within the greater study area (provided that land tenure and funding for conservation is secure in these areas) and should be areas that support some natural vegetation remnants, but that require rehabilitation intervention. This must be overseen by the botanical consultant.

- Given the Endangered and Critically Endangered status of the underlying habitats, and the level of impact (Medium – High negative before mitigation) it is required that any mapped areas of remnant habitat that are lost to development should be offset by formalised conservation of high conservation priority examples of the same habitat in the region, at the appropriate ratios (as per Dept. of Forestry, Fisheries & Environment offset guidelines, 2022). A specialist terrestrial biodiversity offset report has been completed (M. Botha 2024) and found that a terrestrial biodiversity offset of at least 77ha is required (plus ongoing environmental management budget for this). [89ha is being set aside for the biodiversity offset.]

- The applicant, or their appointed management authority, must provide all necessary funding for all required ecological management of the site (airport site and conservation areas in Agricultural Precinct, including all Search and Rescue costs), and for the chosen and agreed biodiversity offset, in perpetuity.

- The botanist must provide input into the Landscaping Plan for the site, which must include a significant indigenous Sand Fynbos and Renosterveld appropriate plant component, in an attempt to maximise biodiversity rehabilitation, whilst adhering to the required airport safety guidelines. Areas that will not be hardened surfaces and that would benefit from rehabilitation should be hydroseeded with appropriate seed mixes, at the appropriate time (late autumn).

- Brush cutting and mowing of open airside (hydroseeded) areas at the operational phase should be timed to allow for winter growth and spring flowering and early summer fruiting of most of the indigenous plant species in these areas and should thus not be undertaken between 1 June and 15 October, provided that this is not in conflict with operational safety.

2.2.5 Freshwater Ecological Mitigation:

Construction Phase:

- Construction work, particularly of works within the 15m construction conservation buffer of the wetlands, must as far as possible be restricted to the dry, summer season. CVB wetlands 2 and 3 and the remainder of seep wetland 1 where development will not occur, and the wetlands' 15m construction phase conservation buffers must be marked as a no-go area during the construction phase of the proposed development;

- Sediment trapping devices must be utilised downgradient of where works are to be undertaken within seep wetland 1 and upgradient of CVB wetland 3;
- Under no circumstances must linear infrastructure be trenched within the CVB wetlands 2 and 3 or their conservation buffer;
- Any fences that are to traverse the CVB wetlands 2 and 3 must be installed in such a way that hydropedological processes are not impeded within these systems. It is recommended that the erection of fence posts within the CVB wetlands 2 and 3 are avoided;
- Stormwater attenuation ponds must be designed and landscaped in accordance with the Concept Stormwater Management Plan with input from a Landscape and Open Space Planning consultant and freshwater ecologist and all stormwater infrastructure are to be incorporated into the final Stormwater Management Plan. The stormwater infrastructure is to be maintained in accordance with the management plan as described in the Concept Stormwater Management Plan;
- For the construction of the maintenance road along the eastern boundary of the study area, culverts must be installed to allow the passage of water from the upgradient portions of the CVB wetlands 2 and 3 to the downgradient portions. Any disturbed areas within these wetlands must be rehabilitated on completion of construction of the road. Cobbles are to be placed downgradient of the maintenance road to trap sediment and reduce flow velocity of surface water entering the wetlands. The maintenance road should ideally avoid seep wetland 1 and circumvent it to avoid further fragmentation of the wetland. Should this not be possible, the road must be designed in such a manner as to allow hydraulic and hydropedological process connectivity in the landscape while also allowing fauna to traverse the roadway;
- Disturbed areas, particularly associated with the CVB wetlands 2 and 3 with regards to the maintenance road and fences that will traverse these wetlands must be rehabilitated once construction activities have ceased;
- Control measures related to trenching and stockpiling activities must be strictly implemented;
- Access to the site must be from existing access roads as far as feasible to avoid indiscriminate driving through the freshwater ecosystems;
- The 15m construction conservation buffer around the freshwater ecosystems must be implemented for the duration of the construction works where development will not occur to mitigate edge effects. The freshwater ecosystems and the respective conservation buffers must be clearly demarcated using a suitable barrier or material by an Environmental Control Officer (ECO) and marked as 'no-go' areas. Only authorised construction personnel may be permitted to enter these 'no-go' areas as part of the clearing activities, where required, to prevent excessive compaction of the soil within the freshwater ecosystems;

Figure 25: Example of a barrier fence used to demarcate the no -go area around the freshwater ecosystems and the 15 m construction conservation buffer.

Contractor laydown areas, vehicle re-fuelling areas and material storage facilities to remain outside of the respective conservation buffers of the freshwater ecosystems and preferably the 32m NEMA ZoR. A designated contractor laydown area must be approved by an independent ECO prior to use;

- Stockpiles must be placed outside the delineated freshwater ecosystems and 32m thereof;
- Site clearing activities (including for contractor laydown areas) are to remain within the authorised footprint and vegetation clearing is to be limited to what is absolutely essential within that active footprint;
- Avoid unnecessary trampling of vegetation irrespective of the vegetation being associated with the freshwater ecosystems or the surrounding terrestrial area;
- Retain as much indigenous vegetation as possible (wetland and terrestrial);
- Dust suppression measures must be implemented throughout construction to prevent excessive dust which may smother freshwater vegetation;
- No indiscriminate movement of vehicles through the freshwater ecosystems may be permitted.
- All vehicles must remain outside the conservation buffers, unless required as part of a specific construction activity for a short period of time. This should also be limited to the drier summer season, where possible;
- Control alien vegetation, specifically invasive and pioneer species which may find a niche to encroach disturbed areas. Ensure AIP species are managed post construction until suitable basal cover is achieved;
- Once all vegetation clearing is completed all vegetation and any removed excess material must be disposed of at a licensed refuse facility and may not be mulched or burned on site; and
- In all events all machinery and vehicles used during construction must be maintained to prevent oil leaks. If breakdowns occur these must be towed offsite site to the designated areas/workshops. The

proposed will ensure that incidental oil spills and leakage are minimised onsite and thus limit any opportunities of water contamination and water quality deterioration.

- All construction personnel, vehicles and construction work must be confined to the boundaries of the development footprint and no edge effects must occur. This is of particular importance at seep wetland 1;
- During the excavation and trenching activities, any soil/sediment or silt removed from the freshwater ecosystems may be temporarily stockpiled outside the freshwater ecosystems if construction activities are confined to the dry summer months;
- Excavated materials may not be contaminated (with hydrocarbons, fuel, etc.). It must be ensured that the minimum surface area is taken up, and the stockpiles may not exceed 2m in height;
- Mixture of the lower and upper layers of the excavated soil should be kept to a minimum, so as for later usage as backfill material;
- All exposed soils must be protected for the duration of the construction phase with a suitable geotextile (e.g. Geojute or hessian sheeting) to prevent erosion and sedimentation;
- Any AIPs within the study area (including the linear infrastructure footprints) must ideally be removed prior to soil stripping to reduce seed loads within the topsoil (which will be used to revegetate post construction). This will assist in reducing the long-term AIP management requirements;
- Dust suppression techniques must be implemented throughout the construction phase to ensure dust does not impact the CVB or seep wetlands, which could affect turbidity of the water and impact on wetland vegetation;
- With the exception of the infrastructure as described in this report (the potable water and stormwater infrastructure along the eastern boundary of the runway), no pipelines may traverse any of the freshwater ecosystems. Should additional freshwater ecosystem crossings be considered, the DWS Risk Assessment must be updated to account for these activities.
- Water and stormwater pipelines to be trenched in the freshwater ecosystems must be installed during the drier summer months to prevent water quality impacts to the freshwater ecosystems;
- Unused excavated soil/sediment must be utilised as part of the open space areas (if applicable) or be removed from site to a registered landfill;
- The soil surrounding the linear infrastructure, particularly within 15 m of the freshwater ecosystems must be suitably loosened on completion of construction activities and revegetated to prevent erosion;

- In addition to the above, with regards to excavation and soil compaction activities regarding trenching for the linear infrastructure within the 15 m construction conservation buffer of the freshwater ecosystems
- Stockpiling of removed materials may only be temporary (i.e. may only be stockpiled during the period of construction at a particular site) and must be disposed of at a registered waste disposal facility. Soil must be stockpiled on the upgradient side of the trench to avoid sedimentation of the downgradient areas;

Figure 26: Excavation for trenching with stockpiles alongside.

- Trenches must be backfilled as soon as the infrastructure has been installed in any given section to reduce potential erosion of exposed soil;
- Material used as bedding material (at the bottom of the excavated trench) must be stockpiled outside of the freshwater ecosystems. Once the trench has been excavated, the bedding material must directly be placed within the trench rather than stockpiling it alongside the trench;
- No stormwater generated during construction may be directly released into the freshwater environment;
- It is considered imperative that all excavation activities be undertaken during the drier summer months to limit surface water contamination and the need for any surface water diversion during the construction works (diverting the flow of water through a pipe was not included as part of this risk assessment);
- Construction activities are only allowed in the development footprint. As far as possible, physical movement in the freshwater ecosystems by personnel must be limited; and
- Under no circumstances must linear infrastructure be trenched within the CVB wetlands 2 and 3 or their conservation buffer. Updated design plans (Zutari, 2024a) indicate that the layout of the linear infrastructure avoids wetlands.

- A 5m RoW for linear developments is considered as part of the RAM. This is of particular relevance to the installation of the water pipeline, fences and maintenance road along the eastern boundary of the study area;

Control measures specific to asphalt / concrete works:

- Asphalt, concrete and cement-related mortars can be toxic to aquatic life. Proper handling and disposal should minimise or eliminate discharges into the wetlands. High alkalinity associated with cement can dramatically affect and contaminate both soil and ground water. The following measures must be adhered to:

- Fresh asphalt, concrete and cement mortar must not be mixed near the wetlands' habitat. Mixing of cement may be done within the construction camp, on an impervious surface only, and must be within a lined, bound or bunded portable mixer. Consideration must be given to the use of ready mix concrete;

- No mixed concrete maybe deposited directly onto the ground within the wetlands or associated wetland habitat, outside of the designated area (i.e. fence traversing the seep wetland 1 and CVB wetlands 2 and 3). Any areas that require manual application of cement require that mixed cement be placed on a batter board or other suitable platform/mixing tray until it is deposited;

- A washout area must be designated outside of the wetlands, and wash water must be treated on-site or discharged to a suitable sanitation system;

- At no point may batter boards/mixing trays or cement trucks be rinsed off on site and runoff water be allowed into the freshwater ecosystems;

- Cement bags (if any) must be disposed of in the demarcated hazardous waste receptacles and the used bags must be disposed of through the hazardous substance waste stream; and

- Spilled or excess concrete must be disposed of at a suitable landfill site. Chain of custody documentation must be provided.

Control measures specific to the construction of stormwater infrastructure:

- All attenuation facilities must be constructed through excavation of the in-situ material, sloped to a ratio not steeper than 3:1 and lined with rocks and cobbles to assist with energy dissipation and prevent sedimentation and erosion as well as improve the aesthetic appeal of the attenuation ponds;

- Attenuation ponds must be vegetated with indigenous obligate and facultative species suitable for seasonal saturation with input from a suitably qualified avifaunal specialist. Given the nature of the development, vegetating the dry attenuation ponds may not be possible. This will assist with energy dissipation and prevent sedimentation and erosion as well as improve habitat provision;

Figure 27: Examples of swales utilised for conveyance of stormwater.

- Cobbles must be placed on all outlet structures and indigenous vegetation established to bind the soil of the bed, to prevent erosion and assist with energy dissipation. This will also promote diffuse flow and decrease the velocity of water released downgradient towards seep wetland 1 and CVB wetland 3. The Stormwater Management Plan compiled by Zutari (2024b) is to be updated to include input from a Landscape and Open Space Planning consultant and freshwater ecologist to determine the system characteristics required to prevent excessive erosion of the downgradient seep and CVB wetland whilst also limiting the creation of habitat for birds which provide a safety risk for aircraft. The design and operation must prevent erosion and/or gully formation as this will have an impact on the water dispersal into and across the seep wetland 1 and CVB wetland, which could potentially reduce the extent and functionality of the wetland systems in the long-term;
- All materials used to construct the attenuation ponds must not generate toxic leachates or lead to significant changes in pH or dissolved salt concentrations;
- No plastic lining may be used as part of the attenuation pond construction as this has various ecological impacts;
- It is recommended that the attenuation ponds be vegetated with indigenous wetland and / or riparian vegetation (with input from a suitably qualified avifaunal specialist) to assist with water polishing, trapping nutrients and hydrocarbons from the proposed CWA development before this is released into the surrounding environment;
- With regards to concrete works for the outlet structures (including concrete aprons, reno mattresses, gabions, headwalls, etc., as applicable), see control measures related to concrete works. These must ideally be constructed during the drier summer months to reduce the impact on water quality of the seep wetland 1;
- Litter traps must be installed at all the outlet structures to prevent any litter from entering the freshwater ecosystems;
- Sediment trapping devices must be utilised downgradient of where works are to be undertaken within seep wetland 1 and upgradient of the CVB wetland 3;

- All soil compacted within the wetlands as a result of construction equipment must be loosened prior to revegetation with suitable indigenous species;
- Suitable dust management practices must be implemented for the duration of construction;
- It is highly recommended that construction work for the linear infrastructure is undertaken in the drier, summer period to avoid excess sediment entering the receiving freshwater ecosystems;
- Careful planning of all construction equipment must be undertaken beforehand to ensure that the minimum impact on the freshwater ecosystems occur;
- Any fences that are to traverse the CVB wetlands 2 and 3 (if applicable) must be installed in such a way that hydropedological processes are not impeded within these systems. It is recommended that the erection of fence posts within the CVB wetlands 2 and 3 are avoided;
- For the construction of the maintenance road along the eastern boundary of the study area, culverts must be installed to allow the passage of water from the upgradient portions of the CVB wetlands 2 and 3 to the downgradient portions. Any disturbed areas within these wetlands must be rehabilitated on completion of construction of the road. The maintenance road should ideally avoid seep wetland 1 and circumvent it to avoid further fragmentation of the wetland. Should this not be possible, the road must be designed in such a manner as to allow hydraulic and hydropedological process connectivity in the landscape while also allowing fauna to traverse the roadway; and
- It is also highly recommended that cobbles be placed downgradient of the road to trap sediment and reduce flow velocity of surface water entering the wetlands.

Development footprint

- All development footprint areas should remain as small as possible and should only encroach into the freshwater ecosystem if considered absolutely essential;
- The boundaries of footprint areas, including contractor laydown areas, are to be clearly defined and it should be ensured that all activities remain within defined footprint areas. Edge effects will need to be extremely carefully controlled;
- Planning of temporary roads and access routes should avoid freshwater ecosystem areas and be restricted to existing or pre-approved access roads and should not traverse the freshwater ecosystem;
- Appropriate sanitary facilities must be provided for the life of the repair and maintenance phase and all waste removed to an appropriate waste facility;
- All hazardous chemicals as well as stockpiles should be stored on bunded surfaces and have facilities constructed to control runoff from these areas;

- It must be ensured that all hazardous storage containers and storage areas comply with the relevant SABS standards to prevent leakage;
- No fires should be permitted in or near the construction area; and
- Ensuring that an adequate number of waste and "spill" bins are provided will also prevent litter and ensure the proper disposal of waste and spills.

Vehicle access

- All vehicles must be regularly inspected for leaks. Re-fuelling must take place on a sealed surface area to prevent ingress of hydrocarbons into the topsoil;
- In the event of a vehicle breakdown, maintenance of vehicles must take place with care and the recollection of spillage should be practised near the surface area to prevent ingress of hydrocarbons into topsoil and subsequent habitat loss; and
- All spills should they occur, should be immediately cleaned up and treated accordingly.

Vegetation

- Proliferation of alien and invasive species is expected within any disturbed areas. Whilst not considered severe at this time, the vegetation component within the freshwater ecosystem environment is already transformed. However, alien invasive species are opportunistic, and where disturbances do occur, they will promulgate; therefore, these species should be eradicated and controlled to prevent their spread beyond the project footprint. Alien plant seed dispersal within the top layers of the soil within footprint areas, that will have an impact on future rehabilitation, has to be controlled;
- Removal of the alien and weed species encountered within the freshwater ecosystem must take place in order to comply with existing legislation (amendments to the regulations under the Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983) and Section 28 of the National Environmental Management Act, 1998 (Act No. 107 of 1998); and
- Species-specific and area-specific eradication recommendations:
    - Footprint areas should be kept as small as possible when removing alien plant species; and
    - No vehicles should be allowed to drive through designated sensitive freshwater ecosystems areas during the eradication of alien and weed species.

Operation of the borehole

- Abstraction volumes must be monitored and recorded at suitable intervals (e.g. monthly) to ensure that the abstraction volume (from what is approved by the DWS) is not exceeded;

- Groundwater abstraction must not drop below the critical water level (still to be determined). The management objective should be to maintain the groundwater level at or near the dynamic water level (still to be determined) to avoid the development of a cone of depression in the local landscape and significant impacts to the freshwater ecosystems within the study and investigation areas;
- Should it be observed that abstraction have dropped below the critical water level or if a water quality change has been observed, the relevant DWS compliance officer should be informed to discuss and develop a new abstraction plan that can sustain the aquifer; and
- During maintenance activities, particular care should be taken with regards to vehicle and spill management.

Solar PV facilities:

- Maintenance activities associated with the PV facility must be confined to the developed footprint of the PV facility and development footprint;
- Under no circumstances may waste (including grey water from the washing of the PV panels) be discarded in the surrounding environment. Suitable waste management practices must be implemented;
- BESS infrastructure (if any) must be regularly inspected and must be operated in line with applicable SANS standards (e.g. SANS 56005:2022 Ed 1 and SANS 62133-2:2022 Ed 1 as issued in Schedule B1 of GN 1427 of 18 November 2022, as issued in terms of section 24(1)(a) of the Standards Act (act 8 of 2008)); and
- Monitoring for the establishment for AIP species must be undertaken, specifically in the PV panel array footprint in the south-eastern portion of the study area. Should AIP species be identified, they must be removed and disposed of at a licenced waste management facility.

Soils

- Sheet runoff from compacted areas should be slowed down by the strategic placement of berms;
- It is considered ideal that activities occur within the current season (low rainfall) to minimise impacts of sedimentation;
- As much vegetation growth as possible (of indigenous floral species) should be encouraged to protect soils;
- Temporary stockpiling of excavated material from trenches can be retained alongside trenches, as required for backfilling. Any soil to be stockpiled for longer than a month should be moved to a designated stockpile area, as approved by the Environmental Control Officer (ECO);
- All soils compacted during the repair and maintenance phase should be ripped and profiled; and

- A monitoring plan for the development and the immediate zone of influence should be implemented to prevent erosion and incision.

Rehabilitation

- Construction rubble must be collected and disposed of at a suitable landfill site; and
- All alien vegetation in the footprint area, as well as the immediate vicinity of the proposed work area, should be removed.

Operational Phase:

- Implement a monitoring programme to detect and prevent the pollution of soils, surface water and groundwater;
- Monitor wetlands that will potentially be impacted by the proposed CWA development to ensure that the PES drivers and receptors are maintained, and where possible improved, in accordance with the REC and RMO.
- A Service Infrastructure Management Plan should be compiled which details the frequency in which service infrastructure, particularly the sewer and water treatment plants, bio-digester and sewer conveyance infrastructure must be serviced. For example, it is recommended that the integrity of the sewer infrastructure and treatment plants be tested at least once every five years or more often should there be any sign of a leak.
- An emergency plan must be compiled to ensure a quick response and attendance to the matter in case of a leakage or bursting of a pipeline or overtopping of sewage at the treatment plant and/or bio-digester.
- Jet fuel and other potential hazardous chemicals must be stored in a manner that reduces the potential for spills.
- An emergency spill protocol must be compiled and is to be maintained for the CWA, especially for potential spills on the runways, aprons, roads, etc. to prevent the pollutants from being transported via stormwater infrastructure into the downgradient wetlands.
- Regular inspection of the stormwater outlet structures must be undertaken (specifically after large storm events) to monitor the occurrence of erosion. If erosion has occurred, it must immediately be rehabilitated through stabilisation of the embankments and revegetation, where applicable.
- All pipelines and attenuation ponds must be regularly cleaned, and all outlet structures (if any) checked to ensure there is no debris/blockages.
- The likelihood of erosion at the discharge points can be reduced provided that a higher surface roughness is implemented in the area from the discharge points down to the delineated freshwater ecosystems, allowing for water to enter the seep wetland 1, CVB wetland 3 and the surrounding

environment at a lower velocity. This can be achieved through the placement of cobbles and ensuring that the area surrounding each discharge point is suitably vegetated.

- No development within the 15m and 16m operational phase conservation buffer of the CVB wetlands 2 and 3 and seep wetland 1, respectively, may be undertaken.
- The proposed stormwater infrastructure must be incorporated into a suitable and site-specific Stormwater Management Plan (e.g. as compiled by Zutari, 2024b) and the stormwater infrastructure are to be maintained as per the requirements of the Concept Stormwater Management Plan (Zutari, 2024b).
- It must be ensured that regular maintenance takes place to prevent failure of any infrastructure associated with the proposed CWA development.
- Only existing roadways should be utilised during maintenance and repairs to avoid indiscriminate movement of vehicles within the wetlands.
- Should repair of the sewer infrastructure be required to address a leak, control measures relating to trenching and stockpiling must be implemented depending upon the location of the leak.
- With regards to maintenance activities for roads, fences and service infrastructure refer to applicable measures in Construction Phase control measures.
- No vehicles are permitted to enter the freshwater ecosystems. Any maintenance works must be undertaken by foot, or the relevant authorisations obtained beforehand.
- The **Wetland Offset Study and Implementation Plan (Annexure 7)** needs to be implemented.

Monitoring:

- A monitoring programme must be implemented to detect and prevent the pollution of soils, surface water and groundwater. This has been compiled by GEOSS.
- Monitoring of the implementation and management of the Freshwater offset plan.
- Monitor wetlands that will potentially be impacted by the proposed CWA development to ensure that the PES drivers and receptors are maintained, and where possible improved, in accordance with the REC and RMO.
- Monitoring for the establishment for AIP species must be undertaken, specifically in the PV panel array footprint in the south-eastern portion of the study area.
- A monitoring plan for the development and the immediate zone of influence should be implemented to prevent erosion and incision.

- Regular inspection of the stormwater outlet structures must be undertaken (specifically after large storm events) to monitor the occurrence of erosion. If erosion has occurred, it must immediately be rehabilitated through stabilisation of the embankments and revegetation, where applicable.

2.2.6 Hydropedological Mitigation:

- All development footprint areas should remain within the demarcated areas as far as possible, and disturbance of soil profiles must be limited to what is essential with a compact footprint.
- Subsurface lateral flow of water through the landscape (under seep wetlands and interflow soils) must be taken into account and buildings/structures should accommodate waterproofing and water management structures to divert laterally seeping water away from foundations into the gardens or storm water structures.
- Increased surface sealing as a result of the proposed development will result in decreased infiltration as bulk of the stormwater from sealed or paved surfaces are generally discharged in stormwater systems. The exception to this is where runoff is localised and directed to unsealed surfaces or adjacent watercourses in an attenuated manner.
- Water from clean water diversion structures should be discharged back into the adjacent wetland features in an attenuated manner.
- Implementation of strict erosion control measures to limit loss of soil and sedimentation of the watercourse within the proposed development footprint.
- Only the designated access routes are to be used to reduce any unnecessary compaction.

2.2.7 Terrestrial Ecological Mitigation:

<u>Construction Phase:</u>

Faunal Mitigation Measures

- The development footprint should be demarcated, and it should be ensured that no development related activities take place outside of the demarcated footprint;
- Faunal habitat beyond the demarcated area should not be cleared or altered, except as needed for safety reasons around taxiways and runways as per the Bird and Wildlife Hazard Management Plan for the airport;
- Site clearance activities should take place in a phase manner, starting from the south moving northwards, or centrally moving outwards, so that faunal species can flee ahead of clearance activities into adjacent habitat and not get trapped in centralised, remnant patches;
- Construction personnel are to be educated about the various faunal species in the area, particularly about venomous spiders, snakes and scorpions. None of these or other species are to be killed or

injured by construction personnel. Should any of these species be encountered, these species are to be safely and carefully relocated to the surrounding natural habitat adjacent the development site, should they not move off on their own;

- The contact details of a suitably qualified snake handler be made available to construction teams should a venomous snake be encountered that needs removal. Alternatively, it is recommended that a member of the construction team be trained to handle and remove snakes through a recognised snake handling course;
- Sound environmental management practices should be adhered to at all times;
- Alien plant species should be suitably managed and no further spread of alien plants should be allowed;
- No illicit fires must be allowed during the construction phase;
- External lighting should be kept to a minimum with downward and inward facing lights being used. Yellow or red fluorescent lights are preferable, while the use of bright white or LED lights should be avoided. Lighting used must be kept to minimum, but in allowance with the required health and safety requirement for nighttime operations;
- Noise must be kept to acceptable levels as per the environmental norms and standards for noise mitigation as stipulated within the noise specialist report;
- No hunting, trapping or collecting of faunal species is to be allowed, other than for rescue and relocation purposes. Setting of snares by personnel is to be prohibited; and
- Suitable measures must be put in place to ensure that no sediment runoff from cleared areas enters any downstream/downslope habitat units which may lead to altered habitat conditions.
- Prior to construction activities, a final walk down of the study area should be undertaken to verify the presence/absence of potential SCC. Should any SCC be found to be breeding in the study area at the time of construction activities, all activities are to be halted, and a suitable qualified ecologist/relevant cape nature specialist must be consulted to determine the best way forwards.

Avifaunal Mitigation Measures:

- The development footprint should be demarcated, and it should be ensured that no development related activities take place outside of the demarcated footprint;
- Avifaunal habitat beyond the demarcated area should not be cleared or altered, except as needed for safety reasons around taxiways and runways;
- Site clearance activities should take place in a phased manner, starting from the south moving northwards, or centrally moving outwards, so that avifaunal species can flee ahead of clearance activities into adjacent habitat and not get trapped in centralised, remnant patches;

- Sound environmental management practices should be adhered to at all times;
- Alien plant species should be suitably managed and no further spread of alien plants should be allowed;
- No illicit fires must be allowed during the construction phase;
- Stormwater/attenuation pond surfaces should be closed off to prevent avifauna from congregating to these areas, notably waterfowl and larger bird species which pose a risk to aircraft;
- As far as possible, vegetation clearance should take place during the winter months, outside of the breeding/nesting periods of avifaunal species;
- Noise must be kept to acceptable levels as per the environmental norms and standards for noise mitigation as stipulated within the noise specialist report; and
- No hunting, trapping or collecting of avifaunal species is to be allowed. Setting of snares by personnel for ground dwelling birds is to be prohibited;

Operational Phase:

Faunal Mitigation Measures

- No further development related activities are to take place outside of the demarcated footprint unless duly authorised by the competent authority;
- Faunal habitat beyond the demarcated area should not be cleared or altered, except as needed for safety reasons around taxiways and runways as per the Bird and Wildlife Hazard Management Plan for the airport;
- Operational personnel are to be educated about the various faunal species in the area, particularly about venomous spiders, snakes and scorpions. None of these or other species are to be killed or injured by personnel. Should any of these species be encountered, these species are to be safely and carefully relocated to the surrounding natural habitat adjacent the development site, should they not move off on their own;
- The contact details of a suitably qualified snake handler be made available to construction teams should a venomous snake be encountered that needs removal. Alternatively, it is recommended that a member of the operational team be trained to handle and remove snakes through a recognised snake handling course;
- Sound environmental management practices should be adhered to at all times;
- Alien plant species should be suitably managed and no further spread of alien plants should be allowed;

- Whilst it is accepted that there will likely be significant external lighting during the operational phase, it is still recommended that the amount of light be minimised as far as possible (notably outward shining/emitted light), and that downward and inward facing lights be used wherever possible, but within legislated operational health and safety guidelines/requirements. Yellow or red fluorescent lights are preferable for building and perimeter lighting, whilst the use of bright white or LED lights should only be used as and where necessary for apron lighting (or as required by operational health and safety for airport operations). Lighting used must be kept to minimum, but in allowance with the required health and safety requirement for airport operations;
- Noise levels must be suitably managed in line with the norms and standards for airports operations. It is however acknowledged that the larger aircraft will generate noise levels beyond the recommended health and safety guidelines, and that these unfortunately cannot, at this point in time, be reduced due to the nature of turbine jet engines;
- Stormwater is to be suitably controlled and discharge points monitored for erosion; and
- No hunting, trapping, or setting of snares by personnel is to be allowed. Suitable fines/disciplinary actions for such must be made known and implemented.

<u>Avifaunal Mitigation Measures</u>

- No further development related activities are to take place outside of the demarcated footprint unless duly authorised by the competent authority;
- Avifaunal habitat beyond the demarcated area should not be cleared or altered, except as needed for safety reasons around taxiways and runways and as per the Bird and Wildlife Hazard Management Plan for the airport;
- Sound environmental management practices should be adhered to at all times;
- Stormwater /attenuation ponds must be monitored and covers/screens of these features repaired if damaged. If leaks appear or ponding at the outlets is evident, this must be rectified to avoid attracting waterfowl or larger avifauna such as herons etc which pose a risk to aircraft
- Noise levels must be suitably managed in line with the norms and standards for airports operations. It is however acknowledged that the larger aircraft will generate noise levels beyond the recommended health and safety guidelines, and that these unfortunately cannot, at this point in time, be reduced due to the nature of turbine jet engines;
- Reactive control measures should be investigated and where needed implemented to manage birds and other wildlife at the airport. Such includes dispersal measures (sirens, lasers, pyrotechnics, and Border Collies) and removal measures (live capture, nest removal etc) as and where feasible/needed; and

- Buildings, structures and landscaped gardens may provide artificial nesting/habitat for avifaunal species and increases their potential activity around the airport. Methods to reduce available shelter include: 1) Exclusion measures such as spikes, netting, panelling on ledges and holes around buildings to assist in prevention of birds taking residence, 2) Nest removal and 3) Cutting / mowing of vegetation where needed (this may however attract a different assemblage of avifauna which selects for such areas). As such, vegetation clearance should be done in line with the recommendations as per the **Wildlife Hazard Management Plan (Annexure 11)** for the airport.
- The presence and abundance of high-risk bird species are primarily associated with agricultural land use and water bodies within the primary bird hazard zone surrounding the proposed CWA. The movement of birds between these habitats warrants attention.
- Specific attention should be given to managing the Fisantekraal wastewater treatment works (WWTW), its expansion, and the surrounding livestock feedlots and lawn cultivation areas.
- Additionally, the large open water body to the southeast of the airfield requires careful oversight.
- Effective management will necessitate engagement with landowners in the vicinity to mitigate the attractiveness of agricultural and farming activities to birds.
- Notably, given that most high-risk bird species are drawn to grasslands, establishing grassed areas directly on the airfield and adjacent to manoeuvring zones is not advisable.
- The Bird and Wildlife Hazard Management Plan - Landscape and Open Space Planning Guidelines for the proposed CWA should be considered where appropriate.

2.2.8 Socio-economic Mitigation:

Pre-construction Phase:

Procurement Strategy that includes the following and applies to the project:

- Initiate the activity during the first phase of the development;
- The strategy is the responsibility of the contractor(s) collectively under the guidance of the Municipality;
- Focus on opportunities for local labour in the surrounding areas and businesses as a priority. Contractors are required to indicate the geographical location of sub-contractors (businesses) and local labour; and
- Local contractors invited to tender for work in the context of the terms and conditions included in RFP documentation, which would include skills development, on-site training, gender equality, etc.

- Approved programme aligned with the future construction phases of Greenville Garden Cities, Bella Riva and other planned/approved developments in the area to minimise the impact on the greater community.

Pre-construction & Construction Phase:

A Communication Strategy that addresses directly and indirectly affected residents and surrounding landowners, with specific reference to activities, timelines and intended impacts related to the construction phase and all related activities associated with the implementation of the project (i.e. during the operational phase).

- Objectives
  - To orientate, generate awareness and gain positive attitudes among stakeholders as far as possible; and
  - To engage and inform stakeholders of progress regarding all phases of construction.
- Target audience
  - Property owners and users of the land portions directly surrounding the proposed activity; and
  - Other stakeholders and property owners that may be affected.
- Major types of messages
  - Inform directly affected residents on the periphery of the development site and others that would frequent the area;
  - The commencement date for construction activities related to the project;
  - Duration and extent of the construction activities and details of individual construction activities;
  - Progress updates, including any delays in a construction-related activity; and
  - Introduce appropriate signage to warn persons frequenting the area and those residing adjacent to the development area.

Construction Phase:

Nuisance factors (dust and noise) - Dust and noise emissions during the construction period should be minimised through a Construction Environmental Management Plan (CEMP).

Influx of job seekers, impact on local communities - Contractors need to employ people from the immediate area whenever possible. A Social Engagement Plan, formal monitoring systems and contingency plans for larger-than-expected in-migration should be prepared and implemented to assist with the management of jobseekers and so-called community business forums.

Increase in local crime - Co-operation between the Developer and contractors is essential to ensure that the area around the proposed development remains secured during construction. On-site security measures, such as perimeter fencing, controlled access and security guards and patrols will minimise the risk.

Operational phase:

Sense of place, residential property values - Implement recommendations by relevant specialists to mitigate negative visual, traffic, noise, air pollution impacts. All these impacts affect the socio-economic fabric of the area surrounding the CWA and along the flight path.

Local crime - Co-operation between Developers and contractors and on-site security measures.

Informal settlements - Formal housing could address the area's housing needs, eliminating the need for informal structures. Private landowners should ensure that the authorities deal with unauthorised land settlements.

Nearby farming and business operations - Refer to mitigating measures relevant specialists proposed (in particular agro-ecosystem, noise and air pollution).

Bulk infrastructure requirements - Implement recommendations from engineering reports.

2.2.9 Visual and Heritage Mitigation:

2.2.9.1 Design Phase

Guidelines required for the overall development (refer to Section 4.1.1 below):

It is recommended that the first Site Development Plan (SDP) to be submitted to the City of Cape Town Municipality for approval must trigger the requirement for the following to be submitted for approval at the same time:

1) An Urban Design Guidelines document to govern all architectural development within the CWA throughout all future phases.

2) A Master Landscape Plan (that supersedes the current Draft Overall Landscape Concept Plan (PAL 4)) to show landscape development within the CWA throughout all future phases.

3) A Landscape Guidelines document to provide a standard and framework for and govern all landscape architectural development within the CWA throughout all future phases.

4) An Overall Lighting Report should be prepared at SDP stage by a suitably qualified electrical engineer, to be submitted to the CoCT for comment and approval.

Plans and Guidelines required to accompany all future Site Development Plans (refer to Section 4.1.2 below)

All future Site Development Plans within the CWA development that are to be submitted to the Municipality for approval must contain / be accompanied by the following:

1) A Detailed Landscape Plan (SDP-level appropriate) prepared by a suitably qualified Landscape Architect.

2) A detailed Fencing proposal.

3) Detailed Irrigation specifications must be included in all landscape proposals at SDP level.

4) A detailed Lighting Proposal

5) A detailed Signage Plan should be developed and submitted to the City of Cape Town for approval under the Outdoor Advertising and Signage Policy and By-law.

Specific Mitigation required to accompany particular Site Development Plans (refer to Section 4.1.3 below)

Certain areas within (or aspects of) the CWA development require particular attention in response to contextual informants or their proposals must be accompanied by additional information or further visual specialist input at a later stage of design development. Section 4.1.3 below elaborates on the following aspects:

- A lighting audit
- Area of Agricultural Significance
- Scenic Routes
- Zone 1: The Services Precinct
- Zone 3: The General Aviation Precinct
- The Airport Airside Precinct
- The Agricultural Precinct
- Outdoor Signage & Advertising

General Guidance for the Design Phase (refer to Section 4.1.4 – 4.1.8 below):

1) Outdoor Signage (detail included in Section 4.1.8):

The subject site is located within and alongside areas of maximum control in terms of the Outdoor Advertising and Signage Policy of the City of Cape Town, 2013; and the Outdoor Advertising and Signage By Law (No. 10518, 2001). Enforcement of the By Law and Policy guidelines are especially important to reduce the impact of possibly inappropriate signage along Scenic Routes. According to the Policy, the City

will encourage creative locality bound signs which are sensitive to natural and Cultural Landscapes in non-urban settings.

2) Fencing, Walls and Boundary interfaces (detail included in Section 4.1.7):

The proposed development must comply with the Boundary Walls and Fences Policy of the City of Cape Town, 2009 in all respects. Other policy relating to fencing and boundary treatment are the Heritage and Scenic Resource: Inventory and Policy Framework for the Western Cape (Respect the landscape setting and gateway qualities of scenic routes by ensuring appropriate design of road verges and fences); and the Western Cape Land Use Planning Guidelines for Rural Areas, 2019.

3) Lighting – General, Outdoor and Sources of Light (detail included in Section 4.1.4):

In principle, lighting in the development should:

- ✓ Only be on when needed for active use;
- ✓ Only light the area that needs it;
- ✓ Be no brighter than necessary;
- ✓ Minimize blue light emissions;
- ✓ Be fully shielded (pointing downward) as far as possible.

It may not be possible for parts of the proposed development to adhere to the certain mitigation measures in every part of the development, given the specialized lighting that would be necessary at an airport. This risk can be managed through the submission of the detailed Lighting proposal at SDP stage. This will allow the CA and/or the visual specialist and/ or the electrical engineer preparing the Lighting Report to be provided with sufficient information during the future approvals process so that visual impacts associated with the direct and indirect visibility of lighting can be avoided, reduced or mitigated wherever possible when this detailed information becomes available.

4) Materials and Finishes (detail included in Section 4.1.5):

Roof and facade materials must be neither bright nor light. The appropriate colour range is achieved by increasing the shade (black) and tone (grey) of the desired colour palette. This darkens the original hue while making the chosen color appear more subtle and less intense.

The use of a range of colours within an approved palette (to be determined as part of the Architectural Guidelines) is recommended for roof and facade materials and finishes. This prevents the development from appearing as a solid and/or overly uniform roofscape typical of newly established developments, especially from views at a higher elevation.

Where tenants or future potential developers within the various precincts of the CWA require the specification of bright colours in line with their branding (which are often on the warm colour spectrum) on exterior portions of buildings, additional mitigation measures have been included.

5) Landscape (detail included in Section 4.1.6):

Theses mitigation measures should be used to assess the compliance of the future Master Landscape Plan and SDP Landscape Plans and Guidelines.

2.2.9.2 Construction phase

Soil disturbance and revegetation

Areas disturbed (for any reason) must be revegetated (or planted as per the approved Landscape Master Plan) within a maximum of 1 year after the disturbance occurs. The ECO must report on disturbed areas and revegetation. The only circumstances under which delay may be tolerated are:

- If the area to be revegetated/planted is still an active construction site;
- If the revegetation/planting must happen during a particular season to await optimal planting conditions. In these cases, revegetation/planting must occur in the first of such season after the delay.

All embankments must be appropriately stabilized and revegetated to match the existing/surrounding natural vegetation.

Rehabilitation/revegetation must be handled in accordance with the recommendations of the botanist or other suitably qualified specialist, and under the supervision of the ECO.

During excavation activities, topsoil must be stockpiled separately from other material. The mixture of the lower and upper layers of the excavated soil must be kept to a minimum, so as for later use as backfill or rehabilitation material after construction has commenced.

Exposed soils must be protected from wind and water erosion (using tarpaulins or a suitable geotextile) for the duration of the construction phase.

Ongoing monitoring for the establishment of alien and invasive vegetation species must be undertaken periodically (during construction, and at least once a year thereafter) within and around the subject site. Should alien and invasive plant species be identified, they must be removed and disposed of as per the development's alien and invasive species control plan (and/or the relevant legislation and guidance from a suitably qualified specialist).

General

A suitably qualified Environmental Control Officer (ECO) must be appointed in order to ensure that all visual related aspects are adequately mitigated and monitored for the duration of the construction phase. The ECO officer must be qualified to monitor and enforce visual impact related management and mitigation measures.

The ECO must monitor use of light and levels of light pollution by means of regular spot-checks, to be included in monthly compliance reporting.

At the end of a construction phase, a lighting audit must be undertaken by the ECO (or a suitably qualified sub-contractor working on behalf of the ECO) to ensure that all lighting related mitigation measures are adhered to and successfully implemented.

In order to minimise the probability of negative community responses, a competent staff member should be appointed at the beginning of the operational phase, to be responsible for handling any complaints or concerns received by any I&AP's (and any other affected neighbours).

All construction site offices, lay down areas, storage areas and active construction activities must be screened from public view by appropriate hoarding and/or screening.

Construction fencing/hoarding and signage must adhere to local policy relating to signage and ensure that no views to scenic routes are impacted by large or numerous construction signage.

All contractors and sub-contractors on site must submit a Temporary fencing, hoarding and screening protocol for active construction sites to the ECO for monitoring.

All contractors and sub-contractors on site must submit a dust and mud control protocol for active construction sites to the ECO for monitoring.

Storage and lay down areas, loading areas and similar temporary infrastructure should be situated to avoid any areas visible from the R312.

- Lay down areas and storage areas must be placed at least 100m away from all property edges.
- Any fencing, visual screens or hoarding erected during the construction phase must be maintained so that they do not become the source of the visual impact.

It is inevitable that waste will be generated during construction. The following is recommended:

- The applicant must ensure that sufficient on-site waste management measures are in place to prevent any escape of waste, litter and packaging materials etc. into the surrounding landscape.
- A weekly litter patrol must be included in the Construction activities on site and monitored for compliance by the ECO.

No construction phase activities may be undertaken within the Agricultural Precinct.

Construction activities must be limited to daylight hours to prevent visual impact of lights at night. Construction activities should not be undertaken at night unless unavoidable.

Dust management, waste management, the placement of screens and hoarding, as well as the location and management of access points to the site must be proactively managed to reduce visual clutter and limit visual impacts associated with construction activity before, during and after each phase of the construction process (demolition, excavation, project execution, close-out etc., establishment, etc.)

All site operatives must receive training in awareness of the issues of fires, litter, and contaminants. No fires are to be allowed on site; no litter and no contaminants to be allowed to enter the surrounding environment by any means. These substances may include amongst other things, diesel, curing compounds, shutter oil and cement. Utilization of such substances should be controlled on site, especially in close proximity to the riverine environment, and guidelines should be included in the EMPr.

No construction activities should be allowed to be undertaken at night, so as to manage the duration and visual impact of construction lights' visibility at night. If construction during the night-time hours is unavoidable, the following should apply:

- No floodlights should be permitted.
- Only the construction activity should be lit- not the entire construction area.
- Construction lighting should not be "always-on" – and should be turned off when active construction activity is not being undertaken.
- The management of construction light impacts at night must be monitored by the ECO and included in compliance reporting.

Public road junctions should have good sightlines, traffic control measures, wayfinding signage, and dust control measures in place.

The construction project management team must enforce dust and mud control measures and protocols at construction site entrances. This is especially important for construction entrances that deliver construction vehicle traffic onto the R312, where poor management of dust and mud will have a negative impact on the visual amenity.

Ensure that no views from R312 or R304 are negatively impacted by large or numerous construction signage, fencing or hoarding.

Dust and debris control must also be implemented to minimize the impacts on the local roads, residents and neighbouring properties. Where necessary, access routes and the site itself should have an effective dust suppression management programme applied, such as the use of non-polluting chemicals that will retain moisture in the exposed site surfaces.

2.2.10 Agro-Ecological Mitigation:

- The loss of productive farmland is regarded as inevitable but further loss of productive farmland should be prevented, by clear demarcation of the development envelope during the construction phase, while no vehicle or other activity should be allowed outside of the demarcated area.
- Soil erosion by wind, during construction, should be mitigated by minimizing bare soil surfaces without adequate protection, either by applying a mulch cover or wetting the surface or similar action.
- Suitable run-off and soil erosion control measures and infrastructure should be designed and implemented to limit and restrict the loss or degradation of soil.
- The release of run-off water into existing streams should be controlled to minimize impact on vleis, marshes, water sponges and water courses. This activity may include a permitting application to the DWS.

2.2.11 Civil Aviation Mitigation:

The mitigation measures for the impacts associated with Civil Aviation have been addressed through the Noise, Transport and Socio-Economic mitigation measures.

2.2.12 Traffic Mitigation:

Construction:

If it is assumed that all earthworks for the CWA construction will be sourced from existing quarries, mostly located west of the site, initial estimates indicate that approximately 875 000 m^3 of earthworks will be required for construction (worst-case scenario). With a truck capacity of 15 m^3, this equates to approximately 58 167 truckloads. However, most of the earthworks will be done onsite to balance cut and fill areas.

The quarries can be accessed either via the existing surfaced road network or the gravel road network. Due to the poor condition of the gravel roads and the heavy loads expected, it is recommended that trucks use the surfaced road network. A detailed construction management plan must be developed for the CWA, ensuring that deliveries are scheduled outside peak hours to prevent congestion during peak periods. This will be done once a suitable contractor has been appointed.

Design & Operation:

- Based on the estimated trip generation and multiple access points, single-lane roads with dedicated turning lanes should be able to accommodate the vehicle demand. However, it is suggested that multi-lane roads be constructed for the main public circulation route for more ideal vehicular flow. The planning of road reserve will make allowance for dualling when necessary.
- Public transport services should be scoped to link the CWA with planned and existing services. Bus stops should be provided near the terminal buildings. Once the Fisantekraal commuter rail service is

in operation, a shuttle service between the CWA and the rail station should be established. Such service will be demand driven and phased with the future development of the CWA. The details of public transport facilities for the CWA will be finalised at a later stage. However, provision for these facilities must be included in the finalisation of the SDP.

- All public roads need to be designed to accommodate pedestrian and bicycle movements. Detailed of which can only be more refined upon development and finalisation of a refined master plan SDP.
- There is the possibility of linking the cargo to the rail. However, this will depend on the regional freight movement along the rail network/infrastructure and the type of cargo and its destinations. These discussions will continue with the refinement of the layouts.
- In concept, the site will be separated by primary and secondary roads. A separate one-way system for drop and go's and access to the parkades are envisioned. These routes also need to be linked with dedicated public transport services. Separate access points and circulation will be identified for the supplemental uses.
- The main internal roads would ultimately have two lanes per direction. However, construction could be phased and only a single lane per direction would be required if vehicle demand does not warrant dual carriageways or significant turning movements.
- Controlled access points to restricted areas need to be identified. Space for U-turns in from of any controlled access points should be provided.
- The main road circulating adjacent to the terminals and parking area should include dedicated public transport, e-hailing and passenger vehicle stop and go zones. Details of this can be finalised with refined of the SDP and terminal layout requirements.
- Based on the CTIA parking provision, 1 705 parking bays should be provided for Phase 1 (PAL 1B) based on the projected 2.5 million annual passengers. The parking provision for any future phases of the CWA can established based on actual parking demand based on the 2032 scenario. Provision of parking within the FBO and hanger restricted areas can be based on the projected number of employees, number of hanger spaces and specific tenant requirements.
- The following upgrades are recommended Phase 1 (PAL 1B) of the CWA:

  Lichtenburg Road/Mellish Road:

  - Southbound – Construct a dedicated right-turn lanes and a dedicated left-turn lane.
  - Eastbound – Construct a dedicated left-turn lane.
  - Westbound – Construct a dedicated right-turn lane.
  - Intersection control – Install a traffic signal.

Lichtenburg Road/Koelenhof Road (R304):

- Northbound – Construct a left-turn slip lane and a dedicated right-turn lane.

East-West Link/CWA Access:

- Intersection control – Construct a dual-lane roundabout.

- Development charges (DCs) were estimated for the CWA and future developments in the area to determine the available funds for the proposed upgrading of the road network for the 2050 scenario. When comparing the cost of the road upgrades with the available DCs, there are sufficient funds available to upgrade the road network. It is recommended that the costs of upgrading the road network should be divided and phased among the various developments to ensure that the road network can accommodate their development as they progress. However, the allocation of these funds must be agreed upon with the City of Cape Town.

2024 Existing Traffic Conditions

Upgrades are recommended for Klipheuwel Road/Lichtenburg Road, including the installation of a traffic signal and additional turn lanes, which are expected to improve the LOS to B. Planned future developments and access management plans (AMPs) for Lichtenburg Road (MR213) and Klipheuwel Road (MR188) include changes to intersection configurations and realignments, which are expected to reduce demand at some constrained intersections. Given these future plans, no further upgrades are recommended for the remaining intersections.

2032 Background Traffic Conditions

This increase in traffic will trigger the need for road upgrades, especially along Klipheuwel and Lichtenburg Roads. The proposed upgrades include the dualling of Klipheuwel Road between Brackenfell Boulevard and Lichtenburg Road, the installation of traffic signals at several intersections, and the construction of additional turning lanes. The Klipheuwel Road/Arum Lily Street intersection will be converted to a left-in, left-out (LILO) configuration as part of their access management plan (AMP). With proposed upgrades in place, capacity constraints are expected at some priority-controlled intersections. However, alternative routes via signalised intersections such as Klipheuwel Road/Darwin Road and Lichtenburg Road/Dulah Omar Street will help alleviate traffic congestion.

Proposed Access Phasing:

1. Mellish Road will be the initial connection from Lichtenburg.

2. The East-West link to Klipheuwel Road when Bella Riva constructs this. CWA to engage with Bella Riva landowner/developer to establish if feasible to build Lucullus Road extension and/or the East-West Class 3 road. The East-West Class 3 at this stage is the most likely to come first.

3. The ultimate link will be via the northern extension of Lucullus Road once the EIA approval has been completed by the City of Cape Town. The alignment and road reserve requirements of Lucullus Road bordering the west edge of the site must be confirmed.

2032 Total Traffic Conditions

This scenario assessed the impact of Phase 1 (PAL 1B) of the CWA the realigned Mellish Road access and the East-West link from Bella Riva as a secondary access. The proposed upgrades include the installation of a traffic signal at Lichtenburg Road/Mellish Road and the construction of a dual-lane roundabout at the East-West Link/CWA Access intersection. As with the 2032 Background Traffic Conditions, capacity constraints are expected to continue at the priority-controlled intersections along Klipheuwel and Lichtenburg Roads. However, alternative routes via signalised intersections on Klipheuwel Road/Darwin Road and Lichtenburg Road/Dulah Omar Street will help alleviate congestion.

Additionally, the Klipheuwel Road/Olifantsrivier Avenue intersection is expected to reach capacity during the PM peak hour. This traffic can be redistributed to the Klipheuwel Road/Okavango Road intersection, which has sufficient capacity.

2032 Sensitivity Analysis

A sensitivity analysis was conducted to evaluate the impact of using only the Mellish Road/Lichtenburg Road access for Phase 1 (PAL 1B) of the CWA. The capacity analysis results show that the proposed upgrades in the 2032 Total Traffic Conditions scenario will be sufficient to accommodate the traffic generated by Phase 1 (PAL 1B). Mellish Road is therefore the only access required to accommodate the CWA Phase 1 (PAL 1B) traffic.

It is, however, recommended that the East-West link across Bella Riva Phase 1 be extended to the airport by CWA when the road reserve is available.

2050 Capacity Analysis

The City's EMME model was updated to evaluate the impact of Phase 2 (PAL 4) of the CWA for the 2050 scenario. This update included the total extent of the future developments in the area and assessed the R300 northern extension along with several new road links, including the Darwin Road extension, and the extensions of Lucullus Road and the East-West links. The results indicated that the future road network will be sufficient to accommodate the future developments, including Phase 2 (PAL 4) of the CWA.

The future developments will require several upgrades to be implemented as more than 4 000 peak-hour trips will be added to the road network. The construction of the R300 northern extension, along with new road links such as the Darwin Road extension and extensions of Lucullus Road and the East-West links, is expected to reduce the demand at some of the study intersections. Therefore, it is recommended that the construction of these road links be fast-tracked to ensure that the intersection upgrades are not abortive in the future.

Based on this assessment, it is evident that the impact of the CWA will be relatively low compared to the other future developments in the area. Hence, it is recommended that the airport be approved from a transport point of view, and that an amended TIA be prepared in the future to accommodate changes in intersection upgrades over time.

2.2.13 Climate Change Mitigation:

Wildfires

- Identify infrastructure and areas on site that are vulnerable to wildfire risks.
- Consider wildfire risks in site design and layout planning and fuel management procedures.
- Construct firebreaks in areas vulnerable to wildfires.
- To ensure health and safety of employees, site evacuation and emergency response plans for wildfire events should be implemented.
- Ensure backup power systems are available, should energy supply be disrupted.

Landslides

- Avoid building near steep slopes, close to cliffs or near stream channels and drainage ways.
- Plant ground cover on slopes.
- If the area is prone to landslides, seek professional evaluation of the site as construction plans may need to consider structures for debris flow diversion or retention.
- Ensure multiple transportation routes of entry to and exit from the site in case roadways are damaged.

Water Scarcity

- A water scarcity management plan should be developed to mitigate water scarcity risks.
- The CWA should increase water storage, reduce water use and improve water consumption efficiencies.
- Ensure that multiple potable water sources are available for the site to alternate between should it be required.
- Investigate monitoring and forecasting systems to help predict future periods of drought and enhance preparedness.
- Monitor water consumption during drought periods to prevent compromising water availability.

Extreme Heat

- Keep facilities/buildings cool with efficient use of air-conditioning.
- Consider building designs appropriate for local climate that are conducive to cooling in summer i.e., consider building orientation, natural shading, and ventilation.
- Ensure that equipment and vehicles purchased for use on site can operate under increased ambient temperatures to avoid downtime.
- Investigate early warning/monitoring systems to inform the site of expected heat wave occurrences.
- Ensure health and safety of employees by regularly monitoring hydration levels, avoiding work hours during the hottest part of the day and providing medical attention/resources to those who are vulnerable.

Urban and Riverine Floods

- Ensure that drainage infrastructure is well maintained.
- Ensure infrastructure built on site is resilient to projected flood levels, and that site design and layout planning considers the potential for flooding event on site
- To ensure health and safety of employees, site evacuation and emergency response plans for flooding events should be implemented.
- Ensure backup power systems are available, should energy supply be disrupted.

The project design already includes several mitigation strategies. The CWA aims to be self-sustainable in meeting its energy needs by implementing renewable energy solutions such as Solar PV and a biodigester system. These measures are important for reducing the project's carbon footprint and enhancing sustainability. Further mitigation actions identified in the Climate Change Impact Assessment for consideration are:

- Collaboration with airline partners to facilitate the development and use of sustainable aviation fuels. The airport operation should also support and promote the development and of sustainable aviation fuel and strive for operational efficiencies such as reduced aircraft idling times on runways and taxiways.
- Collaboration with local authorities to optimise public transport to and from the airport. In employee and passenger, the project should promote the use of electric vehicles (electric busses or shuttle services) and collaborate with the government and the transport sector to improve public transportation links to and from the airport. For business travel, the project should prioritise

sustainable travel options and implement carbon offset programs for unavoidable business travel to neutralise the carbon footprint.

- Feeding of excess renewable electricity to the grid
- Designing green buildings with materials of low embedded GHGs, incorporating designs that reduce the need for external heating and cooling
- A waste management system focusing on recycling and/or composting. When developing the waste reduction and management plan, the project developer should consider implementing comprehensive recycling programs for items such as paper, plastic, glass, and metal. Additionally, on-site composting facilities for organic waste disposal should be established, creating job opportunities and promoting sustainability.
- Incorporating mitigation measures, appropriate to the chosen design of the wastewater treatment plant: The design of the wastewater treatment plant should consider best practises for mitigation depending on the technology chosen. i.e., a standard wastewater treatment plant using anaerobic digestion should consider capturing methane generated and use it to provide some of the energy requirements.

2.2.14 Major Hazard Mitigation:

Regarding the secondary containment for the storage and offloading / loading of road tankers, pooling of fuels below the road tankers, from a loss of containment, should be prevented

Regarding the overfilling instrumentation, compliance with IEC61511 should be contemplated.

Hazardous areas should be reviewed by using a detailed Process Hazard Analysis (PHA)1such as a HAZOP study that should be completed to identify potential hazards and suggest further mitigation for safer operations. Due to the seriousness of the hazardous material stored, transported and produced on site, it is suggested that a detailed PHA / HAZOP study should be completed by an independent chairman, who is registered with the Engineering Council of South Africa. Furthermore, any instruments used should incorporate the findings of a SIL assessment defined in IEC 61511.

Ignition sources near the depot must be minimised as far as possible. This is particularly relevant with the fuel storage area.

A hazardous area classification as per SANS 10108 must be developed for all flammable materials. Only suitable instrumentation and electrical equipment should be installed in accordance with the requirement of the code.

The fast detection of a loss of containment with appropriate shut-down action to limit the amount of Jet A-1 and Avgas released, will assist in the reduction of the site risks.

Applicable international best practice production and guidelines or equivalent international recognised codes of good design and practice of installations, must be incorporated in the designs. This implies that best practices would be applied to the design and operation of the proposed site.

IEC 61508/61511 (Safety Instrumented Systems) are codes specifically related to the instrumentation requirements for adequate protection from hazards in chemical plants and applicable for the life cycle of the plant. These codes are aimed at reducing risks to surrounding populations to acceptable levels. Demonstrating compliance with the IEC 61508/11 can be achieved only once full-detailed designs have been completed and is thus premature at this stage in the project.

General:

- Compliance with all statutory requirements, i.e., pressure vessel designs.
- Compliance with applicable SANS codes, i.e., SANS 10087, SANS 10089, SANS 10108, etc.
- Incorporation of applicable guidelines or equivalent international recognised codes of good design and practice into the designs.
- Completion of a recognised process hazard analysis (such as a HAZOP study, FMEA, etc.) on the proposed facility prior to construction to ensure that the design and operational hazards have been identified and adequate mitigation are put in place.
- Full compliance with IEC 61511 (Safety Instrument Systems) standards or equivalent to ensure that adequate protective instrumentation is included in the design and would remain valid for the full life cycle of the tank farm: This is particularly relevant to the overfilling of the storage tanks and applicable shutdown systems. Including demonstration from the designer that sufficient and reliable instrumentation would be specified and installed at the facility.
- Preparation and issuing of a safety document detailing safety and design features reducing the impacts from fires, explosions and flammable atmospheres to the MHI assessment body at the time of the MHI assessment:
    - Including compliance to statutory laws, applicable codes and standards and world's best practice;
    - Including the listing of statutory and non-statutory inspections, giving frequency of inspections;
    - Including the auditing of the built facility against the safety document; and
    - Noting that codes such as IEC 61511 can be used to achieve these requirements.
- Demonstration by CWA or their contractor that the final designs would reduce the risks posed by the installation to internationally acceptable guidelines.

- Signature of all terminal designs by a professional engineer registered in South Africa in accordance with the Professional Engineers Act, who takes responsibility for suitable designs.
- Completion of an emergency preparedness and response document for on-site and off-site scenarios prior to initiating the MHI risk assessment (with input from the local authorities).
- Permission not being granted for increases to the product list or product inventories without redoing part of or the full EIA.
- Final acceptance of the facility risks with an MHI risk assessment that must be completed in accordance with the MHI regulations. Basing such a risk assessment on the final design and including engineering mitigation.

2.2.15 Poultry Mitigation:

- Planting of fast-growing vegetation that does not attract wild birds, and/or a solid wall to screen the section of the poultry farm closest to the construction. The type and extent of barrier to be implemented should be subjected to consultation between the parties, it must align with regulatory guidelines and requirements and it need to achieve the mitigation requirements for dust, noise and lighting impacts. Furthermore, implement the dust mitigation measures during the construction phase: i.e. use of water to settle dust, enforcement of 30km /h speed limits, rerouting traffic away from the farm.
- Adherence to good housekeeping and municipal by laws to address pests.
- Light mitigation: design the road so that light does not shine into poultry sheds, signs requiring that car lights are dipped on the affected section of road, diversion of traffic to an alternative road, barriers that prevent light going into the sheds erected on farms, hood the sources of light, erection of a facility wall which will block some of the light and the use of minimal lighting in the car park area. Avoid scheduling flights after 11pm.
- Noise mitigation: Plant fast growing vegetation that does not attract birds (to muffle noise), construction of facility wall to muffle sound (see recommendation bullet 1 above), schedule arrivals during the daytime, avoid runways closest to the farm (phase 1). Ensure good management when birds are introduced onto the farm and are being habituated to the unaccustomed noise.
- Implement Air Quality Mitigation Measures.
- Implement Hydrogeological Mitigation Measures.
- Isolate the people from the farm and do not allow people access to the farm.
- Avoid creating stagnant pools of water by treating wastewater in closed systems, handle waste according to municipal by laws.

- Handling and disposal of international galley waste must be done in a safe way and with regard to legislation.

2.2.16 General Mitigation and Management Plans:

Implementation of the following Environmental Plans and Guidelines are essential and form part of the CWA EMPr documentation.

Table 11: Summary of Environmental Plans and Guidelines associated with the CWA EMPr.

PLAN	NEMA APPROVAL	APPROVAL TIMELINE & AUTHORITY (S)	COPIES REQUIRED
VeldFire Management Plan	Approved as part of EMPr (Annexure 5)	Issuing of EA, DEA&DP	N/A
Alien Vegetation Management Plan	Approved as part of EMPr (Annexure 6)	Issuing of EA, DEA&DP	N/A
Wetland Offset Study & Implementation Plan	Approved as part of EMPr (Annexure 7)	Issuing of EA, DEA&DP **Additional:** DWS approval required as part of WULA	N/A
Waste Management Plan	Approved as part of EMPr (Annexure 8)	Issuing of EA, DEA&DP **Additional:** DEA&DP: 90 days prior to the construction of the WMF a NEM: WA Registration form will be submitted	N/A
Concept Landscaping Plan	Concept approved as part of EIA (Annexure 9)	Issuing of EA, DEA&DP **Additional:** Final approval COCT ito Planning Applications (Landscape Guideline & Master Landscape Plan)	DEA&DP, Pre-Operations **Copy of the *Landscape Guidelines & Master Landscape Plan* to be included in Annexure 9 of the EMPr**
Stormwater Management Plan	Approved as part of EMPr (Annexure 10)	Issuing of EA, DEA&DP **Additional:** Final approval COCT ito Planning Applications	**Updated Copy to be included in Annexure 10 of the EMPr.**
Wildlife Hazard Management Plan	Condition of EA (to be compiled)	Issuing of EA, DEA&DP **Additional:** Input from SACAA	DEA&DP, Pre-Operations

			Copy to replace Annexure 11 of the EMPr.
Emergency Preparedness & Response Plan	Condition of EA (to be compiled)	Issuing of EA, DEA&DP **Additional:** Input from SACAA	DEA&DP, Pre-Operations **Insert as Annexure 12 of the EMPr.**
Architectural/ Urban Design Guidelines	Concept approved as part of EIA (Annexure 13)	Issuing of EA, DEA&DP **Additional:** Final approval COCT ito Planning Applications	**Updated Urban Design Guidelines to replace Annexure 13 of the EMPr.**
Outdoor Signage Guidelines / Master Plan	Concept approved as part of EIA (Annexure 14)	Issuing of EA, DEA&DP **Additional:** Final approval COCT ito Planning Applications (Outdoor Signage Master Plan)	**Copy of the *Outdoor Signage Master Plan* to replace Annexure 14 of the EMPr.**
Environmental Awareness Plan	Approved as part of EMPr (Annexure 15)	Issuing of EA, DEA&DP	N/A
Maintenance Management Plan	Approved as part of EMPr (Annexure 16)	Issuing of EA, DEA&DP	N/A
Biodiversity Offset Management Plan	Condition of EA (to be compiled)	Issuing of EA, DEA&DP **Additional:** Input from Cape Nature & CoCT	DEA&DP, 6months post construction Biodiversity Offset incl. as Annexure 18 of the EMPr.
Groundwater Management Plan	Condition of the WULA (to be compiled)	Issuing of WULA, DWS	DEA&DP & DWS Pre Operations Insert as Annexure 17 of the EMPr.
Noise Mitigation and Management Plan (NMMP)	Condition of EA (to be compiled)	Issuing of EA, DEA&DP **Additional:** Input DEA&DP (AQ), SACAA & CoCT	DEA&DP & CoCT, Pre-Operations Insert as Annexure 19 of the EMPr.
Social Engagement Plan	(to be compiled)	Enforced through the approval of the EMPr	DEA&DP Pre-Construction

Refer to Annexure 3B: Environmental Sensitivities Map.

SECTION 3: KEY STAKEHOLDERS

The successful implementation of this EMPr is a collective effort and responsibility of the key stakeholders who perform different functions but with a common goal. Below is a diagrammatic representation of the organisational structure showing the relationships among the key stakeholders. Descriptions of the key individuals with environmental responsibilities are described in the following paragraphs. The role players include:

- Regulatory Authority (s) e.g. DEA&DP, DEA&DP: Waste Management, CoCT, DWS etc.
- The Applicant: Capewinelands Aero (Pty) Ltd
- The CWA Environmental Management Division (EMD) & Environmental Manager (EM)
- Environmental Control Officer (ECO)
- Resident Engineer (RE)
- Contractor (s) (Sub-contractors & Service Providers)
- Specialist Support
- Environmental Auditor

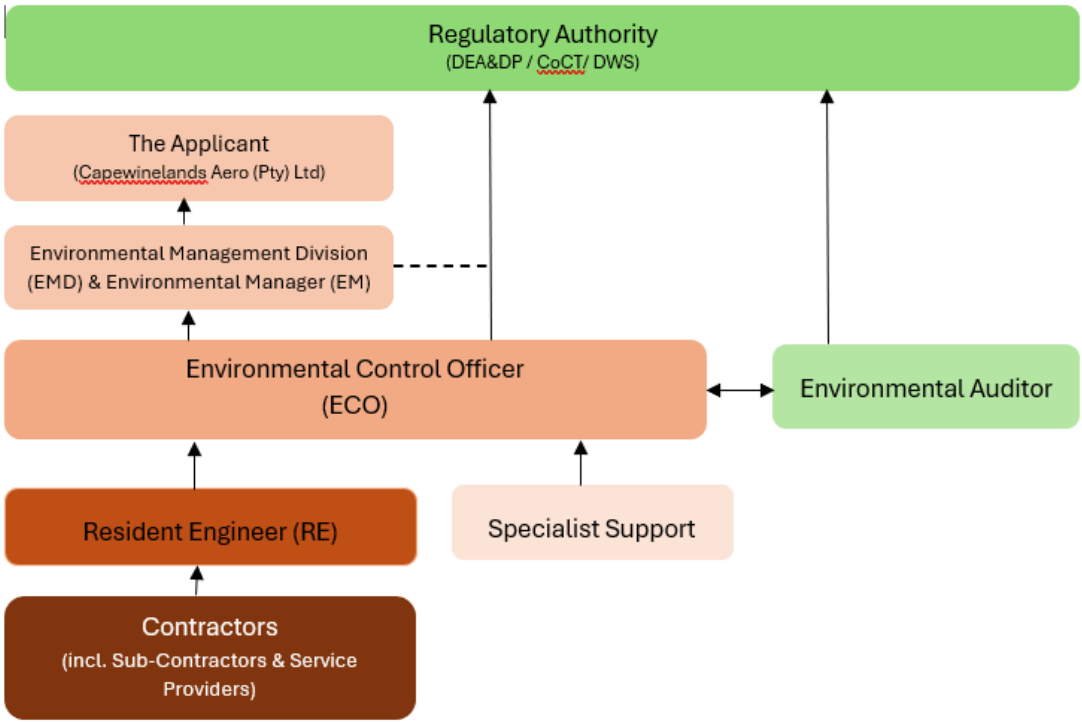


Figure 28: Diagram of the Key-Stakeholders.

3.1 Regulatory Authority

DEA&DP is the competent or lead authority in this instance. This Directorate has overall responsibility for ensuring that the Applicant complies with the conditions of its EA as well as this EMPr once approved. During the construction and operational phases of the EMPr the regulatory authorities will have the following roles to play:

- The authorities may perform random controls to check compliance.
- Review Monitoring and Audit reports, if required.
- Whenever necessary, the authorities are to aid in understanding and meeting the specified requirements.
- Recommend suitable corrective measures are undertaken by the Applicant where non-compliance has been reported.
- Enforcing compliance by the Applicant.

Various other Authorities would be involved to monitor the compliance to the Environmental Authorisation, Licenses, and Permits issued i.e. BOCMA (Breede-Olifants CMA) is the competent authority, which is administered by DWS, in terms of the WUL. The CoCT will be the competent authority in terms of the Atmospheric Emission Licence (AEL) when the AEL is applied for in approx. 2037.

3.2 The Applicant: Capewinelands Aero (Pty) Ltd

The Holder of the EA (e.g. the Applicant) is accountable for the potential impacts of the activities that are undertaken and is responsible for managing these impacts, both in the construction and operational phases. The Applicant therefore has overall and total environmental responsibility to ensure that the EMPr is implemented and that both the EMPr and the EA are complied with, at all times. The Applicant is also responsible for ensuring that all other environmental related legislation is complied with (i.e. NWA, NHRA, NEM: WA, NEM: AQA etc). The Applicant is responsible for the development and implementation of the conditions of the EA in terms of the planning and design of the development and construction thereof.

Amongst the general responsibilities above the Applicant is also responsible for:

- Appointing an Environmental Manager (EM) who will head the Environmental Management Division.
- Appointing an ECO (externally during construction and inhouse during operations), and where required an environmental auditor.
- Establish and maintain an on the ground multi-tasked conservation management team.
- Take the necessary action in terms of non-compliances.

- Ensuring that all the Applicant's, staff, representatives, contractors, consultants and any other agent operating under the employ of the Applicant comply with the EA.
- Considering the ECO's observations and recommendations and acting where required.

3.3 The CWA Environmental Management Division (EMD) & Environmental Manager (EM)

The CWA **Environmental Management Division (EMD)** will be established at the start of construction to ensure environmental compliance throughout the project (Construction and Operational Phases). The CWA EMD will appoint an **Environmental Manager (EM)** to oversee all aspects of the Environmental Management on site. The EM is responsible for ensuring that the organisation meets its environmental policy commitments and improves its environmental performance. Not only do they monitor performance and ensure compliance with relevant laws and regulatory requirements, but they are also proactive in identifying and promoting opportunities to reduce the environmental impact of the organisation's activities, products and services. All decisions regarding environmental procedures and protocol must be approved by the Environmental Manager, who also has the authority to stop any construction activity in contravention of the EMPr.

Led by an Environmental Manager, the CWA EMD will consist of several teams e.g. landscaping, waste management, alien species control, rehabilitation, conservation of off-set sites and fire management etc. During operations these teams will be managed on the ground by the inhouse ECO. During the initial phases it could be one multitask team to be split as the tasks increase. Each team will have a Team Leader reporting directly to the inhouse ECO during operations, and EM during construction. The Environmental Manager will oversee the implementation of EMPr compliance with regulations, day-to-day environmental management of the site, managing the necessary applications, and overseeing external service providers such as the appointed Environmental Control Officer (ECO) during construction. Responsibilities also include internal audits and developing strategies for waste minimization and emissions reduction.

The EM needs to adhere to the following:

- Support the ECO in the monitoring and execution of the Contractors or Sub-contractors' Method Statements by maintaining a permanent presence onsite and offsite.
- Ensure compliance with the wetland off-set requirements on the agricultural precinct and the management of the terrestrial off-set site during the construction and operation phases of the development.
- Ensure compliance with the Maintenance Management Plan (Annexure 16).
- During the construction phase manage the in-house multi-task conservation management team. During operation oversee the in house ECO's role as manager of the team.
- Inspect the site and surrounds as required to ensure adherence to the management actions of the EMPr and the Method Statements.

- Provide inputs to the regular (eg. monthly) environmental reports to be prepared by the ECO.
- Liaise with the construction team on issues related to implementation of, and compliance with, the EMPr.
- Maintain a record of environmental incidents (spills, impacts, legal transgressions etc) as well as corrective and preventive actions taken, for submission to the Applicant.
- Maintain public complaints register in which all complaints are recorded, as well as action taken, for submission to the Applicant. To minimise the probability of negative community responses, a competent staff member should be appointed at the beginning of the construction and operational phases, to be responsible for handling any complaints or concerns received by any I&AP's (and any other affected neighbours).

3.4 Environmental Control Officer (ECO)

A suitably qualified individual will be designated to fulfil the role of Environmental Control Officer (ECO). The ECO is responsible for overseeing and verifying the proper execution of the EMPr during the construction and operational phase. This includes ensuring that various contractors working on-site comply with the EMPr within their designated areas. During the construction phase, an independent Environmental Assessment Practitioner (EAP) firm must be appointed to serve as the ECO who will work alongside the EM. Once the project transitions fully into the operational phase, this function can be managed by an in-house ECO within the CWA Environmental Management Division who will report to the EM. During the construction, monthly ECO reports must be prepared and submitted to the Department of Environmental Affairs and Development Planning (DEADP) and to the EM during operations.

The role of the ECO is essentially seen as an interactive one which commences on the day the construction phase starts and will last for the duration of the construction phase. During construction the ECO will be expected to be on site once a week during bulk earthworks thereafter every second week during construction. During operations the in house ECO will be a permanent appointment. The ECO should have appropriate training and experience in the implementation of environmental management specifications.

The responsibilities of the ECO during the construction and operational phase of the project will include:

- To environmentally educate and raise the awareness of the Contractors and their staff as to the sensitivity of the site and to target responsible individuals as key players for environmental education, to facilitate the spread of the correct environmental attitude during the contract work.
- To review method statements and to determine the most environmentally sensitive options of modus operandi for the development tasks.
- To oversee the implementation of environmental procedures set out in this document.
- To attend site contractor's and report on environmental issues.

- To maintain an open and direct channel of communication with the RE, who will be immediately aware of the actions of the ECO at all times, especially as they relate to implementation policy and corrective actions as detailed in this document.
- To take immediate action on site where clearly defined no-go areas are violated, or in danger of being violated.
- To keep an up-to-date record of works on site, as they relate to environmental issues.
- To be contactable by the public regarding matters of environmental concern as they relate to the development.
- Liaison with in-house multitask conservation management teams in terms of Alien Clearing, Fire Management, Wetland and Biodiversity Rehabilitation, Waste Management, Off-set Management & implementation etc. established in terms of the EMD.
- Liaison with Specialist Support teams in case of emergency.
- Report to the regulating authority of any major incidents.
- Liaison between the Applicant/ EM, Contractors, authorities and other lead stakeholders on all environmental concerns.
- Compilation and administration of an environmental monitoring plan to ensure that the environmental management measures are implemented and are effective.
- Monitoring the performance of the Contractor (and Sub-contractors) and ensuring compliance with the EMPr and associated Method Statements.
- Checking the EMs record of environmental incidents (spills, impacts, legal transgressions etc) as well as corrective and preventive actions taken.
- Checking the EMs public complaints register in which all complaints are recorded, as well as action taken.
- Issuing of site instructions to the Contractor for corrective actions required.
- Assisting in the resolution of conflicts.
- Maintenance, update and review of the EMPr. Communication of all modifications to the EMPs to the relevant stakeholders.
- Conducting regular audits to ensure that the system for implementing the EMPr is operating effectively.

3.5 Resident Engineer (RE)

The engineers, where applicable, are responsible for physically carrying certain development and maintenance activities. The responsibilities of the engineers and contractors include but are not limited to the following:

- Be conversant with the EMPr, any relevant Environmental Authorisation, WUL or any other legally binding documentation;
- Have a responsibility to adhere to any conditions and recommendations laid out in above mentioned documentation;
- Prevent actions that may cause harm to the environment;
- Be responsible for any remedial activities in response to an environmental incident;
- Review and amend any construction activities to align with the EMPr and Best Practice Principles; and
- Ensure compliance of all site personnel and / or visitors to the EMPr and any other authorisations.

3.6 Contractors (Sub-Contractors & Service Providers)

The Contractors, where applicable, are responsible for physically carrying out certain development and maintenance activities. The Contractor or Sub-contractors will be required, where specified, to provide Method Statements setting out in detail how the management actions contained in an EMPr will be implemented in order to ensure that the environmental management objectives are achieved. If separate Method Statements are provided by different Sub-contractors, these may need to be consolidated by the Contractor in order to ensure consistency and optimize overall environmental performance and use of resources. The Method Statements must be reviewed and approved by the EM / ECO.

The responsibilities of the contractors (or sub-contractors) include but are not limited to the following:

- Be conversant with the EMPr, any relevant Environmental Authorisation, WUL or any other legally binding documentation;
- Have a responsibility to adhere to any conditions and recommendations laid out in above mentioned documentation;
- Prevent actions that may cause harm to the environment;
- Be responsible for any remedial activities in response to an environmental incident;
- Review and amend any construction activities to align with the EMPr and Best Practice Principles;
- Ensure compliance of all site personnel and / or visitors to the EMPr and any other authorisations;
- Develop and improve Method Statements other specialist procedures;

- Ensure all sub-contractors are sensitised regarding their environmental obligations;
- Monitor compliance of the sub-contractors to the EMPr; and
- Liaison with the EM, ECO and Resident Engineer.

3.7 Specialist Support

The EM / ECO will liaison with a number of Specialists and Specialist Support teams internally to train and manage aspects such as Alien Clearing, Fire Management, Wetland and Biodiversity Rehabilitation, Waste Management, Off-sets etc. with the in-house multitask conservation management team. However, Specialist support can also be external in the form of required auditing or emergency specialists as and when required. They would:

- Attend to any major spills or environmental incidents that may occur on site;
- Assist with specialist input regarding the Sensitive Areas etc; and
- Keep records of all incidents attended to on file etc.

3.8 Environmental Auditor

Where required by the EA an environmental auditor will be appointed by the Applicant. The auditor will be an independent environmental consultant. The auditor will carry out a compliance audit based on the EA and of all of the activities being undertaken.

Audits are to be undertaken biannually during the construction phase.

Audits are to be undertaken annually during the operational phase.

SECTION 4: IMPACT MANAGEMENT OUTCOMES AND ACTIONS

This section includes a description of proposed impact management actions, identifying the manner in which the impact management outcomes will be achieved and, where applicable, include actions to avoid, modify, remedy, control or stop any action, activity or process which causes pollution or environmental degradation & comply with any prescribed environmental management standards or practices.

4.1 Design Management Plan

4.1.1 Guidelines required for the overall development

It is recommended that the first Site Development Plan (SDP) to be submitted to the City of Cape Town Municipality for approval must trigger the requirement for the following to be submitted for approval at the same time:

An Urban Design Guidelines document, to govern all architectural development within the CWA throughout all future phases, needs to be compiled as follows:

It must include all standard chapters appropriate to the scale and complexity of the CWA development and must demonstrate compliance with all the relevant appliable legal frameworks, policies and By-Laws.

It must establish measures for the CWA to internally oversee the enforcement of and compliance with the Urban Design Guidelines.

It should include the following aspects (which should provide detailed textual and image-based precedent or examples of both inclusions and exclusions to clarify design intent):

- Guidelines for Fencing, Walls, Entrances and Boundary interfaces;
- Lighting guidelines; and
- Materials and finishes guidelines.

A *Master Landscape Plan (that supersedes the current Draft Overall Landscape Concept Plan) showing the landscaping development within the CWA throughout all future phases. This plan must include:*

Enlarged Landscape Plans demonstrating design responses along the various development edges. As noted elsewhere, visual & aesthetic sensitivities vary depending on the development edge, as do design informants such as access control, security and lighting needs, distance of buildings from property boundary and the like.

- Particular attention is required for areas that have a public interface (such as the southern and western property boundaries).
- Valuable view corridors and existing vistas should be enhanced and celebrated by any development proposal (refer to Figure 28 below).

- The enlarged plans should demonstrate the feasibility of the proposed tree lines along fences and roads in terms of the location of irrigation, fencing and underground services, as well as their spatial relationship to SUDS structures.

A Tree Management Strategy for the management of existing trees to be retained.

- Existing landscape patterns are important to conserving landscape character, sense of place and maintaining the inherent VAC of the subject site. The project team is therefore strongly advised to avoid the removal of any additional vegetation (especially established tree avenues and mature copses).

- The Tree Management Strategy is to be preceded by a comprehensive Tree Survey (quantitative and qualitative) of all existing trees on site showing trees to be retained or removed, to be approved by the relevant City of Cape Town officials the before construction (i.e. the removal of existing trees) may commence.

A Tree plan (which includes a site-wide, phased tree planting strategy).

A high-level Irrigation Proposal/Plan:

- It must demonstrate integration with the approved Stormwater management plan.

- It must show all relevant high-level design decision making regarding the provision of irrigation water to soft landscaping and trees. Ideally supported by high-level water demand calculations with irrigation sources specified and quantified (i.e. borehole, rainwater harvesting etc.).

- The adequate and timely provision of water is crucial to the successful establishment and ongoing maintenance of trees and screening planting. The Irrigation Proposal/Plan must demonstrate that the establishment and maintenance of any landscaping (including trees) that perform a screening or direct mitigatory role will be possible and feasible given the volume of irrigation water available (as per the water demand calculations).

A Fencing, Walls, Entrances and Boundary interface plan for the various portions of the development's external perimeter.

A *Landscape phasing plan and implementation strategy*, showing the connection between the phasing of the overall development and the proposed development/implementation of the landscape.

- This plan and implementation strategy must link all proposed landscaping to the development of roads, buildings, precincts, erven or zones; to ensure that the proposed landscaping is implemented concurrently to the development of said roads, buildings, precincts, erven or zones.

- An establishment period of 24 months (and no less than 12 months) is recommended.

- Compliance with the completion schedule for landscape areas shall be enforced through Section 100 Conditions of Approval in terms of the City of Cape Town Municipal Planning By-law (MPBL) (2015).

- The timing of landscape installation:

    - The soft landscaping along all public road verges (and especially trees that play a role in screening the development from the R312) must be specified in the first SDP to be submitted and implemented along with the first phase of the development, and as early in the construction process as possible or feasible.

    - All other trees must be planted along with their associated phases, and as early in the construction process as possible. This phased tree planting strategy is the substance of the *Tree plan* and then executed through the *Landscape phasing plan and implementation strategy* discussed in Section "*4.1.1 Guidelines required for the overall development"* below.

    - The implication of the above recommendation is that the irrigation system design, supply, powering and storage of irrigation water must be developed and functional to the point that it will be able to supply sufficient irrigation water to the newly installed trees at the time of their installation (during Phase 1 and/or whenever a new phase of the proposed development is implemented along with its landscape and trees).

    - The design team (Landscape Architect and/or Engineer) must therefore provide the CA with sufficient detail to demonstrate that the irrigation requirements for proposed trees will be met through rainwater harvesting, borehole supply or similar; and storage capacity must be indicated on the appropriate Landscape Plans. Ideally, the stormwater attenuation ponds should be integrated into the system of rainwater storage and re-use for irrigation purposes.

Lighting Report:

An Overall Lighting Report should be prepared at SDP stage by a suitably qualified electrical engineer, to be submitted to the City of Cape Town for comment and approval.

- The purpose of this report would be to provide an accurate demonstration sketch of the illumination conditions (individual and cumulative) generated by the various light sources within the CWA development that would result in light pollution.

- The report should include the relevant luminaire data, scenes, charts and renderings to illustrate expected illuminance, colour temperatures, light trespass, controls and proposals for the control of backlight, uplight, and glare; and the development's contribution to skyglow.

Compliance with the International Dark Sky Association's (IDA) relevant Criteria should be called for to manage lighting impacts of the proposed development, given proximity to current and future residential areas in addition to the surrounding scenic resources and sensitive receptors.

A **Landscape Guidelines** document to provide a standard and framework for, and govern all landscape architectural development within the CWA throughout all future phases. This must include:

A Landscape Design motivation section, with emphasis on explaining the Landscape Architect's approach to ensuring responsiveness to the scenic and landscape context of the subject site within the Receiving Environment (sense of fit, protection of and contribution to landscape character, sensitive receptors, screening at key points, enhancement of views etc.).

Visual & aesthetic sensitivities vary depending on the development edge, as do design informants such as access control, security and lighting needs, distance of buildings from property boundary and the like. The Landscape Guidelines document must include a set of typical section details for each development edge.

- The section details must illustrate and/or demonstrate architectural responses to the various different site and boundary interface conditions, as well as contextual (visual) informants of relevance.
- The section details should provide further detail regarding type and materials of fencing/boundary treatments, as well as proposed planting, lighting and signage strategies/limitations where relevant, and NGL interaction with SUDS structures etc. where relevant.

Soft and hard landscaping guidelines and specifications (incl. species, materials inclusions and exclusions etc.).

Tree planting guidelines and specifications must be included.

A Landscape management and maintenance strategy and guidelines for implemented landscapes and for areas not earmarked for development (i.e. areas within the Agricultural Precinct, and undeveloped areas within the Airport Airside Precinct). This should include (but are not limited to):

- An Alien Vegetation Management Plan;
- Rehabilitation and Revegetation Guidelines; and
- Hydroseeding Guidelines and protocols for the planting of embankments to stabilize soil.

4.1.2 Plans and Guidelines required to accompany all future Site Development Plans

It is recommended that the City of Cape Town considers imposing the following conditions in terms of Section 100 of the MPBL. All future Site Development Plans within the CWA development that are to be submitted to the Municipality for approval must contain / be accompanied by the following:

A Detailed Landscape Plan (SDP-level appropriate) prepared by a suitably qualified Landscape Architect.

The Landscape Plan must be generally consistent with the with the Master Landscape Plan, the Master Landscape Guidelines, and the recommendations of this report.

The Landscape Plan must indicate which proposed trees function as mitigatory elements (screening, softening, absorbing, greening) especially from views within the surrounding cultural landscapes.

A detailed **Fencing** proposal

The fencing proposal must ensure appropriate design of road verges, stormwater structures, fences etc. which should be in character with the natural or rural surroundings (as per the Heritage and Scenic Resource: Inventory and Policy Framework, 2003).

This requirement is for boundary fencing and public interfaces specifically - internal fencing is not a concern from a visual impact management point of view.

It is paramount that all fencing must comply with aviation safety and security requirements. Within this priority, however, cognizance should be taken of visual sensitivities as far as possible.

Detailed Irrigation specifications must be included in all landscape proposals at SDP level.

Refer to the '*Tree specification and irrigation design guidelines'* under Section *4.16 Landscape* below

A detailed **Signage** proposal.

It is noted here that a Signage Plan should be developed and submitted to the City of Cape Town for approval under the Outdoor Advertising and Signage Policy and By-law. To ensure continuity with the recommendation of this report as well as responsiveness to visual indicators and sensitivities, the following is recommended:

The signage proposal should demonstrate that signage has been designed in such a way that the sensitivities of the adjacent Cultural Landscape and the relevant Scenic Routes have been (a) taken into consideration, and (b) that design responses have been included in the design proposal in a positive way. The signage proposal should include:

- Graphic renderings or 3D models showing the location of proposed signage in context, showing height, mounting details, signage type and proposed content.
- Please note that the category "signage" should include branding, logos and lettering on building facades and boundary walls.

A detailed **Lighting** proposal

For all outdoor lighting, façade lighting (if any), street lighting and security lighting – i.e., all light sources that would be visible from within the Receiving Environment. The lighting proposal must demonstrate that lighting design has been undertaken in such a way that the sensitivities of the adjacent Cultural Landscape and the relevant Scenic Routes have been (a) taken into consideration, and (b) that design responses have been included in the design proposal in a positive way. The lighting proposal should include:

- A consolidated lighting layout showing the location of all sources of light.
- The lighting proposal should include basic technical/specification details for all sources of light.
- The information provided should enable:
    - the visual specialist to properly scope and model/simulate visible light sources (if necessary); and
    - the CA and/or the visual specialist to make an informed decision regarding the acceptability of light impacts at night.

4.1.3 Specific Mitigation required to accompany particular Site Development Plans

Certain areas within (or aspects of) the proposed CWA development require particular attention in response to contextual informants or their proposals must be accompanied by additional information or further visual specialist input at a later stage of design development.

Lighting Audit:

A lighting audit must be conducted by the ECO (or a suitably qualified sub-contractor working on behalf of the ECO) at the end of each Construction phase, to ensure that all lighting related mitigation measures are adhered to and successfully implemented.

Area of Agricultural Significance:

The majority of the Services Precinct and the entirety of the Airport Airside Precinct are located within an Area of Agricultural Significance. The northernmost portions of the subject site fall within the Agterpaarl/Paardeberg Cultural Landscape. Local policy dictates that visual cluttering of the landscape by non-agricultural development must be managed. The following applies to buildings (and associated structures such as the ATCT) that are facing and/or visible from the R304 and the Agter-Paarl Paardeberg Cultural Landscape within the Zone of Visual Influence:

- Building facades and the surfaces of structures may not be illuminated; may not have any signage, lettering, logos or advertising (illuminated or otherwise) mounted upon them.
- Buildings and structures must be designed to be visually recessive in materials/finishes, colour, form and massing.
- Buildings and structures must be designed to be sympathetic to the rural Agricultural landscape character in their design and architectural expression.
- If aviation safety requirements are in conflict with any of the above recommendations, these conflicts should be highlighted in the SDP phase so that the City of Cape Town officials may fully understand the visual/scenic implications of non-discretionary proposals and determine if adjustments to other

aspects, or indirect mitigatory offsets are required to absorb or reduce unmitigable direct visual impacts.

Scenic Routes:

Visual impacts along Scenic routes are generally managed using visual buffer zones with setbacks and height restrictions. The following development parameters are recommended at Conditions of Approval to be considered by the City of Cape Town in the MPBL application:

- Apply a 20m visual buffer zone offset from the R312 Lichtenburg Road scenic Route within which no buildings may be placed.
- Enforce a 100m Signage "buffer zone" along the R312. No 1st Party signage, 3rd Party signage, billboards, outdoor advertising and (specifically) no illuminated or digital signage should be permitted within 100m of the property boundary adjacent to the R312.
    - Standard Provincial road signage within the road verge indicating the location of the entrance to the Cape Winelands Airport is acceptable.
    - 1st Party Signage may be permitted at the entrance to the CWA at the discretion of the CoCT.
- Apply a 9m Height control restriction along the R312 Scenic Route.

Zone 1: The Services Precinct

While there is little or no discretion in terms of the essential structures required for aviation within the Services Precinct, the development proposal must still be responsive to visual sensitivities and informants in terms of landscape proposals; architectural design, materials and finishes; and aspects such as fencing, lighting and signage etc.

- The SDP for the Services Precinct must therefore include simulations / realistic visual renderings of proposed buildings (and associated structures such as the ATCT) that are visible from the R304 and the Agter-Paarl Paardeberg Cultural Landscape within the Zone of Visual Influence.
- This is to ensure that the City of Cape Town is enabled to have sufficient insight should the recommendations in 7.3.1 (c) ii above be adopted during the MPBL application.

Zone 3: The General Aviation Precinct:

The SDP for the General Aviation Precinct must include simulations / realistic visual renderings of proposed buildings that are visible from the R312, as well as the location of the possible future Greenville Garden City residents. This is to ensure that the City of Cape Town is enabled to anticipate and manage potential visual impacts associated with the Lichtenburg Road scenic route and surrounding sensitive receptors during future statutory processes. The following should be avoided within 30m of the R312:

- Building facades and the surfaces of structures may not be illuminated.

- Buildings and structures must be designed to be visually recessive in materials/finishes, colour, form and massing.

- Buildings and structures must be designed to be sympathetic to the current landscape character of the Receiving Environment in their design and architectural expression, so as to retain some of the elements of a rural agricultural sense of place.

- Renderings should include landscaping proposals (preferably illustrated at maturity).

- If aviation safety requirements are in conflict with any of the above recommendations, these conflicts should be highlighted in the SDP phase so that the City of Cape Town officials may fully understand the visual/scenic implications of non-discretionary proposals and determine if adjustments to other aspects, or indirect mitigatory offsets are required to absorb or reduce unmitigable direct visual impacts.

The SDP for the General Aviation Precinct must be accompanied by detailed Landscape Plans that include:

- The entire scenic route envelope of the R312 Lichtenburg Road verge, and showing the landscape proposals within the 20m and 100m buffer zones, where applicable. The guidelines and policies of the City of Cape Town's MSDF must be consulted, as well as the Scenic Drive Network Management Policy, the Heritage and Scenic Resource: Inventory and Policy Framework for the Western Cape, Urban Design Policy, Outdoor Advertising Bylaw and all relevant considerations within the Northern District SDF Development Guidelines for further guidance.

- The western edge of the General Aviation Precinct and the south western corner of the Airport Terminal Precinct, showing landscape proposals to address concerns regarding the possible impacts of lighting on the adjacent poultry breeding facilities. This plan should include road verges, boundary interfaces, soft landscaping and proposed outdoor and street lighting as key information on plan.

A Visual Statement prepared by a suitably qualified specialist consultant may be called for at the discretion of the City of Cape Town during the SDP application phase. The aim of this input would be to ensure that visual impacts are managed as priority in the detailed design development in future planning & approval phases; and to determine if the impact assessment findings of this report are affected.

The Airport Airside Precinct:

While there is little or no discretion in terms of the essential structures required for aviation within the Airport Airside Precinct, the development proposal must still be responsive to visual sensitivities and informants in terms of landscape proposals; architectural design, materials and finishes; and aspects such as fencing, lighting and signage etc.

- The SDP for the Airport Airside Precinct must therefore include simulations / realistic visual renderings of proposed buildings (and associated structures such as the ATCT) that are visible from

the R304, the possible future Greenville Garden City residents and the Agter-Paarl Paardeberg Cultural Landscape within the Zone of Visual Influence.

- This is to ensure that the City of Cape Town is enabled to have sufficient insight should the recommendations in 7.3.1 (c) ii above be adopted during the MPBL application.

The SDP for the Airport Airside Precinct must be accompanied by detailed Landscape Plans that include the entire scenic route envelope of the R312 Lichtenburg Road verge, and showing the landscape proposals within the 20m and 100m buffer zones.

- The guidelines and policies of the City of Cape Town's MSDF must be consulted, as well as the Scenic Drive Network Management Policy, the Heritage and Scenic Resource: Inventory and Policy Framework for the Western Cape, Urban Design Policy, Outdoor Advertising Bylaw and all relevant considerations within the Northern District SDF Development Guidelines for further guidance.

The Agricultural Precinct:

- The Agricultural Precinct must be considered a "No-Go" area in terms of development. Therefore, no further development should be allowed within the Agricultural Precinct.

- Existing landscape patterns are important to conserving landscape character, sense of place and maintaining the inherent VAC of the subject site.

    - No further removal of existing vegetation (with the exception of alien invasive species) should be permitted within the Agricultural Precinct.

    - The Tree Survey and Tree Plan must motivate for the removal of existing trees within Zone 1-3, and existing trees should be retained wherever possible (especially those that contribute to the characteristic landscape patterns of the surrounding Cultural landscapes). This is to ensure that windbreaks, avenues, copses and place-defining or gateway planting is not needlessly destroyed by new development.

Outdoor Signage & Advertising:

Outdoor signage and (especially) outdoor advertising must be kept to a minimum throughout the development. This is especially important to protect the R312 Scenic Route's view corridor, the remnant Landscape Character of the Receiving Environment, and the views of sensitive viewers within the Cultural Landscapes and travelling on the scenic Routes surrounding the subject site.

- The 1st Party Sign at the entrance to the Cape Winelands Airport must adhere to the Principles and Placement contained in the CWA Outdoor Advertising Guidelines for 1st Party Signage (which are generally supported form a Visual Impact management point of view).

- 3rd Party Outdoor Advertising Signage should be restricted along the perimeter of the property boundaries, and should not be permitted if visible from within the surrounding Cultural Landscapes or from Scenic Routes.
- No outdoor signage or 3rd Party Outdoor Advertising Signage should be allowed to be erected along any of the edges of the Airport Airside Precinct, or anywhere within the Agricultural Precinct (i.e., within view of the R304 or the R312).
- No outdoor signage or 3rd Party Outdoor Advertising Signage (including freestanding outdoor billboards and digital screens) should be allowed within the 20m Visual buffer zone or within the 100m Signage buffer zone along the 312.
- No 3rd Part advertising signage should be visible from the R312 Gateway point. Signage on building facades must be sensitively placed and sized to cater for views within the proposed development.
    - No 3rd Party Outdoor Advertising Signage should be allowed on building facades visible from the R312 or R304.
    - No signage or lettering on building facades should be legible to viewers located outside of the Foreground Distance zone of the sign (i.e., signage should not be particularly noticeable for viewers located more than +-800m away.).
    - Refer to Figure 29: Graphic illustrating view cones and corridors (VIA, 2025).

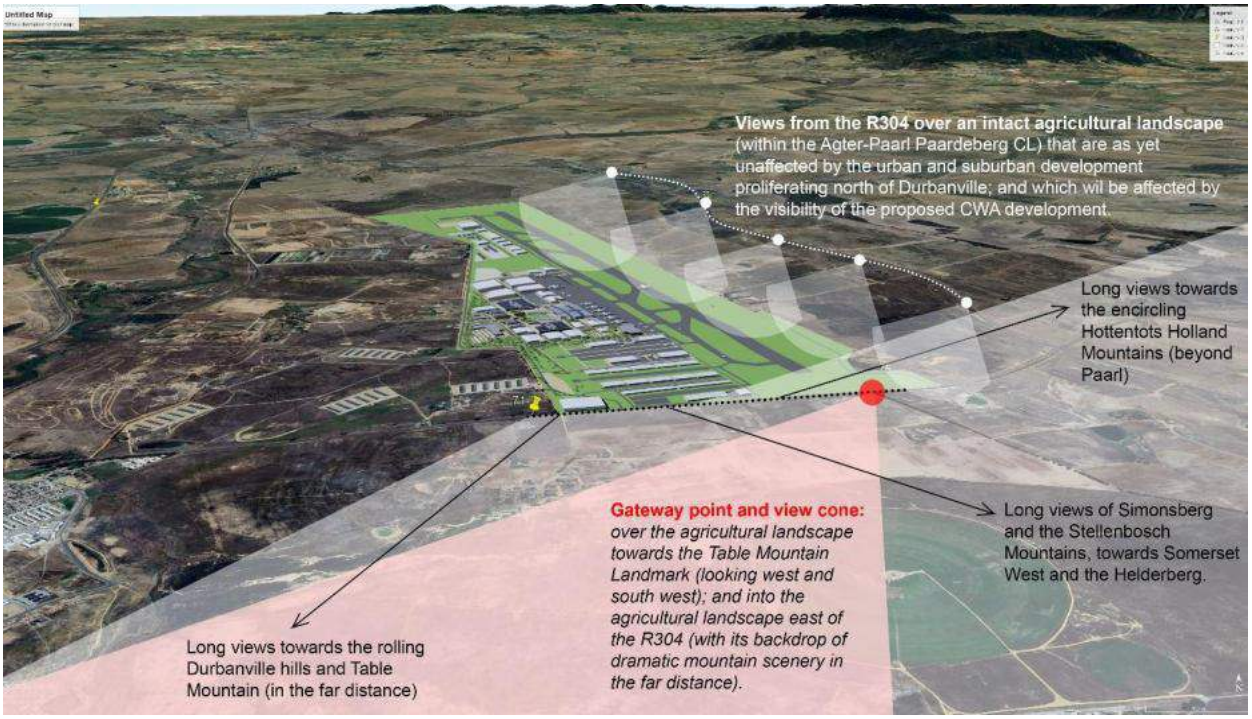


Figure 29: Graphic illustrating view cones and corridors (VIA, 2025).

Unless unavoidable for aviation safety reasons, no "always-on" security flood lights, naked or exposed peripheral/boundary lighting or uncovered luminaires of any kind should be visible from **public roads, the scenic routes, surrounding residential areas or the Cultural Landscapes that surround the site**.

4.1.4 Lighting (General, Outdoor and Sources of Light)

Light pollution should be kept to an absolute minimum throughout the development, and exterior lighting must be limited to areas where this is necessary for utility, safety and security.

In principle, lighting in the development should:

- Only be on when needed for active use;
- Only light the area that needs it;
- Be no brighter than necessary;
- Minimize blue light emissions;
- Be fully shielded (pointing downward) as far as possible.

In some cases, lighting for safety purposes will necessarily take priority, and lighting impacts may therefore be unavoidable. The negative impacts of night lighting should be mitigated in the following ways:

- Install light fixtures that provide precisely directed illumination to reduce light "spillage" beyond the immediate surrounds of the light source, including interior or undercover lighting sources.
- Façade lighting to be limited to accents and features, avoiding large parts of the exterior of buildings to be lit from any side, but especially not the facades facing the R312 scenic route, nearby homes and any of the Cultural Landscapes surrounding.
- Pedestrian pathways, parking areas and vehicular roads should be lit with low level 'bollard' type lights or post lights (maximum 3m tall) that are fully shielded (pointing downward). Fully shielded fixtures minimize skyglow, glare and light trespass.
- Security lighting should be activated on movement as far as possible.
- **The 6m perimeter lighting proposed to encircle the development periphery is not supported.**
- All Future SDP plans must include a lighting proposal.
- Light emitting diodes ("LEDs") are appropriate for outdoor lighting. If it is necessary to use white light, low-color-temperature LED lighting should be used on the condition that the brightness can be dimmed when they aren't needed for active use (for example: to light empty parking lots etc.)

- Because blue light brightens the night sky more than any other color of light (International Dark Sky Association, 2021), it's important to minimize the amount emitted. The proposed development should use warm light sources (lower color temperatures) for outdoor lighting: a maximum of 3000 Kelvins is recommended.

- It may not be possible for parts of the proposed development to adhere to the above mitigation measures in every part of the development, given the specialized lighting that would be necessary at an airport.

  This risk can be managed through the submission of the detailed Lighting proposal at SDP stage. This will allow the CA and/or the visual specialist and/or the electrical engineer preparing the Lighting Report to be provided with sufficient information during the future approvals process so that visual impacts associated with the direct and indirect visibility of lighting can be avoided, reduced or mitigated wherever possible when this detailed information is available.

4.1.5 Materials and Finishes

Roof and facade materials must be neither bright nor light. The appropriate colour range is achieved by increasing the shade (black) and tone (grey) of the desired colour palette. This darkens the original hue while making the chosen color appear more subtle and less intense.

- All roof material finishes should be located on the cool colour spectrum (e.g. the hues of blue, charcoal, grey, green etc.) and should be visually recessive.

- All façade material finishes should be visually recessive, and contrast minimally with roof material finishes.

- White, cream, beige and similarly light colours are not appropriate for roofs and facades.

The use of a range of colours within an approved palette (to be determined as part of the Architectural Guidelines) is recommended for roof and facade materials and finishes. This prevents the development from appearing as a solid and/or overly uniform roofscape typical of newly established developments, especially from views at a higher elevation.

Where tenants or future potential developers within the various precincts of the CWA require the specification of bright colours in line with their branding (which are often on the warm colour spectrum) on exterior portions of buildings, the following:

- These areas must not cover more than 25% of the building façade.

- The placement of these portions of allowable colour must be located sensitively so as not to negatively affect views from the surrounding cultural Landscapes and scenic routes.

- Roof colour should always conform to the overall material palette of the rest of the development, to ensure that views from higher elevations experience a measure of uniformity in the roofscape, within a range of appropriate colours.

4.1.6 Landscape

The following measures should be used to assess the compliance of the future Master Landscape Plan and SDP Landscape Plans and Guidelines called for:

Future revisions of the Landscape Concept Plan (and/or the subsequent Master or Detailed Landscape Plans) should not propose significantly fewer trees to be planted than what was approved at EIA/MPBL stage. No more than 15% of the total number of proposed trees to be planted may be removed from the development's landscape proposal in future iterations.

Tree avenues are an appropriate screening and scaling tool to be used within the proposed development, and the Landscape Architect/s must select a variety of species carefully to ensure that there is a measure of continuity within the soft landscaping of the proposed development with the planting patterns of the receiving environment.

Establish new tree avenues with suitable species to enhance cultural landscape features lost through the development to reinforce or replace traditional patterns of planting where appropriate with suitable species.

Screening with trees and soft landscaping (especially on public road verges) should include areas of higher density (where it is necessary to break up the bulk and mass or horizontality of the buildings, limit the visual impact of signage, or screen views into parking lots and back of house areas), as well as areas where tree planting may be less dense (to allow view corridors and glimpses into the proposed development).

The following Tree specification and irrigation design guidelines must be adopted and displayed on all future Landscape Plans:

- The landscape establishment phase (i.e., the time period after which a Landscape Contractor is employed to maintain and monitor a newly installed landscape after practical completion) must not be less than 24 months in duration.
- The irrigation supply of trees should be maintained consistently throughout the year (i.e.; during the establishment period, as well as on a permanent basis after establishment, and during the operational phase of the development).
- Soil moisture content in the root ball must be consistent, i.e., trees may not be allowed to dry out during the Western Cape summer months or become waterlogged during the wet winter months. This requires rainfall responsive irrigation source and supply design, as well as adjustable irrigation supply management technologies.
- Irrigation design must provide dedicated lines for the irrigation of trees, and these dedicated lines must be programmed to supply water to trees on their own regime.

- Slower, more frequent soaking watering regimes should be preferred for trees over large quantities infrequently over short periods of time.
- The recommended guideline for watering trees is a minimum of 40 – 50L per week.
- A very important aspect of the watering regime is consistency. Once planted, the irrigation cycle should not be allowed to cease (in the summer months especially), and the irrigation regime must maintain a +-7-day cycle at the least.
- Soil samples must be taken prior to the specification and design of the irrigation system and the tree holes to ensure that soil conditioning is responsive to site-specific conditions.
- If the soil is at all sandy, it is strongly recommended that Zeoplant moisture retention granules or a similar product is specified to reduce fluctuations in the soil moisture content of the root balls of trees.
- The root balls of trees must also receive adequate aeration, and compaction of root zones must be avoided.
- Trees in the parking lots will experience far more extreme growing conditions than those on the road verges, and cannot be expected to offer significant screening functionality. Nevertheless, they must receive the same treatment as that of the trees on road verges or within the open landscape.
- The Landscape Architect must therefore ensure that trees in parking lots are given adequate space, irrigation, aeration and soil conditioning to ensure their survival and successful establishment.

The CA should not allow any further development to encroach on the Agricultural Areas of Significance or the Agter-Paarl Paardeberg Cultural Landscape east or north of the subject site. The preservation and enhancement of the remainder of the subject site as untransformed farmland will serve to offset the visual intrusion along this eastern edge somewhat by maintaining the landscape as a container for the proposed development.

It is recommended that the remainder of the Agricultural Precinct retains its agricultural land uses, and should be actively farmed, if possible, to maintain its agricultural character.

4.1.7 Fencing, Walls and Boundary interfaces

The proposed development must comply with the Boundary Walls and Fences Policy of the City of Cape Town, 2009 in all respects. Other policy relating to fencing and boundary treatment are the Heritage and Scenic Resource: Inventory and Policy Framework for the Western Cape (Respect the landscape setting and gateway qualities of scenic routes by ensuring appropriate design of road verges and fences); and the Western Cape Land Use Planning Guidelines for Rural Areas, 2019.

- Boundary walls, fencing and gateways should be in keeping generally with a visually neutral architectural character, designed simply, and remain visually permeable as far as possible.

- High, solid or palisade-type walling, and any form of precast panel type fencing is inappropriate and should be avoided.
- Where security fencing is required, it should be screened with trees or hedging.

4.1.8 Outdoor Signage

The subject site is located within and alongside areas of maximum control in terms of the Outdoor Advertising and Signage Policy of the City of Cape Town, 2013; and the Outdoor Advertising and Signage By Law (No. 10518, 2001). Enforcement of the By Law and Policy guidelines are especially important to reduce the impact of possibly inappropriate signage along the Scenic Routes. According to the Policy, the City will encourage creative locality bound signs which are sensitive to natural and Cultural Landscapes in non-urban settings.

- *In general, the development proposal (including all future SDP plans to be submitted) must comply with the Outdoor Advertising and Signage Policy and By-law in all respects.*
- *Specifically, the development proposal (including all future SDP plans to be submitted) must demonstrate that all outdoor advertising signs and other signage (external advertising, direction signs and/or outdoor display) do not impact negatively on visual corridors, Cultural Landscapes and Scenic Routes.*
- *No signage, lettering or outdoor advertising (within the proposed development or on the perimeter) may be installed higher than the average building height, or the overall height restriction for the development, whichever is the lesser.* ***The illuminated 1st party logo sign proposed to be mounted on the ATC tower is not supported.***

4.1.9 Fuel Storage and Distribution:

Tanks must be double walled / "jacketed" i.e., possessing secondary containment to prevent tank content to release into surrounding soil and groundwater. The underground storage tank must have an internal leak detection monitoring system between the two walls to monitor for product leakage.

Fuel lines and sumps must be secondary contained where lines are joined.

The filling station must include the following design measures:

Fuel Containment Area

The containment slab must be graded to drain a catch-pit that is connected to discharge to the stormwater system via an oil separator while the surrounding paved surface areas must be graded to ensure rainwater runoff to the stormwater system. No washing in this area is allowed.

Forecourt Area

The forecourt area must be provided with its own set of catch pits that is connected to discharge to the sewer via a separate oil separator, the underground storage tanks and the fuel lines cannot be interconnected. The surface area of the forecourt must be graded to the abovementioned catch pits while the surrounding surface area graded to drain rainwater to the stormwater system. Washing of the forecourt surface is allowed in this instance.

Additionally, the following mitigation is required which is associated with petrol filling station Underground Storage Tank (UST) and pipework installations (applicable for the construction and operation phase):

National Standards

All containment manholes must be regularly inspected as part of the normal management procedures at the service station.

The installation of Underground Storage Tanks (UST's) and associated pipework must be implemented in accordance with the relevant South African National Standards (SANS), specifically (not exclusive to) the following standards:

a) SANS 10089-3 (2010) (English): The petroleum industry Part 3: The installation, modification, and decommissioning of underground storage tanks, pumps/dispensers and pipework at service

b) stations and consumer installations.

c) SANS 10 400TT (Fire Protection) 53 Sections 1-6 (The application of the National Building Regulations-Installation of Liquid Fuel Dispensing Pumps and Tanks);

d) SANS 10087-3 (2008) (English): The handling, storage, distribution and maintenance of liquefied petroleum gas in domestic, commercial, and industrial installations Part 3: Liquefied petroleum gas installations involving storage vessels of individual water capacity exceeding 500L.

The installation of the UST's and associated pipework must comply with the National Building Regulations and Standards Act No. 103 of 1977.

The installation must comply with local authority bylaws and all procedures and equipment used must be in accordance with the Occupational Health & Safety Act (No. 85 of 1993).

Upon completion of the UST installation, an engineer is to inspect and verify that the tanks and the associated infrastructure have been installed as per the [approved] design criteria and to all required SABS/SANS standards and applicable legislation. A report thereafter, based on the engineer's findings, is to be submitted to the DEA&DP Land Management and Pollution Directorates for inspection and the City of Cape Town Municipality.

Any repair work required is to be conducted according to SABS 1535 (Glass-reinforced polyester-coated steel tanks, including jacketed tanks, for the underground storage of hydrocarbons and oxygenated solvents and intended for burial horizontally).

Installation of Underground Storage Tanks

The USTs must be reliable in the event of heavy rains and flooding. UST manholes shall be impermeable and resistant to fuel, they shall consist of a heavy-duty cast-iron cover, which shall prevent damage from surface traffic.

Construction of a reinforced concrete slab over the USTs, its thickness and strength are to be determined by a qualified Engineer.

The filler point and tank must be fitted with overfill protection. The critical level should be such that a space remains in the tank to accommodate the delivery hose volume (2%). Earthing and snap tight quick coupling is to be provided for loading of materials into tanks to minimise the risk of fires and prevent spillage and loss of materials.

The USTs are to be fitted with a tank containment sump, fitted on top of the tank and a dispenser containment to be provided for loading of materials into tanks to minimise the risk of fires and prevent spillage and loss of materials; and sump must be provided, fitted underneath the dispenser as containment. A Filler spill containment must also be provided for remote filler containment purposes.

The excavation must be protected against the ingress of surface run off water and is to be kept reasonably free of sub-surface water by pumping out if necessary.

The excavation must be lined with a HDPE liner or a suitable layer to prevent infiltration of product to the groundwater should a spill or leak occur (an impermeable liner).

The UST is to be inspected before installation for damage, including factures or damage to coating work.

Leak and pressure tests must be conducted on tanks and pipelines to ensure integrity prior to operation and the inspection authority must issue pressure test certificates.

The UST must be buried 750mm below finished ground level in accordance with SANS 10089-3.

The local Fire Department must be informed two (2) working days before installation commences and to be called for inspection at the following stages:

a) Installation of tank on clean sand bed before backfilling

b) Witness pressure test (delivery lines 1000kPa, tank 35kPa); and

c) Inspection of slab over tank before concreting.

Pipework

Installation of associated pipe work. This shall include the installation of internationally approved non-corrosive pipework systems. All underground piping is to be Petrotechniks UPP Extra piping (nylon lined, 10 bar rated). Nextube Kableflex sleeving (oil industry green with a smooth internal bore) to be used as secondary containment. This is to limit the possibility of pipe failure due to corrosion; this being the most common cause of pipe failure before this system was introduced to South Africa.

All pipeline connections are to be housed within impermeable containment chambers. A leak detector on all submersible pumps that automatically checks the integrity of the pipework on the pressure side of the pump must be provided. Pipelines must not retain product after use and no joints are to be made underground. An emergency shut-off valve must be supplied between the supply pipeline and dispenser inlet. All pipes (vent, filler and delivery) are to slope back to the USTs so that fuel does not remain in the pipes.

Vent pipes to be fitted with "Fulcrum" vertical vent roses, or an approved equally equivalent market product replacement, that conforms to these standards. Confirmation of filler point and vent position to be made by an approved Engineer for safety distances required.

Vent pipes above ground are to be galvanised mild steel and are to be at least 1000mm above the roof height and away from any doors, windows, chimney openings and other sources of ignition; and the tank product lines must be pressure tested prior to commissioning.

Forecourt Dispensing Area

Installation of pump islands in the forecourt area. The pumps are to be fitted with a Spill Containment Chamber. No compounds containing to PFCs are to be used on site.

Construction of a concrete bunded reinforced graded slab over the forecourt area, with positive falls towards a centrally located catch-pit/sump. The slabs thickness and strength are to be determined by a qualified Engineer. The centrally located catch-pit/sump shall drain into a pollution containment chamber i.e., an approved oil/water separator system. Once the wash water has passed through the system, the separated oil must be collected regularly by an approved waste contractor and removed to an approved hazardous waste disposal facility.

4.1.10 Major Hazard Installations:

- Secondary containment for the storage and offloading / loading of road tankers has been described. However, pooling of fuels below the road tankers, from a loss of containment, should be prevented
- Overfilling instrumentation has been described. However, compliance with IEC61511 should be contemplated.

- Hazardous areas should be reviewed by using a detailed Process Hazard Analysis (PHA)1such as a HAZOP study that should be completed to identify potential hazards and suggest further mitigation for safer operations. Due to the seriousness of the hazardous material stored, transported and produced on site, it is suggested that a detailed PHA / HAZOP study should be completed by an independent chairman, who is registered with the Engineering Council of South Africa. Furthermore, any instruments used should incorporate the findings of a SIL assessment defined in IEC 61511.
- Ignition sources near the depot must be minimised as far as possible. This is particularly relevant with the fuel storage area.
- A hazardous area classification as per SANS 10108 must be developed for all flammable materials. Only suitable instrumentation and electrical equipment should be installed in accordance with the requirement of the code.
- The fast detection of a loss of containment with appropriate shut-down action to limit the amount of Jet A-1 and Avgas released, will assist in the reduction of the site risks.
- Applicable international best practice production and guidelines or equivalent international recognised codes of good design and practice of installations, must be incorporated in the designs. This implies that best practices would be applied to the design and operation of the proposed site.
- IEC 61508/61511 (Safety Instrumented Systems) are codes specifically related to the instrumentation requirements for adequate protection from hazards in chemical plants and applicable for the life cycle of the plant. These codes are aimed at reducing risks to surrounding populations to acceptable levels. Demonstrating compliance with the IEC 61508/11 can be achieved only once full-detailed designs have been completed and is thus premature at this stage in the project.
- Compliance with all statutory requirements, i.e., pressure vessel designs.
- Compliance with applicable SANS codes, i.e., SANS 10087, SANS 10089, SANS 10108, etc.
- Incorporation of applicable guidelines or equivalent international recognised codes of good design and practice into the designs.
- Completion of a recognised process hazard analysis (such as a HAZOP study, FMEA, etc.) on the proposed facility prior to construction to ensure that the design and operational hazards have been identified and adequate mitigation are put in place.
- Full compliance with IEC 61511 (Safety Instrument Systems) standards or equivalent to ensure that adequate protective instrumentation is included in the design and would remain valid for the full life cycle of the tank farm: This is particularly relevant to the overfilling of the storage tanks and applicable shutdown systems. Including demonstration from the designer that sufficient and reliable instrumentation would be specified and installed at the facility.

- Preparation and issuing of a safety document detailing safety and design features reducing the impacts from fires, explosions and flammable atmospheres to the MHI assessment body at the time of the MHI assessment:
  - Including compliance to statutory laws, applicable codes and standards and world's best practice;
  - Including the listing of statutory and non-statutory inspections, giving frequency of inspections;
  - Including the auditing of the built facility against the safety document; and
  - Noting that codes such as IEC 61511 can be used to achieve these requirements.
- Demonstration by CWA or their contractor that the final designs would reduce the risks posed by the installation to internationally acceptable guidelines;
- Signature of all terminal designs by a professional engineer registered in South Africa in accordance with the Professional Engineers Act, who takes responsibility for suitable designs;
- Completion of an emergency preparedness and response document for on-site and off-site scenarios prior to initiating the MHI risk assessment (with input from the local authorities);
- Permission not being granted for increases to the product list or product inventories without redoing part of or the full EIA.
- Final acceptance of the facility risks with an MHI risk assessment that must be completed in accordance with the MHI regulations:
  - Basing such a risk assessment on the final design and including engineering mitigation.

4.1.11 Traffic:

Based on the estimated trip generation and multiple access points, single-lane roads with dedicated turning lanes should be able to accommodate the vehicle demand. However, it is suggested that multi-lane roads be constructed for the main public circulation route for more ideal vehicular flow. The planning of road reserve will make allowance for dualling when necessary.

Public transport services should be scoped to link the CWA with planned and existing services. Bus stops should be provided near the terminal buildings. Once the Fisantekraal commuter rail service is in operation, a shuttle service between the CWA and the rail station should be established. Such service will be demand driven and phased with the future development of the CWA. All public roads need to be designed to accommodate pedestrian and bicycle movements. While the details of public transport facilities for the CWA will be finalised at a later stage, provision for these facilities must be included in the finalisation of the SDP.

There is the possibility of linking the cargo to the rail. However, this will depend on the regional freight movement along the rail network/infrastructure and the type of cargo and its destinations. These discussions will continue with the refinement of the layouts.

In concept, the site will be separated by primary and secondary roads. A separate one-way system for drop and go's and access to the parkades are envisioned. These routes also need to be linked with dedicated public transport services. Separate access points and circulation will be identified for the supplemental uses.

The main internal roads would ultimately have two lanes per direction. However, construction could be phased and only a single lane per direction would be required if vehicle demand does not warrant dual carriageways or significant turning movements.

Controlled access points to restricted areas need to be identified. Space for U-turns in from of any controlled access points should be provided.

The main road circulating adjacent to the terminals and parking area should include dedicated public transport, e-hailing and passenger vehicle stop and go zones. Details of this can be finalised with refined of the SDP and terminal layout requirements.

Based on the CTIA parking provision, 1 705 parking bays should be provided for Phase 1 (PAL 1B) based on the projected 2.5 million annual passengers. The parking provision for any future phases of the CWA can established based on actual parking demand based on the 2032 scenario. Provision of parking within the FBO and hanger restricted areas can be based on the projected number of employees, number of hanger spaces and specific tenant requirements.

The following upgrades are recommended Phase 1 (PAL 1B) of the CWA:

Lichtenburg Road/Mellish Road:

- Southbound – Construct a dedicated right-turn lanes and a dedicated left-turn lane.
- Eastbound – Construct a dedicated left-turn lane.
- Westbound – Construct a dedicated right-turn lane.
- Intersection control – Install a traffic signal.

Lichtenburg Road/Koelenhof Road (R304):

- Northbound – Construct a left-turn slip lane and a dedicated right-turn lane.

East-West Link/CWA Access:

- Intersection control – Construct a dual-lane roundabout.

Development charges (DCs) were estimated for the CWA and future developments in the area to determine the available funds for the proposed upgrading of the road network for the 2050 scenario. When comparing

the cost of the road upgrades with the available DCs, there are sufficient funds available to upgrade the road network. It is recommended that the costs of upgrading the road network should be divided and phased among the various developments to ensure that the road network can accommodate their development as they progress. However, the allocation of these funds must be agreed upon with the City of Cape Town.

2032 Background Traffic Conditions

This increase in traffic will trigger the need for road upgrades, especially along Klipheuwel and Lichtenburg Roads. The proposed upgrades include the dualling of Klipheuwel Road between Brackenfell Boulevard and Lichtenburg Road, the installation of traffic signals at several intersections, and the construction of additional turning lanes. The Klipheuwel Road/Arum Lily Street intersection will be converted to a left-in, left-out (LILO) configuration as part of their access management plan (AMP). With proposed upgrades in place, capacity constraints are expected at some priority-controlled intersections. However, alternative routes via signalised intersections such as Klipheuwel Road/Darwin Road and Lichtenburg Road/Dulah Omar Street will help alleviate traffic congestion.

Proposed Access Phasing:

4. Mellish Road will be the initial connection from Lichtenburg.
5. The East-West link to Klipheuwel Road when Bella Riva constructs this. CWA to engage with Bella Riva landowner/developer to establish if feasible to build Lucullus Road extension and/or the East-West Class 3 road. The East-West Class 3 at this stage is the most likely to come first.
6. The ultimate link will be via the northern extension of Lucullus Road once the EIA approval has been completed by the City of Cape Town. The alignment and road reserve requirements of Lucullus Road bordering the west edge of the site must be confirmed.

2032 Total Traffic Conditions

This scenario assessed the impact of Phase 1 (PAL 1B) of the CWA the realigned Mellish Road access and the East-West link from Bella Riva as a secondary access. The proposed upgrades include the installation of a traffic signal at Lichtenburg Road/Mellish Road and the construction of a dual-lane roundabout at the East-West Link/CWA Access intersection. As with the 2032 Background Traffic Conditions, capacity constraints are expected to continue at the priority-controlled intersections along Klipheuwel and Lichtenburg Roads. However, alternative routes via signalised intersections on Klipheuwel Road/Darwin Road and Lichtenburg Road/Dulah Omar Street will help alleviate congestion.

Additionally, the Klipheuwel Road/Olifantsrivier Avenue intersection is expected to reach capacity during the PM peak hour. This traffic can be redistributed to the Klipheuwel Road/Okavango Road intersection, which has sufficient capacity.

2032 Sensitivity Analysis

A sensitivity analysis was conducted to evaluate the impact of using only the Mellish Road/Lichtenburg Road access for Phase 1 (PAL 1B) of the CWA. The capacity analysis results show that the proposed upgrades in the 2032 Total Traffic Conditions scenario will be sufficient to accommodate the traffic generated by Phase 1 (PAL 1B). Mellish Road is therefore the only access required to accommodate the CWA Phase 1 (PAL 1B) traffic.

It is, however, recommended that the East-West link across Bella Riva Phase 1 be extended to the airport by CWA when the road reserve is available.

2050 Capacity Analysis

The City's EMME model was updated to evaluate the impact of Phase 2 (PAL 4) of the CWA for the 2050 scenario. This update included the total extent of the future developments in the area and assessed the R300 northern extension along with several new road links, including the Darwin Road extension, and the extensions of Lucullus Road and the East-West links. The results indicated that the future road network will be sufficient to accommodate the future developments, including Phase 2 (PAL 4) of the CWA.

The future developments will require several upgrades to be implemented as more than 4 000 peak-hour trips will be added to the road network. The construction of the R300 northern extension, along with new road links such as the Darwin Road extension and extensions of Lucullus Road and the East-West links, is expected to reduce the demand at some of the study intersections. Therefore, it is recommended that the construction of these road links be fast-tracked to ensure that the intersection upgrades are not abortive in the future.

Based on this assessment, it is evident that the impact of the CWA will be relatively low compared to the other future developments in the area. Hence, it is recommended that the airport be approved from a transport point of view, and that an amended TIA be prepared in the future to accommodate changes in intersection upgrades over time.

4.1.12 Waste, Water & Energy Guidelines

During the lifespan of human habitation people generally waste on a daily basis. Examples of additional wastage are excessive electricity consumption for lighting and air-conditioning and excessive water usage.

A. Water Measures

The following Water Efficiency Measures will be implemented:

- Ensure that only water efficient devices such as low-flow taps, low-flow showerheads, washing machines and dishwashers are used.
- Ensure that all toilets are low volume (9.5litres or less), with dual-flush or multi-flush.

- Ensure that outbuildings and outside taps and showers are fitted with metering tap buttons, which have set timers to prevent taps being left on or dripping.
- Design the layout of the plumbing system to avoid long pipe runs between the geyser and supply points.
- Reduce hard surfacing to encourage rainwater to seep back into the ground.
- Design paved areas so that water run-off is slowed down and where possible use soak-aways and permeable paving that allows water to filter into the ground.
- Ensure that the optimum pipe size and water pressure is used. A pressure reducing valve can be installed at a point nearest to where the supply enters the building to ensure that all water supplies in the building are balanced.
- Ensure all buildings are harvesting rainwater and encourage the re-use of grey water where appropriate. However, ensure that the local ecological system is not polluted and that it is managed correctly.
- To keep the volume of polluted water to be disposed of to a minimum, stormwater should not be mixed with greywater (e.g. from showers, sinks, washing machines etc.).
- Ensure the use of indigenous planting and efficient irrigation methods, such as drip irrigation.

B. Energy Efficiency

Reducing the energy consumption of a building not only saves the environment but will also save on the running costs of the building. By designing energy efficient or renewable energy options into a building, the demand for electricity during peak consumption times is reduced. The following Energy Efficiency Measures will be implemented:

- All buildings are to be built in accordance with the "*NHBRC Guidelines for Building an Energy Efficient Home*".
- Install properly insulated ceilings.
- Place and size windows to make optimal use of natural light, winter heating and ventilation without creating draughts, or gaining too much heat in summer or losing heat in winter.
- Use air conditioners with a seasonal energy efficiency ratio of 10 or more (ratio of the seasonal energy output to the seasonal energy input).
- Ensure that the building is constructed so as to be tightly sealed, to prevent unwanted air flows. Doors and windows must be appropriately sized and fitted with seals.
- Energy efficient electrical installations must be used.

- Ensure that artificial lighting is designed so that light is focused where necessary, such as brighter areas where tasks are being performed and more ambient light elsewhere.
- Avoid the use of outdoor 'up-lighting' to reduce light pollution.
- Ensure that energy efficient light bulbs, such as CFLs or LEDs, are used.
- Reduce the electrical energy used to heat water by installation of solar water heaters, or at least geyser blankets, pipe insulation and a geyser timer.

The Design Philosophy for all electrical services is described and defined as follows:

1. The site and facilities housed should be self-sustaining in terms of renewable energy sources and resources.
2. All designs to provide for energy efficient systems and solutions using minimum amount of electrical energy consumption. This will be completed in consultation and coordination with the Project Architects and Mechanical Engineering teams. The systems and solutions employed will be in accordance with Green Star SA (or International Equivalent if required) in accordance with recommended Best Practice/Lowest Emissions. This will routinely deliver energy savings more than 40% in total consumption.
3. Notwithstanding the above, given the critical/aircraft safety/site-security requirements of the airport and supporting aircraft management systems, the electrical systems must include multiple redundant sources of power, including diesel generator plant and uninterruptible-power-supplies.
4. The integration of the various power sources and loads onto a localized micro-grid- system is required to ensure maximum utilization of renewable sources, minimum diesel fuel consumption, and minimum overall electrical energy consumption, especially for non-renewable sources.
5. Lighting systems to include latest generation, high-efficacy LED lighting using ambient light and occupancy sensing to minimize lights-ON time.
6. The inclusion and incorporation of electric vehicle and aircraft charging to be integrated (in future) with bulk mains sustainable and non-sustainable electrical supply sources and systems.
7. The design of all electrical systems and services to be completed in accordance with best-practice, latest generation Green Building Standards Green Star Certifications.

C. Waste

Methods to reduce, reuse and recycle waste need to be encouraged through all aspects of the development:

- Aim for and promote Zero Waste in the planning, operation, management and maintenance of a building. Zero Waste emulates the closed loop processes found in nature, taking a 'cradle –to –cradle' approach to designing products and buildings.

- Separation@Source (S@S) is key! S@S generally refers to the practice of setting aside post-consumer waste materials at household, commercial and industrial level, from a generally mixed waste stream through the use of a split bag system (e.g. a wet/dry two-bag system (recyclable /non-recyclable). In the case of the Airport, S@S would relate to separate bins provided at each waste source which would then be collected and transported to the Waste Management Facility.

- Build waste avoidance into the process at a design phase, by specifying products and materials that have less wasteful production processes and don't create wasteful emissions during construction and maintenance of a building.

- If waste is created, consider how this can firstly be re-used and then recycled to recover the value invested in these materials, rather than losing this value when the resource is dumped in a landfill or incinerated.

- Facilitate the separation of waste at the source for composting, re-use and recycling when designing waste management systems. People should be encouraged to recycle their household waste.

- Material used during construction or in the life-cycle of the project should be focused on renewable and recyclable elements:

    - Select building materials for durability to minimise maintenance or replacement;

    - Use standard materials to increase the potential for re-use and re-cycling;

    - Materials should be sourced locally where possible; and

    - Use recycled material where possible.

The **Waste Management Plan (Annexure 8)** must be strictly adhered too.

4.1.13 Noise Design Considerations:

Encourage airport compatible land-use planning via:

- establishing compatible land use (such as industrial and commercial) to be located around airport facilities; and

- directing incompatible land use (such as houses and schools) away from the airport environs and the runway alignments.

4.1.14 Poultry Biosecurity Design Considerations:

Plant fast-growing vegetation (that does not attract wild birds) and/or erect a solid wall to screen the section of the poultry farm closest to the construction area. The type and extent of barrier to be implemented should be subjected to consultation between the parties, it must align with regulatory guidelines and requirements, and it needs to achieve the mitigation requirements for dust, noise and lighting impacts.

Lighting: design the road so that light does not shine into poultry sheds, erect signs requiring that car lights are dipped on the affected section of road, barriers that prevent light from going into the sheds can be erected on farms, hood the sources of light, erection of a facility wall which will block some of the light and the use of minimal lighting in the car park area.

4.2 Pre-Construction Management Plan

The pre-construction or planning management plan is to be used as a guide during the planning, design and detailing of the development activity.

4.2.1 General Requirements:

A. Contractual Communication Procedures on Site

One book will be kept on site for the purposes of recording on-site instructions and as a general record of environmental issues. The book will consist of three sections:

Environmental Site Instruction Section

The Environmental Site Instruction Section will be used for the recording of general site instructions relating to the protection of environmentally sensitive or potentially impacted areas or features on the site, by the ECO.

Site Diary Section

The purpose of this section will be to record the comments of the ECO as they relate to activities on the site, any problems encountered, or comments or complaints received from the public about works from the site.

Monitoring Section

The purpose of this section will be to record the comments of the ECO during Construction (and Maintenance) during the life cycle of project.

This book is to remain on site at all times and is to be made available for monitoring purposes by the competent / local authority as required.

B. Communication/Contractual Network

There is to be continual communication between the Applicant/ Site Manager, Engineers, Contractors/ Sub-Contractors, and the ECO. The ECO will advise all on factors relating to the EMPr and all environmental matters on site.

The ECO is empowered to order the Contractor immediately to cease any activities or operations that are required to be stopped as a matter of urgency to prevent serious adverse environmental impacts or potential impacts on the site or any of the adjacent properties or areas outside the boundaries of the site. The ECO shall without delay report any such actions to the Competent Authority. The suspension will be enforced until corrective action has been taken, with no extension of time for such delays. In such a case, all costs are to be borne by the Contractor.

A Communication Strategy that address directly and indirectly affected residents and surrounding landowners, with specific reference to activities, timelines and intended impacts related to the construction

phase and all related activities associated with the implementation of the project (i.e. during the operational phase).

Objectives: To orientate, generate awareness and gain positive attitudes among stakeholders as far as possible; and to engage and inform stakeholders of progress regarding all phases of construction.

Target audience: Property owners and users of the land portions directly surrounding the proposed activity; and other stakeholders and property owners that may be affected.

Major types of messages:

- Inform directly affected residents on the periphery of the development site and others that would frequent the area;
- The commencement date for construction activities related to the project;
- Duration and extent of the construction activities and details of individual construction activities;
- Progress updates, including any delays in a construction-related activity; and
- Introduce appropriate signage to warn persons frequenting the area and those residing adjacent to the development area.

C. Method Statement Format

For any activity the Contractor is requested to submit a method statement (MS) for comment by the ECO/Site Manager. The method statement must provide a step-by-step plan (which may include a schematic diagram etc.) to inform the responsible person (s) on the process and actions to take in a sequential and logical manner, which aims to reduce the impact of undertaking the activity within a reasonable timeframe and cost. The format should clearly indicate the following:

- **What:** a brief description of the work to be undertaken;
- **How:** a detailed description of the process of work, methods and materials;
- **Where:** a description/sketch map of the locality of work; and
- **When:** the sequencing of actions with due commencement dates and completion date estimates.

The Contractor must submit the method statement to the ECO prior to the start of any construction activity. Work may not commence until the comments of the environmental site manager (EM)/waste (environmental) control officer ECO have been received and taken into consideration, and the EM and ECO approved the method statement for implementation on site.

D. Programming of Construction Events

The ECO must be supplied with a detailed program of all construction events to allow for proper monitoring and planning on site. Any amendments to the program of construction events for any reason must be forwarded to the ECO.

E. Bylaws and Regulations

All national and provincial laws and regulations, as well as all local authority bylaws and regulations which apply to the development of this site are to be adhered to.

Heritage:

Application to HWC will need to be made for the demolition of the two heritage buildings falling within the footprint of the proposed development (Figure 16 above).

Signage:

The subject site is located within and alongside areas of maximum control in terms of the Outdoor Advertising and Signage Policy of the City of Cape Town, 2013; and the Outdoor Advertising and Signage By Law (No. 10518, 2001). In general, the development proposal (including all future SDP plans to be submitted) must comply with the Outdoor Advertising and Signage Policy and By-law in all respects.

Specifically, the development proposal (including all future SDP plans to be submitted) must demonstrate that all outdoor advertising signs and other signage (external advertising, direction signs and/or outdoor display) do not impact negatively on visual corridors, Cultural Landscapes and Scenic Routes.

No signage, lettering or outdoor advertising (within the proposed development or on the perimeter) may be installed higher than the average building height, or the overall height restriction for the development, whichever is the lesser.

Outdoor signage and (especially) outdoor advertising must be kept to a minimum throughout the development. This is especially important to protect the R312 Scenic Route's view corridor, the remnant Landscape Character of the Receiving Environment, and the views of sensitive viewers within the Cultural Landscapes and travelling on the scenic Routes surrounding the subject site.

Refer to Section 4.1.8 above for additional Outdoor Signage Guidelines.

Waste:

The CWA Waste Facility will have to register and adhere to the following Norms & Standards:

- "National Norms and Standards for the Storage of Waste" (GN926 of 29 November 2013) should the facility have the capacity to store more than 80m^3 for hazardous waste and/or 100m^3 for general waste at any one time and for a period exceeding 90 days.

- "National Norms and Standards for Sorting, Shredding, Grinding, Crushing, Screening, Chipping or Baling of General Waste" (GN1093 of 11 October 2017) if general waste is sorted, shredded, grinded, crushed, screened, chipped or baled in an operational area at the facility exceeding 1000m^2.
- "National Norms and Standards for Organic Waste Treatment" (GN.1984 of 1 April 2022) with regard to the biodigester/ facilities that have the capacity to process more than 10 tonnes of organic waste per day.
- "National Norms and Standards for Organic Waste Composting" (GN.561 of 25 June 2021). Organic waste composting facilities that have the capacity to process compostable organic waste, in excess of 10 tonnes per day.
- "National Norms and Standards for Domestic Waste and Sanitation Services", published as GN No. 982 of 8 September 2017.

F. Protection of sensitive features (Search & Rescue)

Biodiversity & Freshwater Offsets:

Prior to commencement activities taking place, involving the destruction of sensitive wetland or botanical features on site, the applicant must conclude the offset implementation agreements with a suitable person or organisation that secures in perpetuity, through suitable legal protection mechanisms, the area recommended for the Biodiversity and Freshwater Offsets.

Please refer to **Annexure 7** for the **Wetland Offset Study and Implementation Plan.**

Please refer to **Annexure 18** for the **Biodiversity Offset Report**.

Regarding the Biodiversity Offset:

A binding 'Letter of Intent' commitment has been concluded between the Applicant and the Landowner of *Hercules Pilaar* covering a long-term lease agreement/conservation servitude with an accompanying management agreement. This would require the landowner to declare the site as a Nature Reserve if Environmental Authorisation is obtained.

As the Biodiversity Offset will take place off-site a separate stand-alone Biodiversity Offset Management Plan will be drafted for the site. However, this EMPr will effectively address the aspects required to manage the Biodiversity Offset for the site, until such time as it is declared a Nature Reserve, and a compliant (Conservation) Management Plan is submitted to the MEC for approval.

Please refer to *Goal 2B: Safeguard Botanical Features (Off-Site)* under section 4.4 which addresses the Management Aspects of the Biodiversity Offset Area. Although the management of the Biodiversity Offset area will commence during the construction phase of the bigger project, it is considered an Operational Goal and therefore included under the Operational Phase of the EMPr. This Goal will eventually be replaced

by the Biodiversity Offset Management Plan to be compiled in consultation with Cape Nature and CoCT once the site has been declared a Nature Reserve.

Vegetation

All Very High, High and Medium sensitivity areas (Refer Figure 10) that do not fall within the authorised development (construction) footprint should be conserved as part of any redevelopment of this site (no development and no infrastructure through these areas). Two of the Very High sensitivity areas are within the Agricultural Precinct, whilst the other two are within the Airside Precinct.

No perimeter service road may cross or disturb the mapped area of Very High sensitivity east of the main runway. However, as part of the fence line construction existing tracks along the fence line will be used, but no widening of tracks further clearance or removal or earthmoving of vegetation will be allowed.

All protected elements/areas located on the site, will be clearly marked, and care should be taken by the ECO to ensure that they are not unnecessarily disturbed during construction works on site. All alien vegetation must be removed in accordance with the **Alien Vegetation Management Plan (Annexure 6)**.

Apart from the vegetation identified by the project team for removal from the site prior, no indigenous vegetation is to be removed without the written permission of the ECO. Damage to the indigenous vegetation anywhere on the site (outside of the approved area) will be subject to penalties.

Avoid unnecessary trampling of vegetation irrespective of the vegetation being associated with wetland habitats or the surrounding terrestrial area. Retain as much indigenous vegetation as possible (wetland and terrestrial).

A boundary fence line will be erected. There is an existing gravel track along the fence line on the subject property where vegetation is already cleared or cut. The extent of these tracks can be utilised for the construction of the fence line. In 'no-go' botanical areas along the fence line, the existing tracks can be used but must not be made wider. No earthworks are allowed inside the no-go areas.

Plant Search & Rescue Plan:

Large scale Search and Rescue of plant material from all Medium, High and Very High sensitivity areas within the development and clearing footprints must be undertaken prior to any development or disturbance of these areas.

Most of the low and medium significance occurrences of plant SoCC within the proposed development footprint (as well as some of the high significance species) can be successfully translocated, and this will be done by experienced Search and Rescue contractors prior to any site development (pre-construction phase), with the assumption that the receiving areas will be properly managed in perpetuity as plant conservation areas. This must be done in consultation with the botanical specialist and can proceed prior to any authorisation (provided all necessary permits and permissions are obtained).

Action:

- A registered Botanist should be appointed to oversee the search and rescue operation.
- The appointed Botanist must conduct a walk-through survey to identify all listed species that may occur within the project area and record the flowering and seeding times of the species to be search and rescued.
- A plant Search and Rescue "Method Statement" should be prepared (prior to any development or site clearing) by the appointed S&R Contractor, the ECO and the botanist, and should outline who needs to do the work, when seed, sods, bulbs and cuttings need to be collected, how they will be marked for identification and stored, how much should be collected, how receiving sites should be identified and prepared, and how and when the planting out should be undertaken.
- Undertake the demarcation of the search and rescue area as per recommendations of the botanist appointed to conduct the search and rescue operation.
- Rescued plants must be planted into a container to be housed within a temporary nursery on site.
- The collecting of plants by unauthorized persons should be prevented and signs stating so should be placed at the entrance to the site.
- Ensure that only the Botanist/ trained staff handle the plants.
- Do a second walk-through to ensure all plants have been identified.
- Receiving areas should ideally be located within the greater study area (provided that land tenure and funding for conservation is secure in these areas) and should be areas that support some natural vegetation remnants, but that require rehabilitation intervention.
- The size of planting holes should be sufficiently large to ensure the entire root system is well covered with topsoil. During transplanting care shall be taken to limit or prevent damage to roots.
- Topsoil material will be replaced within the planting holes. Any remaining material will be responsible spread around disturbed areas for rehabilitation.
- Plants should be watered immediately after transplanting to help bind soil particles to the roots and facilitate the new growth of functioning roots.
- Ensure staff is trained and guided as to care for the stored, rescued plants i.e. watering practices and replanting practices.
- Areas where plans are relocated must be regarded as no-go areas during construction and operational procedures.
- The ECO to give permission for topsoil removal and vegetation clearing only to start when all search and rescue operations have been completed. The ECO should monitor construction activities to ensure that remnant sensitive vegetation (that does not fall within the construction footprint) is not disturbed.

Monitoring: Post-construction monitoring of plants relocated during the search and rescue operation should be undertaken by the CWA Environmental Management Division. This should be on a three-monthly basis for two years after transplanting to evaluate the success thereof, or as suggested by the appointed botanist who will be conducting the entire search and rescue operation.

Funding: The applicant, must provide all necessary funding for all required ecological management of the site (including all Search and Rescue costs) and take responsibility for the success of the Search and Rescue.

[Guidelines on ongoing management/ maintenance of these areas is addressed in the *Goal 13: Conservation Management of on-site sensitive areas* of the EMPr.]

Rivers, Riparian Habitat & Wetlands

Construction work, particularly of works within the 15m construction conservation buffer of the wetlands, must as far as possible be restricted to the dry, summer season. CVB wetlands 2 and 3 and the remainder of seep wetland 1 where development will not occur, and the wetlands' 15m construction phase conservation buffers must be marked as a no-go area during the construction phase of the proposed development.

Sediment trapping devices must be utilised downgradient of where works are to be undertaken within seep wetland 1 and upgradient of CVB wetland 3.

Under no circumstances must linear infrastructure be trenched within the CVB wetlands 2 and 3 or their conservation buffer.

All construction personnel, vehicles and construction work must be confined to the boundaries of the development footprint and no edge effects must occur. This is of particular importance at seep wetland 1.

Disturbed areas, particularly associated with the CVB wetlands 2 and 3 with regards to the maintenance road and fences that will traverse these wetlands must be rehabilitated once construction activities have ceased. Avoid unnecessary trampling of vegetation irrespective of the vegetation being associated with the freshwater ecosystems or the surrounding terrestrial area.

Careful planning of all construction equipment must be undertaken beforehand to ensure that the minimum impact on the freshwater ecosystems occur.

Reptiles, birdlife and mammals

Construction personnel are to be educated about the various faunal species in the area, particularly about venomous spiders, snakes and scorpions. None of these or other species are to be killed or injured by construction personnel. Should any of these species be encountered, these species are to be safely and carefully relocated to the surrounding natural habitat adjacent the development site, should they not move off on their own.

The contact details of a suitably qualified snake handler be made available to construction teams should a venomous snake be encountered that needs removal. Alternatively, it is recommended that a member of the construction team be trained to handle and remove snakes through a recognised snake handling course.

No hunting, trapping or collecting of faunal and avifaunal species is to be allowed, other than for rescue and relocation purposes. Setting of snares by personnel is to be prohibited.

Prior to construction activities, a final walk down of the study area should be undertaken to verify the presence/absence of potential SCC.

Should any SCC be found to be breeding in the study area at the time of construction activities, all activities are to be halted, and a suitable qualified ecologist/relevant cape nature specialist must be consulted to determine the best way forwards.

Archaeological remains (**Annexure 4: Fossil Finds**)

If any heritage remains are found Heritage Western Cape (HWC) needs to be informed. If heritage remains are disturbed it should be left and demarcated for inspection by HWC. If any archaeological remains (including but not limited to fossil bones and shells, coins, ceramics, antique, marine shell heaps, stone artefacts and bone remains) are discovered HWC need to be notified. If any graves or human remains are discovered HWC need to be notified.

Agricultural Precinct

No construction phase activities may be undertaken within the Agricultural Precinct.

G. Visual Impacts

All contractors and sub-contractors on site must submit a Temporary fencing, hoarding and screening protocol for active construction sites to the ECO for monitoring.

All contractors and sub-contractors on site must submit a dust and mud control protocol for active construction sites to the ECO for monitoring.

Dust management, waste management, the placement of screens and hoarding, as well as the location and management of access points to the site must be proactively managed to reduce visual clutter and limit visual impacts associated with construction activity before, during and after each phase of the construction process (demolition, excavation, project execution, close-out etc., establishment, etc.).

Light pollution should be kept to an absolute minimum throughout the development, and exterior lighting must be limited to areas where this is necessary for utility, safety and security.

The goal should be to keep the ambient light levels within the immediate Receiving Environment low, given the proposed development's proximity to a rural landscape that is a protected area, and the surrounding Cultural Landscapes. Exterior lighting (and therefore any visible light sources) must be carefully directed

away from sensitive receptors (Scenic routes, and viewers within the Cultural Landscape and nearby residential areas/homesteads). Refer to Section 4.1.4 ("Lighting") above.

Construction activities must be limited to daylight hours to prevent visual impact of lights at night. If construction during the night-time hours is unavoidable, the following should apply:

- No floodlights should be permitted.
- Only the construction activity should be lit- not the entire construction area.
- Construction lighting should not be "always-on" – and should be turned off when active construction activity is not being undertaken.
- The management of construction light impacts at night must be monitored by the ECO and included in compliance reporting.

H. Noise Impacts

In terms of noise management, the facility must comply with the Western Cape Noise Control Regulations (P.N. 200/2013).

The contractor must take appropriate measures to limit the impact of unreasonable noise from construction activities on the neighbouring land users by providing training to the personnel to adhere to operational procedures that reduce the occurrence and magnitude of individual noisy events.

Ensuring that equipment is in good working order and properly maintained.

Limit night-time construction activities and avoid night-time construction activities on the property to the west of the airport boundary (earthworks), which are closer to the Fisantekraal residential area.

I. Safety & Security

The Contractor is to appoint a safety steward, who will be responsible for safety of the labour force, construction activities and handling emergency situations on site during construction hours.

Co-operation between the Developer and contractors is essential to ensure that the area around the proposed development remains secured during construction. On-site security measures, such as perimeter fencing, controlled access and security guards and patrols will minimise the risk.

J. Fire Control

The contractor must take appropriate measures to guard against accidental fire, and it will be presumed that any bush fire which starts on the site, or within 100m thereof during the construction period would be the responsibility of the applicant.

No illicit fires are allowed on site.

Fire beaters and "bakkie sakkie" are to be kept on site, and easily accessible at all times, and not locked away. No open fires may be lit anywhere on the construction site, except at locations approved by the ECO and Site Manager. The burning of refuse or vegetation material on site as a means of disposal will not be allowed unless a permit for burning is issued by the competent authority.

The **VeldFire Management Plan** in **Annexure 5** must be implemented.

K. Emergency

All accidents and emergency situations are to be reported to the ECO and Site Manager and full details included in the monthly environmental report.

Fire

SANS 10400–T: 2024 and the Community Fire Safety By-law, Provincial Gazette 5832 (as amended 29 June 2007 and 21 August 2015) is to be complied with.

In the case of a fire occurring on site, the Applicant and Site Manager (safety steward) are to be notified immediately. If fairly localised and effort should be made to extinguish the fire immediately and if required, the assistance of the local fire department should be sought by the safety steward.

The **VeldFire Management Plan** in **Annexure 5** must be implemented.

The **Emergency Preparedness and Response Plan (Annexure 12)** must be implemented.

First Aid

The Contractor must provide and maintain a suitable first aid kit on site, with a member of staff suitable qualified in first aid on site during working hours, in accordance with the Occupational Health and Safety Act.

L. Public Complaints

All public complaints received are to be registered by the ECO or Site Manager and addressed immediately. Public complaints and responses are to be recorded in the Site Diary and included in the monthly environmental report by the ECO.

M. Procurement Strategy

Initiate the activity during the first phase of the development. The strategy is the responsibility of the contractor(s) collectively under the guidance of the Municipality. Focus on opportunities for local labour in the surrounding areas and businesses as a priority. Contractors are required to indicate the geographical location of sub-contractors (businesses) and local labour. Local contractors invited to tender for work in the context of the terms and conditions included in RFP documentation, which would include skills

development, on-site training, gender equality, etc. Approved programme aligned with the future construction phases of Greenville Garden Cities, Bella Riva and other planned/approved developments in the area to minimise the impact on the greater community.

Contractors need to employ people from the immediate area whenever possible. A Social Engagement Plan, formal monitoring systems and contingency plans for larger-than-expected in-migration should be prepared and implemented to assist with the management of jobseekers and so-called community business forums.

4.2.2 Site Establishment Requirements

A. Environmental Awareness Training for Site Personnel

All contractors/ sub-contractors involved in work on the development are to be briefed on their obligations towards the environmental controls and methodologies. The briefing will usually take the form of an on-site talk and demonstration by the ECO. The education program should be aimed at all levels of management within the Contractor team.

The environmental awareness education program should commence with entry onto the site, prior to any construction activities taking place by each team and is likely to be an ongoing process. All personnel are to be made aware of the details of the EMPr which will be applicable to them, in the languages of the site staff. Contractor teams must also be aware of penalties issued by the ECO in terms of environmental conduct on site, as well as safety and emergency procedures to be followed.

An initial environmental induction must occur to all sub-contractors and associated workers on environmental awareness, including minimisation of disturbance to areas of increased ecological sensitivity (i.e. freshwater ecosystems), as well as fauna and flora with a no poaching policy, management of waste, prevention of water pollution and wastage, fires, litter and contaminants.

A regularly updated record is to be kept of all personnel attending the Environmental Awareness training sessions.

Refer to the **Environmental Awareness Plan – Annexure 15**.

B. Site Definition and Demarcation

A boundary fence line will be erected. There is an existing gravel track along the fence line on the subject property where vegetation is already cleared or cut. The extent of these tracks can be utilised for the construction of the fence line. In 'no-go' botanical areas along the fence line, the existing tracks can be used but must not be made wider. No earthworks are allowed inside the no-go areas.

All development footprint areas should remain within the demarcated areas as far as possible, and disturbance of soil profiles must be limited to what is essential with a compact footprint.

All 'fencing' is to be erected prior to construction works commencing on site and are to remain in position and in good repair for the duration of the construction phase. Once this has been done, all works, including stockpiling of construction materials are to be strictly confined to the demarcated area.

All footprint areas must remain as small as possible, vegetation clearing to be limited to the approved development footprint and should only encroach into the freshwater ecosystem if considered essential. The boundaries of footprint areas, including contractor laydown areas, are to be clearly defined and it should be ensured that all activities remain within defined footprint areas. Edge effects will need to be extremely carefully controlled.

Avifaunal habitat beyond the demarcated area should not be cleared or altered, except as needed for safety reasons around taxiways and runways.

For the construction of the maintenance road along the eastern boundary of the study area, culverts must be installed to allow the passage of water from the upgradient portions of the CVB wetlands 2 and 3 to the downgradient portions. Any disturbed areas within these wetlands must be rehabilitated on completion of construction of the road. The maintenance road should ideally avoid seep wetland 1 and circumvent it to avoid further fragmentation of the wetland. Should this not be possible, the road must be designed in such a manner as to allow hydraulic and hydropedological process connectivity in the landscape while also allowing fauna to traverse the roadway. It is also highly recommended that cobbles be placed downgradient of the road to trap sediment and reduce flow velocity of surface water entering the wetlands.

C. Contractor's Camp

All construction site offices, lay down areas, storage areas and active construction activities must be screened from public view by appropriate hoarding and/or screening. The location of the construction camp will be authorised by the ECO prior to construction starting and if required to move, the new site and layout must be authorised by the ECO.

Construction fencing/hoarding and signage must adhere to local policy relating to signage and ensure that no views to scenic routes are impacted by large or numerous construction signage.

No outdoor cooking of any form or open fires are allowed.

All contractors and sub-contractors on site must submit a Temporary fencing, hoarding and screening protocol for active construction sites to the ECO for monitoring. iv. All contractors and sub-contractors on site must submit a dust and mud control protocol for active construction sites to the ECO for monitoring.

Site offices, storage and lay down areas, loading areas and similar temporary infrastructure should be situated centrally on the subject site and avoid any areas visible from the R312.

- Construction site offices, lay down areas and storage areas must be placed at least 100m away from all other property edges.

- Any fencing, visual screens or hording erected during the construction phase must be maintained so that they do not become the source of the visual impact.

D. Toilet Facilities

Suitable sanitary facilities must be provided by the contractor for all staff on site. The Contractor should ensure that ablutions are restricted to the sanitary facilities. Where chemical toilets are provided, the Contractor should ensure that they are kept in hygienic condition and emptied on a regular basis. Waste from the toilets should be disposed of to the satisfaction of the ECO.

Care must be taken that no spillage occurs when chemical toilets are cleaned, and their contents are properly stored and removed off site. A contingency plan for spills must be supplied by the contractor and approved by the ECO. Toilets should be located where their use would result in minimal impact on the surrounding environment and may not be in areas of running or standing water during winter and must be secured to prevent them from blowing over.

E. Sensitive Features (No- Go Areas)

Please also refer to Section 4.1.1 (F) above. The no-go areas for development, as indicated on the Environmental Sensitivities Map (Annexure 3B), are as follows:

Botanical:

All authorised hard infrastructure bordering on any of the mapped areas of Very High, High and Medium sensitivity botanical areas must be surveyed and fenced off prior to any site preparation, clearing or construction. These sensitive areas may not be disturbed in any way during the construction process. Fences should be marked with signage every 15m indicating that these are No Go areas, and all contractors must be made aware of such, starting with and including in their contract quotation requests. Where the perimeters of these areas lie within 20m of the RESA (runway clearance area) they should be buffered by an ecological buffer area at least 5m wide that is not disturbed by any earthmoving or development.

Areas beyond the fencing are to be considered **no-go areas**. All areas outside the boundary of the property are naturally considered no-go areas and boundary fencing is to be secured in areas where work is to take place.

The Very High sensitivity areas falling within the Agricultural Precinct must be fenced off and excluded from grazing and trampling by livestock (especially cattle). This must be done within 60 days of authorisation, or sooner if possible (subject to landowner negotiation).

Aquatic:

The 15m construction conservation buffer around the freshwater ecosystems must be implemented for the duration of the construction works where development will not occur to mitigate edge effects. The freshwater ecosystems and the respective conservation buffers must be clearly demarcated using a suitable barrier or material by an Environmental Control Officer (ECO) and marked as 'no-go' areas. Only authorised

construction personnel may be permitted to enter these 'no-go' areas as part of the clearing activities, where required, to prevent excessive compaction of the soil within the freshwater ecosystems.

Figure 25 above refers to an example of a barrier fence used to demarcate the no -go area around the freshwater ecosystems and the 15m construction conservation buffer.

Any fences that are to traverse the CVB wetlands 2 and 3 must be installed in such a way that hydropedological processes are not impeded within these systems. It is recommended that the erection of fence posts within the CVB wetlands 2 and 3 are avoided.

All 'fencing' is to be erected prior to construction works commencing on site and is to remain in position and in good repair for the duration of the works. No materials, rubble or equipment is to be stored or stockpiled within the Environmental Sensitive Areas. Any deviations from these specifications are subject to the approval of the ECO.

Geohydrological:

Due to the proximity of the Colenso Fault to the CWA, a no-go area for specific high-risk activities is proposed to the northeastern section of the study area. The precise location of the Colenso Fault is uncertain and therefore, the no-go area was drawn 500 m from the closest geologically mapped fault. This no-go area does not have to apply to all activities, but only to certain high-risk activities such as the aviation fuel farm, bulk fuel storage, retail service station or other activities that are considered high risk. However, as this area falls within the Agricultural Area it is already considered a no-go area in terms of construction.

Agricultural Area:

The Agricultural Precinct must be considered a "No-Go" area for further development/ construction activities to be allowed within the Agricultural Precinct.

F. Vegetation Clearance

As far as possible, vegetation clearance should take place during the winter months, outside of the breeding/nesting periods of avifaunal species.

Vegetation to be removed from the site to facilitate development needs to be identified by the ECO, indicated on a site plan and clearly marked prior to any other works on site. Retain as much indigenous vegetation as possible (wetland and terrestrial). Alien vegetation directly adjacent or in close proximity to the construction area should be removed in line with alien clearing methods.

Faunal habitat beyond the demarcated area should not be cleared or altered, except as needed for safety reasons around taxiways and runways as per the **Wildlife Hazard Management Plan (Annexure 11)** for the airport. Site clearance activities should take place in a phase manner, starting from the South moving northwards, or centrally moving outwards, so that faunal species can flee ahead of clearance activities into adjacent habitat and not get trapped in centralised, remnant patches.

Due to the potential fire risk in the area, no vegetation may be removed using fires, and no excess vegetation material may be burned on site. No natural vegetation outside of the site may be removed without approval of the ECO, apart from invasive plant species which are to be removed according to a controlled program.

Once all vegetation clearing is complete, all vegetation and any removed excess material must be disposed of at a licensed refuse facility and may not be mulched or burned on site (unless all approvals have been obtained).

G. Monitoring Requirements:

G1. Groundwater Monitoring Network/ Monitoring Plan

A groundwater monitoring network will be required and will require regional monitoring boreholes to monitor the regional groundwater quality, e.g. of the fractured bedrock aquifer. These boreholes should ideally be monitored prior to the commencement of construction to establish baseline conditions.

Implement the construction specifications and monthly groundwater quality monitoring during the construction phase in accordance with the "*Proposed Groundwater Monitoring Plan (GEOSS, February 2025*)" highlighted below:

It is recommended that a number of groundwater sites should be monitored at the proposed site during the construction and development phases on site. This will allow for monitoring of the groundwater quality and groundwater levels across the site. Monitoring sites need to be strategically placed, typically in the vicinity and downgradient of high-risk activities.

Groundwater flow in the area generally mimics the topography, flowing towards topographical lows. It is recommended that a number of local monitoring sites be located across the site to identify any potential impact of the proposed land uses. The additional suggested monitoring sites are presented in Table 12 and illustrated in Figure 31.

Table 12: Details for the proposed monitoring sites.

Site_ID	Latitude (DD, WGS84)	Longitude (DD, WGS84)	Location	Depth (mbgl)
CWA_BH001	-33.76452	18.73271	Existing borehole	100.0
CWA_BH002	-33.76876	18.732067	Existing borehole	100.4
CWA_BH003	-33.774037	18.747742	Existing borehole	149.9
MBH1	-33.748832	18.727907	Proximal to the WWTW	Until the clay layer/bedrock is reached
MBH2	-33.751598	18.729944	Proximal to the Biogas plant and fuel farm	Until the clay layer/bedrock is reached
MBH3	-33.753503	18.732373	Proximal to the Biogas plant and fuel farm	Until the clay layer/bedrock is reached
MBH4	-33.755629	18.730166	Proximal to the stormwater retention pond (quarry)	Until the clay layer/bedrock is reached
MBH5	-33.755713	18.736537	Airside activities	Until the clay layer/bedrock is reached
MBH6	-33.760356	18.734556	Airside activities	Until the clay layer/bedrock is reached
MBH7	-33.761442	18.730469	Proximal to the Energy Centre	Until the clay layer/bedrock is reached
MBH8	-33.764807	18.730847	Proximal to the retail service station	Until the clay layer/bedrock is reached
MBH9	-33.769336	18.731523	Boundary of the CWA, to screen potential contaminants upgradient of neighbour	Until the clay layer/bedrock is reached
MBH10	-33.773944	18.735199	Boundary of the CWA, to screen potential contaminants upgradient of neighbour	Until the clay layer/bedrock is reached
MBH11	-33.772721	18.747079	Airside activities	Until the clay layer/bedrock is reached
MBH12	-33.763444	18.742089	Airside activities	Until the clay layer/bedrock is reached

Construction Specifications

The drilling of boreholes should be supervised by a hydrogeologist and drill samples should be collected every 1 metre and logged. Additional information should also be collected such as the depth of water strikes, associated water strike yields and groundwater quality. This is crucial information for the optimal design of the boreholes. The driller should be supervised to ensure all site requirements are met. A graphical representation of a proposed borehole construction is presented in Figure 30; the exact construction will, however, be unique for the borehole.

The boreholes are to be drilled by means of rotary drilling until the clay layer or bedrock is reached. A gravel pack should be installed with an annulus of about 12mm. The boreholes should be developed with compressed air for at least two hours upon completion along with an airlift test to estimate the yield of the borehole. Each borehole must be protected with a concrete block or a protected manhole if there is traffic in the area. Each borehole also needs a permanent plate glued to the lid containing the details pertaining to the borehole. A bentonite plug of at least 500mm needs to be installed at the top of the hole to prevent ingress of surface water.

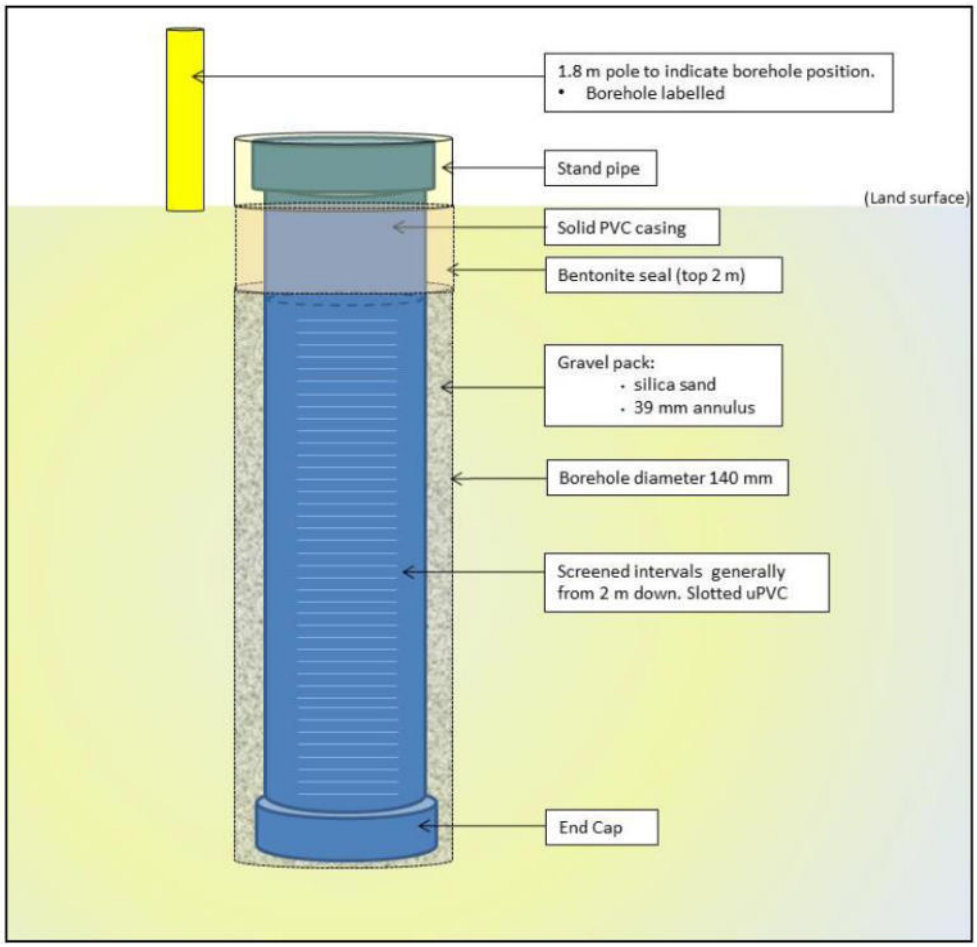


Figure 30: Schematic representation of the proposed general borehole construction.

Groundwater Level Monitoring

Groundwater level measurements are recommended for the monitoring points at the study site. A dip meter can be used to measure the water level below the top of the borehole collar/casing height (mbch). The height of the collar/casing height must then also be measured (m). The water level (metres below ground level (mbgl)) can then be calculated by subtracting the collar/casing height from the water level (mbch). The value must be recorded along with the date and time of measurement.

Groundwater Quality Monitoring

It is recommended that the monitoring wells be purged prior to sampling. A low volume sampling pump can be used or the site can be bailed and allowed to recover prior to sample collection. When using a low volume sampling pump, the groundwater should be pumped through a flow-through cell until field chemistry parameters have stabilised.

Sample Collection, Preservation and Submission

Sample bottles must be labelled with the site name, borehole name and date. At the time of sampling, field chemistry parameters must be measured and recorded. These include electrical conductivity (EC), oxidation reduction potential (ORP), pH, temperature and dissolved oxygen (DO). During sampling, disposable nitrile gloves should be worn to minimise the transfer of any potential contaminants. Nitrile gloves should be

dedicated to a sampling location and disposed of after use. Samples must be collected in an appropriate sampling container and preserved in the correct manner prior to submission to an accredited laboratory for the analysis parameters. The sample method and preservation must be discussed with the laboratory prior to sampling.

Monitoring Frequency and Parameter Analysis

In order to best understand and monitor the site, it is recommended that monthly water level measurements be taken to determine seasonal fluctuation. It is further recommended that the water quality on site is monitored on a quarterly basis for the first year, after which the frequency can be reduced based on the first year's monitoring results.

Groundwater monitoring needs to target the risk of the activity, i.e. organic and microbiological parameters need to be monitored in close proximity to the solid waste storage, WWTW and the biodigestor; BTEX, TPH and GROs need to be monitored in close proximity to fuel storage and dispensing operations, etc. Once the site is approved and the intricate details of the services are made available, a more detailed, standalone monitoring programme report will need to be developed prior to the construction and development phase. Table 13 indicates the potential parameters for ongoing monitoring, this will be revised upon approval and development of the CWA.

Table 13: Proposed groundwater monitoring parameters and their recommended frequency.

Parameter	Frequency*
Groundwater Level	Monthly
pH	Quarterly
Electrical conductivity (EC)	Quarterly
Total Dissolved Solids (TDS)	Quarterly
Inorganic parameters: K, Cl, NO_3, NH_4, P, Na, Ca, HCO_3	Quarterly
Metals: Fe, Mn, Al, Ti, Cr, Cd, Pb, Ni	Quarterly
Total Organic Carbon (TOC)	Quarterly
Biological Oxygen Demand (BOD)	Quarterly
Chemical Oxygen Demand (COD)	Quarterly
Heterotrophic Plate Count	Quarterly
Total Coliforms	Quarterly
E. coli	Quarterly
BTEX	Quarterly
Gasoline Range Organics (GROs)	Quarterly
Total Petroleum Hydrocarbons (TPH)	Quarterly

** Frequency of chemistry sampling may be revised after one year of data has been collected but level monitoring should continue on a monthly basis.*

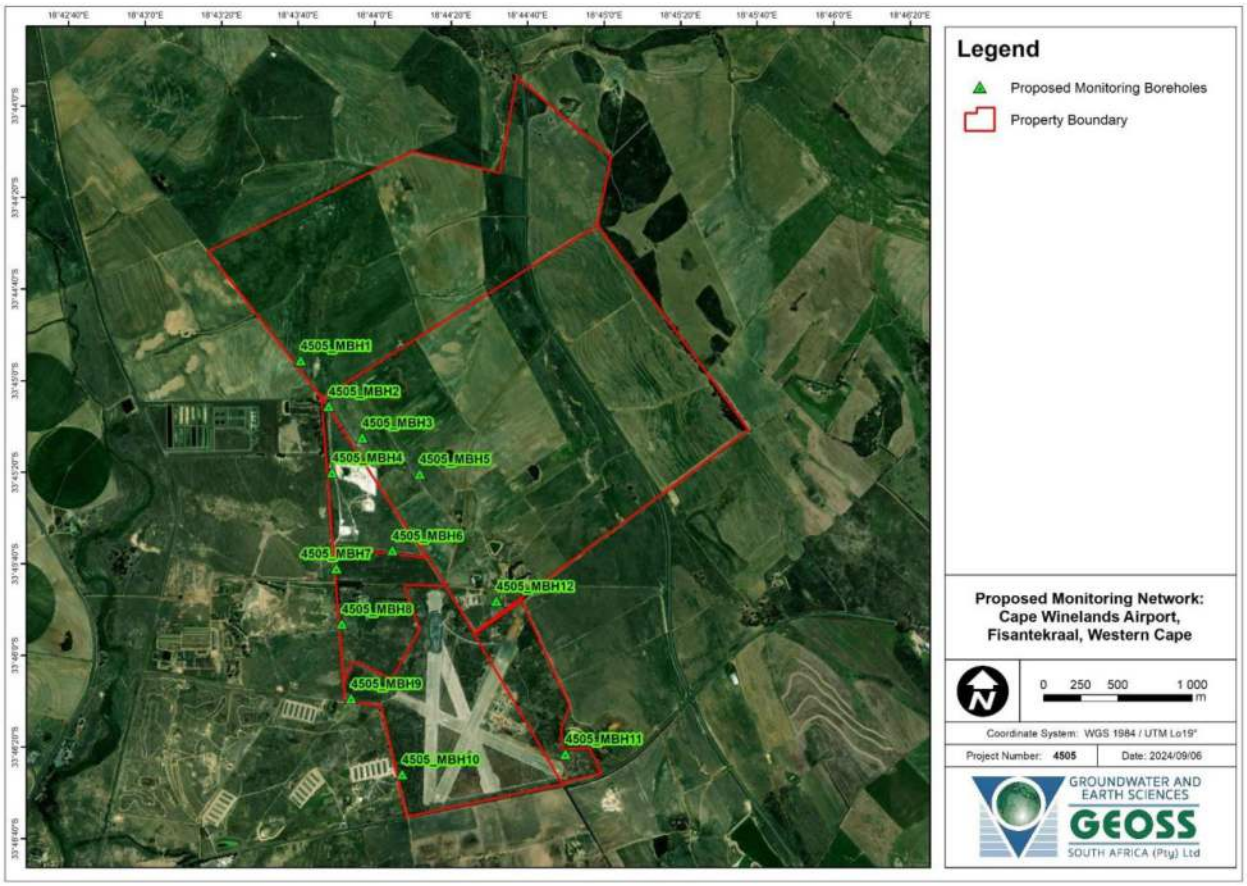


Figure 31: Proposed groundwater monitoring locations across the Cape Winelands Airport development.

G2. Noise Monitoring Network/ Monitoring Plan:

Noise monitoring should be conducted during the construction phase of the new airport and runway. This monitoring is to be carried out in accordance with the methods stipulated in the SANS 10103:2008 Code of Practice and the current Western Cape Noise Control Regulations.

Two points should be used for the noise monitoring locations, positioned on the inside of the airport boundary. These locations should cover the area close to the entry point of the trucks to the site and the community closest to the construction activities. These locations should be finalised once the construction plan and schedule are determined.

The monitoring should be conducted every three months during construction and on a monthly basis during the period when night-time construction will be taking place.

Three-monthly reports should be submitted to the authorities, including a brief assessment indicating if any construction-specific noise exceedances above baseline and SANS district guidelines are taking place. In the event of exceeding noise guidelines, appropriate site- and operation-specific noise mitigation measures should be investigated and implemented.

G3. Air Quality Monitoring:

Based on the air quality modelling results, the highest concentrations occur along the runway and extending north of these runways. This is due to the strong south-easterly wind during the summer season in the Western Cape. Therefore, the existing location of the monitoring station is suitable for current and future runway operations. The concentrations measured represent the highest concentrations. The pollutants' concentrations at other locations around the airport and the surrounding communities are deemed to be much lower.

The station is equipped to measure the ambient concentrations of SO2, NO2, O3, CO and PM10. Monitoring data must be reported on a biannual basis to the City of Cape Town Air Quality Management Unit and the South African Air Quality Information System as operated by SAWS, on an ongoing basis.

G4. Socio-Economic Monitoring:

An essential component of determining the success of a project from a socio-economic perspective entails monitoring, reviewing and evaluating processes to assess the adherence to socio-economic obligations. The following activities are geared towards achieving acceptable and ongoing monitoring standards:

1. Regular field visits to the project and stakeholders benefiting from the project

2. A review after the first six months after implementation to assess the overall progress and achievement of the objectives and milestones related to the specified targets of employment, skills development, small business development and capacity building.

In order to monitor the performance related to the achievement of the socio-economic development obligations, the contractor should record and report progress with agreed socio-economic obligations. Typical reporting information should include:

- Actual total expenditure on Total Procurement;
- Actual total expenditure on Procurement of Materials;
- Actual total expenditure on Sub-contracting;
- Actual total employment categorised according to standard Occupational Categories; and
- Actual total payroll.

The successful implementation and development of the proposed project will ultimately be assessed based on the contribution the project makes during construction and operations to the social development and economic goals of employment creation, skills development and training, small business development and capacity building in the area. The following Key Performance Areas (KPAs) are outcomes based on the scope of social engagement activities:

- Procurement from, or sub-contracting to local enterprises;
- Procurement from, or sub-contracting to enterprises from outside the local area;
- Procurement of local materials/resources;

- Procurement of materials from outside the COCT;
- Recruitment process that promotes gender equality

Social impacts such as the influx or in-migration of job seekers will likely affect the area's local communities and other properties. This assertion is based on the nature, size and scope of the proposed project as a significant contributor to the aviation landscape and the ancillary requirements for the development of airports. Monitoring as a basis for understanding changes in the social landscape is required and should be reported on as part of the socio-economic monitoring proposed above. A system should be developed to assess the impact, and stage gate reviews should be considered to guide the required steps. This requirement should also be aligned with developing a Social Engagement Plan that should be implemented and form the basis of the above review.

4.3 Construction Management Plan

Sound environmental management practices should be adhered to at all times.

4.3.1 Material handling and storage

Fuels and flammable materials are to be stored in suitably equipped storage areas. These areas shall comply with general fire safety requirements. Impervious materials are to be used in these storage areas to prevent contamination of the ground in the event of spillages or leaks. Quantities of fuels and hazardous materials stored on site should be appropriate to the requirement for these substances on site.

Bulk fuel depots are to be placed within hardened bunded areas. Bunds are to have a holding capacity equal to 110% of the largest fuel container. The Contractor is to ensure that he is aware of the effects of all substances on staff and the environment, with the correct action to take in the case of any incident involving these materials.

Contractor laydown areas, vehicle re-fuelling areas and material storage facilities to remain outside of the respective conservation buffers of the freshwater ecosystems and preferably the 32m NEMA ZoR. A designated contractor laydown area must be approved by an independent ECO prior to use. Stockpiles must be placed outside the delineated freshwater ecosystems and 32m thereof.

All hazardous chemicals as well as stockpiles should be stored on bunded surfaces and have facilities constructed to control runoff from these areas. It must be ensured that all hazardous storage containers and storage areas comply with the relevant SABS standards to prevent leakage. Hazardous substances (hydrocarbons) stored on site, must be stored in a secondary containment area having an impermeable floor and be of sufficient area/volume to contain 110% of the spill volume stored.

4.3.2 Asphalt / Concrete Works:

Asphalt, concrete and cement-related mortars can be toxic to aquatic life. Proper handling and disposal should minimise or eliminate discharges into the wetlands. High alkalinity associated with cement can dramatically affect and contaminate both soil and ground water. The following measures must be adhered to:

- Fresh asphalt, concrete and cement mortar must not be mixed near the wetlands' habitat. Mixing of cement may be done within the construction camp, on an impervious surface only, and must be within a lined, bound or bunded portable mixer. Consideration must be given to the use of ready-mix concrete.
- No mixed concrete maybe deposited directly onto the ground within the wetlands or associated wetland habitat, outside of the designated area (i.e. fence traversing the seep wetland 1 and CVB wetlands 2 and 3). Any areas that require manual application of cement require that mixed cement be placed on a batter board or other suitable platform/mixing tray until it is deposited.
- A washout area must be designated outside of the wetlands, and wash water must be treated on-site or discharged to a suitable sanitation system.
- At no point may batter boards/mixing trays or cement trucks be rinsed off on site and runoff water be allowed into the freshwater ecosystems.
- Cement bags (if any) must be disposed of in the demarcated hazardous waste receptacles and the used bags must be disposed of through the hazardous substance waste stream.
- Spilled or excess concrete must be disposed of at a suitable landfill site. Chain of custody documentation must be provided.

4.3.3 Soil disturbance and revegetation:

It is considered imperative that all excavation activities be undertaken during the drier summer months to limit surface water contamination and the need for any surface water diversion during the construction works.

Sheet runoff from compacted areas should be slowed down by the strategic placement of berms. It is considered ideal that activities occur within the current season (low rainfall) to minimise impacts of sedimentation. As much vegetation growth as possible (of indigenous floral species) should be encouraged to protect soils. Temporary stockpiling of excavated material from trenches can be retained alongside trenches, as required for backfilling. Any soil to be stockpiled for longer than a month should be moved to a designated stockpile area, as approved by the Environmental Control Officer (ECO). All soils compacted during the repair and maintenance phase should be ripped and profiled. All soil compacted within the wetlands as a result of construction equipment must be loosened prior to revegetation with suitable indigenous species. A monitoring plan for the development and the immediate zone of influence should be implemented to prevent erosion and incision.

Areas disturbed (for any reason) must be revegetated (or planted as per the approved Landscape Master Plan) within a maximum of 1 year after the disturbance occurs.

- The only circumstances under which delay may be tolerated are:
    - If the area to be revegetated/planted is still an active construction site;

  - If the revegetation/planting must happen during a particular season to await optimal planting conditions. In these cases, revegetation/planting must occur in the first of such season after the delay.

- The ECO must report on disturbed areas and revegetation.

All embankments must be appropriately stabilized and revegetated to match the existing/surrounding natural vegetation.

Rehabilitation/revegetation must be handled in accordance with the recommendations of the botanist or other suitably qualified specialist, and under the supervision of the ECO.

During excavation activities, topsoil must be stockpiled separately from other material. The mixture of the lower and upper layers of the excavated soil must be kept to a minimum, so as for later use as backfill or rehabilitation material after construction has commenced.

Exposed soils must be protected from wind and water erosion (using tarpaulins or a suitable geotextile) for the duration of the construction phase.

4.3.4 Trenching and Stockpiling Activities:

Any AIPs within the study area (including the linear infrastructure footprints) must ideally be removed prior to soil stripping to reduce seed loads within the topsoil (which will be used to revegetate post construction). This will assist in reducing the long-term AIP management requirements.

During the excavation and trenching activities, any soil/sediment or silt removed from the freshwater ecosystems may be temporarily stockpiled outside the freshwater ecosystems if construction activities are confined to the dry summer months. Excavated materials may not be contaminated (with hydrocarbons, fuel, etc.). It must be ensured that the minimum surface area is taken up, and the stockpiles may not exceed 2m in height. Mixture of the lower and upper layers of the excavated soil should be kept to a minimum, so as for later usage as backfill material.

With the exception of the infrastructure as described in this report (the potable water and stormwater infrastructure along the eastern boundary of the runway), no pipelines may traverse any of the freshwater ecosystems. Should additional freshwater ecosystem crossings be considered, the DWS Risk Assessment must be updated to account for these activities. Water and stormwater pipelines to be trenched in the freshwater ecosystems must be installed during the drier summer months to prevent water quality impacts to the freshwater ecosystems. Unused excavated soil/sediment must be utilised as part of the open space areas (if applicable) or be removed from site to a registered landfill.

The soil surrounding the linear infrastructure, particularly within 15m of the freshwater ecosystems must be suitably loosened on completion of construction activities and revegetated to prevent erosion.

In addition to the above, with regards to excavation and soil compaction activities regarding trenching for the linear infrastructure within the 15m construction conservation buffer of the freshwater ecosystems,

stockpiling of removed materials may only be temporary (i.e. may only be stockpiled during the period of construction at a particular site) and must be disposed of at a registered waste disposal facility. Soil must be stockpiled on the upgradient side of the trench to avoid sedimentation of the downgradient areas. Figure 26 above shows excavation for trenching with stockpiles alongside.

Trenches must be backfilled as soon as the infrastructure has been installed in any given section to reduce potential erosion of exposed soil. Material used as bedding material (at the bottom of the excavated trench) must be stockpiled outside of the freshwater ecosystems. Once the trench has been excavated, the bedding material must directly be placed within the trench rather than stockpiling it alongside the trench.

Under no circumstances must linear infrastructure be trenched within the CVB wetlands 2 and 3 or their conservation buffer. The SDP Indicates that the layout of the linear infrastructure avoids wetlands. A 5m RoW for linear developments is considered as part of the RAM. This is of particular relevance to the installation of the water pipeline, fences and maintenance road along the eastern boundary of the study area. It is highly recommended that construction work for the linear infrastructure is undertaken in the drier, summer period to avoid excess sediment entering the receiving freshwater ecosystems.

4.3.5 Effluent and Waste Management

General Wastes

Waste management during the construction phase is the responsibility of the Contractor. The Contractor must establish a system acceptable to the ECO for control during execution of the works. Refuse generated during the execution phase should be managed according to the guidelines for waste management and recycling adopted for the life-cycle of the project.

- Waste must be identified and analysed for reduction, re-use and recycling opportunities;
- Arrange for storage and transportation/collection of various wastes to their final destination or use areas on-site;
- Staff must be trained in waste management.

Refuse should be stored in an appropriate area on site, protected against wind dispersion and removed on a regular basis for disposal of at a permitted disposal site. No burning or burying of refuse on site should be allowed. Refuse bins must be watertight and wind-proof.

Ensuring that an adequate number of waste and "spill" bins are provided will also prevent litter and ensure the proper disposal of waste and spills.

The applicant must ensure that sufficient on-site waste management measures are in place to prevent any escape of waste, litter and packaging materials etc. into the surrounding landscape.

A weekly litter patrol must be included in the Construction activities on site and monitored for compliance by the ECO.

Pollution:

Pollution of the development footprints (either through the leaking of chemicals such as oil and fuel, or through discarding of waste), as well as any areas adjacent to these footprints, should be monitored and avoided.

Dirty water should be captured, to be re-used where possible. No dirty water is allowed to be discharged into the surrounding environment. A dewatering plan to be developed prior to construction (where required). Should this be required, the dewatering plan could be devised by a professional. It is important that if the water is to be released back into the environment, it should be done under the guidance of relevant regulations and supervised/monitored by an appropriately qualified professional.

Eating areas

Contractor shall remove waste from the site on a daily basis.

The **Waste Management Plan (Annexure 8)** needs to be implemented.

4.3.6 Maintenance of equipment

All mechanical equipment and work vehicles which may be kept on site are to be stored, serviced and refuelled only at designated areas within the Contractor's Camp. Within these areas drip trays and other impervious materials, for example plastic or metal sheeting are to be used to prevent contamination of the ground in any way.

In all events all machinery and vehicles used during construction must be maintained to prevent oil leaks. If breakdowns occur these must be towed offsite site to the designated areas/workshops. The proposed will ensure that incidental oil spills and leakage are minimised onsite and thus limit any opportunities of water contamination and water quality deterioration.

The Applicant or ECO may order the removal of equipment that is causing continual environmental damage by leaking oil or diesel for example, until such equipment has been repaired.

4.3.7 Stormwater and Erosion Control/Management

Soil erosion by wind, during construction, should be mitigated by minimizing bare soil surfaces without adequate protection, either by applying a mulch cover or wetting the surface or similar action.

Suitable run-off and soil erosion control measures and infrastructure should be designed and implemented to limit and restrict the loss or degradation of soil.

The release of run-off water into existing streams should be controlled to minimize impact on vleis, marshes, water sponges and water courses. This activity may include a permitting application to the DWS.

Implementation of strict erosion control measures to limit loss of soil and sedimentation of the watercourse within the proposed development footprint. No stormwater generated during construction may be directly released into the freshwater environment.

Increased surface sealing as a result of the proposed development will result in decreased infiltration as bulk of the stormwater from sealed or paved surfaces are generally discharged in stormwater systems. The exception to this is where runoff is localised and directed to unsealed surfaces or adjacent watercourses in an attenuated manner.

Water from clean water diversion structures should be discharged back into the adjacent wetland features in an attenuated manner.

Subsurface lateral flow of water through the landscape (under seep wetlands and interflow soils) must be taken into account and buildings/structures should accommodate waterproofing and water management structures to divert laterally seeping water away from foundations into the gardens or storm water structures.

The **Stormwater Management Plan (Annexure 10)** needs to be implemented which includes the Freshwater Consultants input.

Installation of appropriate stormwater systems with catch pits to isolate fuel and other contaminants. Petrol interceptors might be considered to mitigate the risks of contaminants draining into the environment. Silt traps must be installed at any stormwater release areas and energy dissipating structures to ensure that erosion of the area does not occur.

All attenuation facilities must be constructed through excavation of the in-situ material, sloped to a ratio not steeper than 3:1 and lined with rocks and cobbles to assist with energy dissipation and prevent sedimentation and erosion as well as improve the aesthetic appeal of the attenuation ponds. Attenuation ponds must be vegetated with indigenous obligate and facultative species suitable for seasonal saturation with input from a suitably qualified avifaunal specialist. Given the nature of the development, vegetating the dry attenuation ponds may not be possible. This will assist with energy dissipation and prevent sedimentation and erosion as well as improve habitat provision. Figure 27 above shows examples of swales utilised for conveyance of stormwater.

Cobbles must be placed on all outlet structures and indigenous vegetation established to bind the soil of the bed, to prevent erosion and assist with energy dissipation. This will also promote diffuse flow and decrease the velocity of water released downgradient towards seep wetland 1 and CVB wetland 3. The Stormwater Management Plan compiled by Zutari (2024b) is to be updated to include input from a Landscape and Open Space Planning consultant and freshwater ecologist to determine the system characteristics required to prevent excessive erosion of the downgradient seep and CVB wetland whilst also limiting the creation of habitat for birds which provide a safety risk for aircraft. The design and operation must prevent erosion and/or gully formation as this will have an impact on the water dispersal into and

across the seep wetland 1 and CVB wetland, which could potentially reduce the extent and functionality of the wetland systems in the long-term.

All materials used to construct the attenuation ponds must not generate toxic leachates or lead to significant changes in pH or dissolved salt concentrations. No plastic lining may be used as part of the attenuation pond construction as this has various ecological impacts.

It is recommended that the attenuation ponds be vegetated with indigenous wetland and / or riparian vegetation (with input from a suitably qualified avifaunal specialist) to assist with water polishing, trapping nutrients and hydrocarbons from the proposed CWA development before this is released into the surrounding environment.

Stormwater/attenuation pond surfaces should be closed off to prevent avifauna from congregating to these areas, notably waterfowl and larger bird species which pose a risk to aircraft. The **Wildlife Hazard Management Plan (Annexure 11)** needs to be implemented which addresses aspects associated with open water bodies.

With regards to concrete works for the outlet structures (including concrete aprons, reno mattresses, gabions, headwalls, etc., as applicable), see control measures related to concrete works. These must ideally be constructed during the drier summer months to reduce the impact on water quality of the seep wetland 1. Litter traps must be installed at all the outlet structures to prevent any litter from entering the freshwater ecosystems. Sediment trapping devices must be utilised downgradient of where works are to be undertaken within seep wetland 1 and upgradient of the CVB wetland 3.

All exposed soils must be protected for the duration of the construction phase with a suitable geotextile (e.g. Geojute or hessian sheeting) to prevent erosion and sedimentation.

Care must be taken at all times to prevent erosion of soils on the construction site. Suitable measures must be put in place to ensure that no sediment runoff from cleared areas enters any downstream/downslope habitat units which may lead to altered habitat conditions. Should any erosion be detected on site, the ECO, RE or Site Manager must identify the cause of such erosion and ensure that the most appropriate method of mitigation or stabilisation is employed as soon as possible.

4.3.8 Dust Control

Dust generated from all the activities of the development must comply with the NEM: AQA, National Dust Control Regulations (Government Notice No. R. 827) of 1 November 2013. These regulations prohibit a person from conducting any activity in such a way as to give rise to dust in such quantities and concentrations that the dust, or dust fallout, has a detrimental effect on the environment, including human health.

"Good practice" dust suppression measures must be implemented, such as:

- Apply wet/ chemical suppression on the main site roads.

- Implement a speed limit of 30km/hour on unpaved roads on site.
- Give preference to routes away from the western site boundary.
- Reduce the frequency of disturbance of stockpiles.

Dust monitoring along the western, southern and northern boundaries of the site is recommended to be conducted on a monthly basis during construction and to be reported quarterly to the authorities.

Dust suppression techniques must be implemented throughout the construction phase to ensure dust does not impact the CVB or seep wetlands, which could affect turbidity of the water and impact on wetland vegetation.

All exposed soils must be protected for the duration of the construction phase with a suitable geotextile (e.g. Geotextile or hessian sheeting) to prevent dust generation that could potentially result in vegetation smothering. Timing of bulk earthworks is important to avoid large open areas exposed during the December holidays. Mulch generated on site from vegetation chipping, strawbales, hardening and compaction soon after clearing and the application of Dustex is some of the most effective methods to be applied. Watering down large areas partly effective but the use of large volumes of potable water is discouraged. None-potable sources need to be sourced and used.

Dust and debris control must also be implemented to minimize the impacts on the local roads, residents and neighbouring properties. Where necessary, access routes and the site itself should have an effective dust suppression management programme applied, such as the use of non-polluting chemicals that will retain moisture in the exposed site surfaces.

4.3.9 Construction Traffic Management

Movement of all construction vehicles on site is to be strictly limited to existing haul and access routes at all times (to reduce any unnecessary compaction). Should deviation from these routes be necessary for any reason, this is to be with approval of the ECO who is to ensure that no significant environmental damage results. Rerouting of construction traffic away from the Poultry Farm, where possible.

No indiscriminate movement of vehicles through the freshwater ecosystems may be permitted. Planning of temporary roads and access routes should avoid freshwater ecosystem areas and be restricted to existing or pre-approved access roads and should not traverse the freshwater ecosystem.

All vehicles must remain outside the conservation buffers, unless required as part of a specific construction activity for a short period of time. This should also be limited to the drier summer season, where possible.

Quarries can be accessed from the CWA either via the existing surfaced road network or the gravel road network. Due to the poor condition of the gravel roads and the heavy loads expected, it is recommended that trucks use the surfaced road network.

All deliveries are to be scheduled outside peak hours to prevent congestion during peak periods.

Vehicles must be maintained regularly and kept in a good working order, and park on hardstand areas with appropriate drainage and catchment systems, where possible. Drip trays to be used under stationary vehicles and machinery where possible.

In the event of a vehicle breakdown, maintenance of vehicles must take place with care and the recollection of spillage should be practised near the surface area to prevent ingress of hydrocarbons into topsoil and subsequent habitat loss. All spills should they occur, should be immediately cleaned up and treated accordingly. Dedicated parking area for construction vehicles must be located away from sensitive areas, and drip trays must be located beneath any leaking equipment and lubricant/fuel absorbing media (moss/peat type products) within drip trays must be used to contain spilled material.

Public road junctions should have good sightlines, traffic control measures, wayfinding signage, and dust control measures in place. The construction project management team must enforce dust and mud control measures and protocols at construction site entrances. This is especially important for construction entrances that deliver construction vehicle traffic onto the R312 Scenic Route, where poor management of dust and mud will have a negative impact on the visual amenity of the scenic route. Ensure that no views from R312 or R304 are negatively impacted by large or numerous construction signage, fencing or hoarding.

4.3.10 Site Clean Up

The Contractor must ensure that all structures, equipment materials and facilities used on site are removed once the project has been completed. The construction site shall be cleared and cleaned to the satisfaction of the ECO.

Disturbed areas, particularly associated with the CVB wetlands 2 and 3 with regards to the maintenance road and fences that will traverse these wetlands must be rehabilitated once construction activities have ceased. The **Wetland Offset Study and Implementation Plan (Annexure 7)** needs to be adhered to in terms of the rehabilitation of wetlands.

The on-site no-go areas will be managed in terms of this EMPr and in accordance with the Alien Vegetation Management Plan, Veldfire Management Plan and Landscape Plan. These areas will further be fenced during construction.

The Final Completion of the landscape installation should be made a condition for final occupancy certificates to be issued during the Construction phase. This is to ensure that the landscape installation accompanies (and is completed during) the construction phase of its associated building/s, precinct, erven etc.

The botanist must provide input into the Landscaping Plan for the site, which must include a significant indigenous Sand Fynbos and Renosterveld appropriate plant component, in an attempt to maximise biodiversity rehabilitation, whilst adhering to the required airport safety guidelines. Areas that will not be hardened surfaces and that would benefit from rehabilitation should be hydroseeded with appropriate seed mixes, at the appropriate time (late autumn).

4.3.11 Alien Clearing

All invasive alien vegetation in the conservation areas on site must be removed within one year of any project approval, using appropriate methodology (see Martens et al 2021), by qualified personnel. Ongoing annual alien vegetation removal must be undertaken.

Proliferation of alien and invasive species is expected within any disturbed areas. Whilst not considered severe at this time, the vegetation component within the freshwater ecosystem environment is already transformed. However, alien invasive species are opportunistic, and where disturbances do occur, they will promulgate; therefore, these species should be eradicated and controlled to prevent their spread beyond the project footprint. Alien plant seed dispersal within the top layers of the soil within footprint areas, that will have an impact on future rehabilitation, has to be controlled.

Removal of the alien and weed species encountered within the freshwater ecosystem must take place in order to comply with existing legislation (amendments to the regulations under the Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983) and Section 28 of the National Environmental Management Act, 1998 (Act No. 107 of 1998).

Species-specific and area-specific eradication recommendations:

- Footprint areas should be kept as small as possible when removing alien plant species; and
- No vehicles should be allowed to drive through designated sensitive freshwater ecosystems areas during the eradication of alien and weed species.

An Alien Vegetation Management Plan has been compiled for the Construction and Operational Phase of the Development. The Alien Vegetation Management Plan outlines a comprehensive strategy for the complete eradication of alien invasive plants and the long-term maintenance of the site in an alien-free condition. This plan aims to ensure compliance with airport safety standards, restore ecological functioning, and improve habitat quality, particularly in areas of botanical sensitivity and ecological importance.

To achieve these goals, the plan focuses on meeting the following objectives:

- Identify and confirm areas for alien vegetation clearing.
- Establish methods for effective alien clearing, including necessary follow-up actions.
- Provide a realistic program with clear targets for the clearing process.
- Promote the conservation of indigenous plant species within the property.
- Support job creation and skills development in local communities.
- Ensure the sustainable reuse of cleared biomass to maximize environmental benefits.

Ongoing monitoring for the establishment of alien and invasive vegetation species must be undertaken periodically within and around the subject site.

The **Alien Vegetation Management Plan (Annexure 6)** needs to be implemented.

4.3.12 Fire Prevention/ Management

SANS 10400–T: 2024 and the Community Fire Safety By-law, Provincial Gazette 5832 (as amended 29 June 2007 and 21 August 2015) is to be complied with.

The Contractor shall ensure that basic fire-fighting equipment is available at all 'construction' areas and facilities. The workforce should be appropriately trained in the use of all equipment. Fire beaters and "bakkie sakkie" are to be kept on site, and easily accessible at all times, and not locked away.

Smoking shall not be permitted in areas where it is a fire hazard. Such areas shall include any workshop and fuel storage areas and areas where the vegetation or other material may promote the rapid spread of an initial flame. A fire extinguisher of the appropriate type must be present when welding or other "hot" activities are undertaken.

Any work that requires the use of fire or open flame may only take place at a designated area approved by the ECO and must be supervised at all times. Serviced fire-fighting equipment shall be available.

No fires should be permitted in or near the construction area.

The **Veld Fire Management Plan (Annexure 5)** needs to be implemented in accordance with firebreaks, controlled burns and the general management of VeldFires.

4.3.13 Construction Monitoring Requirements:

The management of construction light impacts at night must be monitored by the ECO and included in compliance reporting. The ECO must monitor use of light and levels of light pollution by means of regular spot-checks, to be included in monthly compliance reporting.

The ECO must conduct a lighting audit at the end of each Construction phase, to ensure that conditions regarding the management of lighting impacts at night have been met.

Refer to '*Section 4.2.2 Site Establishment Requirements*', Point G, above with regard Groundwater and Noise Monitoring Networks/ Plan.

Dust monitoring along the western, southern and northern boundaries of the site is recommended to be conducted on a monthly basis during construction and to be reported quarterly to the authorities.

Continuous and periodic monitoring and evaluation are required to ensure the achievement of milestones and the overall success of achieving the socio-economic objectives envisaged for the Project. Please refer to Section 4: Goal 17.

4.3.14 Environmental Control Sheets

A. Communications

TASK	MITIGATION AND ENVIRONMENTAL CONTROLS	ACTION
Site Diary and Site Instruction Book	To be updated on a regular basis	ECO
Public complaints	To be recorded, along with records of responses to them in the Site Diary	ECO
Environmental Awareness/ Education	Each contractor team to attend a training session prior to commencing work on site Record of members attending training sessions to be kept and updated regularly	ECO
Method Statements	- Method statements to indicate: What, How, Where and When activities are to take place. - Method statements for each relevant activity to be submitted to ECO prior to the start of that activity on site. - Work is not to commence until method statement approved by ECO and Site Manager if necessary.	Contractor/ ECO
Bylaws and Regulations	All national and provincial laws and regulations, as well as all local authority bylaws and regulations which apply to the development of this site are to be adhered to.	Contractor/ ECO/ EM

COMMENTS/ UPDATE

RECORD OF PERFORMANCE

Acceptable		Details of Transgression	Responsible Party	Action Taken	Date
Yes	No				

B. Site Preparation

TASK	MITIGATION AND ENVIRONMENTAL CONTROLS	ACTION
Site demarcation & definition in terms of Sensitive features: Botanical	Vegetation: - All authorised hard infrastructure bordering on any of the mapped areas of Very High, High and Medium sensitivity botanical areas must be surveyed and fenced off prior to any site preparation, clearing or construction. These sensitive areas may not be disturbed in any way during the construction process. Fences should be marked with signage every 15m indicating that these are "No Go Areas". Where the perimeters of these areas lie within 20m of the RESA (runway clearance area) they should be buffered by an ecological buffer area at least 5m wide that is not disturbed by any earthmoving or development. - Areas beyond the fencing are to be considered no-go areas. All areas outside the boundary of the property are naturally considered no-go areas and boundary fencing is to be secured in areas where work is to take place. - The Very High sensitivity areas falling within the Agricultural Precinct must be fenced off and excluded from grazing and trampling by livestock (especially cattle). This must be done within 60 days of authorisation, or sooner if possible (subject to landowner negotiation). - All Very High, High and Medium sensitivity areas that do not fall within the authorised development (construction) footprint should be conserved as part of any redevelopment of this site (no development and no infrastructure through these areas). Two of the Very High sensitivity areas are within the Agricultural Precinct, whilst the other two are within the Airside Precinct. - No perimeter service road may cross or disturb the mapped area of Very High sensitivity east of the main runway. - All protected elements/areas located on the site, will be clearly marked, and care should be taken by the ECO to ensure that they are not unnecessarily disturbed during construction works on site. All alien vegetation must be removed in accordance with the **Alien Vegetation Management Plan (Annexure 6)**. - Apart from the vegetation identified by the project team for removal from the site prior, no indigenous vegetation is to be removed without the written permission of the ECO. Damage to the indigenous vegetation anywhere on the site (outside of the approved area) will be subject to penalties. - Avoid unnecessary trampling of vegetation irrespective of the vegetation being associated with wetland habitats or the surrounding terrestrial area. Retain as much indigenous vegetation as possible (wetland and terrestrial). *Plant Search and Rescue*	Surveyor/Contractor/ ECO/ EM Contractor/ ECO Contractor/ ECO Contractor/ ECO Contractor/ ECO

Plant Search and Rescue	- Most of the low and medium significance occurrences of plant SoCC within the proposed development footprint (as well as some of the high significance species) can be successfully translocated, and this will be done by experienced Search and Rescue contractors prior to any site development (pre-construction phase), with the assumption that the receiving areas will be properly managed in perpetuity as plant conservation areas. This must be done in consultation with the botanical specialist and can proceed prior to any authorisation (provided all necessary permits and permissions are obtained).	ECO/EM
	- A plant Search and Rescue plan should be prepared (prior to any development or site clearing) by the appointed S&R contractor, the ECO and the botanist, and should outline who needs to do the work, when seed, sods and cuttings need to be collected, how they should be stored, how much should be collected, how receiving sites should be identified and prepared, and how and when the planting out should be undertaken and who is responsible. Guidelines on ongoing maintenance of these areas must also be included.	ECO/EM
	- Large scale Search and Rescue of plant material from all Medium, High and Very High sensitivity areas within the development and clearing footprints must be undertaken prior to any development or disturbance of these areas. Receiving areas should ideally be located within the greater study area (provided that land tenure and funding for conservation is secure in these areas) and should be areas that support some natural vegetation remnants, but that require rehabilitation intervention. This must be overseen by the botanical consultant.	ECO
	- <u>Refer to Section 4.2.1. *F. Protection of sensitive features (Search & Rescue)* for the Search and Rescue Plan.</u>	
Freshwater Ecosystems	<u>Rivers, Riparian Habitat & Wetlands</u> - The 15m construction conservation buffer around the freshwater ecosystems must be implemented for the duration of the construction works where development will not occur to mitigate edge effects. The freshwater ecosystems and the respective conservation buffers must be clearly demarcated using a suitable barrier or material by an Environmental Control Officer (ECO) and marked as 'no-go' areas. Only authorised construction personnel may be permitted to enter these 'no-go' areas as part of the clearing activities, where required, to prevent excessive compaction of the soil within the freshwater ecosystems. (refer to Figure 25) - Any fences that are to traverse the CVB wetlands 2 and 3 must be installed in such a way that hydropedological processes are not impeded within	ECO/EM/Contractor

	these systems. It is recommended that the erection of fence posts within the CVB wetlands 2 and 3 are avoided. - All 'fencing' is to be erected prior to construction works commencing on site and is to remain in position and in good repair for the duration of the works. No materials, rubble or equipment is to be stored or stockpiled within the Environmental Sensitive Areas. Any deviations from these specifications are subject to the approval of the ECO. - Construction work, particularly of works within the 15m construction conservation buffer of the wetlands, must as far as possible be restricted to the dry, summer season. CVB wetlands 2 and 3 and the remainder of seep wetland 1 where development will not occur, and the wetlands' 15m construction phase conservation buffers must be marked as a no-go area during the construction phase of the proposed development. - Sediment trapping devices must be utilised downgradient of where works are to be undertaken within seep wetland 1 and upgradient of CVB wetland 3. - Under no circumstances must linear infrastructure be trenched within the CVB wetlands 2 and 3 or their conservation buffer. - All construction personnel, vehicles and construction work must be confined to the boundaries of the development footprint and no edge effects must occur. This is of particular importance at seep wetland 1. - Disturbed areas, particularly associated with the CVB wetlands 2 and 3 with regards to the maintenance road and fences that will traverse these wetlands must be rehabilitated once construction activities have ceased. Avoid unnecessary trampling of vegetation irrespective of the vegetation being associated with the freshwater ecosystems or the surrounding terrestrial area. - Careful planning of all construction equipment must be undertaken beforehand to ensure that the minimum impact on the freshwater ecosystems occur.	ECO/EM/Contractor
Faunal Monitoring	<u>Reptiles, birdlife and mammals</u> - Construction personnel are to be educated about the various faunal species in the area, particularly about venomous spiders, snakes and scorpions. None of these or other species are to be killed or injured by construction personnel. Should any of these species be encountered, these species are to be safely and carefully relocated to the surrounding natural habitat adjacent the development site, should they not move off on their own. - The contact details of a suitably qualified snake handler be made available to construction teams should a venomous snake be encountered that needs removal. Alternatively, it is recommended that a member of the construction team be trained to handle and remove snakes through a recognised snake handling course.	ECO/EM/Contractor

	- No hunting, trapping or collecting of faunal and avifaunal species is to be allowed, other than for rescue and relocation purposes. Setting of snares by personnel is to be prohibited.	ECO/EM/Contractor
Fossil Finds (refer to Annexure 4)	<u>Archaeological remains</u> If any heritage remains are found Heritage Western Cape (HWC) needs to be informed. If heritage remains are disturbed it should be left and demarcated for inspection by HWC. If any archaeological remains (including but not limited to fossil bones and shells, coins, ceramics, antique, marine shell heaps, stone artefacts and bone remains) are discovered HWC need to be notified. If any graves or human remains are discovered HWC need to be notified.	ECO/Contractor
Agricultural Precinct	<u>Agricultural Precinct</u> No construction phase activities may be undertaken within the Agricultural Precinct.	
Geohydrological	<u>Geohydrological</u> Due to the proximity of the Colenso Fault to the CWA, a no-go area for specific high-risk activities is proposed to the northeastern section of the study area. This no-go area does not have to apply to all activities, but only to certain high-risk activities such as the aviation fuel farm, bulk fuel storage, retail service station or other activities that are considered high risk. However, as this area falls within the Agricultural Area it is already considered a no-go area in terms of construction.	ECO/EM/Contractor
Site Definition and Demarcation	- All development footprint areas should remain within the demarcated areas as far as possible, and disturbance of soil profiles must be limited to what is essential with a compact footprint. - All 'fencing' is to be erected prior to construction works commencing on site and are to remain in position and in good repair for the duration of the construction phase. Once this has been done, all works, including stockpiling of construction materials are to be strictly confined to the demarcated area. - All footprint areas must remain as small as possible, vegetation clearing to be limited to the approved development footprint and should only encroach into the freshwater ecosystem if considered essential. The boundaries of footprint areas, including contractor laydown areas, are to be clearly defined and it should be ensured that all activities remain within defined footprint areas. Edge effects will need to be extremely carefully controlled. - Avifaunal habitat beyond the demarcated area should not be cleared or altered, except as needed for safety reasons around taxiways and runways. - For the construction of the maintenance road along the eastern boundary of the study area, culverts must be installed to allow the passage of water from the upgradient portions of the CVB wetlands 2 and 3 to the downgradient portions. Any disturbed areas within these wetlands must be	Surveyor/Contractor/ ECO/EM ECO/Contractor

	rehabilitated on completion of construction of the road. The maintenance road should ideally avoid seep wetland 1 and circumvent it to avoid further fragmentation of the wetland. Should this not be possible, the road must be designed in such a manner as to allow hydraulic and hydropedological process connectivity in the landscape while also allowing fauna to traverse the roadway. It is also highly recommended that cobbles be placed downgradient of the road to trap sediment and reduce flow velocity of surface water entering the wetlands.	ECO/Contractor
Vegetation Clearance	<u>Vegetation Clearance</u> - As far as possible, vegetation clearance should take place during the winter months, outside of the breeding/nesting periods of avifaunal species. - Vegetation to be removed from the site to facilitate development needs to be identified by the ECO, indicated on a site plan and clearly marked prior to any other works on site. Retain as much indigenous vegetation as possible (wetland and terrestrial). Alien vegetation directly adjacent or in close proximity to the construction area should be removed in line with alien clearing methods. - Faunal habitat beyond the demarcated area should not be cleared or altered, except as needed for safety reasons around taxiways and runways as per the Wildlife Hazard Management Plan (Annexure 11) for the airport. Site clearance activities should take place in a phase manner, starting from the South moving northwards, or centrally moving outwards, so that faunal species can flee ahead of clearance activities into adjacent habitat and not get trapped in centralised, remnant patches. - Due to the potential fire risk in the area, no vegetation may be removed using fires, and no excess vegetation material may be burned on site. No natural vegetation outside of the site may be removed without approval of the ECO, apart from invasive plant species which are to be removed according to a controlled program. - Once all vegetation clearing is complete, all vegetation and any removed excess material must be disposed of at a licensed refuse facility and may not be mulched or burned on site (unless all approvals have been obtained).	ECO/Contractor
Visual	<u>Visual</u> - All contractors and sub-contractors on site must submit a Temporary fencing, hoarding and screening protocol for active construction sites to the ECO for monitoring. - All contractors and sub-contractors on site must submit a dust and mud control protocol for active construction sites to the ECO for monitoring. - Dust management, waste management, the placement of screens and hoarding, as well as the location and management of access points to the site must be proactively managed to reduce visual clutter and limit visual impacts associated with construction activity before, during and after each	ECO/Contractor

	phase of the construction process (demolition, excavation, project execution, close-out etc., establishment, etc.). - Light pollution should be kept to an absolute minimum throughout the development, and exterior lighting must be limited to areas where this is necessary for utility, safety and security. - The goal should be to keep the ambient light levels within the immediate Receiving Environment low, given the proposed development's proximity to a rural landscape that is a protected area, and the surrounding Cultural Landscapes. Exterior lighting (and therefore any visible light sources) must be carefully directed away from sensitive receptors (Scenic routes, and viewers within the Cultural Landscape and nearby residential areas/homesteads). *Refer to Section 4.1.4 ("Lighting") above*. - Construction activities must be limited to daylight hours to prevent visual impact of lights at night. If construction during the night-time hours is unavoidable, the following should apply: • No floodlights. • Only the construction activity should be lit. • Construction lighting should be turned off when active construction activity is not being undertaken.	ECO/Contractor ECO
Monitoring Requirements: Groundwater & Noise	Implement the construction specifications and monthly groundwater quality monitoring during the construction phase in accordance with the "Proposed Groundwater Monitoring Plan (GEOSS, Sept 2024)" summarized in the EMPr: *4.2.2 Site Establishment Requirements: G. Monitoring requirements.*	EM/ECO

COMMENTS/ UPDATE

RECORD OF PERFORMANCE

Acceptable		**Details of Transgression**	**Responsible Party**	**Action Taken**	**Date**
Yes	**No**				

C. Site Procedures

TASK	MITIGATION AND ENVIRONMENTAL CONTROLS	ACTION
Noise	The contractor must take appropriate measures to limit the impact of unreasonable noise from construction activities on the neighbouring land users by providing training to the personnel to adhere to operational procedures that reduce the occurrence and magnitude of individual noisy events. Ensuring that equipment is in good working order and properly maintained. Limit night-time construction activities and avoid night-time construction activities on the property to the west of the airport boundary (earthworks), which are closer to the Fisantekraal residential area.	Contractor
Safety	- The Contractor is to appoint a safety steward, who will be responsible for safety of the labour force, construction activities and handling emergency situations on site during construction hours. - The Contractor must provide and maintain a suitable first aid kit on site, with a member of staff suitable qualified in first aid on site during working hours, in accordance with the Occupational Health and Safety Act.	Contractor
Fire control	- The contractor must take appropriate measures to guard against accidental fire, and it will be presumed that any bush fire which starts on the site, or within 100m thereof during the construction period would be the responsibility of the applicant. - No illicit fires are allowed on site. - Fire beaters and "bakkie sakkie" are to be kept on site, and easily accessible at all times, and not locked away. No open fires may be lit anywhere on the construction site, except at locations approved by the ECO and Site Manager. The burning of refuse or vegetation material on site as a means of disposal will not be allowed unless a permit for burning is issued by the competent authority. - The **VeldFire Management Plan** in **Annexure 5** must be implemented.	Contractor/ EM/ECO
Toilet facilities	- Suitable sanitary facilities must be provided by the contractor for all staff on site. The Contractor should ensure that ablutions are restricted to the sanitary facilities. - Where chemical toilets are provided, the Contractor should ensure that they are kept in hygienic condition and emptied on a regular basis. Waste from the toilets should be disposed of to the satisfaction of the ECO. - Care must be taken that no spillage occurs when chemical toilets are cleaned, and their contents are properly stored and removed off site. A	Contractor/ECO

Contractor's Camp	contingency plan for spills must be supplied by the contractor and approved by the ECO. - Toilets should be located where their use would result in minimal impact on the surrounding environment and may not be in areas of running or standing water during winter and must be secured to prevent them from blowing over. - All construction site offices, lay down areas, storage areas and active construction activities must be screened from public view by appropriate hoarding and/or screening. - Construction fencing/hoarding and signage must adhere to local policy relating to signage and ensure that no views to scenic routes are impacted by large or numerous construction signage. - All contractors and sub-contractors on site must submit a Temporary fencing, hoarding and screening protocol for active construction sites to the ECO for monitoring. iv. All contractors and sub-contractors on site must submit a dust and mud control protocol for active construction sites to the ECO for monitoring. - Site offices, storage and lay down areas, loading areas and similar temporary infrastructure should be situated centrally on the subject site and avoid any areas visible from the Scenic route.	Contractor/ECO
Material handling and storage	- Fuels and flammable materials are to be stored in suitably equipped storage areas. These areas shall comply with general fire safety requirements. Impervious materials are to be used in these storage areas to prevent contamination of the ground in the event of spillages or leaks. Quantities of fuels and hazardous materials stored on site should be appropriate to the requirement for these substances on site. - Bulk fuel depots are to be placed within hardened bunded areas. Bunds are to have a holding capacity equal to 110% of the largest fuel container. The Contractor is to ensure that he is aware of the effects of all substances on staff and the environment, with the correct action to take in the case of any incident involving these materials. - Contractor laydown areas, vehicle re-fuelling areas and material storage facilities to remain outside of the respective conservation buffers of the freshwater ecosystems and preferably the 32m NEMA ZoR. A designated contractor laydown area must be approved by an independent ECO prior to use. Stockpiles must be placed outside the delineated freshwater ecosystems and 32m thereof. - All hazardous chemicals as well as stockpiles should be stored on bunded surfaces and have facilities constructed to control runoff from these areas. It must be ensured that all hazardous storage containers and storage areas comply with the relevant SABS standards to prevent leakage. - Fresh asphalt, concrete and cement mortar must not be mixed near the wetlands' habitat. Mixing of cement may be done within the construction camp, on an impervious surface only, and must be within a lined, bound or bunded portable mixer. Consideration must be given to the use of ready-mix concrete.	Contractor Contractor Contractor/ ECO

Asphalt / Concrete Works	- No mixed concrete maybe deposited directly onto the ground within the wetlands or associated wetland habitat, outside of the designated area (i.e. fence traversing the seep wetland 1 and CVB wetlands 2 and 3). Any areas that require manual application of cement require that mixed cement be placed on a batter board or other suitable platform/mixing tray until it is deposited. - A washout area must be designated outside of the wetlands, and wash water must be treated on-site or discharged to a suitable sanitation system. - At no point may batter boards/mixing trays or cement trucks be rinsed off on site and runoff water be allowed into the freshwater ecosystems. - Cement bags (if any) must be disposed of in the demarcated hazardous waste receptacles and the used bags must be disposed of through the hazardous substance waste stream. - Spilled or excess concrete must be disposed of at a suitable landfill site. Chain of custody documentation must be provided.	Contractor/ ECO
Soil disturbance and revegetation	- It is considered imperative that all excavation activities be undertaken during the drier summer months to limit surface water contamination and the need for any surface water diversion during the construction works. - Sheet runoff from compacted areas should be slowed down by the strategic placement of berms. It is considered ideal that activities occur within the current season (low rainfall) to minimise impacts of sedimentation. As much vegetation growth as possible (of indigenous floral species) should be encouraged to protect soils. Temporary stockpiling of excavated material from trenches can be retained alongside trenches, as required for backfilling. Any soil to be stockpiled for longer than a month should be moved to a designated stockpile area, as approved by the Environmental Control Officer (ECO). All soils compacted during the repair and maintenance phase should be ripped and profiled. All soil compacted within the wetlands as a result of construction equipment must be loosened prior to revegetation with suitable indigenous species. A monitoring plan for the development and the immediate zone of influence should be implemented to prevent erosion and incision. - Areas disturbed (for any reason) must be revegetated (or planted as per the approved Landscape Master Plan) within a maximum of 1 year after the disturbance occurs. • The only circumstances under which delay may be tolerated are a) If the area to be revegetated/planted is still an active construction site; and b) If the revegetation/planting must happen during a particular season to await optimal planting conditions. In these cases, revegetation/planting must occur in the first of such season after the delay. • The ECO must report on disturbed areas and revegetation. - All embankments must be appropriately stabilized and revegetated to match the existing/surrounding natural vegetation. - Rehabilitation/revegetation must be handled in accordance with the recommendations of the botanist or other suitably qualified specialist, and under the supervision of the ECO. - During excavation activities, topsoil must be stockpiled separately from other material. The mixture of the lower and upper layers of the excavated	Contractor/ECO/ EM

	soil must be kept to a minimum, so as for later use as backfill or rehabilitation material after construction has commenced. - Exposed soils must be protected from wind and water erosion (using tarpaulins or a suitable geotextile) for the duration of the construction phase.	
Trenching and Stockpiling Activities	- Any AIPs within the study area (including the linear infrastructure footprints) must ideally be removed prior to soil stripping to reduce seed loads within the topsoil (which will be used to revegetate post construction). This will assist in reducing the long-term AIP management requirements. - Any soil/sediment or silt removed from the freshwater ecosystems may be temporarily stockpiled outside the freshwater ecosystems if construction activities are confined to the dry summer months. Excavated materials may not be contaminated (with hydrocarbons, fuel, etc.). It must be ensured that the minimum surface area is taken up, and the stockpiles may not exceed 2m in height. Mixture of the lower and upper layers of the excavated soil should be kept to a minimum, so as for later usage as backfill material. - With the exception of the infrastructure as described in this report (the potable water and stormwater infrastructure along the eastern boundary of the runway), no pipelines may traverse any of the freshwater ecosystems. Should additional freshwater ecosystem crossings be considered, the DWS Risk Assessment must be updated to account for these activities. Water and stormwater pipelines to be trenched in the freshwater ecosystems must be installed during the drier summer months to prevent water quality impacts to the freshwater ecosystems. Unused excavated soil/sediment must be utilised as part of the open space areas (if applicable) or be removed from site to a registered landfill.	Contractor/ECO
Trenching and Stockpiling Activities	- The soil surrounding the linear infrastructure, particularly within 15m of the freshwater ecosystems must be suitably loosened on completion of construction activities and revegetated to prevent erosion. - In addition to the above, with regards to excavation and soil compaction activities regarding trenching for the linear infrastructure within the 15m construction conservation buffer of the freshwater ecosystems, stockpiling of removed materials may only be temporary (i.e. may only be stockpiled during the period of construction at a particular site) and must be disposed of at a registered waste disposal facility. Soil must be stockpiled on the upgradient side of the trench to avoid sedimentation of the downgradient areas. Figure 26 above shows excavation for trenching with stockpiles alongside. - Trenches must be backfilled as soon as the infrastructure has been installed in any given section to reduce potential erosion of exposed soil. Material used as bedding material (at the bottom of the excavated trench) must be stockpiled outside of the freshwater ecosystems. Once the trench has been excavated, the bedding material must directly be placed within the trench rather than stockpiling it alongside the trench. - Under no circumstances must linear infrastructure be trenched within the CVB wetlands 2 and 3 or their conservation buffer. The SDP Indicates that the layout of the linear infrastructure avoids wetlands. A 5m RoW for linear developments is considered as part of the RAM. This is of particular relevance to the installation of the water pipeline, fences and maintenance road along the eastern boundary of the study area. It is highly recommended that construction work for the linear infrastructure is	Contractor/ECO

Waste Management	undertaken in the drier, summer period to avoid excess sediment entering the receiving freshwater ecosystems. General Waste - Waste management during the construction phase is the responsibility of the Contractor. The Contractor must establish a system acceptable to the ECO for control during execution of the works. Refuse generated during the execution phase should be managed according to the guidelines for waste management and recycling adopted for the life-cycle of the project. - Waste must be identified and analysed for reduction, re-use and recycling opportunities; - Arrange for storage and transportation/collection of various wastes to their final destination or use areas on-site; - Staff must be trained in waste management. - Refuse should be stored in an appropriate area on site, protected against wind dispersion and removed on a regular basis for disposal of at a permitted disposal site. No burning or burying of refuse on site should be allowed. Refuse bins must be watertight and wind-proof. - Ensuring that an adequate number of waste and "spill" bins are provided will also prevent litter and ensure the proper disposal of waste and spills. - The applicant must ensure that sufficient on-site waste management measures are in place to prevent any escape of waste, litter and packaging materials etc. into the surrounding landscape. - A weekly litter patrol must be included in the Construction activities on site and monitored for compliance by the ECO. Pollution - Pollution of the development footprints (either through the leaking of chemicals such as oil and fuel, or through discarding of waste), as well as any areas adjacent to these footprints, should be monitored and avoided. - Dirty water should be captured, to be re-used where possible. No dirty water is allowed to be discharged into the surrounding environment. A dewatering plan to be developed prior to construction (where required). Should this be required, the dewatering plan could be devised by a professional. It is important that if the water is to be released back into the environment, it should be done under the guidance of relevant regulations and supervised/monitored by an appropriately qualified professional. Eating areas - Contractor shall remove waste from the site on a daily basis. The **Waste Management Plan (Annexure 8)** needs to be implemented. - All mechanical equipment and work vehicles which may be kept on site are to be stored, serviced and refuelled only at designated areas within the Contractor's Camp. Within these areas drip trays and other impervious materials, for example plastic or metal sheeting are to be used to prevent contamination of the ground in any way. - In all events all machinery and vehicles used during construction must be maintained to prevent oil leaks. If breakdowns occur these must be towed offsite site to the designated areas/workshops. The proposed will ensure	Contractor/ECO/ EM Contractor/ECO

Maintenance of equipment	that incidental oil spills and leakage are minimised onsite and thus limit any opportunities of water contamination and water quality deterioration. - The Applicant or ECO may order the removal of equipment that is causing continual environmental damage by leaking oil or diesel for example, until such equipment has been repaired.	
Stormwater and Erosion Control/ management	- Soil erosion by wind, during construction, should be mitigated by minimizing bare soil surfaces without adequate protection, either by applying a mulch cover or wetting the surface or similar action. - Suitable run-off and soil erosion control measures and infrastructure should be designed and implemented to limit and restrict the loss or degradation of soil. - The release of run-off water into existing streams should be controlled to minimize impact on vleis, marshes, water sponges and water courses. This activity may include a permitting application to the DWS. - Implementation of strict erosion control measures to limit loss of soil and sedimentation of the watercourse within the proposed development footprint. No stormwater generated during construction may be directly released into the freshwater environment. - Increased surface sealing as a result of the proposed development will result in decreased infiltration as bulk of the stormwater from sealed or paved surfaces are generally discharged in stormwater systems. The exception to this is where runoff is localised and directed to unsealed surfaces or adjacent watercourses in an attenuated manner. - Water from clean water diversion structures should be discharged back into the adjacent wetland features in an attenuated manner.	Contractor/ ECO/EM
Stormwater and Erosion Control/ management	- Subsurface lateral flow of water through the landscape (under seep wetlands and interflow soils) must be taken into account and buildings/structures should accommodate waterproofing and water management structures to divert laterally seeping water away from foundations into the gardens or storm water structures. - The **Stormwater Management Plan (Annexure 10)** needs to be implemented which includes the Freshwater Consultants input. - Installation of appropriate stormwater systems with catch pits to isolate fuel and other contaminants. Petrol interceptors might be considered to mitigate the risks of contaminants draining into the environment. Silt traps must be installed at any stormwater release areas and energy dissipating structures to ensure that erosion of the area does not occur. - All attenuation facilities must be constructed through excavation of the in-situ material, sloped to a ratio not steeper than 3:1 and lined with rocks and cobbles to assist with energy dissipation and prevent sedimentation and erosion as well as improve the aesthetic appeal of the attenuation ponds. Attenuation ponds must be vegetated with indigenous obligate and facultative species suitable for seasonal saturation with input from a suitably qualified avifaunal specialist. Given the nature of the development, vegetating the dry attenuation ponds may not be possible. This will assist with energy dissipation and prevent sedimentation and erosion as well as improve habitat provision. Figure 27 above shows examples of swales utilised for conveyance of stormwater. - Cobbles must be placed on all outlet structures and indigenous vegetation established to bind the soil of the bed, to prevent erosion and assist with	Contractor/ ECO/EM

Stormwater and Erosion Control/ management	energy dissipation. This will also promote diffuse flow and decrease the velocity of water released downgradient towards seep wetland 1 and CVB wetland 3. The Stormwater Management Plan needs to be adhered too. - All materials used to construct the attenuation ponds must not generate toxic leachates or lead to significant changes in pH or dissolved salt concentrations. No plastic lining may be used as part of the attenuation pond construction as this has various ecological impacts. - It is recommended that the attenuation ponds be vegetated with indigenous wetland and / or riparian vegetation (with input from a suitably qualified avifaunal specialist) to assist with water polishing, trapping nutrients and hydrocarbons from the proposed CWA development before this is released into the surrounding environment. - Stormwater/attenuation pond surfaces should be closed off to prevent avifauna from congregating to these areas, notably waterfowl and larger bird species which pose a risk to aircraft. The Wildlife Hazard Management Plan (Annexure 11) needs to be implemented which addresses aspects associated with open water bodies. - With regards to concrete works for the outlet structures (including concrete aprons, reno mattresses, gabions, headwalls, etc., as applicable), see control measures related to concrete works. These must ideally be constructed during the drier summer months to reduce the impact on water quality of the seep wetland 1. Litter traps must be installed at all the outlet structures to prevent any litter from entering the freshwater ecosystems. Sediment trapping devices must be utilised downgradient of where works are to be undertaken within seep wetland 1 and upgradient of the CVB wetland 3. - All exposed soils must be protected for the duration of the construction phase with a suitable geotextile (e.g. Geojute or hessian sheeting) to prevent erosion and sedimentation. - Care must be taken at all times to prevent erosion of soils on the construction site. Suitable measures must be put in place to ensure that no sediment runoff from cleared areas enters any downstream/downslope habitat units which may lead to altered habitat conditions. Should any erosion be detected on site, the ECO, RE or Site Manager must identify the cause of such erosion and ensure that the most appropriate method of mitigation or stabilisation is employed as soon as possible.	Contractor/ ECO
Dust control	- "Good practice" dust suppression measures must be implemented, such as: • Apply wet suppression on the main site roads. • Implement a speed limit of 30km/hour on unpaved roads on site. • Give preference to routes away from the western site boundary. • Reduce the frequency of disturbance of stockpiles. - Dust monitoring along the western, southern and northern boundaries of the site is recommended to be conducted on a monthly basis during construction and to be reported quarterly to the authorities. - Dust suppression techniques must be implemented throughout the construction phase to ensure dust does not impact the CVB or seep wetlands, which could affect turbidity of the water and impact on wetland vegetation. - All exposed soils must be protected for the duration of the construction phase with a suitable geotextile (e.g. Geotextile or hessian sheeting) to prevent dust generation that could potentially result in vegetation	Contractor/ ECO

Construction traffic management	smothering. Timing of bulk earthworks is important to avoid large open areas exposed during the December holidays. Mulch generated on site from vegetation chipping, strawbales, hardening and compaction soon after clearing and the application of Dustex is some of the most effective methods to be applied. Watering down large areas partly effective but the use of large volumes of potable water is discouraged. None-potable sources need to be sourced and used. - Dust and debris control must also be implemented to minimize the impacts on the local roads, residents and neighbouring properties. Where necessary, access routes and the site itself should have an effective dust suppression management programme applied, such as the use of non-polluting chemicals that will retain moisture in the exposed site surfaces. - Movement of all construction vehicles on site is to be strictly limited to existing haul and access routes at all times (to reduce any unnecessary compaction). Should deviation from these routes be necessary for any reason, this is to be with approval of the ECO who is to ensure that no significant environmental damage results. No indiscriminate movement of vehicles through the freshwater ecosystems may be permitted. Planning of temporary roads and access routes should avoid freshwater ecosystem areas and be restricted to existing or pre-approved access roads and should not traverse the freshwater ecosystem. All vehicles must remain outside the conservation buffers, unless required as part of a specific construction activity for a short period of time. This should also be limited to the drier summer season, where possible. - Vehicles must be maintained regularly and kept in a good working order, and park on hardstand areas with appropriate drainage and catchment systems, where possible. Drip trays to be used under stationary vehicles and machinery where possible. - In the event of a vehicle breakdown, maintenance of vehicles must take place with care and the recollection of spillage should be practised near the surface area to prevent ingress of hydrocarbons into topsoil and subsequent habitat loss. All spills should they occur, should be immediately cleaned up and treated accordingly. Dedicated parking area for construction vehicles must be located away from sensitive areas, and drip trays must be located beneath any leaking equipment and lubricant/fuel absorbing media (moss/peat type products) within drip trays must be used to contain spilled material. - Public road junctions should have good sightlines, traffic control measures, wayfinding signage, and dust control measures in place. The construction project management team must enforce dust and mud control measures and protocols at construction site entrances. This is especially important for construction entrances that deliver construction vehicle traffic onto the R312 Scenic Route, where poor management of dust and mud will have a negative impact on the visual amenity of the scenic route. Ensure that no views from R312 or R304 are negatively impacted by large or numerous construction signage, fencing or hoarding. - Quarries can be accessed from the CWA either via the existing surfaced road network or the gravel road network. Due to the poor condition of the gravel roads and the heavy loads expected, it is recommended that trucks use the surfaced road network. All deliveries are to be scheduled outside peak hours to prevent congestion during peak periods.	Contractor/ ECO

	- A detailed construction traffic management plan must be developed for the CWA, ensuring that deliveries are scheduled outside peak hours to prevent congestion during peak periods etc. This will be done once a suitable contractor has been appointed.	
	- The Contractor must ensure that all structures, equipment materials and facilities used on site are removed once the project has been completed. The construction site shall be cleared and cleaned to the satisfaction of the ECO. - Disturbed areas, particularly associated with the CVB wetlands 2 and 3 with regards to the maintenance road and fences that will traverse these wetlands must be rehabilitated once construction activities have ceased. The **Wetland Offset Study and Implementation Plan (Annexure 7)** needs to be adhered to in terms of the rehabilitation of wetlands.	
Site Clean up	- The on-site no-go areas will be managed in terms of this EMPr and in accordance with the Alien Vegetation Management Plan, Veldfire Management Plan and Landscape Plan. These areas will further be fenced during construction.	Contractor/ ECO
Site Clean up	- The Final Completion of the landscape installation should be made a condition for final occupancy certificates to be issued during the Construction phase. This is to ensure that the landscape installation accompanies (and is completed during) the construction phase of its associated building/s, precinct, erven etc.	Contractor/ ECO/EM
	- The botanist must provide input into the Landscaping Plan for the site, which must include a significant indigenous Sand Fynbos and Renosterveld appropriate plant component, in an attempt to maximise biodiversity rehabilitation, whilst adhering to the required airport safety guidelines. Areas that will not be hardened surfaces and that would benefit from rehabilitation should be hydroseeded with appropriate seed mixes, at the appropriate time (late autumn).	
	The **Alien Vegetation Management Plan (Annexure 6)** needs to be implemented.	
	The **Veld Fire Management Plan (Annexure 5)** needs to be implemented.	
Alien Clearing	- The management of construction light impacts at night must be monitored by the ECO and included in compliance reporting. The ECO must monitor use of light and levels of light pollution by means of regular spot-checks, to be included in monthly compliance reporting.	Contractor/ ECO/EM
Fire Prevention/ Management	- The ECO must conduct a lighting audit at the end of each Construction phase, to ensure that conditions regarding the management of lighting impacts at night have been met. - Refer to the groundwater and noise monitoring under the '*B. Site Preparation'* table above.	Contractor/ ECO/EM
	- Dust monitoring along the western, southern and northern boundaries of the site is recommended to be conducted on a monthly basis during construction and to be reported quarterly to the authorities.	ECO/EM

Construction Monitoring Requirements		
TASK	**MITIGATION AND ENVIRONMENTAL CONTROLS**	**ACTION**
COMMENTS/ UPDATE		
RECORD OF PERFORMANCE		

Acceptable		**Details of Transgression**	**Responsible Party**	**Action Taken**	**Date**
Yes	**No**				

4.4 Operational Management Plan (incl. Maintenance and Rehabilitation)

4.4.1 Components of Operational Management

- Goals: The key environmental goals are set for the operation of the development
- Objectives: These are set to meet the goals.
- Risk: If the goal is not achieved.
- Actions: Measures put in place to achieve objectives.
- Monitoring: To check if the objectives are achieved.
- Targets: Indicators of the effectiveness of the programme.
- Remedial Action: If targets are not met.

4.4.2 Goals (Operational Management Outcomes and Actions):

GOAL 1: SAFEGUARD GEOHYDROLOGICAL AND GROUNDWATER FEATURES		
Objective	**Effective containment, distribution and storage of fuel and other chemical substances.**	
Risk	**Actions & Monitoring:**	**Targets**
Potential impact on groundwater quality deterioration because of leaks from fuel storage and distribution.	Tank (USTs) and pipe integrity testing shall be carried out in the following instances: Following installation of a new UST and associated underground pipework or following repair, maintenance or upgrade of an existing UST or underground pipework (or both). Testing shall be carried out prior to burial of the installation. When ownership of the UST and associated underground pipework changes. When leak detection monitoring methods that may be in place, such as Stock Inventory Reconciliation Analysis, Automatic Tank Gauging (with a reconciliation facility) or interstitial vapour or liquid monitoring of double-walled or jacketed steel tanks, indicate the possibility of a leak. In this instance, an investigation into the possible leak, including integrity testing in the final stages of the investigation, shall be used to track the reasons for a failure to reconcile. Where continuous leak detection monitoring, such as Stock Inventory Reconciliation (SIR), is not carried out at a site. In this instance, UST and associated underground pipe integrity testing should be carried out every 2 years. If USTs and underground	Enforcement of the Groundwater Monitoring Action Plan. No leaks or groundwater contamination.

	pipes do not operate with a continuous leak detection system, but do have cathodic protection installed, then this period may be extended to 10-year intervals. USTs are to be fitted with a monitoring tube to allow for the monitoring of leaks through the tank surface. Leak detectors are to be installed to the submersible pumps within UST manholes to ensure that there are no line leaks. A relatively inexpensive soil vapour monitoring installation must be installed which can be monitored on a frequent basis (monthly intervals) using a Photo Ionisation Detector (PID) e.g., Mini RAE 2000. The installation of Soil Vapour Sampling Points will require the placement of a permeable coarse clean sand layer beneath the storage tanks for a vertical depth of approximately 0.5m to 1m in order to locate the vents in the 16mm diameter monitoring pipe over portion of this depth. Observation wells must be installed in the sand fill surrounding the underground storage tanks for regular monitoring purposes. Continuous electronic monitoring (CEM) of product must be carried out. Should discrepancies occur an alarm will be triggered and site management will review the finding and take appropriate action to rectify the situation as required. <u>Fuel Containment Area</u> No washing in this area is allowed. <u>Petrol filling station Underground Storage Tank (UST) and pipework installations:</u> All containment manholes must be regularly inspected as part of the normal management procedures at the service station. Any repair work required is to be conducted according to SABS 1535 (Glass-reinforced polyester-coated steel tanks, including jacketed tanks, for the underground storage of hydrocarbons and oxygenated solvents and intended for burial horizontally). <u>Forecourt Dispensing Area:</u> Once the wash water has passed through the system, the separated oil must be collected regularly by an approved waste contractor and removed to an approved hazardous waste disposal facility. <u>No compounds containing to PFCs are to be used on site.</u>	
Remedial Action	Should a leak be found or should the groundwater in the monitoring wells be found to be contaminated with hydrocarbons, a baseline Phase 1 Contamination Assessment should be undertaken and the site remediated in consultation with a contamination remediation consultant and the Authorities.	
Objective	**Efficient Aircraft operations (engine starting, run-ups, testing, ground manoeuvring, take-off, and landing), handling vehicles and equipment, and heating and/or cooling systems.**	
Risk	**Actions**	**Monitoring**	**Targets**

Potential impact on groundwater quality deterioration because of atmospheric deposition.	Where vehicles are required for airport operation, make use of electrical vehicles as opposed to conventional combustion engine powered vehicles. Reduce/minimise traffic requirements/ground support vehicles for aircraft operations where possible. Also refer to **Goal 12: Air Quality Control** below.	Implement the Groundwater Monitoring Plan below.	Reduce carbon emissions.
Remedial Action	Non-compliance to be reported to the Applicant and the Competent Authority. Penalise individuals who deviate from the targets.		
Objective	**Prevention of groundwater quality deterioration:** **Direct surface release of contaminants to the soil is that of airport rescue and firefighting (ARFF) training. During such training fires are started using oils, and other fuels (including metal, wood and other raw materials), to allow for emergency training of the fire and rescue staff to take place. Further, other than the fuels used to create fires for simulation purposes, the agents used to extinguish the fires consist primarily of foams with other additives to stabilise, ensure readiness, and allow for longevity of extinguishing agents. These additives contain perfluorochemicals (PFCs) that remain stable for long durations of time in the environment. The practises, protocols and equipment required for the safe and successful emergency operation of the facility will depend on the type of aircraft used at the airport and the scale of the airport.** **The origins of accidental releases of contaminants to the environment are electrical infrastructure (substations) and spillages by chemical storage facilities (Nunes, 2011).**		
Risk	**Actions**	**Monitoring**	**Targets**
Potential impact on groundwater quality deterioration because of direct and/ or accidental release.	For routine burns and training purposes, make use of biodegradable fuels, which once burn minimise the impact on the groundwater. Erect bunds on which training can take place to contain the waste from the fire residue as well as the extinguishing agents. Devise and design appropriate bunding for storage of chemical substances that are to be stored on site, as well as erecting the electrical infrastructure (where risk of contamination exists, i.e. substations) on appropriate bunding.	The discharge generated by training exercises will need to be monitored and analysed for several chemical parameters (to be established once the composition of the extinguishing agents used on site are known). Implement appropriate monitoring infrastructure, e.g. borehole monitoring around the sites where electrical infrastructure	Disposal or storage must be done appropriately in accordance with the National Water Act (DWS, 1998) (and relevant amendments).

		and chemicals are stored, to identify leakages and spillages from chemical storage facilities and electrical infrastructure.	
Remedial Action	It is likely that disposal and/or storage of the waste from training will give rise to the need for a Water Use License (WUL), depending on the waste composition, frequency of training and planned disposal of training residue.		
Objective	**Prevention of groundwater quality deterioration:** **Digestate leakage/leaching from facility and potential accumulation of contaminants from application of digestate to land as fertiliser. Leakages of digestate from the facility itself.** **Use of cleaning agents to ensure maximal power generation from solar panels.**		
Risk	**Actions**	**Monitoring**	**Targets**
Potential impact on groundwater quality deterioration because of bio-digestor facilities for energy generation. and/ or operation of photovoltaic solar facilities.	Proper management and design of digestate application (i.e. use as fertiliser) to areas on the property and/or surrounding areas. Monitoring of the impacts on the groundwater will need to be implemented should this biproduct of the facility be used in this way. Ensure design of facility is appropriate, e.g. include bunding in high-risk areas or where applicable, instate appropriate monitoring around facility and along relevant points through the system. Make use of biodegradable cleaning agents (solar facility) to ensure little to no impact on the quality of the groundwater is experienced.	Implement the Groundwater Monitoring Plan.	Maintain or improve baseline groundwater quality values.
Remedial Action	Non-compliance to be reported to the Applicant and the Competent Authority. Penalise individuals who deviate from the targets.		
Objective	**Prevent the over-abstraction from the borehole dropping below the regional groundwater level.**		
Risk	**Actions**	**Monitoring**	**Targets**

Potential impact due to the depletion of groundwater resources as a result of over-abstraction.	Groundwater abstraction volumes must be monitored. Water levels must be monitored and should not drop below the critical water level (refer to yield testing reports). Monitoring information must be assessed regularly (suggested monthly). If the water level in the boreholes drops below the dynamic water level. i.e. 72mbgl for CWA_BH001. and 40mbgl for CWA_BH002, and 61mbgl for CWA BH003, abstraction will immediately be reduced by 10%. This would be for normal rainfall events. If a hydrological drought persists for more than two years, the water level can drop to above the critical water level i.e. 85mgbl for CWA_BH001 and 61mbgl for CWA_BH002 and 101 mbgl for CWA BH003. Monitoring will persist for 30 days. In the event of lowered levels persisting after the initial 10% reduction, further reductions in excess of 10% must be implemented and if the low levels persist for more than 60 days, abstraction must cease until the levels have been recovered. This process will continue until the water level in the borehole is stable.	Implement the Groundwater Monitoring Plan.	Sustainable abstraction of groundwater. Implementation of best practice methods.
Remedial Action	Non-compliance to be reported to the Applicant and the Competent Authority. Penalise individuals who deviate from the targets.		
Objective	**Prevent the exposure and oxidation of minerals through the lowering of the water table.**		
Risk	**Actions**	**Monitoring**	**Targets**
Potential impact on groundwater quality deterioration as a result of over-abstraction.	Groundwater abstraction volumes must be monitored. Water levels must be monitored. Monitoring information must be assessed regularly (suggested quarterly). If an increase of 25% in electrical conductivity is observed, abstraction will immediately be reduced by 10%. Monitoring will persist after 30 days if the water quality of the borehole does not recover. In the event of poor quality persisting after the initial 10% reduction, further reductions in excess of 10% must be implemented and if quality continues to deteriorate for more than 60 days, abstraction must cease until the water quality has stabilised.	Implement the Groundwater Monitoring Plan.	Sustainable abstraction of groundwater. Implementation of best practice methods.
Remedial Action	Non-compliance to be reported to the Applicant and the Competent Authority. Penalise individuals who deviate from the targets.		
Objective	**Prevent the contamination of groundwater due to the cracking, leaking or overflow of the concrete ponds and/or pipelines (allowing the seepage of contaminants into the groundwater):**		

	a) within the WWTW and to and from inflow and outflow points; **b) pipelines containing brine from treated potable water.**		
Risk	**Actions**	**Monitoring**	**Targets**
Potential impact on groundwater quality deterioration as a result wastewater storage before treatment and/ or brine storage.	Spillages or leakages from the WWTW and/or brine ponds could contaminate the surrounding non-perennial freshwater systems and groundwater in the area. Therefore, the effluent containment ponds should be appropriately lined to avoid discharge into the subsurface, and potentially groundwater. Solid waste should be stored on concrete bunded or lined surfaces and water drainage from the solid waste should be captured and returned to the WWTW. It is recommended that **Groundwater Management Plan** compiled and implemented to ensure the groundwater quality is not affected by the operations of the WWTW or brine ponds (to be inserted into **Annexure 17**). Monitoring of the WWTW infrastructure is required to ensure that there is no loss of water in the system; flow meters measuring influent and effluent must be installed, monitored and recorded. Regular internal and external inspections and auditing of the facility must take place to ensure the infrastructure is in good working order.	Implement the Groundwater Monitoring Plan and Emergency Preparedness Plan. Frequent water quality monitoring of the treated effluent intended for re-use must be undertaken, to ensure that human well-being is not impacted by the reuse of poor-quality effluent.	Regular internal and external inspections and auditing of the facility must take place to ensure the infrastructure is in good working order.
Remedial Action	Non-compliance to be reported to the Applicant and the Competent Authority. Penalise individuals who deviate from the targets.		
Objective	**Contamination of groundwater due to:** **a) the leaking or spilling of containers storing chemicals associated with the WWTW, allowing the seepage of contaminants into the groundwater;** **b) irrigation with poorly treated waste water effluent (TSE)**		
Risk	**Actions**	**Monitoring**	**Targets**
Potential impact on groundwater quality deterioration as a result irrigation and/	Spillages or leakages from the WWTW chemical storage areas could contaminate the groundwater in the area. Therefore, the chemical storage areas should be appropriately lined with additional bunding structures to avoid discharge into the subsurface, and potentially groundwater. It is recommended that **Groundwater Management Plan** be implemented to ensure the groundwater quality is not affected by the operations of the WWTW, brine ponds or irrigation with treated effluent (to be inserted into **Annexure 17**).	Implement the Groundwater Monitoring Plan and Emergency Preparedness Plan.	Regular internal and external inspections and auditing of the facility must take place to ensure the infrastructure is in good working order.

or chemical storage associated with the WWTW.	Monitoring of the WWTW infrastructure is required to ensure that there is no loss of water in the system; flow meters measuring influent and effluent must be installed, monitored and recorded. Contaminated water used to irrigate the demarcated fields could contaminate the groundwater in the area. The WWTW needs to ensure that the water released into the environment is within the limits of the General Authorisation. Monthly monitoring of the quality of the treated effluent must take place to ensure that quality objectives are reached.		
Remedial Action	Non-compliance to be reported to the Applicant and the Competent Authority. Penalise individuals who deviate from the targets.		

Groundwater Monitoring Plan (GEOSS, February 2025):

A number of groundwater sites should be monitored at the proposed site during the construction and development phases on site. This will allow for monitoring of the groundwater quality and groundwater levels across the site. Monitoring sites need to be strategically placed, typically in the vicinity and downgradient of high-risk activities. Groundwater flow in the area generally mimics the topography, flowing towards topographical lows. A number of local monitoring sites must be located across the site to identify any potential impact of the proposed land uses. The additional monitoring sites are presented in Table 10 and illustrated in Figure 31 above to be constructed prior to the construction phase.

Groundwater Level Monitoring

Groundwater level measurements are recommended for the monitoring points at the study site. A dip meter can be used to measure the water level below the top of the borehole collar/casing height (mbch). The height of the collar/casing height must then also be measured (m). The water level (metres below ground level (mbgl)) can then be calculated by subtracting the collar/casing height from the water level (mbch). The value must be recorded along with the date and time of measurement.

Groundwater Quality Monitoring

It is recommended that the monitoring wells be purged prior to sampling. A low volume sampling pump can be used or the site can be bailed and allowed to recover prior to sample collection. When using a low volume sampling pump, the groundwater should be pumped through a flow-through cell until field chemistry parameters have stabilised.

Sample Collection, Preservation and Submission

Sample bottles must be labelled with the site name, borehole name and date. At the time of sampling, field chemistry parameters must be measured and recorded. These include electrical conductivity (EC), oxidation reduction potential (ORP), pH, temperature and dissolved oxygen (DO). During sampling, disposable nitrile gloves should be worn to minimise the transfer of any potential contaminants. Nitrile gloves should be dedicated to a sampling location and disposed of after use. Samples must be collected in an appropriate sampling container and preserved in the correct manner prior to submission to an accredited laboratory for the analysis parameters. The sample method and preservation must be discussed with the laboratory prior to sampling.

Monitoring Frequency and Parameter Analysis

In order to best understand and monitor the site, it is recommended that monthly water level measurements be taken to determine seasonal fluctuation. It is further recommended that the water quality on site is monitored on a quarterly basis for the first year, after which the frequency can be reduced based on the first year's monitoring results.

Groundwater monitoring needs to target the risk of the activity, i.e. organic and microbiological parameters need to be monitored in close proximity to the solid waste storage, WWTW and the biodigestor; BTEX, TPH and GROs need to be monitored in close proximity to fuel storage and dispensing operations, etc. Once the site is approved and the intricate details of the services are made available, a more detailed, standalone monitoring programme report will need to be developed prior to the construction and development phase. Table 11 above indicates the potential parameters for ongoing monitoring, this will be revised upon approval and development of the CWA.

A comprehensive Groundwater Management Plan must be compiled, implemented and included as **Annexure 17** prior to the proposed operational activities commencing.

PERFORMANCE

Date	Details of Transgression	Responsible Party	Action Taken

GOAL 2A: SAFEGUARD BOTANICAL FEATURES (ON-SITE)			
Objective	**All Very High, High and Medium sensitivity areas that do not fall within the authorised development (construction) footprint should be conserved as part of any redevelopment of this site (no development and no infrastructure through these areas), and ideally, they would also all be ecologically connected via rehabilitated Low sensitivity areas.**		
Risk	**Actions**	**Monitoring**	**Targets**
Potential impact/ loss of Very High, High and Medium sensitivity botanical areas.	Motor vehicle tracks and firebreaks for the operations were designed to avoid the botanical no-go areas as per the Concept landscape plan. However, the existing gravel fence line tracks will be used in its original state for security fence line and emergency patrols, no widening or additional clearance allowed along these existing tracks. Key ecological management interventions required are ongoing alien invasive vegetation management (pre and post burn) and management burns in the appropriate autumn season. An EMPr (THIS DOCUMENT) for the remaining conservation worthy areas on site (all remaining areas of Very High, High and Medium botanical sensitivity, including all such areas within the Agricultural Precinct, refer Figure 10) must be implemented, with input from the botanist where applicable, and management of these areas could be outsourced to the CoCT Environmental Management Department, provided that the applicant covers all ongoing management costs. Guidelines on ongoing maintenance of these areas within which S&R plants have been established must also be included. No spraying of herbicide should be undertaken in any conservation areas. Once all alien invasive vegetation has been removed from the conservation areas all these areas must be subject to planned (controlled) burn regimes, as this vegetation needs fire for optimal ecological functioning. The two Very High sensitivity areas are the priority areas for ecological burns, which must be undertaken in the period February to March. These burns should be professionally managed. Prior to the controlled burn firebreaks should be brushcut by hand around the perimeter of the sensitive areas (not within them) using handheld brushcutters. The botanically sensitive areas will need to be burnt every 8-12 years for optimum ecological functioning. Fire management within the site must be done according to the **Veldfire Management Plan (VFMP) in Annexure 5**. Brush cutting and mowing of open airside (hydroseeded) areas should be timed to allow for winter growth and spring flowering and early summer fruiting of most of the indigenous plant species in these areas and should thus not be undertaken between 1 June and 15 October, provided that this is not in conflict with operational safety.	The condition of all Very High, High and Medium sensitivity areas (Agricultural Precinct and on site) will be monitored every year by a suitably competent botanist (or CoCT Environmental Management Dept.), and they will make recommendations for any management changes or actions (alien clearing, lack of fire, etc.) that are needed.	Achieve optimal ecological functioning in these areas.

	Alien invasive vegetation management within the site must be done according to the **Alien Vegetation Management Plan in Annexure 6**.		
Remedial Action	Non-compliance to be reported to the Applicant and the Competent Authority. Penalise individuals who deviate from the targets. The condition of Botanical sensitivity areas will be monitored every year by a suitably competent botanist, and they will make recommendations for any management changes or actions (alien clearing, lack of fire, etc.) that are needed.		
PERFORMANCE			
Date	**Details of Transgression**	**Responsible Party**	**Action Taken**

GOAL 2B: SAFEGUARD BOTANICAL FEATURES (OFF-SITE) This Goal will eventually be replaced by the Biodiversity Offset Management Plan to be compiled in consultation with Cape Nature and CoCT once the site has been declared a Nature Reserve.			
Objective	**Biodiversity Offset**		
Risk	**Actions**	**Monitoring**	**Targets**
Permanent loss of Conservation worthy vegetation with no compensation.	Given the Endangered and Critically Endangered status of the underlying habitats, and the level of impact (Medium – High negative before mitigation) it is required that any mapped areas of remnant habitat that are lost to development should be offset by formalised conservation of high conservation priority examples of the same habitat in the region, at the appropriate ratios (as per Dept. of Forestry, Fisheries & Environment offset guidelines, 2022). The applicant, or their appointed management authority, must provide all necessary funding for all required ecological management of the site (airport site and conservation areas in Agricultural Precinct), and for the chosen and agreed biodiversity offset, in perpetuity. In accordance with the Biodiversity Offset Report (Annexure 18), prior to commencement, the applicant must conclude an offset implementation agreement(s) with a suitable person or organisation that secures in perpetuity, through suitable legal protection mechanisms, an area (or areas) meeting the following criteria: • be within the Klipheuwel Corridor region of the City of Cape Town's Biodiversity Network, or if proof of no such site being available is provided, then another priority area acceptable to the City's Biodiversity Management branch and CapeNature. • contain in aggregate not less than 77 ha of Swartland Renosterveld (or closely related ecosystems) in good ecological condition. An area of 89ha will be set aside for the biodiversity offset. • host populations of at least 50% of the impacted species of conservation concern, as evidenced by a suitable botanical or protected area site assessment. • be rezoned to open space for conservation or equivalent zoning; and • if not able to be declared as a protected area for any reason, then the site must have a servitude registered over it in favour of the applicant and/or City of Cape Town reserving for them the rights of ownership that may otherwise impact negatively on the persistence of biodiversity on the site. A binding 'Letter of Intent' commitment has been concluded between the Applicant and the Landowner of *Hercules Pilaar* covering a long-term lease agreement/conservation servitude with an	Monitoring requirements must be undertaken in accordance with the **Biodiversity Offset Report (Annexure 18).**	A terrestrial biodiversity offset of ~~at least 77ha~~ 89ha is proposed (plus ongoing environmental management budget for this). The Biodiversity Offset Area is to be proclaimed a Nature Reserve. A Biodiversity Offset Management Plan is to be compiled and adopted for the site in consultation with Cape Nature and CoCT.

	accompanying management agreement. This would require the landowner to declare the site as a Nature Reserve if Environmental Authorisation is obtained. As the Biodiversity Offset will take place off-site a separate stand-alone Biodiversity Offset Management Plan will be drafted for the site. However, this EMPr will effectively address the aspects required to manage the Biodiversity Offset for the site, until such time as it is declared a Nature Reserve, and a compliant (Conservation) Management Plan is submitted to the MEC for approval (within 6 months after commencement of construction activities). The EMPr therefore includes the required interventions to protect, rehabilitate and manage the biodiversity offset site, including but not limited to: • Management plans and costs for invasive alien plant control, fire belt establishment, prescribed burns, ecological rehabilitation, ecological auditing and other matters that may be necessary for the proper management of the offset site as a nature reserve. • Oversight responsibility for site management for the entire 30-year duration of the offset management liability. • Sufficient provision to ensure that these costs are catered for over a minimum of thirty years, and ideally in perpetuity. The Applicant will have a large environmental management responsibility around the airport site including almost all the kinds of interventions that need to be carried out on the offset site (Fencing and security, controlled burns, invasive plant control, erosion and rehabilitation etc). Therefore, the offset site management will be included under the purview of this EMPr and thereby the CWA Environmental Management Division (EMD). This enables the EM/ECO to assess compliance with biodiversity offset site management requirements and to update the Interim Site Management Action Plan as circumstances dictate until the formal Biodiversity Offset Management Plan is completed The specific management requirements, the level of effort required and return frequency, have been set out in a more detailed budget and are summarised in Table 14 below). The projected 30-year costing of this budget was used to determine the Net Present Value of any penalty required to be paid by the Applicant to ensure site management for the duration of the liability period. This is calculated and included in *Section 14. Determination of management liabilities in succeeding years* of the Biodiversity Offset Report (Annexure 18). A detailed budget has been drawn up for the priority candidate site using accurate and current actual unit costs incurred by the CoCT for specific management actions as well as some additional staff capacity to undertake specific tasks. The following management interventions are catered for and		

were considered to be satisfactory for maintaining and improving site condition. These form the basis for the Biodiversity Offset (Conservation) Management Plan when the site is declared:

Table 14. Proposed management interventions on the priority candidate site, their metrics, costs and frequency

7%	Inflation	length	width				
#	***Intervention***	***Unit / Dist***	***Unit/ Dist***	***Cost/ unit***	Est. 2025 cost	***Repeats in 30yr***	***Assumptions***
1	Firebelt brush cut	3000m	6m	3,8 R/m^2	R73 188	annually	annual bush-cutter & tractor for accessible portions, Teams & brush cutters for steeper slopes. Team costs = R3,80 sqm
2	Prescribed burn	1150m	800m	R1 957	R192 600	four X	burn half site every 8 years. Assumes CoCT covers 40 -50% costs
3	FPA membership	107 ha			R2 301	annually	required for risk / liability management
4	IAP clearing	108 ha	5%	R200/ha	R23 112	three X	clear large seeding trees, at least every 10 yrs
5	IAP follow up	108 ha	1%	R100/ha	R11 556	15 X	clear seedlings and saplings every other yr
6	Fence Maintenance	4000m		R2/m	R8 560	annually	annual fence fixing
7	Head cut /erosion control	40sqm		R80/sqm	R3 424	three X	decadal check and erosion control, especially at dams / after heavy rain
8	Audit	108 ha		R100/ha	R11 556	annually	required for risk / liability management
9	Field Ranger	2/5time			R160 000		Employed by CWA, report to ECO
10	Management fee	9%			R40 787	annually	If this must be executed by an PBO and not the applicant
11	Contingency	5%			R22 671	annually	
	Total				R516 060		For FY 2025. Each yr differs

Practical Implementation and establishment of an Interim Site Management Action Plan:

1. On confirmation that EA as been granted (and the EA is upheld i.e. no appeals) the CWA EMD would take control of the Biodiversity Offset Area.
2. CWA EMD commits to an annual budget of R517 000 for first operational year and thereafter it will be reviewed annually in accordance with the Biodiversity Offset Management Plan.

	3. The EM will assist the Landowner to register the site as a Nature Reserve and be integral in the completion of the Biodiversity Offset Management Plan for the site. 4. The EM is to appoint a suitably qualified person to compile a Biodiversity Offset Management Plan (CMP) in consultation with Cape Nature and the CoCT. 5. The EM will assist the landowner to register the site with the Fire Protection Association (FPA). 6. The CWA EMD will consist of several teams e.g. landscaping, waste management, alien species control, rehabilitation, conservation of off-set sites and fire management etc. During operations these teams will be managed on the ground by the in house ECO and each Team Leader will report to the ECO. The biodiversity offset Team Leader/ Field Ranger will therefore undertake a site assessment within 1 month after commencment activties take place and produce a Situation Analysis. This analysis will determine action priorities to be set out in the Interim Site Management Action Plan (ISMAP) compiled by the EMD. The outcome and priorities will be determined largely by to the time of year and will include aspects identified below (Refer to Table 14): • Alien Clearing Management; • Fire Management; • Erosion Control; and • Fence maintenance. 7. Once the ISMAP is in place, montly reports must be issued by the ECO to the EMD reporting on progress and the management aspects pertaining to the Biodiversity Offset site. 8. Until the approval of the Biodiversity Offset Management Plan an annual audit of the site in relation to the ISMAP must be undertaken.		
Remedial Action	Non-compliance to be reported to the Applicant and the Competent Authority. Should the applicant fail to execute such an implementation agreement prior to commencement with the activities, or fail to effectively manage the site through compliance with the applicable management plan, then: The environmental authorisation is immediately suspended, and the applicant may be liable for administrative penalties and/or other sanction under NEMA in addition to compliance with this offset condition; and In addition to any other administrative penalties that may be determined, the sum of R8 million becomes immediately payable to the Endangered Wildlife Trust, to establish a, or augment an existing, fund for the management of the offset site and adjacent priority conserved areas in the Klipheuwel Corridor not currently in City ownership. The priorities for deploying the funds must be determined in consultation with the DEA&DP and CoCT Biodiversity Management Branch.		

	The Endangered Wildlife Trust [EWT] has formally committed to receive, manage and deploy any financial penalty which may arise due to CWA non-compliance or breach of agreement regarding any biodiversity offset condition that may be imposed by the Competent Authority regarding the CWA. EWT contact: Hannah de Villiers [HannahDV@ewt.org].

PERFORMANCE			
Date	**Details of Transgression**	**Responsible Party**	**Action Taken**

GOAL 3: SAFEGUARD FRESHWATER ECOLOGICAL FEATURES			
Objective	**Protection of the Freshwater Ecosystems.**		
Risk	**Actions**	**Monitoring**	**Targets**
Increased risk of pollution of surface water potentially affecting the downgradient freshwater ecosystems, leading to impaired water quality and salination of soils. Increased risk of sediment transport in surface runoff leading to altered water quality, smothering of biota and altered vegetation community composition. Increased risk of erosion.	A Service Infrastructure Management Plan should be compiled (once the construction of operational activities has been completed) which details the frequency in which service infrastructure, particularly the sewer and water treatment plants, bio-digester and sewer conveyance infrastructure must be serviced. For example, it is recommended that the integrity of the sewer infrastructure and treatment plants be tested at least once every five years or more often should there be any sign of a leak. An emergency plan must be compiled to ensure a quick response and attendance to the matter in case of a leakage or bursting of a pipeline or overtopping of sewage at the treatment plant and/or bio-digester. The **Emergency Preparedness and Response Plan (Annexure 12)** needs to be implemented. Jet fuel and other potential hazardous chemicals must be stored in a manner that reduces the potential for spills. An emergency spill protocol must be compiled and is to be maintained for the CWA, especially for potential spills on the runways, aprons, roads, etc. to prevent the pollutants from being transported via stormwater infrastructure into the downgradient wetlands. Regular inspection of the stormwater outlet structures must be undertaken (specifically after large storm events) to monitor the occurrence of erosion. If erosion has occurred, it must immediately be rehabilitated through stabilisation of the embankments and revegetation, where applicable. All pipelines and attenuation ponds must be regularly cleaned, and all outlet structures (if any) checked to ensure there is no debris/blockages. The likelihood of erosion at the discharge points can be reduced provided that a higher surface roughness is implemented in the area from the discharge points down to the delineated freshwater ecosystems, allowing for water to enter the seep wetland 1, CVB wetland 3 and the surrounding environment at a lower velocity. This can be achieved through the placement of cobbles and ensuring that the area surrounding each discharge point is suitably vegetated. No development within the 15m and 16m operational phase conservation buffer of the CVB wetlands 2 and 3 and seep wetland 1, respectively, may be undertaken.	Implement a monitoring programme to detect and prevent the pollution of soils, surface water and groundwater. Monitor wetlands that will potentially be impacted by the proposed CWA development to ensure that the PES drivers and receptors are maintained, and where possible improved, in accordance with the REC and RMO. The **Wetland Offset Study and Implementation Plan (Annexure 7)** needs to be implemented. Monitoring of the implementation and management of the Freshwater offset plan. Monitoring for the establishment for AIP species must be undertaken, specifically in the PV panel array footprint in the south-	Achieve optimal ecological functioning in these areas.

Potential eutrophication of water. Potential fragmentation of the freshwater ecosystems. Potential loss of indigenous vegetation.	The **Stormwater Management Plan (Annexure 10)** needs to be adhered too. It must be ensured that regular maintenance takes place to prevent failure of any infrastructure associated with the proposed CWA development. Only existing roadways should be utilised during maintenance and repairs to avoid indiscriminate movement of vehicles within the wetlands. Should repair of the sewer infrastructure be required to address a leak, control measures relating to trenching and stockpiling must be implemented depending upon the location of the leak. With regards to maintenance activities for roads, fences and service infrastructure refer to applicable measures in Construction Phase control measures. No vehicles are permitted to enter the freshwater ecosystems. Any maintenance works must be undertaken by foot, or the relevant authorisations obtained beforehand. The **Wetland Offset Study and Implementation Plan (Annexure 7)** needs to be implemented. Adhere to the **Maintenance Management Plan (Annexure 16)** for all maintenance aspects undertaken within the vicinity of Freshwater Ecosystems.	eastern portion of the study area. A monitoring plan for the development and the immediate zone of influence should be implemented to prevent erosion and incision. Regular inspection of the stormwater outlet structures must be undertaken (specifically after large storm events) to monitor the occurrence of erosion.	
Remedial Action	If erosion has occurred, it must immediately be rehabilitated through stabilisation of the embankments and revegetation, where applicable. **The Wetland Offset Study and Implementation Plan (Annexure 7) needs to be implemented.** NOTE: it is recommended that the wetland offset area be registered as a conservation servitude to ensure future protection of the offset site in perpetuity (at least 30 years). Adhere to the **Maintenance Management Plan (Annexure 16)** for all maintenance aspects undertaken within the vicinity of Freshwater Ecosystems.		
Objective	**Optimal functioning of the sustainability of the borehole (s)**		
Risk	**Actions**	**Monitoring**	**Targets**
A cone of depression in the local landscape and significant impacts to the freshwater ecosystems.	Groundwater abstraction must not drop below the critical water level (still to be determined). The management objective should be to maintain the groundwater level at or near the dynamic water level (still to be determined). During maintenance activities, particular care should be taken with regards to vehicle and spill management.	Abstraction volumes must be monitored and recorded at suitable intervals (e.g. monthly).	Ensure that abstraction volumes (from what is approved by the DWS) is not exceeded.
Remedial Action	Should it be observed that abstraction has dropped below the critical water level or if a water quality change has been observed, the relevant DWS compliance officer should be informed to discuss and develop a new abstraction plan that can sustain the aquifer.		

Objective	**Optimal management of the Solar PV facilities:**		
Risk	**Actions**	**Monitoring**	**Targets**
Pollution of Freshwater Ecosystems.	Maintenance activities associated with the PV facility must be confined to the developed footprint of the PV facility. Under no circumstances may waste (including grey water from the washing of the PV panels) be discarded in the surrounding environment. Suitable waste management practices must be implemented. BESS infrastructure (if any) must be regularly inspected and must be operated in line with applicable SANS standards (e.g. SANS 56005:2022 Ed 1 and SANS 62133-2:2022 Ed 1 as issued in Schedule B1 of GN 1427 of 18 November 2022, as issued in terms of section 24(1)(a) of the Standards Act (act 8 of 2008)).	Monitoring for the establishment for AIP species must be undertaken, specifically in the PV panel array footprint in the south-eastern portion of the study area.	Optimal management of the Solar PV Facilities to ensure no environmental pollution occurs.
Remedial Action	Alien invasive vegetation management within the site must be done according to the **Alien Vegetation Management Plan in Annexure 6**. Waste management within the site must be undertaken according to the **Waste Management Plan in Annexure 8.**		
PERFORMANCE			
Date	**Details of Transgression**	**Responsible Party**	**Action Taken**

GOAL 4: SAFEGUARD TERRESTRIAL (FAUNA & AVIFAUNA) ECOLOGICAL FEATURES			
Objective	**Protect all Fauna and Avifauna.**		
Risk	**Actions**	**Monitoring**	**Targets**
Reduction in Fauna and/or Avifauna habitat and increased mortalities.	No further development related activities are to take place outside of the demarcated footprint unless duly authorised by the competent authority. Faunal and Avifaunal habitat beyond the demarcated area should not be cleared or altered, except as needed for safety reasons around taxiways and runways as per the **Wildlife Hazard Management Plan** (**Annexure 11**) for the airport. Operational personnel are to be educated about the various faunal species in the area, particularly about venomous spiders, snakes and scorpions. None of these or other species are to be killed or injured by personnel. Should any of these species be encountered, these species are to be safely and carefully relocated to the surrounding natural habitat adjacent the development site, should they not move off on their own. The contact details of a suitably qualified snake handler be made available to construction teams should a venomous snake be encountered that needs removal. Alternatively, it is recommended that a member of the operational team be trained to handle and remove snakes through a recognised snake handling course. Sound environmental management practices should be adhered to at all times. Alien plant species should be suitably managed and no further spread of alien plants should be allowed (**refer to Goal 6**). Whilst it is accepted that there will likely be significant external lighting during the operational phase, it is still recommended that the amount of light be minimised as far as possible (notably outward shining/emitted light), and that downward and inward facing lights be used wherever possible, but within legislated operational health and safety guidelines/requirements. Yellow or red fluorescent lights are preferable for building and perimeter lighting, whilst the use of bright white or LED lights should only be used as and where necessary for apron lighting (or as required by operational health and safety for airport operations). Lighting used must be kept to minimum, but in allowance with the required health and safety requirement for airport operations.	Implement monitoring in accordance with the **Wildlife Hazard Management Plan - Annexure 11**.	Achieve the targets set in the **Wildlife Hazard Management Plan - Annexure 11**.

	Noise levels must be suitably managed in line with the norms and standards for airports operations. It is however acknowledged that the larger aircraft will generate noise levels beyond the recommended health and safety guidelines, and that these unfortunately cannot, at this point in time, be reduced due to the nature of turbine jet engines. Stormwater is to be suitably controlled and discharge points monitored for erosion (**refer to Goal 7**). Stormwater /attenuation ponds must be monitored and covers/screens of these features repaired if damaged. If leaks appear or ponding at the outlets is evident, this must be rectified to avoid attracting waterfowl or larger avifauna such as herons etc which pose a risk to aircraft. No hunting, trapping, or setting of snares by personnel is to be allowed. Suitable fines/disciplinary actions for such must be made known and implemented. With regards to maintenance activities for roads, fences and service infrastructure refer to applicable measures in Construction Phase control measures. Reactive control measures should be investigated and where needed implemented to manage birds and other wildlife at the airport. Such includes dispersal measures (sirens, lasers, pyrotechnics, and Border Collies) and removal measures (live capture, nest removal etc) as and where feasible/needed; and Buildings, structures and landscaped gardens may provide artificial nesting/habitat for avifaunal species and increases their potential activity around the airport. Methods to reduce available shelter include: 1) Exclusion measures such as spikes, netting, panelling on ledges and holes around buildings to assist in prevention of birds taking residence, 2) Nest removal and 3) Cutting / mowing of vegetation where needed (this may however attract a different assemblage of avifauna which selects for such areas). As such, vegetation clearance and stormwater management undertaken must be in line with the recommendations as per the **Wildlife Hazard Management Plan in Annexure 11**. Standard Operating Procedures (SOPs) for Bird and Wildlife Management needs to be compiled.		
Remedial Action	Implementation of the **Wildlife Hazard Management Plan in Annexure 11**. Non-compliance to be reported to Applicant and the Competent Authority.		

PERFORMANCE			
Date	**Details of Transgression**	**Responsible Party**	**Action Taken**

GOAL 5: VELDFIRE MANAGEMENT			
Objective	**The prevention and management of Veldfires on and around the site.**		
Risk	**Actions**	**Monitoring**	**Targets**
Impact on natural Fire Cycles Liability	Smoking shall not be permitted in areas where it is a fire hazard. Such areas shall include any workshop and fuel storage areas and areas where the vegetation or other material may promote the rapid spread of an initial flame. A fire extinguisher of the appropriate type must be present when welding or other "hot" activities are undertaken. Any work that requires the use of fire or open flame may only take place at a designated areas approved by the ECO and must be supervised at all times. SANS 10400–T: 2024 and the Community Fire Safety By-law, Provincial Gazette 5832 (as amended 29 June 2007 and 21 August 2015) is to be complied with. The airport will have a 24/7 dedicated on-site Airport Fire & Rescue Team, including a dedicated Fire Prevention Officer. The on-site Fire & Rescue Team will respond to incidents related to aircraft arrivals and departures, structural fires on site and veld fires on site or on surrounding and neighbouring properties. The on-site Fire & Rescue Team will have Memorandums of Agreements with the various Emergency, Fire & Rescue services in the greater Metro to deal with large scale emergencies and incidents. Fire management within the site must be done according to the **Veldfire Management Plan (VFMP) in Annexure 5**. The purpose of this VFMP is to ensure the safety of personnel and infrastructure, minimize environmental impact and ensure uninterrupted airport operations. To achieve these goals, the plan focuses on meeting the following objectives: • Protect Human Life: Ensure the safety of all individuals, including staff and tenants, firefighters, and the public. • Safeguard Property and Assets: Protect infrastructure and assets from veldfire damage. • Minimize Physical and Environmental Impact: Reduce the adverse effects of veldfires and fire suppression techniques on both physical structures and the environment. • Promote Sustainable and Cost-Effective Protection: Implement veldfire protection measures in an environmentally responsible and financially efficient manner.	Be part of the Fire Protection Association programme	Effective implementation of the VeldFire Management Plan. Zero liability

	• Maintain Appropriate Fire Regimes: Preserve environmental values by managing fire regimes that are suitable and necessary for conservation purposes.		
Remedial Action	Non-compliance to be reported to Applicant and the Competent Authority. Contractor to ensure Fire Fighting Equipment are in place and serviced regularly. **VeldFire Management Plan (Annexure 5)** to be implemented.		
PERFORMANCE			
Date	**Details of Transgression**	**Responsible Party**	**Action Taken**

<table>
<tr><th colspan="4">GOAL 6: ALIEN CLEARING MANAGEMENT</th></tr>
<tr><td>Objective</td><td colspan="3">Continued Alien Clearing Management of the site with the aim of zero Alien vegetation on site.</td></tr>
<tr><td>Risk</td><td>Actions</td><td>Monitoring</td><td>Targets</td></tr>
<tr><td>Loss of biodiversity

Alien Vegetation infestation

Fire Risk</td><td>Alien invasive vegetation management within the site must be done according to the Alien Vegetation Management Plan in Annexure 6.

The purpose of this Alien Vegetation Management Plan is to outline a comprehensive strategy for the complete eradication of alien invasive plants and the long-term maintenance of the site in an alien-free condition. This plan aims to ensure compliance with airport safety standards, restore ecological functioning, and improve habitat quality, particularly in areas of botanical sensitivity and ecological importance.

To achieve these goals, the plan focuses on meeting the following objectives:
• Identify and confirm areas for alien vegetation clearing.
• Establish methods for effective alien clearing, including necessary follow-up actions.
• Provide a realistic program with clear targets for the clearing process.
• Promote the conservation of indigenous plant species within the property.
• Support job creation and skills development in local communities.
• Ensure the sustainable reuse of cleared biomass to maximize environmental benefits.

Standard Operating Procedures (SOPs) can be compiled for Alien vegetation and invasive plants.</td><td>Monitor natural vegetation for Alien Invasives.

Ensure that no fire hazards are created by stockpiling alien vegetation which has been removed.</td><td>Preservation of indigenous vegetation and zero Alien Vegetation on site.</td></tr>
<tr><td>Remedial Action</td><td colspan="3">Non-compliance to be reported to Applicant and the Competent Authority.
Implementation of the Alien Vegetation Management Plan in Annexure 6.</td></tr>
<tr><td colspan="4">PERFORMANCE</td></tr>
<tr><td>Date</td><td>Details of Transgression</td><td>Responsible Party</td><td>Action Taken</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
</table>

<table>
<tr><th colspan="4">GOAL 7: STORM WATER MANAGEMENT</th></tr>
<tr><td>Objective</td><td colspan="3">Successful implementation of the Stormwater Management Plan.</td></tr>
<tr><td>Risk</td><td>Actions</td><td>Monitoring</td><td>Targets</td></tr>
<tr><td>Incorrect Stormwater Management on site resulting in flooding, erosion and incisions, pollution and damages.</td><td colspan="2">a. <u>Typical Operating and Maintenance activities for Dry Attenuation Ponds:</u>

<table>
<tr><th>Maintenance schedule</th><th>Required action</th><th>Typical frequency</th></tr>
<tr><td rowspan="5">Regular maintenance</td><td>Remove litter and debris</td><td>Monthly</td></tr>
<tr><td>Manage vegetation</td><td>Monthly</td></tr>
<tr><td>Inspect inlets, outlets, and overflows for blockages</td><td>Monthly</td></tr>
<tr><td>Inspect inlets and basin for sediment accumulation. Determine appropriate frequencies.</td><td>Monthly, then as required</td></tr>
<tr><td>Tidy dead vegetation before growth season</td><td>Annually</td></tr>
<tr><td rowspan="3">Occasional maintenance</td><td>Manage wetland plants in pools – where provided</td><td>Annually</td></tr>
<tr><td>Reseed or replant in dilapidated areas</td><td>As required</td></tr>
<tr><td>Prune and trim plants where necessary and remove cuttings</td><td>Every 2 years or as required</td></tr>
<tr><td rowspan="4">Remedial actions</td><td>Remove sediment from inlets, outlets and forebays</td><td>Annually, or as required</td></tr>
<tr><td>Repair erosion or other damage</td><td>As required</td></tr>
<tr><td>Repair or rehabilitate inlets, outlets, and overflows</td><td>As required</td></tr>
<tr><td>Relevel uneven surfaces and reinstate design levels</td><td>As required</td></tr>
<tr><td>Realign riprap, gabions, and/or Reno mattresses</td><td>As required</td></tr>
</table>
<u>Additional:</u>

Litter clearing: A litter clean-up is to take place monthly or as required.

Cleaning of kerbs and channels: Sand, litter and refuse should be removed from kerbs and channels monthly or as required.

Cleaning of pipes: Refuse should be removed from pipes monthly. Sand and silt should also be removed by using high pressure jetting.

Cleaning of covers and frames: The covers and frames should be inspected monthly and need to be replaced, repositioned, or repaired where necessary.</td><td>Successful Stormwater Management on site.</td></tr>
</table>

Earth embankment inspection: Embankments should be inspected monthly or after each rain. If the embankment is compromised, it should be reshaped to tie in with the original slope.

Headwalls inspection: The headwalls should be inspected monthly or after each rain. Any blockage should be removed, and the natural vegetation trimmed to allow free drainage of water

b. Typical Operating and Maintenance activities for Swales:

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly
	Manage vegetation, retain vegetation to design levels	Monthly
	Inspect inlets, outlets, and overflows for blockages	Monthly
	Inspect inlets and basin for sediment accumulation. Determine appropriate frequencies.	Monthly, then as required
	Tidy dead vegetation before growth season	Annually
	Manage wetland plants in pools – where provided	Annually
Occasional maintenance	Reseed or replant in dilapidated areas	As required
	Prune and trim plants where necessary and remove cuttings	Every 2 years or as required
	Remove sediment from inlets, outlets and forebays	Annually, or as required
Remedial actions	Repair erosion or other damage	As required
	Repair or rehabilitate inlets, outlets, and overflows	As required
	Relevel uneven surfaces and reinstate design levels	As required
	Realign Riprap, gabions, and/or Reno mattresses	As required

Additional:

Litter clearing: A litter clean-up is to take place monthly or as required.

Embankment inspection: Embankments should be inspected monthly or after each rain. If the embankment is compromised, it should be reshaped to tie in with the original slope.

Cleaning of headwalls: Refuse should be removed from headwalls within the dry swale monthly. Sand and silt should also be removed by using high pressure jetting.

Headwalls inspection: The headwalls should be inspected monthly or after each rain. Any blockage should be removed, and the natural vegetation trimmed to allow free drainage of water.

c. Typical Operating and Maintenance activities for Detention Basins:

Activity	Typical frequency
Remove litter and debris from Inlet and outlet structures	Monthly
Mow vegetation (Side slopes)	Monthly
Inspect inlets, outlets, and overflows for blockages	Monthly
Inspect inlet and forebay for sediment accumulation	Semi-Annually
Inspect for invasive vegetation	Semi-Annually
Manage wetland plants in pools – where provided	Annually
Check for signs of Hydrocarbon buildup and remove appropriately	Inspection
Prune and trim plants where necessary and remove cuttings	Every 2 years or as required
Remove sediment from inlets, outlets and forebays	Annually, or as required
Inspect for damage paying attention to the variable outlet control structure	Annually
Remove sediment from forebay	5 to 7 years or when 50% of forebay capacity is lost
Repair undercut or eroded areas	As required
Realign riprap, gabions, and/or Reno mattresses	As required

Additional:

Irrigation system: It will take some time for the vegetation in the pond to be fully established. As such, it is proposed that an irrigation system or procedure be put in place to ensure the vegetation survive the initial dry seasons. Suitable inspections to identify potential faulty elements should be conducted on the irrigation system to ensure its proper functioning.

Litter clearing: A litter clean-up is to take place monthly or as required.

Alien and problem vegetation: It is proposed that the pond must be inspected for invasive alien vegetation routinely by the appointed landscaper. As far as possible all alien vegetation should be manually removed. Where manual removal is not possible, alien vegetation should be treated with an appropriate herbicide using the correct application method and to the manufacturer's directions and specifications. Herbicides should not be applied when conditions are windy, so as to avoid spray drift. No herbicides should be applied when rain is forecast within 2 days. Colour dyes should be used with the herbicides to clearly mark areas that have been treated, taking exceptional care when working near water. It must be recognized that under certain conditions some indigenous vegetation may become problematic and may require intervention.

	Cleaning of silt traps: The sedimentation forebay as well as the apron of the outlet headwalls must be inspected every six months, with one of the inspections taking place just before the first seasonal rains. These must be inspected for build-up of silt, dirt, mud, and similar material. All silt and other material must be removed and disposed of at a suitable landfill site. Care must be taken to ensure that no silt enters the stormwater system during the cleaning process. The **Stormwater Management Plan (Annexure 10)** needs to be adhered too.	
Remedial Action	If erosion has occurred, it must immediately be rehabilitated through stabilisation of the embankments and revegetation, where applicable.	

PERFORMANCE			
Date	**Details of Transgression**	**Responsible Party**	**Action Taken**

GOAL 8: ADDITIONAL MANAGEMENT FOR AGRICULTURAL AREAS.			
Objective	**Agricultural Best Practice**		
Risk	**Actions**	**Monitoring**	**Targets**
Fire Risks Pollution Visibility	Standard Operating Procedures (SOPs) will be established for the following agricultural practices: • Planned burning of the wheatfields by farmers on agricultural land; and • Crop spraying during winter. Both these aspects must be managed via SOP engagements between the CWA and the Farmers Association in the area. All farmers must belong to a Fire Association and Burning Permits must be obtained from the CoCT prior to any burning undertaken. Burning takes place during the months of March and April only. Furthermore, no burning is allowed to take place on days that have been identified by the CoCT as "red" or "yellow" days. Burning may only take place on "green" days. The Fire Department as well as the CWA representative needs to be notified in advance of agreed upon burn days. All efforts must be made to reduce the practice of burning fields, where possible.	Monitor the effectiveness of burning and crop spraying methods used.	Efficient management and control of agricultural practices.
Remedial Action	Refer non- compliance to the Contractor. Liaise with the Farmers Association on a continual basis to ensure agricultural practices and airport operations are symbiotic.		
Objective	**Management & Control of Soil Erosion (water).**		

Risk	Actions	Monitoring	Targets
Soil erosion	According to Regulation 4 of the Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983) Regulations: Every land user shall by means of as many of the following measures as are necessary in his situation, protect the cultivated land on his farm unit effectively against excessive soil loss: • *A suitable soil conservation work shall be constructed and thereafter be maintained in order to divert run-off water from other land or to restrict the run-off speed of run-off water;* • *The land concerned shall be cultivated in accordance with such method or be laid out in such a manner that the run-off speed of run-off water is restricted;* • *The land concerned shall be utilised in accordance with a crop rotation system;* • *Alternate strips on which a cover crop occurs shall be left undisturbed annually;* • *Crop residues and other plant material shall be left on the land concerned, or shall be utilised as grazing or otherwise be removed only to such an extent that the remaining portion thereof will be sufficient to form a mulch; and/or* • *A suitable grazing crop shall be established on the land concerned, whereafter it shall be permanently withdrawn from cultivation.* *According to Regulation 7 (2) of the Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983) Regulations: Every land user shall remove the vegetation in a water course on his farm unit to such an extent that will not constitute an obstruction during a flood that could cause excessive soil loss as a result of erosion through the action of water.*	Monitor the effectiveness of soil erosion methods used.	Efficient management and control of soil erosion
Remedial Action	Refer non- compliance to the Contractor.		
Objective	**Management & Control of Soil Erosion (wind).**		
Risk	**Actions**	**Monitoring**	**Targets**
Soil erosion	According to Regulation 5 of the Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983) Regulations: Every land user shall by means of as many of the following measures as are necessary in his situation, protect the cultivated land on his farm unit effectively against excessive soil loss:	Monitor the effectiveness of soil erosion methods used.	Efficient management and control of soil erosion

	• *The land concerned shall be cultivated in accordance with such method or be laid out in such manner that the surface movement of soil particles through the action of wind is restricted.* • *Strips of natural vegetation shall be left at right angles to the prevailing wind direction, a suitable wind break shall be constructed or suitable vegetation shall be established to serve as a wind break.* • *The land concerned shall be utilised in accordance with a crop rotation system.* • *Alternate strips on which a cover crop occurs shall be left undisturbed annually.* • *The land concerned shall not be left fallow.* • *The cultivation and grazing of the land concerned during periods of high winds shall be avoided.* • *The establishing of crops of which the harvesting causes the disturbance of the topsoil shall be avoided.* • *Crop residues and other plant material shall be left on the land concerned, or shall be utilised as grazing or otherwise be removed only to such extent that the remaining portions thereof will be sufficient to form mulch.* • *A suitable grazing crop shall be established on the land concerned, where after it shall be permanently withdrawn from cultivation.* • *A suitable soil conservation work shall be constructed and thereafter be maintained in order to restrict the surface movement of soil particles through the action of wind.* Any rehabilitation and remedial action concerning soil erosion, in the event it does occur, needs to be per Regulation 14 of the Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983).		
Remedial Action	Refer non- compliance to the Contractor.		
Objective	**Management & Control of Soil Erosion (wind).**		
Risk	**Actions**	**Monitoring**	**Targets**
Waterlog-ging & Salination	According to Regulation 6 of the Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983) Regulations: Every land user should implement measures as required to protect the irrigated land on his farm unit effectively against waterlogging and salination. Measures that may be applicable include implementing a run-off control plan or draining plan (suitable soil preparation) before the establishment of the vineyards and maintaining such works to draw off excess surface and	Monitor the effectiveness of methods used.	Efficient management and control of waterlogging.

	subterranean water and to dispose of it safely to prevent waterlogging and salination of lower lying land.		
Remedial Action	Refer non- compliance to the Contractor.		
PERFORMANCE			
Date	**Details of Transgression**	**Responsible Party**	**Action Taken**

GOAL 9: POULTRY MANAGEMENT			
Objective	**Poultry Biosecurity and prevention of transmission of poultry diseases.**		
Risk	**Actions**	**Monitoring**	**Targets**
Compromised biosecurity Poultry Diseases Production losses	Light mitigation: Erect signs requiring that car lights are dipped on the affected section of road, barriers that prevent light going into the sheds can be erected on farms, hood the sources of light disturbance, erection of a facility wall which will block some of the light and the use of minimal lighting in the car park area. Mitigation related to private property can be negotiated with landowners and only undertaken upon agreement with landowners. Avoid scheduling flights after 11pm. Implement the Noise Mitigation Measures addressed in Goal 10: Noise Management. In addition, schedule Arrivals during the daytime and avoid runways closest to the poultry farm during Phase 1. Implement the Air Quality Mitigation Measures addressed in Goal 12: Air Quality Control. Avoid creating stagnant pools of water by treating wastewater in closed systems, handle waste according to municipal by laws. This is addressed in the **Stormwater Management Plan (Annexure 10)** in consultation with the **Wildlife Hazard Management Plan (Annexure 11)**. Refer to Goal 7: Storm Water Management. Adherence to good housekeeping and municipal by laws to address pests. Handling and disposal of international galley waste must be done in a safe way and with regard to legislation. This is addressed in the **Waste Management Plan** (**Annexure 8**) which will be implemented on site. Refer to Goal 15: Waste Management.	Noise Monitoring to be undertaken in accordance with Goal 10 below. Air Quality Monitoring to be undertaken in accordance with Goal 12 below. Waste Monitoring to be undertaken in accordance with Goal 15. Storm water Monitoring to be undertaken in accordance with Goal 7 and the SWMP (Annexure 10). Bird and Wildlife Monitoring to be undertaken in accordance with Annexure 11.	Poultry Biosecurity
Remedial Action	Non-compliance to be reported to Applicant and the Competent Authority.		
PERFORMANCE			

Date	Details of Transgression	Responsible Party	Action Taken

GOAL 10: NOISE MANAGEMENT			
Objective	**Keeping noise levels and disturbance within acceptable limits.**		
Risk	**Actions**	**Monitoring**	**Targets**
Noise Disturbance	Provide incentives for airlines to obtain aircraft with the latest available noise reduction technology, through for example noise-related landing charges. Consider the use of specific take-off or approach procedures (such as Continuous Descent Operations, or steeper landing trajectories) to minimise and optimize the distribution of noise on the ground. Use noise preferential routes to assist aircraft in avoiding noise-sensitive areas, such as Klipheuwel, on departure and arrival, and the use of turns to direct aircraft away from noise-sensitive areas. Consider approaches at slightly steeper angles. A small increase in the glide-path angle to 3.2°, rather than the standard 3.0°, may be feasible and offer scope for noise reduction. Establish and maintain effective communication channels with the affected public and provide real-time information on incoming and outgoing flights and their evolving noise footprints. Consider noise-related operating restrictions for night-time. These can be imposed on a voluntary basis by the airport, or by the Government. In conjunction with the above-mentioned noise abatement measures, the introduction of 'passive' mitigation measures, such as noise insulation on existing residential dwellings and noise-sensitive buildings (schools, hospitals, etc.) may be considered, upon negotiations and agreements with applicable parties. **Standard Operating Procedures (SOPs)** are to be compiled for each of the following: • Noise abatement procedures for aircraft – landing and take-off; and • Noise and emissions control on apron – APU usage, GSE equipment. **<u>Noise Monitoring Network and Plan:</u>** Three permanent noise monitoring terminals should be established before or by the operational year of the new airport and runway.	The Noise Monitoring Plan needs to be implemented.	Limited noise complaints.

	The first of these terminals should be established at the Klipheuwel area, preferably close to its south-eastern boundary. The second should be positioned within the Greenville Garden City Development, in line with the new runway 01/19 and the third on the eastern side of the Bella Riva development. A summary of the noise monitoring results should be reported on a quarterly basis to the appropriate authorities. These reports should contain, but not be limited to the: • 24-hour equivalent continuous A-weighted sound pressure level, LAeq,T; • equivalent continuous day-night rating level, LRdn; • equivalent continuous day and night rating levels, LRd and LRn; • maximum A-weighted level, LAmax; • percentile levels Ln; • number of exceedances above 70 dB(A) and 60 dB(A) of the LAmax and SEL. A noise complaints registry should be established and connected with the noise monitoring system, in order to provide the capability for correlation of the complaints with the actual measured levels, as well as the aircraft-related operational data. The complaints and relevant aircraft-related operational data should be included in the quarterly report to the authorities. A Noise Mitigation and Management Plan (NMMP), with measurable goals, which will effectively prevent and intricately manage noise emissions from the Operational Phase of the CWA must be compiled prior to the implementation of the proposed Operational Phase. The NMMP is to be included in Annexure 19.		
Remedial Action	Non-compliance to be reported to Applicant and the Competent Authority. The Noise Monitoring Plan needs to be implemented, and the results will determine whether remedial action is necessary.		
PERFORMANCE			
Date	**Details of Transgression**	**Responsible Party**	**Action Taken**

GOAL 11: EMERGENCY PREPARDNESS AND RESPONSE MANAGEMENT.			
Objective	**Emergency Preparedness**		
Risk	**Actions**	**Monitoring**	**Targets**
Liability Death Destruction of natural habitat	It is essential that the CWA develop an **Emergency Preparedness and Response Plan (Annexure 12)** to provide for emergency procedures during operational phase. **Standard Operating Procedures (SOPs)** are to be compiled for each of the following: • Off-loading of fuel into depot; • Filling of fuel bowsers; • Filling of aircraft with fuel; • Operational spillages – clean-up procedures i.e. hydrocarbon spillage; • Minimizing of fuel vapours in fuel depot; • Procedures for engine run-up; • Maintenance workshops – oil separators; • Aircraft wash bays – oil separators; • WWTW (on site); and • Servicing of Infrastructure. The emergency plan must be compiled to ensure a quick response and attendance to the matter in case of a leakage or bursting of a pipeline or overtopping of sewage at the treatment plant and/or bio-digester.	The **Emergency Preparedness and Response Plan (Annexure 12)** needs to be implemented and adhered too.	Minimal damages associated with Emergency situations.

	An emergency spill protocol must be included and is to be maintained for the CWA, especially for potential spills on the runways, aprons, roads, etc. to prevent the pollutants from being transported via stormwater infrastructure into the downgradient wetlands. Private landowners, as well as the CWA Landowners, should ensure that unauthorised land settlements are dealt with by the authorities. A Leak Detection and Repair (LDAR) programme will form part of the Emergency Preparedness & Response Plan and is to be developed as a preventative measure to mitigate emissions to atmosphere, leaks from fuel tanks and related infrastructure as well as any spillages during re-fuelling of the tanks.		
Remedial Action	Non-compliance to be reported to Applicant and the Competent Authority. The **Emergency Preparedness and Response Plan (Annexure 12)** needs to be implemented and adhered too.		
PERFORMANCE			
Date	**Details of Transgression**	**Responsible Party**	**Action Taken**

GOAL 12: AIR QUALITY CONTROL			
Objective	**Reduce Air Emissions to ensure Air Quality is within acceptable limits.**		
Risk	**Actions**	**Monitoring**	**Targets**
Air Pollution	*Scenario 1: Existing runway setup under full utilisation* In line with the ICAO emission reduction action plans and best practices with respect to airport-related air quality, the following "best practice" emission mitigation measures could be investigated for implementation for Scenario 1: • Implementation of measures to decrease the queuing lines. • Minimisation of the waiting time for parking. • Examination of permitting aircraft taxiing at higher speeds. • Limitation of the length of the course of taxiing. • Utilisation of aircraft-serving equipment with "cleaner" technology. *Scenario 2: Operations on the new runway 01/19 in the operational year* However, the most suitable and cost-effective mitigation measures should be investigated, and an acceptable implementation timeframe should be established before the new runway reaches its capacity. *Scenario 3: Operations on the new runway 01/19 at full capacity* For Scenario 3, a number of mitigation measures should be considered for implementation in consultation with the various stakeholders associated with all the airport operations. In addition, in line with the noise impact recommendations, the airport-compatible land-use planning immediately south of the new runway would be recommended. As such, the identified potential mitigation measures are: • Encourage airport-compatible land-use planning. • Implement measures to decrease the queuing lines. • Limit the length of the course of taxiing. • Shutting down as many engines as possible when idling and taxiing. • Reduce reverse thrust use during landing. • Utilise aircraft-serving equipment with "cleaner" technology.	The existing location of the monitoring station is suitable for current and future runway operations. The station is equipped to measure the ambient concentrations of SO_2, NO_2, O_3, CO and PM_{10}. Monitoring data must be reported on a biannual basis to the City of Cape Town Air Quality Management Unit and the South African Air Quality Information System as operated by SAWS, on an ongoing basis.	Acceptable Air Quality Standards.

	• Investigate the provision of electricity at terminal gates, so as to minimise use of the APUs and GSE as much as possible.		
Remedial Action	Non-compliance to be reported to Applicant and the Competent Authority. The monitoring results should be reported on a biannual basis to the to the City of Cape Town Air Quality Management Unit and the South African Air Quality Information System as operated by SAWS, on an ongoing basis.		
PERFORMANCE			
Date	**Details of Transgression**	**Responsible Party**	**Action Taken**

GOAL 13: CONSERVATION MANAGEMENT OF ON-SITE SENSITIVE AREAS			
Objective	**The ongoing rehabilitation, maintenance and management of identified Sensitive Areas (No-Go Areas) within the site boundaries.**		
Risk	**Actions**	**Monitoring**	**Targets**
Potential impact/ loss of Very High, High and Medium sensitivity botanical areas. Potential fragmentation and associated impacts on the freshwater ecosystems. Reduction in Fauna and/or Avifauna habitat and increased mortalities.	The sensitive areas within the site are identified in Figure 8 above (**Annexure 3B**). These areas, including the entire Agricultural Precinct, are important from a Botanical, Freshwater, Faunal, Avifaunal and Visual perspective. No development within the 15m operational phase conservation buffer of the CVB wetlands 2 and 3 and the 16m operational phase conservation buffer seep wetland 1, respectively, may be undertaken. The botanical sensitive areas falling inside the development footprint but within landscaped areas will be conserved – as indicated on the **Landscaping Plans (Annexure 9)**. No spraying of herbicide should be undertaken in any conservation areas. No further development related activities are to take place outside of the demarcated footprint unless duly authorised by the competent authority. No vehicles are permitted to enter the freshwater ecosystems. Any maintenance works must be undertaken by foot, or the relevant authorisations obtained beforehand. Operational personnel are to be educated about the various faunal species in the area, particularly about venomous spiders, snakes and scorpions. None of these or other species are to be killed or injured by personnel. Should any of these species be encountered, these species are to be safely and carefully relocated to the surrounding natural habitat adjacent the development site, should they not move off on their own. The contact details of a suitably qualified snake handler be made available to construction teams should a venomous snake be encountered that needs removal. Alternatively, it is recommended that a member of the operational team be trained to handle and remove snakes through a recognised snake handling course. No hunting, trapping, or setting of snares by personnel is to be allowed. Suitable fines/disciplinary actions for such must be made known and implemented. With regards to maintenance activities for roads, fences and service infrastructure refer to applicable measures in Construction Phase control measures. Fire management (firebreaks, controlled burns etc.) within these areas must be undertaken in accordance with the **Veldfire Management Plan (VFMP) in Annexure 5**.	The condition of all Very High, High and Medium sensitivity areas (Agricultural Precinct and on site) will be monitored every year by a suitably competent botanist (or CoCT Environmental Management Dept.), and they will make recommendations for any management changes or actions (alien clearing, lack of fire, etc.) that are needed. Monitor wetlands that will potentially be impacted by the proposed CWA development to ensure that the PES drivers and receptors are maintained, and where possible improved, in accordance with the REC and RMO. The **Wetland Offset Study and Implementation Plan (Annexure 7)** needs to be implemented.	Achieve optimal ecological functioning in these areas. Sound environmental management practices should be adhered to at all times.

	Alien invasive vegetation management within these areas must be done according to the **Alien Vegetation Management Plan in Annexure 6**. The **Wetland Offset Study and Implementation Plan (Annexure 7)** needs to be implemented. NOTE: it is recommended that the wetland offset area be registered as a conservation servitude to ensure future protection of the offset site in perpetuity (at least 30 years). Adhere to the **Maintenance Management Plan (Annexure 16)** for all maintenance aspects undertaken within the vicinity of Freshwater Ecosystems. Faunal and Avifaunal habitat beyond the demarcated area should not be cleared or altered, except as needed for safety reasons around taxiways and runways as per the **Wildlife Hazard Management Plan** (**Annexure 11**) for the airport.	Implement monitoring in accordance with the **Wildlife Hazard Management Plan - Annexure 11.**	
Remedial Action	Non-compliance to be reported to the Applicant and the Competent Authority. Penalise individuals who deviate from the targets. The condition of Botanical sensitivity areas will be monitored every year by a suitably competent botanist, and they will make recommendations for any management changes or actions (alien clearing, lack of fire, etc.) that are needed. Guidelines on ongoing maintenance of these areas within which S&R plants have been established must also be included. If erosion has occurred, it must immediately be rehabilitated through stabilisation of the embankments and revegetation, where applicable. **The Wetland Offset Study and Implementation Plan (Annexure 7) needs to be implemented.** Implementation of the **Wildlife Hazard Management Plan in Annexure 11**. Adhere to the **Maintenance Management Plan (Annexure 16)** for all maintenance aspects undertaken within the vicinity of Freshwater Ecosystems.		
PERFORMANCE			
Date	**Details of Transgression**	**Responsible Party**	**Action Taken**

GOAL 14: ADAPTION TO CLIMATE CHANGE (Wild Wires, Water Scarcity, Extreme Heat, Urban and Riverine Floods)			
Objective	**Reduce the risks associated with Climate Change.**		
Risk	**Actions**	**Monitoring**	**Targets**
Health & Safety and Operational & Value Chain Impacts associated with Wildfires, Landslides, Water Scarcity, Extreme Heat, Urban & Riverine Floods.	<u>Wildfires</u> • Identify infrastructure and areas on site that are vulnerable to wildfire risks. • Consider wildfire risks in site design and layout planning and fuel management procedures. • Construct firebreaks in areas vulnerable to wildfires. • To ensure health and safety of employees, site evacuation and emergency response plans for wildfire events should be implemented. • Ensure backup power systems are available, should energy supply be disrupted. Veld Fire management within the site must be undertaken in accordance with the **Veld Fire Management Plan - Annexure 5**. It is essential that the CWA develop an **Emergency Preparedness and Response Plan** to provide for emergency procedures during operational phase. <u>Water Scarcity</u> • The CWA should increase water storage, reduce water use and improve water consumption efficiencies. • Ensure that multiple potable water sources are available for the site to alternate between should it be required. • Investigate monitoring and forecasting systems to help predict future periods of drought and enhance preparedness. • Monitor water consumption during drought periods to prevent compromising water availability. <u>Refer to GOAL 18: WATER EFFICIENCY & CONSERVATION.</u> <u>Extreme Heat</u> • Keep facilities/buildings cool with efficient use of air-conditioning. • Consider building designs appropriate for local climate that are conducive to cooling in summer i.e., consider building orientation, natural shading, and ventilation. • Ensure that equipment and vehicles purchased for use on site can operate under increased ambient temperatures to avoid downtime.	Waste management within the site must be undertaken in accordance with the **Waste Management Plan - Annexure 8**. Veld Fire management within the site must be undertaken in accordance with the **Veld Fire Management Plan - Annexure 5**. Design Principles must be undertaken in accordance with the **Architectural/ Urban Design Guidelines for the Cape Winelands Airport Development (Annexure 13)** and in Accordance with the **Landscaping Plans (Annexure 9).** The CWA **Stormwater Management Plan (Annexure 10)** needs to be adhered too.	Reducing the project's carbon footprint and enhancing sustainability.

	• Investigate early warning/monitoring systems to inform the site of expected heat wave occurrences. • Ensure health and safety of employees by regularly monitoring hydration levels, avoiding work hours during the hottest part of the day and providing medical attention/resources to those who are vulnerable. Design Principles must be undertaken in accordance with the **Architectural/ Urban Design Guidelines** for the Cape Winelands Airport Development **(Annexure 13)** and in Accordance with the **Landscaping Plans (Annexure 9)**. <u>Urban and Riverine Floods</u> • Ensure that drainage infrastructure is well maintained. • Ensure infrastructure built on site is resilient to projected flood levels, and that site design and layout planning considers the potential for flooding event on site • To ensure health and safety of employees, site evacuation and emergency response plans for flooding events should be implemented. • Ensure backup power systems are available, should energy supply be disrupted. The CWA **Stormwater Management Plan (Annexure 10)** needs to be adhered too. The CWA aims to be self-sustainable in meeting its energy needs by implementing renewable energy solutions such as Solar PV and a biodigester system. These measures are important for reducing the project's carbon footprint and enhancing sustainability. Further mitigation actions identified in the Climate Change Impact Assessment for consideration are: 1. Collaboration with airline partners to facilitate the development and use of sustainable aviation fuels. The airport operation should also support and promote the development and of sustainable aviation fuel and strive for operational efficiencies such as reduced aircraft idling times on runways and taxiways. 2. Collaboration with local authorities to optimise public transport to and from the airport. In employee and passenger, the project should promote the use of electric vehicles (electric busses or shuttle services) and collaborate with the government and the transport sector to improve public transportation links to and from the airport. For business travel, the project should prioritise sustainable travel options and implement carbon offset programs for unavoidable business travel to neutralise the carbon footprint. 3. Designing green buildings with materials of low embedded GHGs, incorporating designs that reduce the need for external heating and cooling.		

	4. A waste management system focusing on recycling and/or composting. The project developer should consider implementing comprehensive recycling programs for items such as paper, plastic, glass, and metal. Additionally, on-site composting facilities for organic waste disposal should be established, creating job opportunities and promoting sustainability. 5. Incorporating mitigation measures, appropriate to the chosen design of the wastewater treatment plant: The design of the wastewater treatment plant should consider best practises for mitigation depending on the technology chosen. i.e., a standard wastewater treatment plant using anaerobic digestion should consider capturing methane generated and use it to provide some of the energy requirements. Waste management within the site must be undertaken in accordance with the **Waste Management Plan - Annexure 8**.		
Remedial Action	Non-compliance to be reported to Applicant and the Competent Authority.		
PERFORMANCE			
Date	**Details of Transgression**	**Responsible Party**	**Action Taken**

GOAL 15: WASTE MANAGEMENT			
Objective	**Effective Waste Management**		
Risk	**Actions**	**Monitoring**	**Targets**
Litter Wasteful use of resources Attraction of Birds and Vermin. Pollution	Waste management within the site must be undertaken in accordance with the **Waste Management Plan in Annexure 8**. The purpose of the Waste Management Plan (WMP) is to describe the principles, procedures and management of the waste generated by Cape Winelands Airport and to ensure waste is reduced, reused and recycled wherever possible. The Waste Management Plan outlines measures to manage and mitigate waste generation and resource consumption during the construction and operation of the development. The Waste Management Plan is therefore designed to support an ecological based management approach underpinned by adaptive management principles through the entirety of the project life cycle. The following national Norms & Standards also need to apply to the Waste Facility proposed on site and need to be adhered too: • "National Norms and Standards for the Storage of Waste" (GN926 of 29 November 2013) should the facility have the capacity to store more than 80m^3 for hazardous waste and/or 100m^3 for general waste at any one time and for a period exceeding 90 days. • "National Norms and Standards for Sorting, Shredding, Grinding, Crushing, Screening, Chipping or Baling of General Waste" (GN1093 of 11 October 2017) if general waste is sorted, shredded, grinded, crushed, screened, chipped or baled in an operational area at the facility exceeding 1000m2. If the operational area does not exceed 1000m2, the facility needs to register in terms of GN1093 only and adhere to section 28 of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended, and sections 16(1) and 16(3) of the NEM: WA. • "National Norms and Standards for Organic Waste Treatment" (GN.1984 of 1 April 2022) with regard to the biodigester which no longer requires an application for a waste management licence. Facilities that have the capacity to process more than 10 tonnes of organic waste per day need to register in terms of these 'Norms and Standards' and adhere to GN1984. • "National Norms and Standards for Organic Waste Composting" (GN.561 of 25 June 2021). Organic waste composting facilities that have the capacity to process compostable organic waste, in excess of 10 tonnes per day.	Waste management within the site must be undertaken in accordance with the WMP in Annexure 8. Monitoring Measures have been set out therein.	Reduce, Reuse, Recycle.

	• "National Norms and Standards for Domestic Waste and Sanitation Services", published as GN No. 982 of 8 September 2017. GN No. 1984 does not apply to any infectious animal waste, raw sewage or sewage sludge that does not meet the minimum quality standards for sludge as determined by the Department of Waste and Sanitation in their Norms and Standards (No. 982 of 8 September 2017). Please note the requirement for the submission of **Standard Operating Procedures (SOPs)** in accordance with section 6.2 of GN No. 1984.		
Remedial Action	Waste management within the site must be undertaken in accordance with the **Waste Management Plan in Annexure 8**. Remedial Action has been included in the WMP.		
PERFORMANCE			
Date	**Details of Transgression**	**Responsible Party**	**Action Taken**

GOAL 16: TRAFFIC MANAGEMENT			
Objective	**Effective Traffic Management**		
Risk	**Actions**	**Monitoring**	**Targets**
Traffic congestion on and off the site.	The 2050 (Phase 2) capacity EMME model results showed that the future road network will be capable of supporting future developments in the area, including Phase 2 (PAL 4) of the CWA. **However, an updated TIA needs to be prepared after 2032 for each PAL once new SDPs are available and the latest traffic conditions can be assessed closer to the time.** <u>2032 Background Traffic Conditions</u> This increase in traffic will trigger the need for road upgrades, especially along Klipheuwel and Lichtenburg Roads. The proposed upgrades include the dualling of Klipheuwel Road between Brackenfell Boulevard and Lichtenburg Road, the installation of traffic signals at several intersections, and the construction of additional turning lanes. The Klipheuwel Road/Arum Lily Street intersection will be converted to a left-in, left-out (LILO) configuration as part of their access management plan (AMP). With proposed upgrades in place, capacity constraints are expected at some priority-controlled intersections. However, alternative routes via signalised intersections such as Klipheuwel Road/Darwin Road and Lichtenburg Road/Dulah Omar Street will help alleviate traffic congestion. <u>Proposed Access Phasing:</u> Mellish Road will be the initial connection from Lichtenburg. The East-West link to Klipheuwel Road when Bella Riva constructs this. CWA to engage with Bella Riva landowner/developer to establish if feasible to build Lucullus Road extension and/or the East-West Class 3 road. The East-West Class 3 at this stage is the most likely to come first. The ultimate link will be via the northern extension of Lucullus Road once the EIA approval has been completed by the City of Cape Town. The alignment and road reserve requirements of Lucullus Road bordering the west edge of the site must be confirmed. <u>2032 Total Traffic Conditions</u> This scenario assessed the impact of Phase 1 (PAL 1B) of the CWA the realigned Mellish Road access and the East-West link from Bella Riva as a secondary access. The proposed upgrades include the installation of a traffic signal at Lichtenburg Road/Mellish Road and the construction of a dual-lane roundabout at the East-West Link/CWA Access intersection. As with the 2032 Background Traffic Conditions, capacity constraints are expected to continue at the priority-controlled intersections along Klipheuwel and Lichtenburg Roads. However, alternative routes via signalised intersections on	An updated TIA needs to be prepared after 2032 for each PAL once new SDPs are available and the latest traffic conditions can be assessed closer to the time.	Effective Traffic Management

	Klipheuwel Road/Darwin Road and Lichtenburg Road/Dulah Omar Street will help alleviate congestion. Additionally, the Klipheuwel Road/Olifantsrivier Avenue intersection is expected to reach capacity during the PM peak hour. This traffic can be redistributed to the Klipheuwel Road/Okavango Road intersection, which has sufficient capacity. 2032 Sensitivity Analysis A sensitivity analysis was conducted to evaluate the impact of using only the Mellish Road/Lichtenburg Road access for Phase 1 (PAL 1B) of the CWA. The capacity analysis results show that the proposed upgrades in the 2032 Total Traffic Conditions scenario will be sufficient to accommodate the traffic generated by Phase 1 (PAL 1B). Mellish Road is therefore the only access required to accommodate the CWA Phase 1 (PAL 1B) traffic. It is, however, recommended that the East-West link across Bella Riva Phase 1 be extended to the airport by CWA when the road reserve is available. 2050 Capacity Analysis The City's EMME model was updated to evaluate the impact of Phase 2 (PAL 4) of the CWA for the 2050 scenario. This update included the total extent of the future developments in the area and assessed the R300 northern extension along with several new road links, including the Darwin Road extension, and the extensions of Lucullus Road and the East-West links. The results indicated that the future road network will be sufficient to accommodate the future developments, including Phase 2 (PAL 4) of the CWA. The future developments will require several upgrades to be implemented as more than 4 000 peak-hour trips will be added to the road network. The construction of the R300 northern extension, along with new road links such as the Darwin Road extension and extensions of Lucullus Road and the East-West links, is expected to reduce the demand at some of the study intersections. Therefore, it is recommended that the construction of these road links be fast-tracked to ensure that the intersection upgrades are not abortive in the future. Based on this assessment, it is evident that the impact of the CWA will be relatively low compared to the other future developments in the area. Hence, it is recommended that the airport be approved from a transport point of view, and that an amended TIA be prepared in the future to accommodate changes in intersection upgrades over time.		
Remedial Action	An amended TIA must be prepared in the future phases of the CWA.		

PERFORMANCE			
Date	**Details of Transgression**	**Responsible Party**	**Action Taken**

GOAL 17: SOCIO-ECONOMIC BENEFITS			
Objective	**Ensuring the socio-economic benefits of the project are achieved.**		
Risk	**Actions**	**Monitoring**	**Targets**
Unsuccessful socio-economic objectives.	Continuous and periodic monitoring and evaluation are required to ensure the achievement of milestones and the overall success of achieving the socio-economic objectives envisaged for the Project. The following activities are geared towards achieving acceptable and ongoing monitoring standards: 1. Regular field visits to the project and stakeholders benefiting from the project 2. A review after the first six months after implementation to assess the overall progress and achievement of the objectives and milestones related to the specified targets of employment, skills development, small business development and capacity building. To monitor the performance related to the achievement of the socio-economic development obligations, the contractor should record and report progress with agreed socio-economic obligations. Typical reporting information should include: • Actual total expenditure on Total Procurement; • Actual total expenditure on Procurement of Materials; • Actual total expenditure on Sub-contracting; • Actual total employment categorised according to standard Occupational Categories; and • Actual total payroll. The successful implementation and development of the proposed project will ultimately be assessed on the contribution the project makes during construction and operations to the social development and economic goals of employment creation, skills development and training, small business development and capacity building in the area. The following Key Performance Areas are outcomes based on the scope of social engagement activities: • Procurement from, or sub-contracting to local enterprises; • Procurement from, or sub-contracting to enterprises from outside the local area; • Procurement of local materials/resources;	Continuous and periodic monitoring as per this Goal.	Achieving the socio-economic objectives envisaged for the Project.

	• Procurement of materials from outside the CMA; • Recruitment process that promotes gender equality Social impacts such as the influx or in-migration of job seekers will likely affect the area's local communities and other properties. This assertion is based on the nature, size and scope of the proposed project as a significant contributor to the aviation landscape and the ancillary requirements for the development of airports. Monitoring as a basis for understanding changes in the social landscape is required and should be reported on as part of the socio-economic monitoring proposed above. A system should be developed to assess the impact, and stage gate reviews should be considered to guide the required steps. This requirement should also be aligned with developing a Social Engagement Plan that should be implemented and form the basis of the above review. The remaining operational socio-economic impacts are addressed through other means in the form of separate Goals e.g. Noise, Air Quality, Traffic etc. whereas bulk infrastructure requirements are addressed through the implementation of the respective Engineering Reports.		
Remedial Action	Non-compliance to be reported to Applicant and the Competent Authority.		
PERFORMANCE			
Date	**Details of Transgression**	**Responsible Party**	**Action Taken**

GOAL 18: WATER EFFICIENCY & CONSERVATION			
Objective	**Sustainable water management practices.**		
Risk	**Actions**	**Monitoring**	**Targets**
Water Scarcity	The following mitigation and adaptation measures are essential to reduce the vulnerability of the CWA to water scarcity: • The CWA must increase water storage, reduce water use and improve water consumption efficiencies. • Ensure that multiple potable water sources are available for the site to alternate between, should it be required. • Investigate monitoring and forecasting systems to help predict future periods of drought and enhance preparedness. • Monitor water consumption during drought periods to prevent compromising water availability. These overarching measures will be addressed through the following ways: • The implementation of the Geohydrological Monitoring Plan & Groundwater Management Plan [refer to GOAL 1: SAFEGUARD GEOHYDROLOGICAL AND GROUNDWATER FEATURES]. • The implementation of the *design principles* in accordance with the Architectural/ Urban Design Guidelines for the CWA (Annexure 13). The following sustainable inclusions are incorporated into the Architectural/ Urban Guidelines: o Eco-Friendly Design: Incorporate sustainable design practices, including energy-efficient systems, renewable materials, and optimal use of natural light and ventilation. o Water Management: Implement water-saving technologies, such as rainwater harvesting and efficient irrigation systems, to minimize water consumption and promote responsible water use. o Energy Efficiency: Integrate energy-efficient lighting, HVAC systems, and appliances throughout the complex to reduce energy consumption and lower the environmental impact.	Annual Water Efficiency Audit: These audits provide a detailed assessment of water usage patterns, identify areas of inefficiency and recommend tailored solutions to address immediate concerns and long-term sustainability targets. Waste management within the site must be undertaken in accordance with the **Waste Management Plan - Annexure 8**. Veld Fire management within the site must be undertaken in accordance with the **Veld Fire Management Plan - Annexure 5**. Design Principles must be undertaken in accordance with the **Architectural/ Urban Design Guidelines for the Cape Winelands Airport Development**	Reduced water consumption Sustainable water management practices Reduce the airport's reliance on freshwater sources

	○ Green Building Certification: Strive for recognized green building certifications to ensure the complex meets rigorous sustainability standards and contributes positively to the environment. ○ Waste Reduction: Implement waste reduction and recycling programs to minimize the generation of waste and encourage responsible disposal practices. • Installation of efficient appliances & technology i.e. smart taps, efficient toilet systems, metered taps (to reduce water consumption) & efficient ticketing management systems (to minimize delays and long overlays). • Improving overall airport efficiency thereby reducing the passengers time spent at the terminal, thereby reducing the pressure on the airports resources. • Provide passengers with information to assist with water management at CWA, including airside, landside and aircraft water management aspects through e.g. signage, inserts in the cabin documents and mainstreamed public addresses both on board aircrafts and in the terminal building. Successful water conservation strategies for airports include: 1. Reclaimed Water and Advanced Water Purification Utilisation of reclaimed water and advanced water purification systems. Reclaimed water, or recycled water, is wastewater that has undergone treatment processes to remove pollutants and contaminants, making it suitable for non-potable uses e.g. landscape irrigation, toilet flushing and aircraft washing. 2. Geothermal Cooling and Condensate Recovery Geothermal cooling systems are gaining popularity in airports due to their energy efficiency and water-saving potential. These systems utilize the Earth's natural thermal properties to provide cooling. By eliminating water-intensive cooling processes, airports can significantly reduce their water consumption while also minimizing their carbon footprint. Additionally, airports can implement condensate recovery systems to capture and reuse the condensed water generated by air conditioning units. This water can be repurposed for various applications, such as irrigation or aircraft washing, further reducing the airport's water footprint.	**(Annexure 13)** and in Accordance with the **Landscaping Plans (Annexure 9).** The CWA **Stormwater Management Plan (Annexure 10)** needs to be adhered too.	

	3. Low-Flow Fixtures and Infrastructure Upgrades Water-efficient fixtures i.e. low-flow toilets, urinals, faucets and showerheads and appliances is a straightforward yet effective approach to water conservation in airport terminals. Furthermore, airports can invest in infrastructure upgrades to improve water distribution and management systems. This may include installing smart metering systems, implementing leak detection and repair programs and optimizing water pressure to reduce water waste. 4. Water-Efficient Landscaping and Stormwater Management Landscaping which involves the use of drought-tolerant and indigenous plant species, can significantly reduce water demand for irrigation while also enhancing the aesthetic appeal of the airport. Efficient irrigation systems, such as drip irrigation and smart irrigation controllers, can further optimize water usage for landscaping purposes. Incorporating rainwater harvesting and stormwater management systems can provide an alternative water source for irrigation, reducing the reliance on potable water supplies. 5. Wastewater Recycling and Resource Recovery Airports generate various types of wastewater, including aircraft de-icing and anti-icing fluids, aircraft and vehicle wash water and industrial wastewater from maintenance facilities. Implementing wastewater recycling and resource recovery systems can not only reduce water consumption but also minimize the environmental impact of wastewater discharge. Advanced treatment technologies can be employed to treat wastewater and recover valuable resources, such as water for non-potable uses, biogas for energy generation and nutrient-rich biosolids for agricultural applications.		
Remedial Action	Non-compliance to be reported to Applicant and the Competent Authority.		
PERFORMANCE			

Date	Details of Transgression	Responsible Party	Action Taken

SECTION 5: COMPLIANCE AND MONITORING

5.1 Monitoring

The monitoring of works on site is necessary to demonstrate compliance with the specifications of the EMPr and to allow for problems or issues of non- conformance to be identified and appropriate corrective measures to minimise environmental damage to be implemented.

Monitoring should include visual checks by the ECO on a daily basis, checks on particular requirements for site activities by the ECO, as well as a review of site documentation. The ECO or suitable person shall complete the performance record at the end of each table, as a record of transgressions or problems experienced on site and how they were dealt with.

Monitoring of activities on site by the ECO should be done as follows:

Prior to construction commencing the Applicant will establish an Environmental Management Division to be lead by an Environmental Manager.

During the Construction Phase an external ECO will be appointed for the duration of the construction phase who is to be on site daily. The ECO is to liase and report their findings to the Environmental Manager. Monthly ECO reports are to be compiled and submitted to the EM, City of Cape Town's Environmental and Heritage Management Branch (Northern Region) and DEA&DP.

During the Operational Phase a permanent internal ECO will be appointed for the duration of the operational phase undertaking daily environmental tasks. The ECO is to liase and report their findings to the Environmental Manager. Monthly ECO reports are to be compiled and submitted to the EM and DEA&DP.

A number of specialist support teams are to be appointed (from the onset of the construction and throughout the operational phases - depending on the level of activities being undertaken) who will report to the ECO/ EM. These teams will address aspects such as Alien Management, Waste management, Fire Management, Wetland/ Botanical Rehabilitation etc. Specialists must also be appointed ad-hoc to address aspects such as spills or emergency incidents.

Monitoring in terms of Specialist Mitigation Measures is addressed throughout the report, where applicable.

5.2 Penalties and Incentives

Transgressions relate to actions by the Contractor and team members whereby damage or harm is inflicted upon the environment or any feature thereof and where any of the conditions or specifications of the EMPr are infringed upon.

In the instance of environmental damage, the damage is where possible to be repaired and rehabilitated using appropriate measures, as specified and undertaken by appropriate specialists for the account of the Applicant or other guilty party.

Where infringement of the specifications or conditions of the EMPr is registered, appropriate remedial action or measures are to be implemented for the account of the Applicant. Where non-repairable damage is inflicted upon the environment or non-compliance with any of the EMPr obligations is registered then the Contractor may face a monetary penalty to an amount specified by the ECO. The ECO reserves the right to implement a first offence warning.

Transgressions are most likely to occur with respect to litter on site, damage to trees on site, disturbance of sensitive areas. The following penalties are suggested for the above-mentioned transgressions:

- Waste: In the case of excessive waste, the ECO is to allow the Contractor 24 hours in which to remove the litter or face a monetary penalty at the ECO's discretion.
- Damage of River System or conservation area: A monetary penalty to the maximum of R5000 is to be paid for each waste act within a River System or the Conservation Area.
- Erosion: Erosion resulting from any work on site is to be rectified at the cost of the operator.

If excessive infringement with regard to any of the specifications is registered, the Applicant reserves the right to terminate the Contractor's contract.

The above-mentioned controls are to be identified and enforced by the ECO. Issues of non-compliance noted by the ECO are to be communicated to the site manager, who holds the responsibility of ensuring that the relevant parties are made aware of the lack of compliance with EMPr specifications and that appropriate action is taken to rectify the situation. The ECO will advise on appropriate corrective actions when necessary.

5.3 Site record

Minutes of the Contractors or Operators meetings on site must reflect:

- environmental queries and complaints;
- actions agreed upon;
- dates of eventual compliance;
- must form part of the official environmental site record; and
- along with the Environmental Site Book and Site Diary.

In additions to the summary report, the ECO shall keep a monthly photographic record of progress on site at the start of the construction phase and an ad hoc record of incidents or events on site, especially in the case of transgressions from EMPr specifications.

5.4 Review of EMPr

The EMPr will be reviewed by the ECO on an ongoing basis. Based on observations during site inspections and issues raised at site meetings, the ECO will determine whether any procedures require modification to improve the efficiency and applicability of the EMPr on site.

Any such changes or updates will be registered in the ECO's monthly record, as well as being included as an annexure to this document. Annexures of this nature must be distributed to all relevant parties on site.

5.5 Environmental Audits

A suitably qualified Environmental Auditor is to be appointed, to undertake audits of compliance with the EMPr. An audit should be undertaken biannually (every 6 months) during the construction phase and annually during the operational phase. Objectives should be to audit compliances with the key components of the EMPr, to identify main areas requiring attention and recommend priority actions. The audit should cover a cross section of issues, including implementation of environmental controls, environmental management, and environmental monitoring.

Results of the audits should inform changes required to the specifications of the EMPr, or additional specifications to deal with any environmental issues which arise on site and have not been dealt with in the current document.

APPENDIX 39B

ANNEXURES TO THE ENVIRONMENTAL MANAGEMENT PROGRAMME FOR THE EXPANSION OF THE CAPE WINELANDS AIRPORT.

ANNEXURE

ANNEXURE 1 - EAP CV
ANNEXURE 2 - LOCALITY PLAN
ANNEXURE 3 - SDP AND SITE SENSITIVITY MAPS
ANNEXURE 4 – FOSSIL FINDS POSTER
ANNEXURE 5 - VELDFIRE MANAGEMENT PLAN
ANNEXURE 6 - ALIEN VEGETATION MANAGEMENT PLAN
ANNEXURE 7 - WETLAND OFFSET STUDY AND IMPLEMENTATION PLAN
ANNEXURE 8 - WASTE MANAGEMENT PLAN
ANNEXURE 9 – CONCEPT LANDSCAPING PLAN

ANNEXURE 1: CURRICULUM VITAE

CURRICULUM VITAE of PAUL HENDRIK SLABBERT

ENVIRONMENTAL & HERITAGE IMPACT PRACTITIONER

EAPASA Reg 2020 • Ref: 2019/1036 & APHP Professional Heritage Practitioner

1. PERSONAL DETAILS

Born:	23 May 1973
Nationality:	South African
Drivers License:	Code EB
Languages:	Proficient in English and Afrikaans

2. KEY COMPETENCIES

I've completed my BACCALAUREUS ARTIUM ET SCIENTIAE Honors degree at the Potchefstroom University for CHO in 1995. The degree is primarily focused on qualifying Town and Regional Planners, but due to the SCIENTIAE (Science) component it equipped and stimulated my passion for environmental planning. Geography & Environmental studies, Sociology, Statistics and Mathematics in the first year and Geography & Environmental studies, Sociology in the second year formed the bases of my environmental education and interest. Economics up to 3rd year level and Statistics, Project Management and Planning Legislation at 4th year level provided me with an advance understanding of the development industry. The Town and Regional Planning curriculum from 1st to 4th year covered the entire spectrum of the built, people, heritage, natural and aesthetic environment in relation to the potential impacts on the socio, economic and bio-physical environment.

I started my Environmental Assessment Practitioner (EAP) career in 1998 as a professional practicing initially in the eco-tourism development industry. My passion for environmental, heritage & land-use planning with associated management strategies enable me to facilitate with all role players to find workable solutions in order to implement sustainable development in Greenfield areas. Due to the ECA (Act No. 73 of 1989) Section 21 Activities identified in 1997/8 the projects I was involved with required authorisation ito the ECA. As a result I started to practice as an EAP obtaining authorisations for triggered developments. I gained experience in rural and urban development with the emphasis on environmental impact assessments and management. This enabled me to have various publications in leading eco-tourism magazines. I've been witness to the evolution of the EIA industry from ECA to NEMA up to the current EIA Regulations. I've been operating as a Principal EAP and Environmental Practice owner for over 20 years.

During my career to date I have accumulated experience in the following key areas:

Impact Practitioner & Environmental Planner:

- Environmental Impact Assessments [legislative & process],
- Heritage & Visual Impact Assessments [legislative & process],
- Mining; Processing & Industrial [legislative & process],

- Environmental Management [environmental control, management plans, Environmental & Social Management Systems],
- Conservation [management strategies, funding & alien vegetation],
- Power Generation [generation, distribution and powerline alignment]
- Land-Use [forward planning, feasibility study, business plan],
- Eco-tourism [trails, birding, recreation, construction, lodging],
- Community [facilitating, public participation, education],
- Water use authorisation [WULA's, GA's pollution prevention management plans and ELU's];
- Waste Management Licences [legislative & process];
- Air Emission Licences [legislative & process],
- Coastal Water Discharge Permits [legislative & process],
- Organizers [events, strategic, project management].

Business & Corporate Reasonability:

- Information on my Environmental Practice, PHS Consulting please view at www.phsconsulting.co.za
- For overview of my social and community engagement programme visit www.africanvisionfoundation.co.za

Advanced Legislative Knowledge:

Providing specialist services and managing and driving projects related to the following legislation:

- National Environmental Management Act (Act No. 107 of 1998) and 2017 Regulations;
- Environmental Conservation Act (Act No. 73 of 1989);
- National Heritage Resources Act (Act No. 25 of 1999);
- Land Use Planning Ordinance (Ordinance 15 of 1985);
- National Environmental Management: Integrated Coastal Management Act (Act No. 24 of 2008);
- National Environmental Management: Waste Act (Act No. 59 of 2008);
- National Environmental Management: Air Quality Act (Act No. 39 of 2004);

- Mineral and Petroleum Resources Development Act (Act No. 28 of 2002);
- National Water Act (Act 36 of 1998);
- National Water Services Act (Act 108 of 1997).
- National Environmental Management Act (Act No. 107 of 1998); Public Participation Guideline (10 October 2012)

3. TERTIARY EDUCATION

3.1 Honors Degree in B Art Et Scien (Planning)

Year/s of study:	1992 – 1995 (received 96/03/04)
Institution:	University of Potchefstroom (PU for CHO)
Course Modules:	Geography and Environmental Studies Industrial Sociology Town & Regional Planning Economics Mathematics Philosophy Sociology Statistics Planning Legislation
Honors Thesis:	Sustainable Development of Ikageng Township

4. REGISTRATIONS AND AFFILIATIONS

- Certified Member of the Environmental Assessment Practitioners Assocoation of South Africa – Reg 2019/1036
- Professional Certified Member of Association of Professional Heritage Practitioners (APHP)
- Professional Member of the International Association for Impact Assessment (IAIA)

5. EMPLOYMENT RECORD

4.1 Current

Designation:	Self-Employed Principal Environmental Assessment Practitioner Heritage Assessment Practitioner Environmental Planner
Period:	1998 to current
Key responsibilities:	Environmental Practice (PHS Consulting) Owner that conduct, manage and review EIA's, Basic Assessments, Coastal Water Discharge Permit, Air Quality Licenses, Waste Management Licenses, Setback Line applications,

Water Use Authorizations, General Authorizations, NEMA S24G Applications, Mining Permit and License applications. Authorisation and License compliance audits, EMP's, ECO work, Social and Labour plan compilations, Alien Eradication Management Plans, Fire Management Plans, Maintenance Management Plans, Wild Life Management Plans. Environmental feasibility planning, event organizing and Corporate Social Investment programmes.

PHS Consulting: As sole Member of the Close Corporation I currently employ two fulltime EAP's namely Amanda Fritz-Whyte and Nadine Duncan. We make use of various freelance EAP's and specialist consultants depending on the project type.

4.2 Pre PHS Consulting

Designation: Employed by OmniPlan
Period: 1997 to 1998
Key responsibilities: Planning Administration, Town Planning Applications, Constraint Analysis, Layout and Design, Community Presentations.

6. COURSE / CONFERENCE PARTICIPATION

5.1 Short courses completed

I attended various DEA&DP, APHP, IAIA, Fynbos & SANBI forum workshops, training programmes and conferences since 1999 to date.

7. LIST OF EIA PROJECTS TO DATE

Please note over the years in practice I conducted many projects and it's impossible to list them all. He is a summary of the most relevant EAP projects that illustrate my competence, knowledge and experience. **Please note that all projects listed below required the need to conduct Public and Authority Participation, the result is 25 years of consultation experience.**

Major project	Tasks	Employer/client	Responsibility
Namaqualand Casino Development **1998**	Evaluate and assess various site alternatives for the development of a casino in Namaqualand. Assess bio-physical & socio-economic environments from Garies to Vioolsdrif to Pella inland environments. Assessment of the entire coastal environment from Groenrivier mouth to Alexander bay. Presented preferred site alternative to be included in national bid for license allocations	Namaqualand District Council	Act as researcher, public participation liaison and site assessment consultant
Barolong Archaeological Eco-tourism Assessment **1999 - 2000**	Investigate the feasibility to develop eco-tourism activities amongst the Barolong Tribe kraal systems on the highlands of the North West Province. After survey and mapping, proposed a feasible site close to Hartebeesfontein (NW). Planned hiking and mountain bike trails system in terms of bio-	Hartebeesfontein Farmers Association	Site Analysis, layout development, Heritage Practitioner (HP) and environmental management and ECO work

	physical and heritage constraints. Drafted a management plan for trail system and developed the trail system and product. Launched and operated initial phase until handover to landowners.		
EIA's on 4x4 trails and overnight huts, **2000 - 2001**	Completed 3 x EIA's on 4x4 trails in the Du Toit Kloof and Hexriver mountains. Worked according to DECAS guidelines and ECA process at the time.	Private Landowners and conservancies	EAP
Anglo Gold Game Reserves – North West, Gauteng, Free State Provinces **2001**	Contracted as Environmental Management Officer for Anglo Gold mining group in Vaal Reefs. I drafted EMP's for all three of the Nature Reserves and Interpretation Centres. This was followed by ecotourism master plans to focus on sustainable use of the Reserves. I acted as ECO, for the building projects (Lodges) in the reserves and on most of the adjacent mining areas. Water Management and monitoring of water samples were part of the duties	Anglo Gold Ashanti	ECO, HP and IEM officer
Contracted by Uluntu Environments for trail planning and assessments **2002**	Status quo assessments on all trails and tracks conditions in the Rhodes Memorial, Devils Peak, Sandy Bay , Buffels Bay, Table Mountain and Cape Point areas of the Cape Peninsula National Park. Proposed rehabilitation plans, construction plans and new routes. Assess potential impact on new and disturbed areas. Construction implementation and ECO.	City of Cape Town, Cape Nature	Planning, Environmental Assessment & ECO
Kronendal Estate Residential Development – Houtbay, **2003** Community Centre site selection – Pringle Bay **2003**	Environmental Impact Assessment and EMP's Site Analyses in coastal zone, with comprehensive public participation. This was to determine a feasible site form both an environmental and community perspective	Dormacorp Pty Ltd & First Plan town and regional Planners Hangklip Kleinmond Municipality	EAP Site Assessor and Public participation Liaison
Mosaic Farm, Walkerbay Fynbos Conservancy, Stanford, Western Cape **2003 – 2005** Chairman Birdlife Walke Bay **2003 - 2005**	Project and Conservation Management contract, responsible for drafting and implementing a major, building restoration and alien clearance program. Planning and implementing the Walkerbay Fynbos Conservancy Hiking trail alignments and management plans. Responsible for assessing development footprints for overnight camps. Implementation of a fire management plan and action plan. Established bird club and birding project in the Overberg and the Stanford Bird fair	Hermanus Riviera Estates Birdlife South Africa	Environmental Planner, HP, Implementing Agent and Assessor Chairman (WB), Event Organiser and Community Liaison
Hoopjiesrivier, Free Range Chicken Farm (Farm 541 Caledon)–	Basic Assessment and EMP's	ITAKANE	EAP

Karwyderskraal, **2006** Heritage Heights (Portion 81 of the Farm 229) residential development – VanWyksdorp, **2006**	Visual Impact Assessment (VIA) and Heritage Impact Assessment (HIA)	Andre Snyman	VIA and HP
Kleinberg residential and retirement village development (erf 459) – Riviersonderend **2007**	Basic Assessment, EMP's and Landscape Planning	Jacob du Toit	EAP
Gansbaai Industrial extension (erf 210) – Gansbaai **2007**	Basic Assessment, EMP's	Overstrand Municipality	EAP
Kleinbaai harbour dredging – Gansbaai **2007**	Basic Assessment, EMP's	Overstrand Municipality	EAP & ECO
Langeberg Cheese factory (Portion 69 of Farm no.159) – Buffelsjag **2008**	Basic Assessment, EMP's	Langeberg Kaas Pty Ltd	EAP
Industrial development (erf 931)- Struisbaai **2008**	Basic Assessment, EMP's, Landscape Planning	Louis Greeff	EAP
Shopping Centre Development – Livingstone Zambia **2008**	EIA and EMP's	Shoprite Checkers	EAP
Billboard development (erf 35270) – Milnerton **2008**	Basic Assessment, EMP's	CK Outdoor Advertising Pty Ltd	EAP
Fick's Pool Restuarant – Hermanus **2008**	Basic Assessment, VIA and HIA	Overstrand Municipality	EAP. VIA & HP Practitioner
Residential Development (erf 1497) – Vermont **2009**	Basic Assessment, EMP's, Landscape Planning	CRISTATUS INV 85 CC	EAP
	Basic Assessment, EMP's	PJW Terblanche	EAP & ECO

Single Dwelling Development (erf 278) – Malgas **2009**	Scoping, EIA and EMP's	Swellendam Municipality	EAP
Petrol Filling Station (erf 1) – Swellendam **2009**	Basic Assessment, EMP's	West Point Processing Pty Ltd	EAP & ECO
Fish Processing Plant – St Helena Bay **2009**	VIA and HIA	Spirito Trade 82 Pty Ltd	VIA & HP Practitioner
Bloemendal Wine Estate – Durbanville **2009**	Environmental Management Programme Reports and Audits	Terblanche Transport	Environmental Auditor
Maandagskop and Airport Quarries – Mosselbay and George **2009**			
Matroosberg Reserve (Farm 424) Ceres **2010**	Basic Assessment & EMP's	Erfdeel Boerdery	EAP & ECO
Kleinbaai Harbour Expansion (Erf 423) - Gansbaai **2010**	Basic Assessment & EMP's	Overstrand Municipality	EAP
Retirement Village Development (Erf 5379 & 5300) – Onrusrivier **2010**	Basic Assessment, EMP's & ECO	Tweefonteine Ontwikkelings Trust	EAP & ECO
Industrial Development (Erf 2015) – Riversdale **2010**	Basic Assessment, EMP's & ECO	Hessequa Municipality	EAP & ECO
Residential Development (Erf 987) – De Kelders **2011**	Basic Assessment & EMP's	Hopefull Trust	EAP
Unlawful Vegetation Removal (Farm 237) - Elim **2011**	S 24 G & EMP	Moravian Church of Elim	EAP
Graveyard Development – Springbok, Okiep, Bergsig, Matjieskloof, Kommagas, Nababeep – Northern Cape **2011**	Basic Assessments & EMP's	Nama Khoi Local Municipality	EAP
Residential Development (Erf 8704) – Paarl **2011**	Basic Assessment & EMP's	Nevensaan Ontwikkelings	EAP

Wetland Rehabilitation – Tesselaarsdal **2011**	Basic Assessment & EMP's	Department of Agriculture and Tesselaarsdal Action Group	EAP
Mushroom Farm Development (Farm 436/27) – Botrivier **2011**	Basic Assessment & EMP's Waste Licence	Ocean Mushrooms	EAP & ECO
Blouberg Mine Development (Farm 88 & 91) – Melkbosstrand **2012**	Visual Impact Assessment	Tip Trans	Visual Assessor
Urban Expansion Residential Estate (Farm 436/5) – Botrivier **2012**	Scoping, EIA & EMP's	Crimson Properties	EAP
Cemetery Development (Erf 513 – Napier **2012**	Basic Assessment & EMP's	Cape Agulhas Municipality	EAP
Coastal Sidewalks Development (Erf 462) - Franskraal **2012**	Basic Assessment & EMP's	Overstrand Municipality	EAP
Riverside Residence Development (Farm 321) – Stanford **2012**	Basic Assessment & EMP's	Astrodome Investments	EAP
Eco- Village Development (Farm 483/2) - Caledon **2012**	Basic Assessment & EMP's	Theewaterskloof Municipality	EAP
Botrivier Windfarms – Botrivier **2013**	Appointed to oppose the development of windfarms outside regional allocated areas as part of the "Wind Rush" period. Scrutinise and evaluate Scoping & EIA Documents on behalf of opposition. Handling of Appeal.	Wildekrans Wine Estate and Botriver Community	Opposing EAP
Resort Development (Farm 213) – Bonnievale **2013**	S24 G & EMP's	De Hoek Trust	EAP
Commercial Development – Chililabombwe Zambia **2013**	EIA	Shoprite Checkers	EAP
Birding Route Development – South Africa **2013 to 2016**	Environmental Planning to establish and support birding development in all the South African Provinces	E Snell & Co Funder and BirdLife	Environmental Planner

		SA and SANPARKs Honorary Rangers	
Intensive Feed Farm Development (Farm 728/2) – Grabouw **2013**	Basic Assessment & EMP's	Babel Trading	EAP & ECO
Uilenvlei Private Nature Reserve, resort development – Uilkraalmond **2013**	Basic Assessment & EMP's	Southern Spirit Properties	Compile & Review EAP
Development of five Cemeteries - Upington **2014**	Basic Assessment & EMP's	Khara Hais Local Municipality	EAP & HP
Commercial Development – Mongu Zambia **2014**	EIA	Shoprite Checkers	EAP
Establish Hartenbos River Water Users Association – Hartenbos **2014**	Draft Constitution, verify ELU's conduct Public Consultation	Hartenbos River Water Users Association	Water Resource Consulting
Commercial Development Cabinda – Angola **2014**	EIA	Shoprite Checkers	EAP
Resort Development (Farm 633 & 273) – Swellendam **2014**	Basic Assessment & EMP's	Bakkelys Drift Properties	EAP
Natures Path Lifestyle Village - Keurboomstrand **2015**	Heritage Impact Assessment guiding the EIA process towards a more aesthetic SDP	Sharples Environmental	Heritage Impact Assessor (HP)
Hazardous Waste Assessment – Castle Mews Woodstock **– 2015**	Assess hazardous waste contamination in basement of old buildings, establishing the source and report finding the competent authorities. Assist with drafting management actions to clean-up and resolve.	Castle Mews	Waste Assessor
Commercial Development Kuito – Angola **2015**	EIA	Shoprite Checkers	EAP
Residential Development (Farm 142/14) – Rheebok **2015**	Basic Assessment & EMP's	Mercedes Trust	EAP & ECO
		Shoprite Checkers	Water Assessor

Water Act and Use Interpretations for Commercial off grid Systems – Western Cape **2015**	Site Assessments, Technology Assessment, Legislation Applicability, Interpretation of the Water Act.		
Coastal Sidewalk and Trail Development – Kleinmond **2015**	Basic Assessment & EMP's	Overstrand Municipality	Review EAP
Wetland Rehabilitation Plan; Operational Environmental Management Plan and Environmental Liaison Committee – Sun Valley Mall Noordhoek **– 2015**	Rehabilitation Plan, OEMP & ELC	Shoprite Checkers and City of Cape Town	EAP & ECO
Air Emissions Licence (2 Neil Hare Rd) - Atlantis **2016**	Air Emissions Assessment	Malmesbury Sterilisasie Aanleg	EAP
Kenhardt Solar Power Farms and Power Lines – Northern Cape **2016-2018**	Appointed to investiage the development of solar farms an powerline distribution lines outside regional allocated areas as part of the "Solar Rush" period. Scrutinise and evaluate Scoping & EIA Documents on behalf of opposition. Handling of Appeal.	Dagab & Rooidam Farms	Analysing EAP
Jetty Development in Protected Area (Farm 480/136) – Stillbaai **2016**	Basic Assessment & EMP's	Koringfontein Farm	Review EAP
Intensive feed Farm (Farm 226) – Hermanus **2016**	Basic Assessment & EMP's	Bapchix	Review EAP & ECO
Industrial Development (Erf 1) - Caledon **2016**	Basic Assessment & EMP's	Theewaterskloof Municipality	EAP
Abalone Farm Development (Farm 421/1) – Doringbaai **2016**	Basic Assessment & EMP's	Doring Bay Abalone	Review EAP
Stander Mine (Farm 189/83) – Wilderness **2016**	Basic Assessment & EMP's	Viadro 127	EAP & ECO

ECO Lifestyle Estate & Nature Reserve, Hoek vd Berg (Farm 572) – Hermanus **2017**	Scoping EIA & EMP's, HIA	Saddle Path Properties	Review EAP, Heritage Assessor and Water Assessor
Abalone Farm Development (Farm 108) - Jacobsbaai **2017**	Basic Assessment & EMP's	Jacobsbaai Sea Products	Compile & Review EAP & ECO
Demolition Waste Management – Cape Peninsula **2017 ongoing**	Waste Management Plans for demolition and redevelopments	Shoprite Checkers	Waste Assessor
Resort Development (406/58) – Slanghoek **2017**	Basic Assessment & EMP's	Slanghoek Resort	Review EAP & Visual Assessor
Resort Development (Farm 627/1) - Stanford **2017**	Basic Assessment & EMP's	Philipskop	Review EAP
Intensive Feed Farm (Farm 541/6) – Karwyderskraal **2017**	Basic Assessment & EMP's	Itakane Trading	Review EAP & ECO
Henkershoek Mine (Farm 628) – Albertinia **2017**	Basic Assessment & EMP's	Viadro 127	Compile & Review EAP
Heavy Minerals Prospecting (Alexcor Mining Right Area) – Alexanderbaai **2018**	Basic Assessment & EMP's	Vast Mineral Sands	EAP
Commercial Development Namibe – Angola **2018**	EIA	Shoprite Checkers	EAP
Resort Development (Farm 465) – Elgin **2018**	Basic Assessment & EMP's	On The Earth	Review EAP
Residential Development (Erf 1019) - Wilderness **2018**	Basic Assessment & EMP's	Costa	Compile & Review EAP
Residential Development (Erf 1156) – Witsand **2018**	Basic Assessment & EMP's	Westfield Trust	EAP & ECO
Van Der Stell Liquor Store – Stellenbosch **2019**	Heritage Impact Assessment	Shoprite Checkers	HP

Weir and Pipeline Development (Huiskloof River) – Botrivier **2019**	S24G & EMP's	Erin de Vigne	EAP
Crocodile Diving Facility (Erf 48) – Birkenhead **2019**	Cape Nature Permitting & EMP	Afrikanos	EAP
Abalone Farm Development (Farm 6/453) – Gouritsrivier **2019**	Basic Assessment & EMP's	Aqunion	Compile & Review EAP
Heavy Minerals Prospecting (Trans Hex Mining Right Area) – Hondelipbaai **2019**	Basic Assessment & EMP's	Saxon	EAP
Intensive Chicken Farm (Farm 487) – Caledon **2019**	Basic Assessment & EMP's	Elgin Free Range Chickens	Review EAP
Agricultural Cultivation (Farm 3/497) – Malgas **2019**	Scoping, EIA & EMP's	Eksteen Familie Trust	Review EAP
Airport Quarry (Farm 129/208) – George **2019**	Scoping, EIA & EMP's	Mercedes Trust	Compile & Review EAP
Constantia Emporium Retail Centre - **2020**	Heritage Interpretation Story & Signage	Shoprite Checkers	HP
Commercial Retail Development – City of Cape Town **2017 – 2020**	Environmental Management Plans & Environmental Control Officers various projects, Delft, Sun Valley, Constantia, Sitari, Brackenfell, Paarl, Table View and Gordons Bay.	Shoprite Checkers	EMP & ECO
Heavy Mineral Mines – Alexcor Northern Cape **2020 – 2021**	Environmental Impact Study	Deep Blue Minerals	EAP
Free Range Chicken Farms – **2020 – 2021**	Environmental Impact Assessment	Elgin Free Range Chickens	EAP
Sitari Retail Centre - **2021**	Heritage Interpretation Story & Signage	Shoprite Checkers	HP
Hoop Urban Expansion – Overberg **2022**	Environmental Impact Study Heritage and Visual Impact Study	Hoop Trust	EAP & HIA

EFRC Abattoir – **2022**	Environmental Impact Assessment	Elgin Free Range	EAP
Atlantis Air Quality - **2022**	Atmospheric Impact Assessment	Atlantis Processors	EAP
Cape Winelands Airport – City of Cape Town **2021 – 2023**	Environmental Impact Assessment	Cape Winelands Airport	EAP
West Point Processors (Fish Meal & Oil) – St Helena Bay **2019 – 2023**	Environmental & Atmospheric Impact Study	TerraSan Group	EAP
Sea Concession 2A, Heavy Mineral Mine – Port Nolloth **2023-2024**	Environmental Impact Assessment & EMP	Whale Head Minerals	EAP
Memorialisation of Hardekraaltjie Cemetery – **2024**	Heritage Assessment	University of Stellenbosch	HP
Rogland Sand Mine – Albertinia – **2024**	Basic Assessment & EMP	Terblanche Transport	EAP
Revitalization of Stellenbosch Mills Square - **2024**	Heritage Assessment	Shoprite Checkers	HP

References:

1. **Shoprite Checkers - Leon Myburgh (084 223 4788) lemyburgh@shoprite.co.za.**
2. **Cape Winelands Airport - Nick Ferguson (082 374 8769) nick@capewinelands.aero**
3. **West Point Processors - Marthin Potgieter (082 551 0217) marthin@saldanha.co.za**

C U R R I C U L U M V I T A E

J E N N A M A R E E T H E R O N

E N V I R O N M E N T A L A S S E S S M E N T P R A C T I T I O N E R

EAPASA Reg no: 2022/5926

PERSONAL PROFILE

Gender: Female	Date of Birth: 4 October 1984
Nationality: South African	Languages: Proficient in English and Afrikaans

KEY COMPETANCIES

I completed my Bachelor's degree (International Studies) focusing on Political Science, History and Sociology in 2005 and my Master's degree (Cultural Tourism and Heritage Studies) at the University of Stellenbosch in 2007. My Master's degree was undertaken predominately through the Department of History and the Department of Geography & Environmental Studies. In 2008 I was accepted into the City of Cape Town's Environmental Resource Management Departments Internship Program for a 12-month period. My internship was invaluable to my career as it equipped me with the practical skills and knowledge behind environmental planning. I received a certificate of commendation for 'Outstanding contribution to the Environmental Internship Programme 2008'. I officially started my EAP career in 2009 as a professional Environmental Consultant within the Private Sector and resign from Doug Jeffery Environmental Consultants as a Senior Environmental Consultant in 2016 to pursue a freelance career as an Environmental Consultant. I have gained experience in rural and urban development with the emphasis on environmental impact assessment and management within South Africa, operating as an EAP for over 15 years.

During my career to date, I have accumulated experience in the following key areas:

- Environmental Impact Assessments [legislative & process],
- Environmental Management [environmental control, management plans, Environmental Management Systems],
- Community [facilitating, public participation];
- Waste Management Licenses [legislative & process];
- Air Emission Licenses [legislative & process],
- Coastal Water Discharge Permits [legislative & process],
- Section 34 Heritage Permits,
- Organizers [project management].

Advanced Legislative Knowledge in:

- National Environmental Management Act (Act No. 107 of 1998) and 2017 EIA Regulations;
- National Heritage Resources Act (Act No. 25 of 1999);
- Land Use Planning Ordinance (Ordinance 15 of 1985);
- National Environmental Management: Integrated Coastal Management Act (Act No. 24 of 2008);
- National Environmental Management: Waste Act (Act No. 59 of 2008);
- National Environmental Management: Air Quality Act (Act No. 39 of 2004); and
- National Water Act (Act 36 of 1998).

EDUCATION

2006-2007 Tertiary education (Cum Laude)

Stellenbosch University

Masters in Philosophy (MPhil), Cultural Tourism and Heritage Studies (2 Years)

2003-2005 Tertiary education

Stellenbosch University
Bachelor of Arts (BA), International Studies (3 Years)

EMPLOYMENT RECORD

OVER 15 YEARS EXPERIENCE IN EIA'S

Freelance Environmental Consultant (2017 - present)

Senior Environmental Assessment Practitioner

- Training and experience in applying the principles of Integrated Environmental Management (IEM), and in applying the Environmental Impact Assessment (EIA) Regulations to a number of development projects and initiatives in South Africa that trigger the National Environmental Management Act.
- Facilitation, co-ordination, management and monitoring of all aspects of the EIA process.
- Liaising with specialists and all members of the project team to ensure a full understanding of the scope of work required throughout the process;
- The compilation of reports: Applicability Applications, Constraints Analysis, Basic Assessment Reports, Scoping and Environmental Impact Assessment Reports, Damage Assessment Reports (24G Applications), Rehabilitation Plans, Audit Reports and Environmental Management Programmes;
- Liaising with interested and affected parties and facilitating the public participation process required in terms of the EIA Regulations; and
- The compilation of Section 34 Heritage Applications including the liaising with the public and heritage authorities.

Doug Jeffery Environmental Consultants (2009 - 2016)

Senior Environmental Assessment Practitioner

- Training and experience in applying the principles of Integrated Environmental Management (IEM), and in applying the Environmental Impact Assessment (EIA) Regulations to a number of development projects and initiatives in South Africa that trigger the National Environmental Management, the National Environmental Management: Waste Act etc..
- Facilitation, co-ordination, management and monitoring of all aspects of the EIA process.
- Liaising with specialists and all members of the project team to ensure a full understanding of the scope of work required throughout the process;
- The compilation of reports: Constraints Analysis, Basic Assessment Reports, Scoping and Environmental Impact Assessment Reports, and Damage Assessment Reports (24G Applications) etc.;
- Liaising with interested and affected parties and facilitating the public participation process required in terms of the EIA Regulations.

City of Cape Town: Environmental & Heritage Resource Management

Internship (2008)

- Read, assess and comment on EIA, EMP, OEMP, CEMP, and Basic Assessments as per NEMA.
- Read, assess and comment on land-use planning applications, mining applications and heritage applications.
- Process signage applications.
- Assess and prepare approvals for landscaping plans.
- Compliance monitoring.
- Undertake site visits and write reports.
- Attend meetings and take minutes.
- Liaise with ECO's.
- Filling and administrative tasks.
- Assist members of the public with general environmental, heritage and signage queries.

PROFESSIONAL AFFILIATION:

Member of IAIA (International Association for Impact Assessment)
Member of Association of Professional Heritage Practitioners – Western Cape (APHP)
Professional Member of EAPASA - EAPASA Reg no: 2022/5926

COURSE CONFERENCE PARTICIPATION:

I attended various DEA&DP & IAIA forum workshops, training programmes and conferences since 2008 to date.

PROJECT RECORD TO DATE:

COMPLETION DATE	PROJECT DESCRIPTION	TYPE	APPLICANT:	ROLE:
1 NOVEMBER 2023	THE "CARPENTERS WORKSHOP" ON ERF 18792, SOMERSET WEST	Section 34, NHRA	SHOPRITE CHECKERS (PTY) LTD	Main Author & Researcher of Heritage Statement. Assisted & reviewed by Paul Slabbert Liaised with Authorities & IA&Ps and conducted PPP
29 AUGUST 2023	THE "LOCOMOTIVE SHED" ON ERF 18792, SOMERSET WEST	Section 34, NHRA	SHOPRITE CHECKERS (PTY) LTD	
3 APRIL 2023	ERF 12257, HERMANUS (4 SEA ROAD, "THE KEEP")	Section 34, NHRA & NEMA Applicability Checklist	SERAF DEVELOPMENT 1 (PTY) LTD.	
1 AUGUST 2023	EXPANSION OF THE EXISTING SHOPRITE CHECKERS DISTRIBUTION CENTRE SITUATED ON ERF 8741 WELLS ESTATE, EASTERN CAPE PROVINCE.	AMMENDED EA	EQUITIES PROPERTY FUND LIMITED	<u>Principle EAP:</u> Main Author of all reports (reviewed by Paul Slabbert) Liaised with Authorities, Organs of State, Public Consultation and Specialists Conducted PPP
End 2022	THE WEST POINT PROCESSORS FISH PROCESSING PLANT ERF 1097/3, ST HELENA BAY.	ANNUAL AUDIT REPORT	WEST POINT PROCESSORS	
AUGUST 2022	THE MATROOSBERG 4x4 TRAIL ON THE REMAINDER OF FARM 424 (CERES), PORTION 3 OF FARM 356 (CERES), FARM 355 (CERES), FARM 40 (WOCESTER) & THE REMAINDER OF FARM 57 (WOCESTER), WESTERN CAPE	EMP (OPERATIONAL PHASE)	MATROOSBERG RESERVAAT CC	
OCTOBER 2022	THE PROPOSED EXPANSION/ UPGRADING OF THREE DAMS AND ASSOCIATED INFRASTRUCTURE FOR THE PURPOSES OF ESTABLISHING ORCHARDS AS WELL AS THE CONSTRUCTION OF AN AIRSTRIP, HANGAR AND JETTY ON PORTION 4 OF FARM	BAR/EMP	FULELA TRADE AND INVEST 68 CC.	

	NO. 493 (INHOEK FARM), SWELLENDAM			
NOVEMBER 2022	THE PROPOSED REVERSE OSMOSIS (RO) PLANT AT THE WEST POINT FISH MEAL PROCESSING PLANT, ON ERF 1097, ST HELENA BAY, WESTERN CAPE	BAR/ EMP/ CWDP	WEST POINT PROCESSORS	
MAY 2022, amended AUG 23	REMOVAL OF VEGETATION ON PORTION 3 OF FARM JONKERSRUST, NO. 548, SWELLENDAM	REHAB PLAN	BLOMDAL PLASE PTY LTD	<u>Principle EAP:</u> Main Author of all reports (reviewed by Paul Slabbert) Liaised with Authorities, Organs of State, Public Consultation and Specialists Conducted PPP
APRIL 2022	CAMP SITE ON PORTION 3 OF FARM MICHELS KRAAL NO. 457, SWELLENDAM	REHAB PLAN	KOESANIE TRUST	
27/07/2022	THE PROPOSED EXPANSION OF WEST POINT PROCESSORS, ON ERF 1097, ST HELENA BAY, WESTERN CAPE.	BAR/ EMP/ AEL/ CWDP	WEST POINT PROCESSORS	
End 2021	THE WEST POINT PROCESSORS FISH PROCESSING PLANT ERF 1097/3, ST HELENA BAY.	ANNUAL AUDIT REPORT	WEST POINT PROCESSORS	
NOVEMBER 2020	REMAINDER OF FARM (HOEK VAN DE BERG) NO. 572, HERMANUS: LANDING STRIP REHABILITATION PLAN	AUDIT REPORT	UVA PROPERTIES (PTY) LTD	
AUGUST 2020	THE WEST POINT PROCESSORS FISH PROCESSING PLANT ERF 1097/3, ST HELENA BAY.	CONTINGENCY PLAN	WEST POINT PROCESSORS	
End 2020	THE WEST POINT PROCESSORS FISH PROCESSING PLANT ERF 1097/3, ST HELENA BAY.	ANNUAL AUDIT REPORT	WEST POINT PROCESSORS	
25/11/2019	THE WEST POINT PROCESSORS FISH PROCESSING PLANT ERF 1097/3, ST HELENA BAY.	EXTERNAL AUDIT REPORT	WEST POINT PROCESSORS	<u>Principle EAP:</u> Independent Auditor
22/11/2019	THE PROPOSED CULTIVATION OF LAND ON PORTION 3 OF FARM MELK HOUTE BOSCH NO. 497, SWELLENDAM, WESTERN CAPE	EIA/EMP	JOHANNES EKSTEEN FAMILIETRUST	<u>Principle EAP:</u> Main Author of all reports

14/11/2019	THE UNLAWFUL CONSTRUCTION OF A PIPELINE AND A WEIR IN THE HUISKLOOF RIVER (BOTRIVIER)	24G/EMP	ERIN DE VIGNE (PTY) LTD.	(reviewed by Paul Slabbert) Liaised with Authorities, Organs of State, Public Consultation and Specialists Conducted PPP
16/01/2017	THE CONSTRUCTION OF A COMMERCIAL SHOPPING CENTRE ON PORTION 6 OF FARM BARDALE NO.451 AND PORTION 6 OF FARM AMSTERDAM NO 949, BLUE DOWNS	AMENDMENT	SHOPRITE CHECKERS PROPERTIES (PTY) LTD.	
22/11/2016	THE PROPOSED CONSTRUCTION OF A JETTY, ON PORTION 136 OF FARM 480, MELKHOUTFONTEIN (RIVERSDAL).	BAR/ EMP	FARM KONINGSFONTEIN (PTY) LTD.	
22/08/2016	THE PROPOSED DEVELOPMENT OF AN ADDITIONAL RESERVOIR ON A PORTION OF PORTION 1 OF FARM NO. 888 (LA PARRISSA), PAARL (15/44)	BAR	DRAKENSTEIN MUNICIPALITY	<u>Principle EAP:</u> Main Author of all reports (reviewed by Paul Slabbert) Liaised with Authorities, Organs of State, Public Consultation and Specialists Conducted PPP
20/07/2015	THE PROPOSED CONSTRUCTION OF A RESIDENTIAL DEVELOPMENT ON PORTIONS 9 AND 17 OF THE FARM NO. 681, FIRGROVE	BAR	JANIGENIX (PTY) LTD	
30/04/2015	THE PROPOSED DEMOLISHMENT OF THE EXISTING DWELLING AND THE CONSTRUCTION OF A NEW DWELLING ON ERF 46, CASTLE ROCK (14/39)	SBL	MR ROY JAMES GILES	
06/06/2016	THE PROPOSED RESIDENTIAL ESTATE ON PORTIONS 3, 9 & 14 OF FARM NO. 654, CROYDON, STELLENBOSCH	BAR	JV WILNET (PTY) LTD	
08/09/2014	THE PROPOSED FLAT SIGNAGE TO BE ERECTED ON THE FAÇADE OF BUILDINGS AND AN ENTRANCE WALL LOCATED ON PORTION 477 OF FARM NO 728 JOOSTENBERG VLAKTE 14/35	SIGNAGE APP	LOUGOT PROPERTY INVESTMENTS (PTY) LTD.	<u>Principle EAP</u> compilation & submission of application.

22/03/2016	THE UNLAWFUL CONSTRUCTION OF FACILITIES FOR THE CONCENTRATION OF ANIMALS FOR THE PURPOSE OF COMMERCIAL PRODUCTION (FEEDLOTS) ON PORTION 3 & 8 OF FARM 128 (OSDAM FARM), PIKETBERG 14/27	24G	OSDAM BOERDERY (PTY) LTD.	<u>Principle EAP:</u> Main Author of all reports (reviewed by Doug Jeffery) Liaised with Authorities, Organs of State, Public Consultation and Specialists Conducted PPP
01/12/2015	THE PROPOSED RESIDENTIAL FARMING VILLAGE ON A PORTION OF FARM 1793, SIMONDIUM, PAARL (14/42)	BAR	NIEUWE SION (PTY) LTD.	
30/10/2014	THE UNLAWFUL DECOMMISSIONING OF A SERVICE STATION ON ERF 37366, OMURAMBA DRIVE, MONTAGUE GARDENS.	24G	VAIDRO 184 CC C/O JAN DE MUNCK INC.	
28/01/2015	THE PROPOSED UPGRADE OF MAIN ROAD 281 (DRAAIBERG), VILLIERSDORP (14/14).	BAR	PROVINCIAL GOVERNMENT WESTERN CAPE: DEPARTMENT OF TRANSPORT AND PUBLIC WORKS	
10/11/2015	THE PROPOSED INSTALLATION OF A PEDESTRIAN FOOTBRIDGE AND ASSOCIATED INFRASTRUCTURE OVER THE VYGEKRAAL RIVER ON ERF 32604 LOCATED BETWEEN KEWTOWN AND BRIDGETOWN	BAR	CITY OF CAPE TOWN TRANSPORT PLANNING DEPARTMENT	
11/08/15	THE UNLAWFUL EXPANSION OF TOURIST FACILITIES AND THE CONSTRUCTION OF INFRASTRUCTURE ON PORTION 26 OF FARM NO. 1041, FRANSCHHOEK 14/01.	24G	LA MOTTE WINE ESTATE (PTY) LTD.	
29/04/2014	THE PROPOSED FORMALISATION OF THE STORMWATER DRAINAGE LINE AT KM 1.6 OFF THE KLAASVOOGDS WES ROAD (DR 01368), ROBERTSON 13/35.	BAR	CAPE WINELANDS DISTRICT MUNICIPALITY	
24/01/2014	THE PROPOSED ADDITIONS TO THE EXISTING DWELLING, ERF	SBL	MR. GEORGE P	<u>Principle EAP:</u>

	5599, BETTY'S BAY		DALL	Main Author of all reports (reviewed by Doug Jeffery) Liaised with Authorities, Organs of State, Public Consultation and Specialists Conducted PPP
07/01/2014	THE PROPOSED ALTERATIONS AND ADDITIONS TO THE EXISTING BUNGALOW ON ERF 490, THE RIDGE, CLIFTON.	SBL	MR.& MS. C. WIESE	
10/12/2014	THE PROPOSED CONSTRUCTION OF A WASTE RECYCLING FACILITY ON PORTION 660 OF FARM NO. 454, WIMBLEDON ESTATE, BLACKHEATH.	BAR	RE-ETHICAL ENVIRONMENTAL RE-ENGINEERING (KZN) (PTY) LTD.	
04/03/2014	THE PROPOSED DEMOLITION OF AN EXISTING DWELLING AND CONSTRUCTION OF A SINGLE RESIDENTIAL DWELLING AND ASSOCIATED INFRASTRUCTURE ON ERF 45, BANTRY BAY.	SBL	MR.S. B. UPPINK	
30/03/2016	THE PROPOSED DEVELOPMENT OF AN ADDITIONAL DWELLING ON PORTION 99 OF FARM 559 SKILPADVLEI, PRINGLE BAY 13/02	BAR	SKILPADVLEI FARM (PTY) LTD.	
14/11/2014	UNLAWFUL CONSTRUCTION OF A TRACK FOR THE TESTING AND RECREATIONAL USE OF MOTOR POWERED VEHICLES ON THE REMAINDER OF FARM 1610, FRANSCHHOEK (13/23)	24G	L'ORMARINS (PTY) LTD.	
19/03/2015	THE UNLAWFUL CONSTRUCTION OF A SLAGMENT PLANT AND A CEMENT BLENDING PLANT ON PORTION 656, 664 AND 665 OF FARM WIMBLEDON NO. 454, BLACKHEATH	24G	MR WILLIE SCHEEPERS	
10/10/2014	THE PROPOSED ESTABLISHMENT OF THE SITARI LIFESTYLE ESTATE ON ERF 1840, CROYDON IN THE HELDERBERG.	EIA/ AMENDMENT	SITARI COUNTRY ESTATE (PTY) LTD	
10/06/2014	THE UNLAWFUL COMMENCEMENT OF A LISTED ACTIVITY: THE INFILLING OF A WETLAND ON PORTION 10 OF FARM 654, CROYDON, STELLENBOSCH	24G	JV WILNET (PTY) LTD	<u>Principle EAP:</u> Main Author of all reports (reviewed by Doug Jeffery) Liaised with
28/11/2014	THE UNLAWFUL COMMENCEMENT Of A LISTED ACTIVITY: DISPOSAL Of WASTE TO LAND ON PORTION 14 OF FARM 654, CROYDON, STELLENBOSCH	24G	JV WILNET (PTY) LTD	

11/11/2014	THE PROPOSED DEMOLITION OF THE EXISTING RESIDENTIAL DWELLING AND ASSOCIATED INFRASTRUCTURE AND THE CONSTRUCTION OF A NEW RESIDENTIAL DWELLING AND ASSOCIATED INFRASTRUCTURE ON ERF 2595, GLEN BEACH, CAMPS BAY.	SBL	MR N. M. PHILLIPS	Authorities, Organs of State, Public Consultation and Specialists Conducted PPP
03/06/2013	THE ESTABLISHMENT OF THE HERITAGE PARK RETIREMENT VILLAGE ON A PORTION OF THE FARM ONVERWACHT NO. 811 AND A PORTION OF THE FARM DIE BOS NO. 810, SOMERSET WEST (AN 231 /25/4 FARM 810 AND 811, SOMERSET WEST)	AMENDMENT	MR. S. H. EHLERS	
22/10/2012	THE PROPOSED FLAT 'LETTER' SIGN TO BE ERECTED ON THE FAÇADE OF A BUILDING LOCATED ON ERF 160462, RIEBEEK STREET, CAPE TOWN CBD.	SIGNAGE APP	ATTERBURY INVESTMENTS HOLDINGS LTD	Principle EAP compilation & submission of application.
18/01/2013	THE PROPOSED NEW SINGLE RESIDENTIAL DWELLING ON ERF 27, CASTLE ROCK, SIMON'S TOWN	BAR	MR AND MRS HUGH AND JENNIFER HERMAN	Principle EAP: Main Author of all reports (reviewed by Doug Jeffery) Liaised with Authorities, Organs of State, Public Consultation and Specialists Conducted PPP
23/11/2012	THE PROPOSED UPGRADING OF THE R304 (KOELENHOF ROAD), STELLENBOSCH.	BAR	STELLENBOSCH MUNICIPALITY	
25/09/2014	THE UNLAWFUL RECONSTRUCTION AND EXPANSION OF AN IN-STREAM DAM ON PORTION 15 OF FARM NO. 1646, TWO RIVERS FARM, FRANSCHOEK	24G	TWO RIVERS FARMS AND GARDENS (PTY) LTD	
19/08/2013	THE PROPOSED UPGRADING OF THE MEDIUM VOLTAGE DISTRIBUTION NETWORK BETWEEN CLOVELL Y AND SIMONSTOWN	BAR	CITY OF CAPE TOWN: ELECTRICITY DIRECTORATE	
16/01/2013	THE PROPOSED GREEN TECHNOLOGY MANUFACTURING CLUSTER INDUSTRIAL DEVELOPMENT AND ASSOCIATED INFRASTRUCTURE ON PORTION 4 AND PORTION 1 Of FARM 1183, ATLANTIS.	BAR	CITY OF CAPE TOWN	

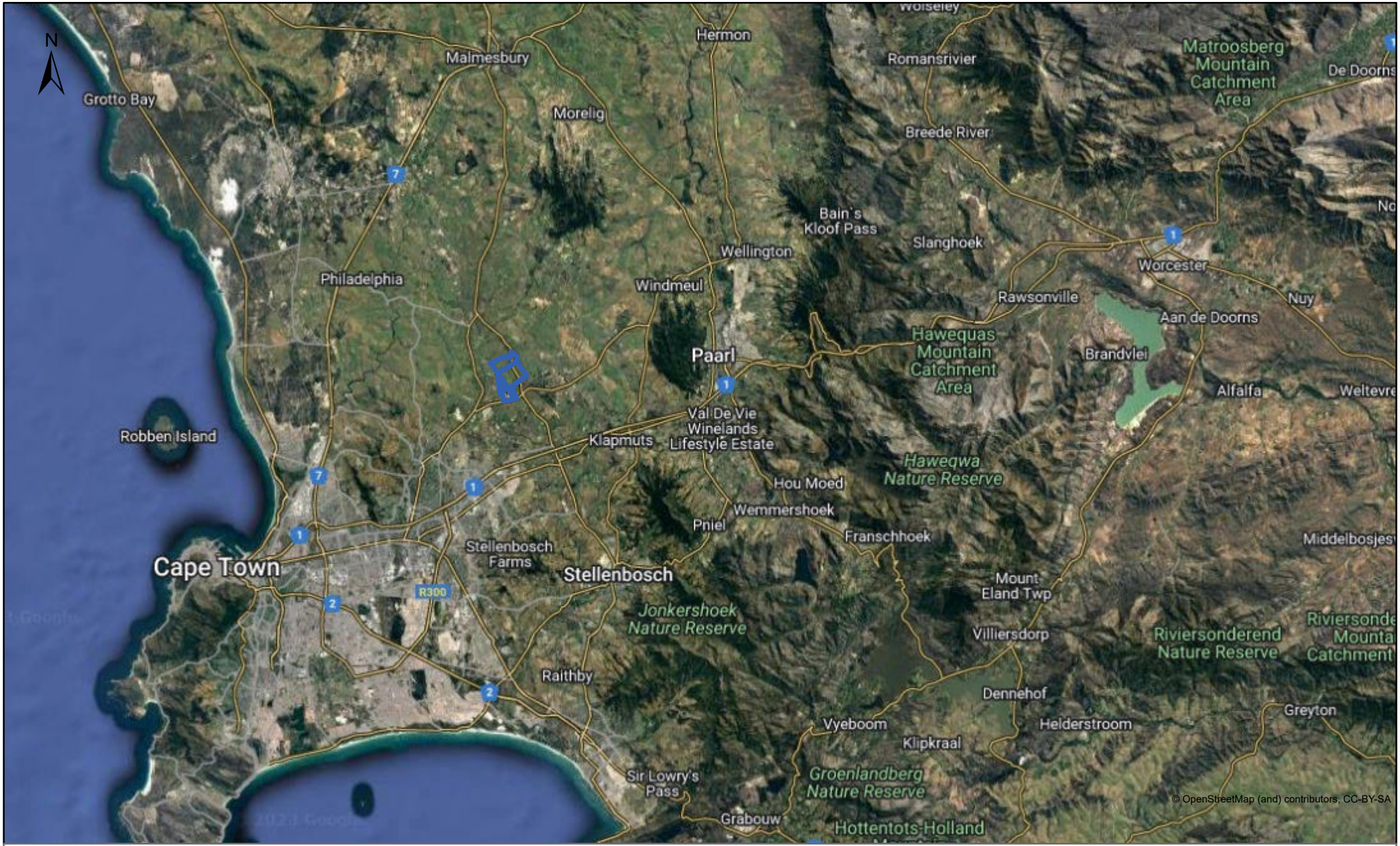
16/01/2013	THE PROPOSED GREEN TECHNOLOGY MANUFACTURING CLUSTER INDUSTRIAL DEVELOPMENT AND ASSOCIATED INFRASTRUCTURE ON PORTION O OF FARM CA1183 AND PORTION 93 OF FARM CA4, ATLANTIS.	BAR	CITY OF CAPE TOWN	
26/09/2014	THE UNLAWFUL COMMENCEMENT OF A LISTED ACTIVITY: DREDGING OF A CHANNEL IN THE KLEIN RIVER ESTUARY, CONSTRUCTION OF A WALKWAY AND THE PROPOSED CONSTRUCTION OF A JETTYY ON PORTION 1 OF FARM NO. 723, WORTELGAT, HERMANUS	24G	HERMANUS RIVIERA ESTATES CC TRADING AS MOSAIC PRIVATE SANCTUARY	
28/05/2012	THE PROPOSED FLAT SIGN TO BE ERECTED ON THE FAÇADE OF A BUILDING LOCATED ON ERF 3316, VICTORIA STREET, SOMERSET WEST.	SIGNAGE APP	BEAV INVESTMENT HOLDINGS	<u>Principle EAP</u> compilation & submission of application.
08/02/2012	THE PROPOSED FLAT SIGN TO BE ERECTED ON THE FAÇADE OF A BUILDING LOCATED ON ERF 12715, PHILLIPI.	SIGNAGE APP	CASHBUILD	
20/02/2012	THE PROPOSED CHICKEN HOUSES ON THE REMAINDER OF FARM NO. 403, TULBAGH DIVISION AND FARM NO. 201/3, PAARL DIVISION.	NID	KLEIN VALLEI (PTY) LTD	
19/06/2012	THE THEMBOKWEZI RESIDENTIAL DEVELOPMENT ON ERF NO. 51097, KHAYELITSHA, CAPE TOWN.	AMENDMENT	OLD MUTUAL PROPERTY (PTY) LTD	<u>Principle EAP:</u> assisted by Doug Jeffery Main Author of all reports (reviewed by Doug Jeffery) Liaised with Authorities,
12/04/2011 07/03/2014	THE PROPOSED RESIDENTIAL DEVELOPMENT ON ERF 4694 (MILKWOOD RISE), KOMMETJIE.	AMENDMENT	THE KOMMETJIE ESTATES (PTY) LTD	
25/11/2014	THE PROPOSED ESTABLISHMENT OF RESIDENTIAL ERVEN ON THE REMAINDER OF FARM NO. 948, KOMMETJIE	BAR	THE KOMMETJIE ESTATES LIMITED	
12/07/2013	PROPOSED UPGRADE AND EXTENTION OF THE WELLINGTON WASTEWATER TREATMENT WORKS.	EIA	DRAKENSTEIN MUNICIPALITY	
30/03/2011	CULTIVATION OF VIRGIN SOIL ON PORTIONS 11 AND 21 OF	BAR	SPRINGFIELD	

	FARM NO. 11.2, SPRINGFIELD ESTATE, ROBERTSON		ESTATE VINEYARDS (PTY} LTD	Organs of State, Public Consultation and Specialists Conducted PPP
25/11/2010	THE PROPOSED CHANGE OF LAND USE FROM ZONED UNDETERMINED TO ESTABLISH MALIBONGWE PARK RESIDENTIAL AREA ON THE REMAINDER OF ERF 830, PELICAN PARK	AMENDMENT	THE DEPARTMENT OF HUMAN SETTLEMENTS	
01/07/2014	THE PROPOSED UPGRADE OF THE WASTEWATER TREATMENT WORKS "WWTW" AT THE 'OLOF BERGH' DISTELLERY, GOUDINI	EIA	DISTELL (PTY) LTD	
19/10/2010	THE PROPOSED FLAT SIGN TO BE ERECTED ON THE FAÇADE OF A BUILDING LOCATED ON ERF 173335, PAARDEN EILAND.	SIGNAGE APP	FRANCIS CONSULTANTS (TOWN PLANNERS)	compilation & submission of application.
29/03/2012	THE TOWNSHIP DEVELOPMENT ON ERF NO. 56719, PHENDULA CRESENT, KHAYELITHSA.	AMENDMENT	JUBELIE PROJECT MANAGEMENT (PTY) LTD	<u>Secondary EAP</u> Main Author of all reports (reviewed by Doug Jeffery) Liaised with Authorities, Organs of State, Public Consultation and Specialists Conducted PPP
08/02/2013	THE PROPOSED UPGRADE OF THE VILLIERSDORP WASTE WATER TREATMENT WORKS	EIA/ WASTE LICENSE	THEEWATERSKLOOF MUNICIPALITY	
30/01/2015	THE PROPOSED DEVELOPMENT OF A RETIREMENT VILLAGE AND ASSOCIATED INFRASTRUCTURE ON THE REMAINDER OF ERF 61, SIMONS TOWN	BAR	THE ROTARY CLUB OF CAPE TOWN	
12/05/2011	THE CONSTRUCTION OF A RESIDENCE ON ERF 52, LOVERS WALK, ROOIELS	24G	MIKE LEVETT	
24/10/2016	THE UNLAWFUL COMMENCEMENT OF LISTED ACTIVITIES: UNLAWFUL COMMENCEMENT OF LISTED ACTIVITIES TO ESTABLISH AN AGRI-PARK ON PORTION 128 OF FARM 468, STELLENBOSCH	24G	OLD ABLAND (PTY) LTD	
22/06/2011	THE RECTIFICATION OF THE UNLAWFUL CONSTRUCTION OF AN AIRSTRIP ON FARM NO. 417, GROOTVLEI, TULBAGH	24G	KARWEIDERSKRAAL TRUST	

19/11/2007	PROPOSED RESIDENTIAL DEVELOPMENT ON ERF NO. 1491, HAGLEY, BLUE DOWNS	AMENDMENT	MEIPROPS 22 (PTY) LTD	
27/07/2010	THE ESTABLISHMENT OF A SERVICE TRADE AREA ON FARM GROENFONTEIN NO. 716/16, PAARL	BAR	HELU PARK (PTY) LTD	
09/06/2010	THE DEVELOPMENT OF A RETIREMENT VILLAGE ON ERF NO.1738, MONTAGU	BAR	REALTY DYNAMIX 104 (PTY) LTD	
22/08/2011	UPGRADE OF THE DWARSKERSBOS SEWERAGE TREATMENT WORKS: PORTION 4 OF THE FARM 109 DWARSKERSBOS, BERGRIVIER MUNICIPALITY	EIA	BERGRIVIER MUNICIPALITY	
20/06/2012	THE DEVELOPMENT ON MEERENDAL PORTION 1 OF FARM NO. 159, DURBANVILLE.	BAR	MEERENDAL WINE ESTATE (PTY) LTD	<u>Secondary EAP</u> Main Author of all reports (reviewed by Doug Jeffery) Liaised with Authorities, Organs of State, Public Consultation and Specialists Conducted PPP
16/03/2011	CONSTRUCTION OF A SEWERAGE PIPELINE TO SERVE DRIFTSANDS	BAR	CITY OF CAPE TOWN	
24/11/2009	THE REZONING AND SUBDIVISION OF ERF NO. 21973, KHAYELITSHA	BAR	NU-WAY HOUSING DEVELOPMENTS (PTY) LTD	
24/11/2010	DAL JOSAFAT DEVELOPMENT ON ERF NO. 16161 AND REMAINDER OF ERF NO. 17680, PAARL	EIA	ERF 16161 PAARL DEVELOPMENT (PLY} LID	
21/07/2009	THE PROPOSED USE AND/OR DISPOSAL OF SEDIMENT FROM ZEEKOEVLEI, CAPE FARM NOS. 848-0, 840-1, 847-01, 846-0, 844-31, 837-0, 838-0 AND ERF 93284, ZEEKOEVLEI NATURE RESERVE	BAR	CITY OF CAPE TOWN	

ANNEXURE 2: LOCALITY PLAN

Location of CWA (cadastrals shown in blue outline



Date created: 2023/10/15

0 3 6 12 18 24 30 km

Western Cape Government FOR YOU

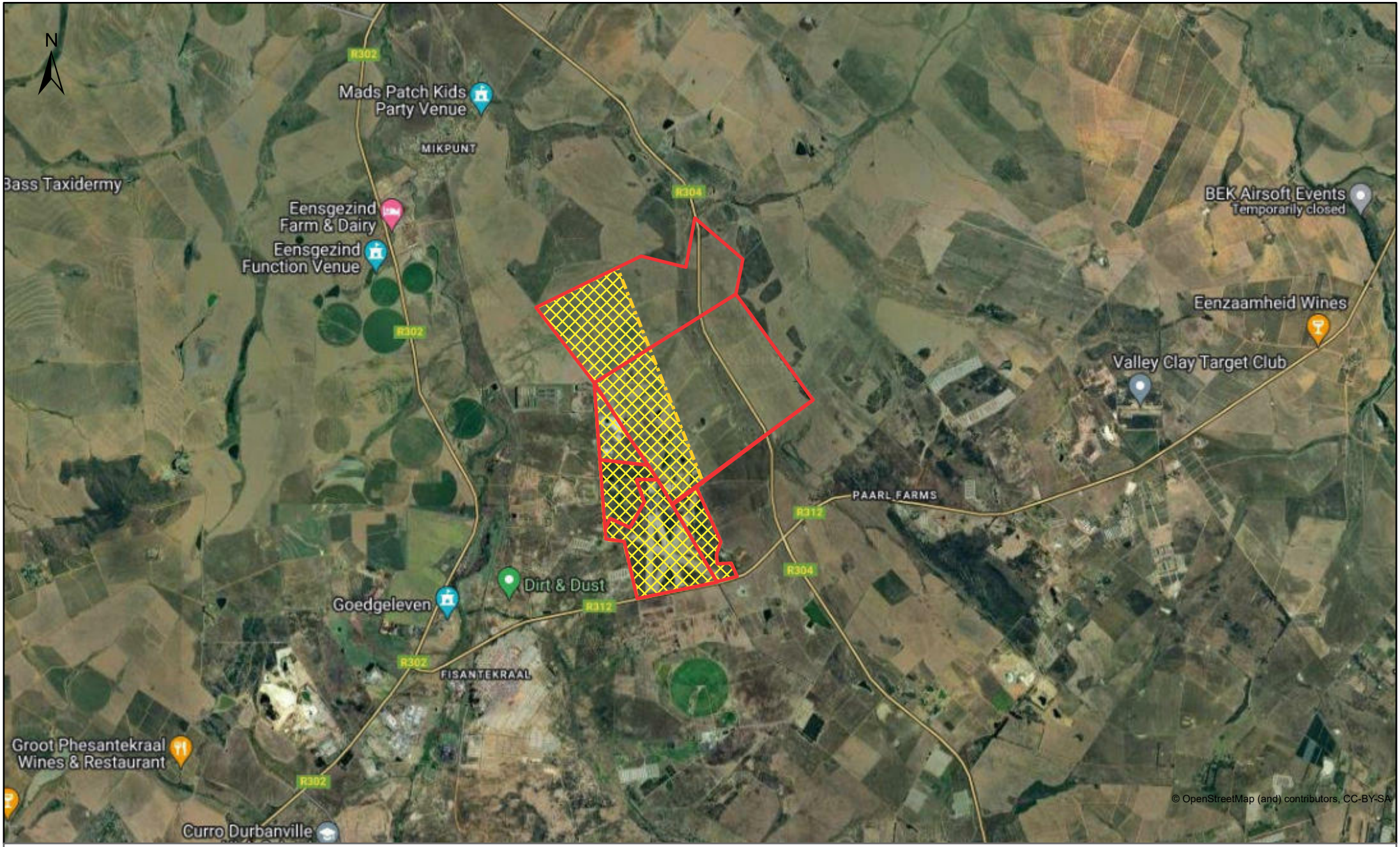
Location of CWA (cadastrals shown in blue outline)

Date created: 2023/10/15

km
0 0.4 0.8 1.6 2.4 3.2 4

Western Cape Government
FOR YOU

Development area CWA (yellow hatched area)

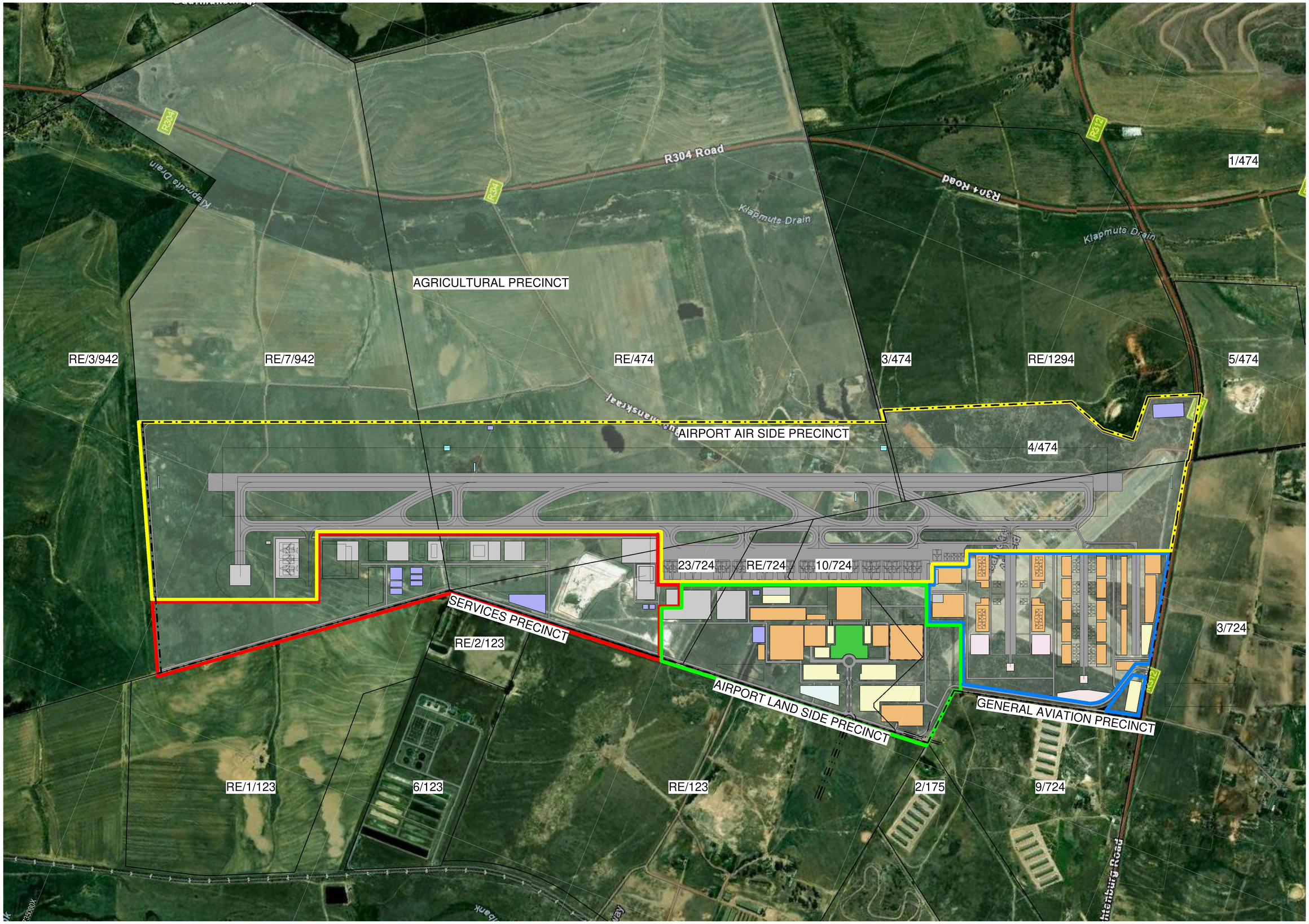


Date created: 2023/10/15

km
0 0.4 0.8 1.6 2.4 3.2 4

Western Cape Government
FOR YOU

ANNEXURE 3A: SITE DEVELOPMENT PLAN



SITE PLAN - PHASE 1

0 62.5 m 125.0 m 250.0 m

SCALE: 1:5000

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DRAINAGE NOTES

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FIRE DEPARTMENT'S REQUIREMENTS

* ALL WORK IS TO COMPLY WITH SABS 400.
* a) EXTINGUISHERS TO BE INSTALLED IN ACCORDANCE WITH SABS 0105.
  b) HOSE REELS TO BE INSTALLED IN ACCORDANCE WITH SABS 543.
  c) HYDRANTS TO BE INSTALLED IN ACCORDANCE WITH SABS 1128 PART 1
* PORTABLE FIRE EXTINGUISHERS TO BE HUNG ON PURPOSE MADE BOARDS AND LOCATED IN SECURE POSITIONS AS INDICATED ON PLAN.
* CLASS "B" FIRE DOORS TO COMPLY WITH SABS 1253 AND TO BE FITTED WITH APPROVED SELF CLOSING OR AUTOMATIC CLOSING DEVICES.
* STRUCTURAL ELEMENTS AND COMPONENTS TO COMPLY WITH TT7.
* FIRE EXIT DOORS ARE TO BE FITTED WITH EMERGENCY EXIT LOCKSETS.
* SYMBOLIC SAFETY SIGNS TO BE IN ACCORDANCE WITH S.A.B.S. CODE 1186 AND POSITIONED AS REQUIRED BY THE FIRE DEPARTMENT.

Rev	Description	Revision Date
9	ISSUED - BOUNDARY FENCE LINE ADJUSTED	2024-09-20
8	ISSUED - PHASE 1 UPDATED	2024-09-19
7	ISSUED FOR COMMENT	2024-09-15
6	ROADS UPDATED	2024-09-15
5	ISSUED FOR REVIEW	2024-09-14
4	Added ATCT and Helipad	2024-05-24
3	FOR REVIEW	2024-04-10
2	FOR REVIEW	2024-04-03
1	FOR REVIEW	2024-04-03

CAPEX PROJECTS
UNIT 10 First Floor
BOSKRUIN BUSINESS PARK
BOSKRUIN
cnr Kelly & Bodiok street
2188
Tel: 011 792 4260/ 8169

CLIENT
CAPE WINELANDS AERO

Client
Engineer
Registration NO: Designer
SACAP NO: -

CLIENT: ENVIRONMENTAL CONSULTANT

TITLE: PHASE 1

DRAWING: CWA - PRECINCT PLANS

SIZE	DWG NO	REV
A0	2024-3297 408	9

SCALE 1: 5000 | DATE 2024-09-20 | DRAWN BY CW DENNIS

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DRAINAGE NOTES

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FIRE DEPARTMENT'S REQUIREMENTS

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  c) HYDRANTS TO BE INSTALLED IN ACCORDANCE WITH SABS 1128 PART 1
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SITE PLAN - PHASE 2

0 62.5 m 125.0 m 250.0 m

SCALE: 1:5000

Rev	Description	Revision Date
16	Amendment to BDL Update to table names	2025-01-23
15	BH, COCT Water Line, Fuel Line and Boundary Adjustments	2025-01-15
14	ISSUED - BOUNDARY FENCE LINE ADJUSTED	2024-09-20
13	ISSUED - PHASE 1 UPDATED	2024-08-19
12	ISSUED FOR REVIEW	2024-08-14
11	ISSUED TO PROFESSIONALS	2024-07-24
10	ISSUED	2024-07-24
9	ISSUED	2024-07-24
8	ISSUED	2024-07-23
7	Revised SDP/EIA For Comment	2024-07-23
6	Revised SDP/EIA For Comment	2024-07-23
5	Added ATCT and Helipad	2024-05-24
4	FOR REVIEW	2024-04-10
3	FOR REVIEW	2024-04-03
2	FOR REVIEW	2024-04-03
1	FOR REVIEW	2024-03-28

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2188
Tel: 011 792 4260/ 8169

CLIENT

CAPE WINELANDS AERO

Client

Engineer

Registration NO: Designer

SACAP NO: -

CLIENT: ENVIRONMENTAL CONSULTANT

TITLE: PHASE 2

DRAWING: CWA - PRECINCT PLANS

SIZE	DWG NO	REV
A0	2024-3297 400	16

SCALE	DATE	DRAWN BY:
1: 5000	2025-01-23	CW DENNIS

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FIRE DEPARTMENT'S REQUIREMENTS

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* a) EXTINGUISHERS TO BE INSTALLED IN ACCORDANCE WITH SABS 0105.
  b) HOSE REELS TO BE INSTALLED IN ACCORDANCE WITH SABS 543.
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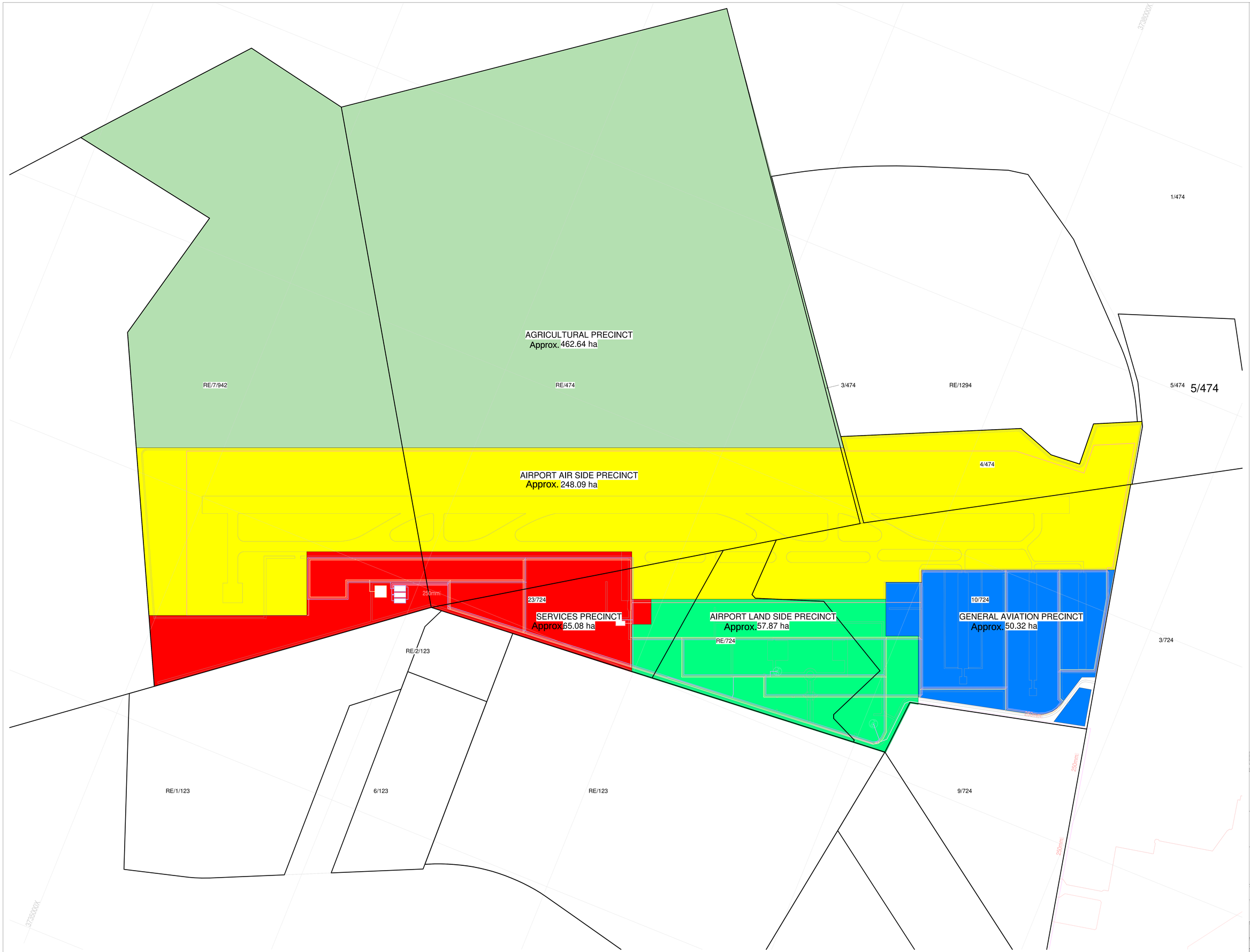


Rev	Description	Revision Date
3	AMENDMENT TO AFRICULTURAL PRECINCT AREA	2025-03-14
2	ha ADDED TO AREAS	2025-03-14
1	PHASE 2 KEY PLAN CREATED	2025-03-13

CAPEX PROJECTS
UNIT 10 First Floor
BOSKRUIN BUSINESS PARK
BOSKRUIN
cnr Kelly & Bosbok street
2188
Tel: 011 792 4260/ 8169

CLIENT

CAPE WINELANDS AERO

Client

Engineer

Registration NO: Designer

SACAP NO:

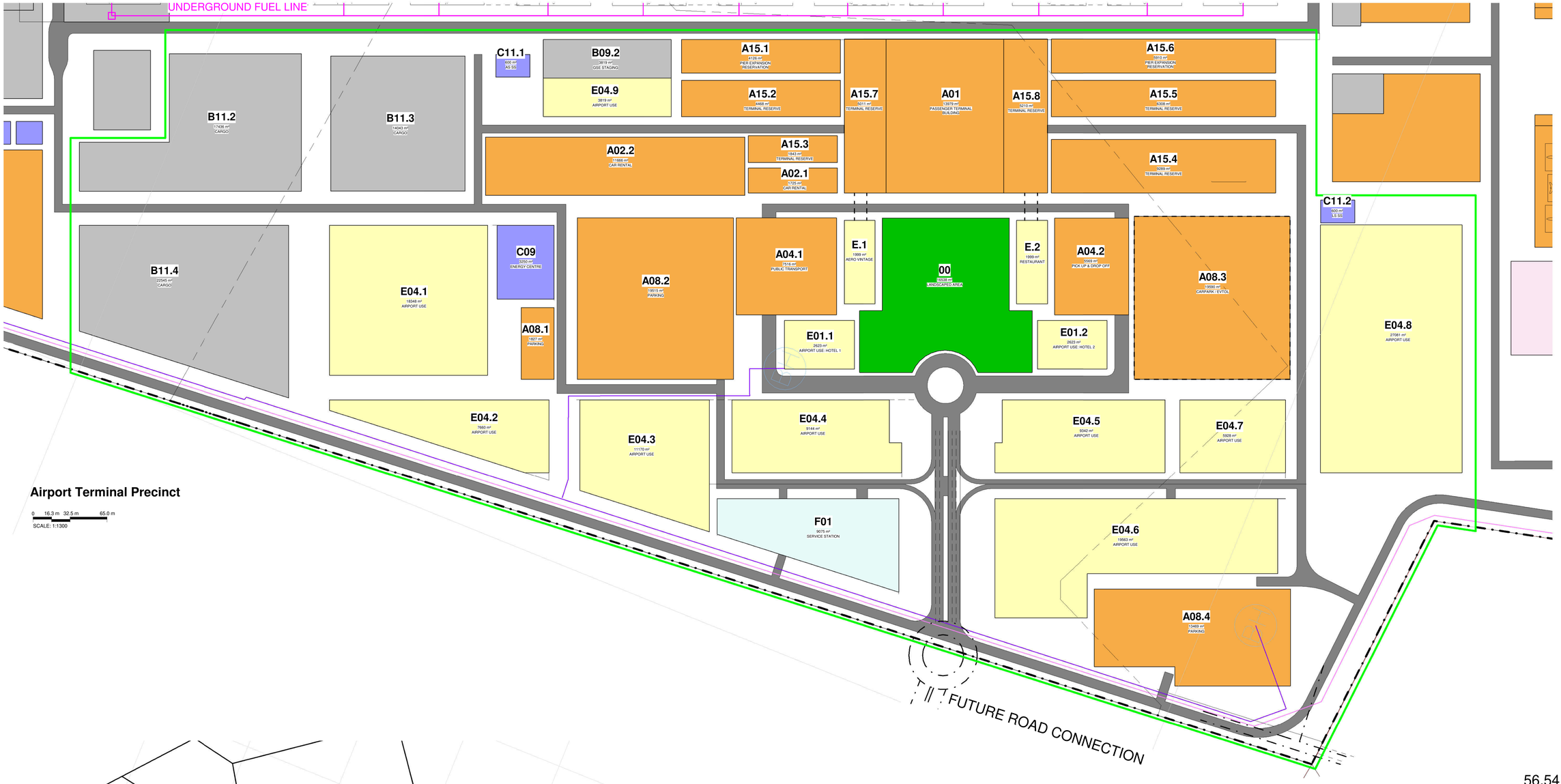
CLIENT: ENVIRONMENTAL CONSULTANT

TITLE: PHASE 2 KEY PLAN

DRAWING: CWA - PRECINCT PLANS

SIZE	DWG NO	REV
A0	2024-3297 405	3

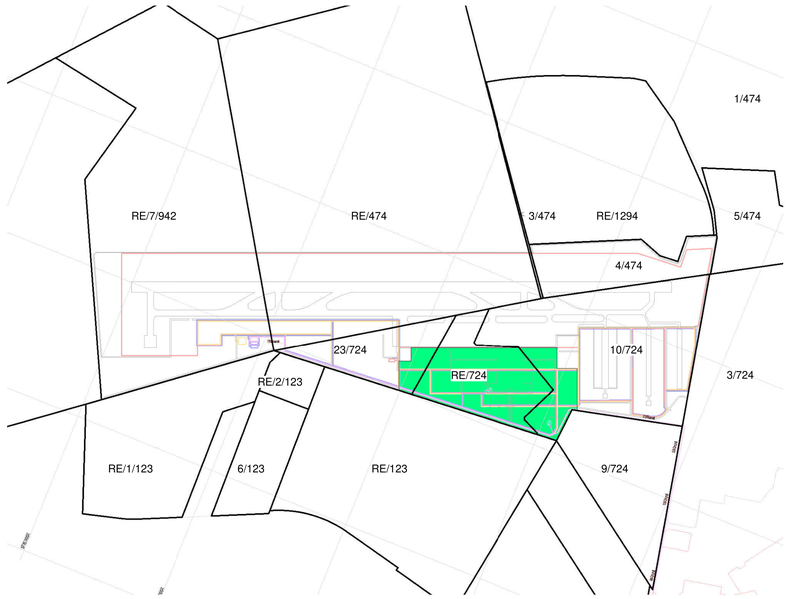
SCALE	DATE	DRAWN BY
1: 5000	2025-03-14	CW DENNIS



Airport Terminal Precinct

0 16.3 m 32.5 m 65.0 m

SCALE: 1:1300



Key Plan - Airport Terminal Precinct

56.54 ha

Name	Occupancy	Plot Area
00	LANDSCAPED AREA	16538 m²
A01	PASSENGER TERMINAL BUILDING	13979 m²
A02.1	CAR RENTAL	1725 m²
A02.2	CAR RENTAL	11666 m²
A04.1	PUBLIC TRANSPORT	7516 m²
A04.2	PICK UP & DROP OFF	5569 m²
A08.1	PARKING	1827 m²
A08.2	PARKING	19515 m²
A08.3	CARPARK / EVTOL	19590 m²
A08.4	PARKING	13469 m²
A15.1	PIER EXPANSION RESERVATION	4126 m²
A15.2	TERMINAL RESERVE	4468 m²
A15.3	TERMINAL RESERVE	1843 m²
A15.4	TERMINAL RESERVE	9289 m²
A15.5	TERMINAL RESERVE	6308 m²
A15.6	PIER EXPANSION RESERVATION	5910 m²
A15.7	TERMINAL RESERVE	5011 m²
A15.8	TERMINAL RESERVE	5210 m²

Name	Occupancy	Plot Area
B09.2	GSE STAGING	3819 m²
B11.2	CARGO	17436 m²
B11.3	CARGO	14043 m²
B11.4	CARGO	22545 m²

Name	Occupancy	Plot Area
C09	ENERGY CENTRE	3250 m²
C11.1	AS SS	600 m²
C11.2	LS SS	600 m²
E01.1	AIRPORT USE: HOTEL 1	2623 m²
E01.2	AIRPORT USE: HOTEL 2	2623 m²
E04.1	AIRPORT USE	18348 m²
E04.2	AIRPORT USE	7660 m²
E04.3	AIRPORT USE	11170 m²
E04.4	AIRPORT USE	9144 m²
E04.5	AIRPORT USE	9342 m²
E04.6	AIRPORT USE	19563 m²
E04.7	AIRPORT USE	5928 m²
E04.8	AIRPORT USE	27081 m²
E04.9	AIRPORT USE	3819 m²
E.1	AERO VINTAGE	1999 m²
E.2	RESTAURANT	1999 m²
F01	SERVICE STATION	9075 m²

MRO	Maintenance Repairs and Operations
FBO	Fixed Based Operators
GA	General Aviation
GSE	Ground Support Equipment
ARFF	Aircraft Rescue and Firefighting
FATO	Final Approach and Take-off (Helipad)
WTWP/WTWW	Wastewater Treatment Plant / Works
RDTS	Remote Digital Control Tower System
PAPI	Precision Approach Path Indicator
ASS	Aircraft Sanitary Station

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CLIENT: CAPE WINELANDS AERO

Client

Engineer

Registration NO: Designer

SACAP NO:

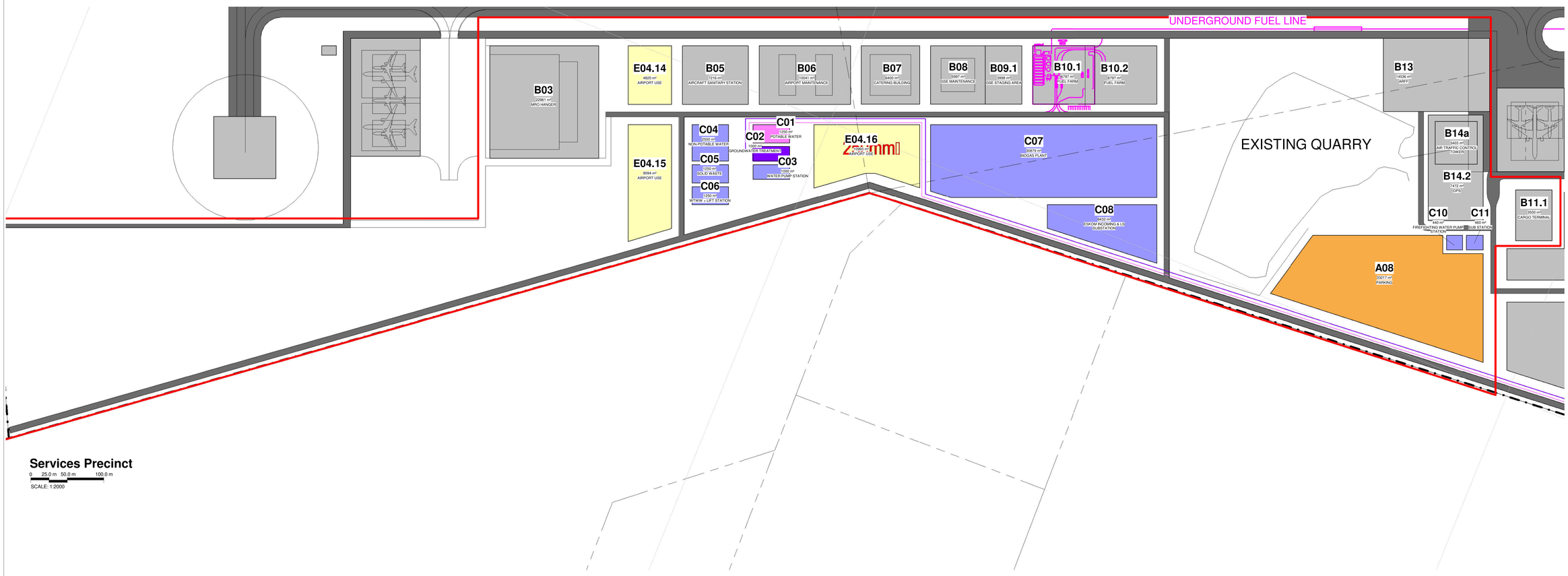
CLIENT: ENVIRONMENTAL CONSULTANT

TITLE: PHASE 2 TERMINAL PRECINCT

DRAWING: CWA - PRECINCT PLANS

SIZE	DWG NO	REV
A0	2024-3297 401	16

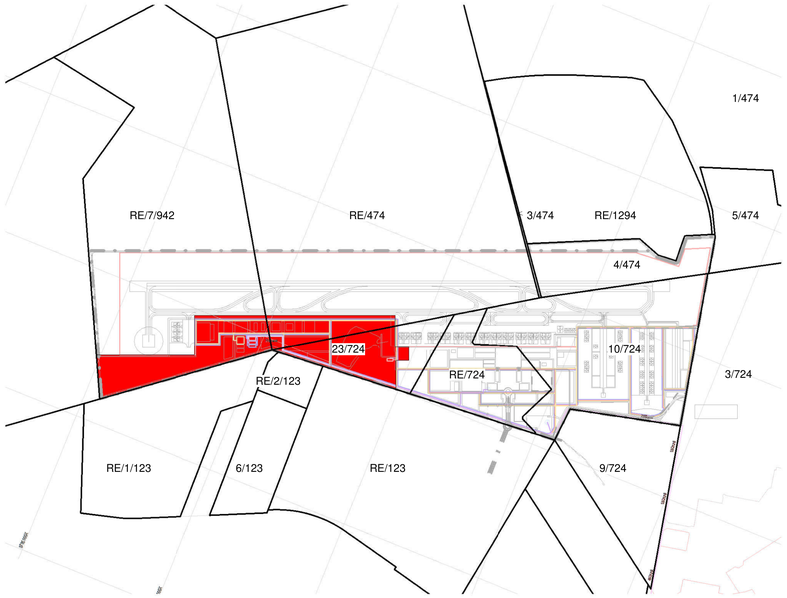
SCALE: As indicated | DATE: 2025-01-23 | DRAWN BY: CW DENNIS



Services Precinct

0 25.0 m 50.0 m 100.0 m

SCALE: 1:2000



Key Plan - Services Precinct

64.49 ha

Name	Occupancy	Plot Area
A08	PARKING	33217 m²
B03	MRO HANGER	22961 m²
B05	AIRCRAFT SANITARY STATION	7216 m²
B06	AIRPORT MAINTENANCE	10041 m²
B07	CATERING BUILDING	6400 m²
B08	GSE MAINTENANCE	5997 m²
B09.1	GSE STAGING AREA	3998 m²
B10.1	FUEL FARM	6797 m²
B10.2	FUEL FARM	6797 m²
B11.1	CARGO TERMINAL	3500 m²
B13	ARFF	14536 m²
B14.2	OPS	7472 m²
B14a	AIR TRAFFIC CONTROL TOWER	3403 m²

Name	Occupancy	Plot Area
C01	POTABLE WATER	1250 m²
C02	GROUNDWATER TREATMENT	1000 m²
C03	WATER PUMP STATION	1000 m²
C04	NON-POTABLE WATER	2500 m²
C05	SOLID WASTE	1250 m²
C06	WTWW + LIFT STATION	1250 m²
C07	BIOGAS PLANT	30879 m²
C08	ESKOM INCOMING & LS SUBSTATION	8432 m²
C10	FIREFIGHTING WATER PUMP STATION	440 m²
C11	SUB STATION	460 m²

Name	Occupancy	Plot Area
E04.14	AIRPORT USE	4820 m²
E04.15	AIRPORT USE	9094 m²
E04.16	AIRPORT USE	10993 m²

MRO	Maintenance Repairs and Operations
FBO	Fixed Based Operators
GA	General Aviation
GSE	Ground Support Equipment
ARFF	Aircraft Rescue and Firefighting
FATO	Final Approach and Take-off (Helipad)
WTWP/WTWW	Wastewater Treatment Plant / Works
RDTS	Remote Digital Control Tower System
PAPI	Precision Approach Path Indicator

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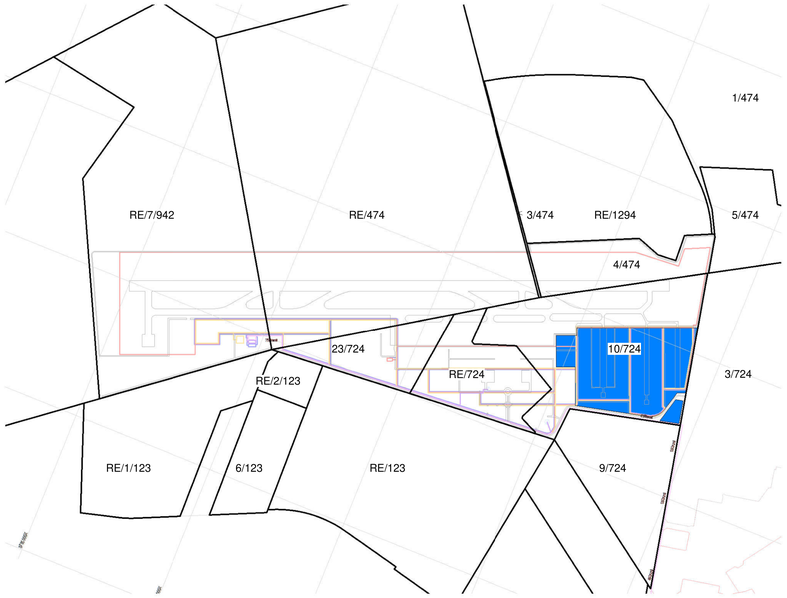
TITLE: PHASE 2 SERVICES PRECINCT

DRAWING: CWA - PRECINCT PLANS

SIZE: A0 | DWG NO: 2024-3297 402 | REV: 16

SCALE: As indicated | DATE: 2025-01-23 | DRAWN BY: CW DENNIS



Key Plan - General Aviation Precinct

49.10 ha

Name	Occupancy	Plot Area
A03	GA/VIP/GOVERNMENT TERMINAL	6419 m²
A08.5	PARKING	10753 m²
A08.6	PARKING	2987 m²
A10.1A	FBO 1	5787 m²
A10.1B	FBO 1	1230 m²
A10.2A	FBO 2	5787 m²
A10.2B	FBO 2	1230 m²
A10.3A	FBO 4	5787 m²
A10.3B	FBO 4	1230 m²
A10.4A	FBO 3	5798 m²
A10.4B	FBO 3	1220 m²
A11.1	GA HANGERS	3200 m²
A11.2	GA HANGERS	3200 m²
A11.3	GA HANGERS	3200 m²
A11.4	GA HANGERS	3200 m²
A11.5	GA HANGERS	3200 m²
A11.6	GA HANGERS	3200 m²
A11.7	GA HANGERS	3200 m²
A11.8	GA HANGERS	3200 m²
A11.9	GA HANGERS	3200 m²
A11.10	GA HANGERS	3200 m²
A11.11	GA HANGERS	4678 m²
A11.12	GA HANGERS	4971 m²
A11.13	GA HANGERS	8512 m²
A16	GA CLUBHOUSE & FUELING	5204 m²

Name	Occupancy	Plot Area
B11	SPECIAL CARGO FACILITY	1575 m²
B14.1	OPS	1500 m²
B17.1	ACCESS CONTROL	102 m²
B17.2	ACCESS CONTROL	100 m²
B17.3	ACCESS CONTROL	100 m²
E04.12	TRANSPORT USE	6315 m²
E04.13	AIRPORT USE	4636 m²
PH.1	HELIPORT	6220 m²
PH.2	HELIPORT	6220 m²
PH.3	HELIPORT	992 m²
PH.4	HELIPORT	992 m²
PH.5	HELIPORT	8938 m²

MRO	Maintenance Repairs and Operations
FBO	Fixed Based Operators
GA	General Aviation
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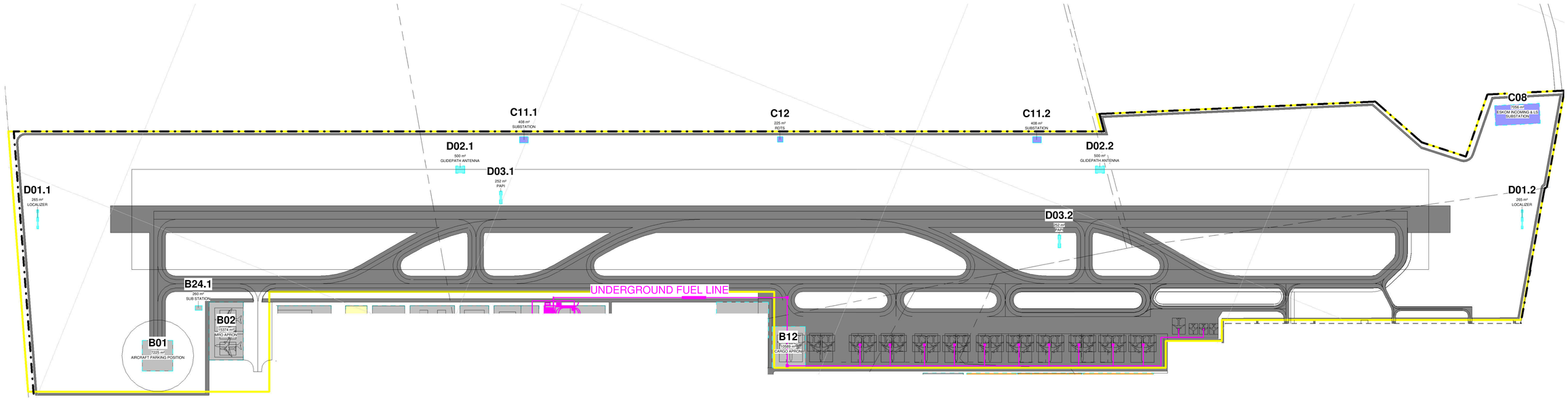
TITLE: PHASE 2 GENERAL AVIATION PRECINCT

DRAWING: CWA - PRECINCT PLANS

SIZE	DWG NO	REV
A0	2024-3297 403	16

SCALE: As indicated | DATE: 2025-01-23 | DRAWN BY: CW DENNIS



Airport Air Side Precinct

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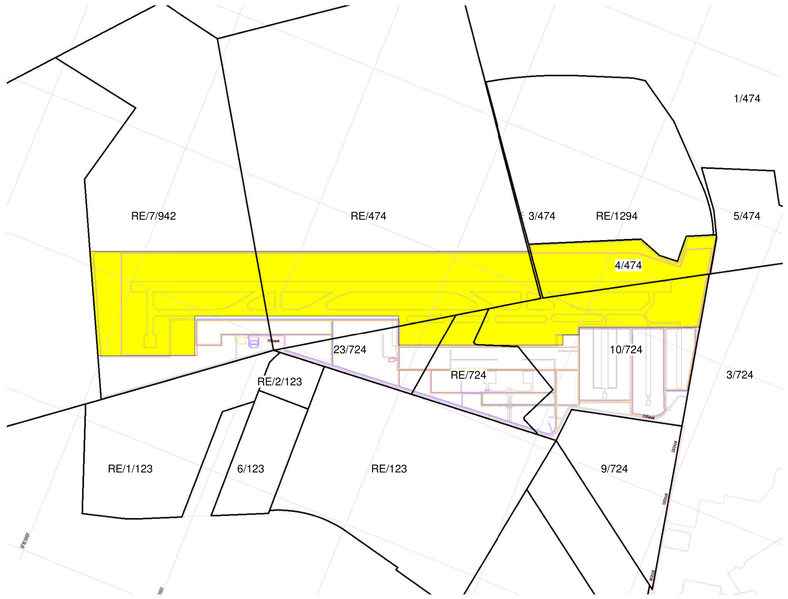
SCALE: 1:4000



Key Plan - Airport Air Side Precinct

248.41 ha

Name	Occupancy	Plot Area
B01	AIRCRAFT PARKING POSITION	7225 m²
B02	MRO APRON	15374 m²
B12	CARGO APRON	10589 m²
B24.1	SUB STATION	260 m²

MRO	Maintenance Repairs and Operations
FBO	Fixed Based Operators
GA	General Aviation
GSE	Ground Support Equipment
ARFF	Aircraft Rescue and Firefighting
FATO	Final Approach and Take-off (Helipad)
WTWP/WTWW	Wastewater Treatment Plant / Works
RDTS	Remote Digital Control Tower System
PAPI	Precision Approach Path Indicator

Name	Occupancy	Plot Area
C08	ESKOM INCOMING & LS SUBSTATION	7056 m²
C11.1	SUBSTATION	408 m²
C11.2	SUBSTATION	408 m²
C12	RDTS	225 m²
D01.1	LOCALIZER	265 m²
D01.2	LOCALIZER	265 m²
D02.1	GLIDEPATH ANTENNA	500 m²
D02.2	GLIDEPATH ANTENNA	500 m²
D03.1	PAPI	252 m²
D03.2	PAPI	252 m²

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GENERAL NOTES

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* THIS DRAWING IS NOT TO BE SCALED. USE FIGURED DIMENSIONS ONLY.
* ALL DIMENSIONS AND LEVELS, ETC., TO BE CHECKED ON SITE, BEFORE ANY WORK IS COMMENCED.
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* REINFORCED CONCRETE AND STRUCTURAL STEELWORK IS TO BE IN ACCORDANCE WITH THE STRUCTURAL ENGINEER'S DESIGN AND SPECIFICATIONS.

DRAINAGE NOTES

* ALL DRAINAGE RUNS TO BE ACCESSIBLE ALONG THEIR ENTIRE LENGTH.
* V.P.'s TO BE CARRIED UP TO 2m ABOVE ANY WINDOW OR DOOR OPENING IN THE BUILDING OR ANY OTHER BUILDING WITHIN A DISTANCE OF 9m.
* INSPECTION EYES (i.e.'s) TO BE PROVIDED AT ALL BENDS AND JUNCTIONS OF SOIL AND WASTE PIPES.
* RODDING EYES (r.e.'s) TO BE PROVIDED AT HEADS OF DRAINS AND AT A MAXIMUM OF 25m SPACINGS ALONG RUNS OF DRAINS.
* MARKED COVERS TO BE PROVIDED AT GROUND LEVEL FOR i.e's BELOW PAVING
* RESEAL TRAPS TO BE PROVIDED TO ALL WASTE FITTINGS.
* SOIL WATER DRAINS PASSING UNDER BUILDINGS TO BE ENCASED IN 150mm CONCRETE ALL ROUND AND BE PROVIDED WITH r.e.'s AS CLOSE TO THE BUILDING AS POSSIBLE AT BOTH ENDS.
* SOIL WATER PIPES HAVING A VERTICAL DROP EXCEEDING 1200mm TO THE MAIN DRAIN TO BE ANTI-SYPHONED.
* ALL BRANCH DRAINS EXCEEDING 6m IN LENGTH TO BE VENTED.
* uPVC PIPES ARE TO BE LAID IN ACCORDANCE WITH THE MANUFACTURERS TECHNICAL SPECIFICATIONS.

FIRE DEPARTMENT'S REQUIREMENTS

* ALL WORK IS TO COMPLY WITH SABS 400.
* a) EXTINGUISHERS TO BE INSTALLED IN ACCORDANCE WITH SABS 0105.
  b) HOSE REELS TO BE INSTALLED IN ACCORDANCE WITH SABS 543.
  c) HYDRANTS TO BE INSTALLED IN ACCORDANCE WITH SABS 1128 PART 1
* PORTABLE FIRE EXTINGUISHERS TO BE HUNG ON PURPOSE MADE BOARDS AND LOCATED IN SECURE POSITIONS AS INDICATED ON PLAN.
* CLASS "B" FIRE DOORS TO COMPLY WITH SABS 1253 AND TO BE FITTED WITH APPROVED SELF CLOSING OR AUTOMATIC CLOSING DEVICES.
* STRUCTURAL ELEMENTS AND COMPONENTS TO COMPLY WITH TT7.
* FIRE EXIT DOORS ARE TO BE FITTED WITH EMERGENCY EXIT LOCKSETS.
* SYMBOLIC SAFETY SIGNS TO BE IN ACCORDANCE WITH S.A.B.S. CODE 1186 AND POSITIONED AS REQUIRED BY THE FIRE DEPARTMENT.

Rev	Description	Revision Date
16	Amendment to BDS. Update to table names	2025-01-23
15	BH, CDCT Water Line, Fuel Line and Boundary Adjustments	2025-01-15
14	ISSUED - BOUNDARY FENCE LINE ADJUSTED	2024-09-20
13	ISSUED - PHASE 1 UPDATED	2024-09-15
12	ISSUED FOR REVIEW	2024-09-14
11	ISSUED TO PROFESSIONALS	2024-07-24
10	ISSUED	2024-07-24
9	ISSUED	2024-07-24
8	ISSUED	2024-07-23
7	Revised SDP/EIA For Comment	2024-07-23
6	Revised SDP/EIA For Comment	2024-07-23
5	Added ATCT and Helipad	2024-05-24
4	FOR REVIEW	2024-04-15
3	FOR REVIEW	2024-04-03
2	FOR REVIEW	2024-04-03
1	FOR REVIEW	2024-03-28

CAPEX PROJECTS
UNIT 10 First Floor
BOSKRUIN BUSINESS PARK
BOSKRUIN
cnr Kelly & Bostock street
2188
Tel: 011 792 4260/ 8169

CLIENT: CAPE WINELANDS AERO

Client

Engineer

Registration NO: Designer

SACAP NO:

CLIENT: ENVIRONMENTAL CONSULTANT

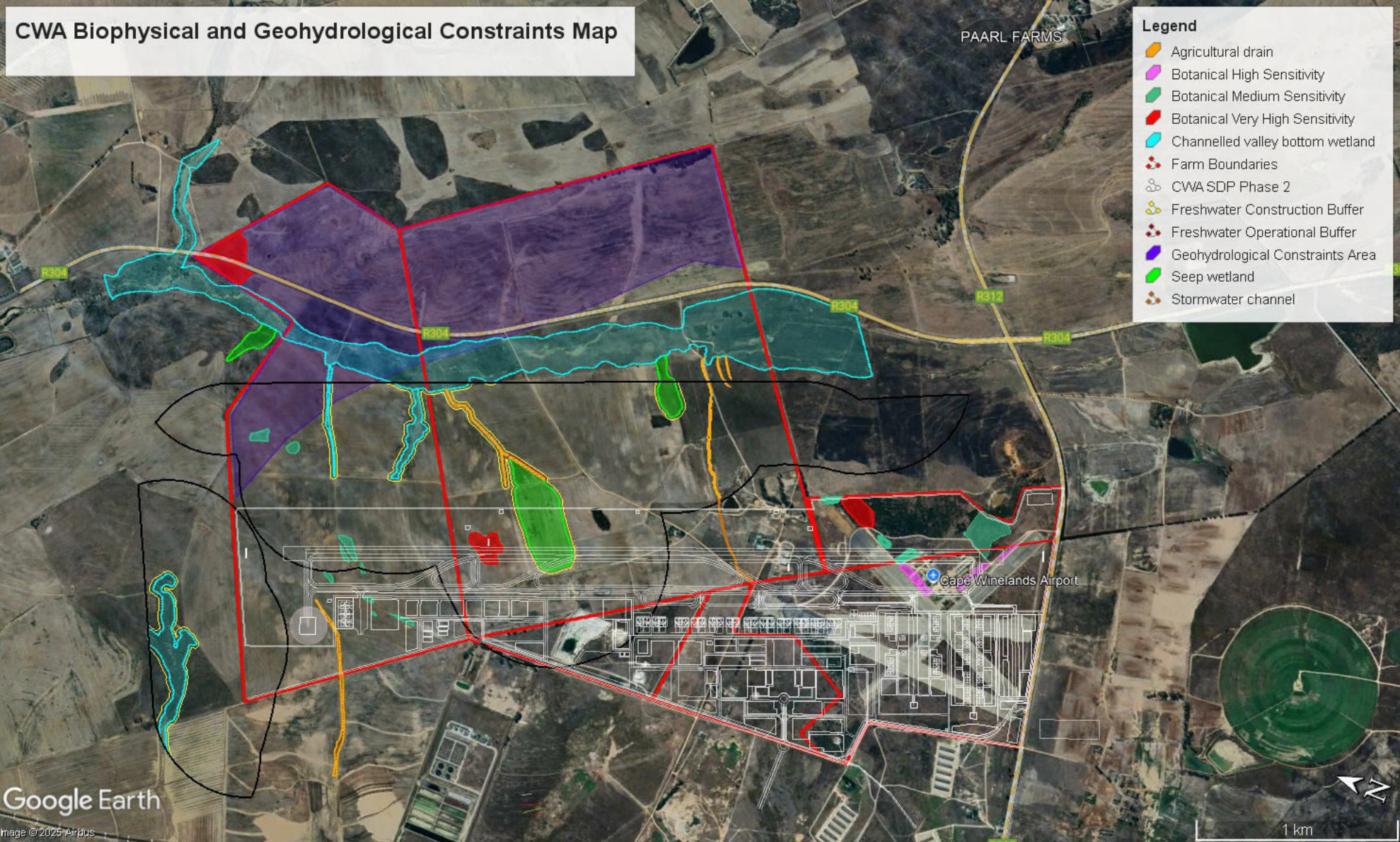
TITLE: PHASE 2 AIRPORT AIR SIDE PRECINCT

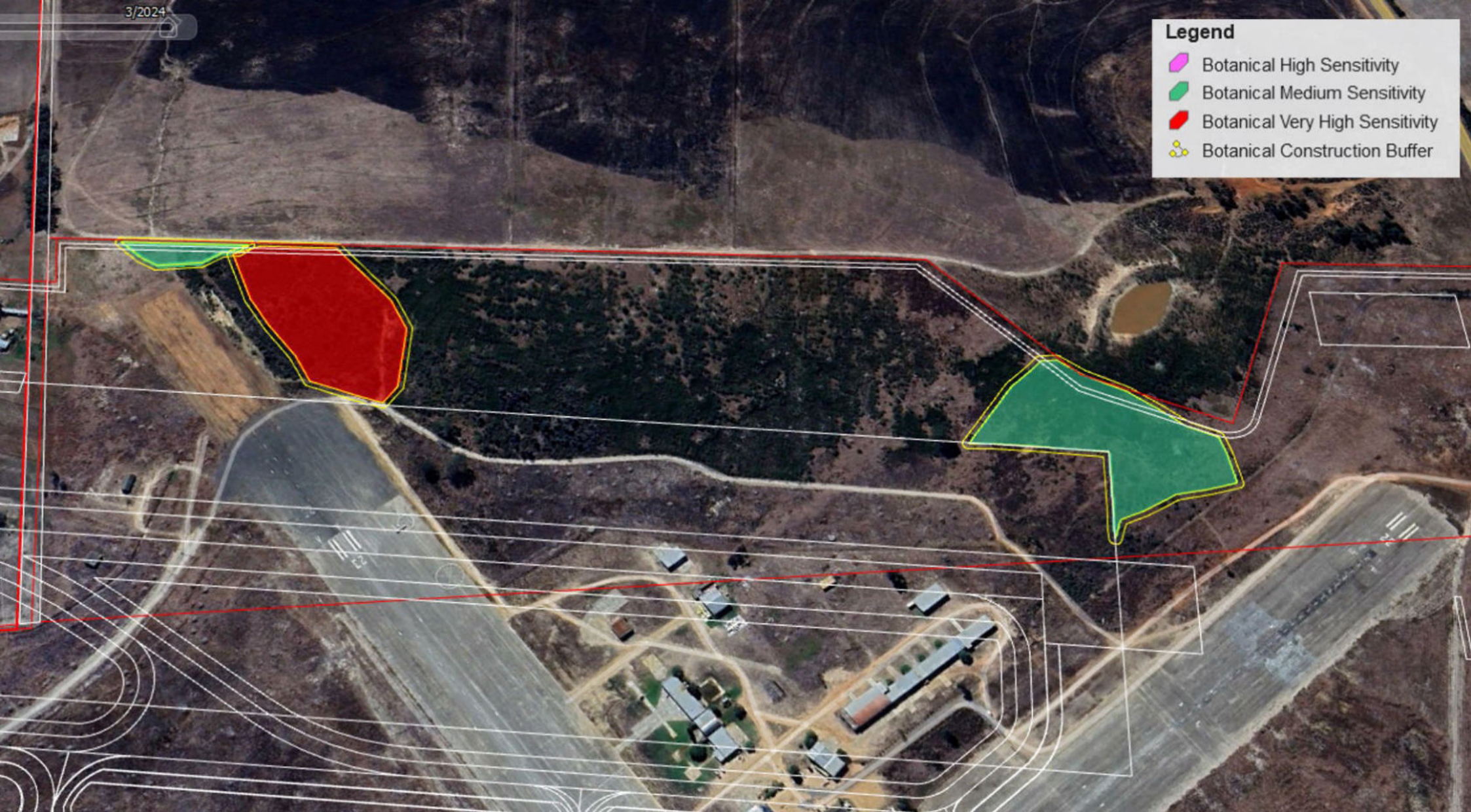
DRAWING: CWA - PRECINCT PLANS

SIZE	DWG NO	REV
A0	2024-3297 404	16

SCALE: As indicated | DATE: 2025-01-23 | DRAWN BY: CM DENNIS

ANNEXURE 3B: ENVIRONMENTAL SENSITIVITY MAP


CWA Biophysical and Geohydrological Constraints Map
PAARL FARMS
Legend
Agricultural drain
Botanical High Sensitivity
Botanical Medium Sensitivity
Botanical Very High Sensitivity
Channelled valley bottom wetland
Farm Boundaries
CWA SDP Phase 2
Freshwater Construction Buffer
Freshwater Operational Buffer
Geohydrological Constraints Area
Seep wetland
Stormwater channel
R304
R304
R304
R312
R304
Cape Winelands Airport
Google Earth
Image © 2025 Airbus
1 km

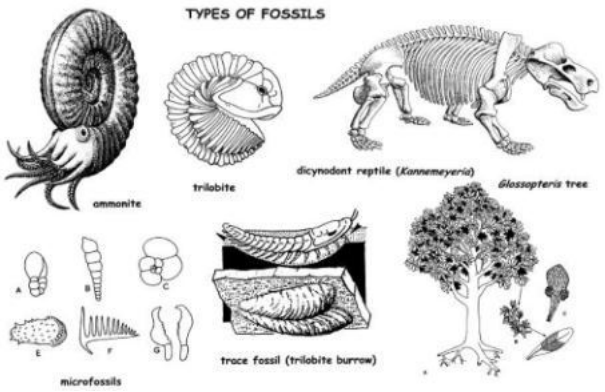

3/2024
Legend
Botanical High Sensitivity
Botanical Medium Sensitivity
Botanical Very High Sensitivity
Botanical Construction Buffer

ANNEXURE 4: FOSSIL FINDS POSTER

Palaeontology: what is a fossil?

Fossils are the traces of ancient life (animal, plant or microbial) preserved within rocks and come in two forms:

- Body fossils preserve parts, casts or impressions of the original tissues of an organism (e.g. bones, teeth, wood, pollen grains); and
- Trace fossils such as trackways and burrows record ancient animal behaviour.



How to report chance fossil finds: What should I do if I find a fossil during construction/mining?

If you think you have identified a fossil:

Immediately inform the ECO or Site Agent. He/she will then contact HWC and write a report and if necessary operations will stop in that specific area until the fossil is recovered

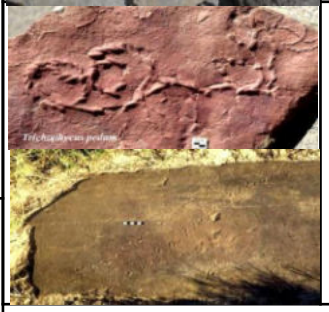
Heritage Western Cape
ceoheritage@westerncape.gov.za
021 483 5959
www.hwc.org.za

iLifa leMveli Wes-Kaap
Erfenis Wes-Kaap
Heritage Western Cape

Types of palaeontological finding - What does a fossil look like?

Fossils vary in size, from fossilised tree trunks and dinosaur bones down to very small animals or plants. Finds can be **individual fossils** (one isolated wood log or bone) or **clusters and beds** (several bones, teeth, animal or plant remains, trace fossils in close proximity or bones resembling part of a skeleton). A bed of fossils is a layer with many fossil remains.

Below there is a list of few examples of fossils which may be identified during excavations in the Western Cape.

Image	Description	Image	Description
	Leaves		Snail shells and other shells
	Fossil wood		Bones of larger animals
	The remains of fish and marine life (e.g. teeth, scales, starfish)		Large burrows made by moles and other animals
	Stromatolites		Traces made by burrowing insects (ants, wasps, dung-beetles etc.).
	Animal footprints		

Images provided by Dr John Almond

Text by HWC's Archaeology, Palaeontology & Meteorites Committee June 2016

ANNEXURE 5: VELD FIRE MANAGEMENT PLAN

DEA&DP IN-PROCESS NR: 16/3/3/2/A5/20/2046/24

VELDFIRE MANAGEMENT PLAN FOR THE PROPOSED EXPANSION OF THE CAPE WINELANDS AIRPORT

(P10 OF FARM 724, RE OF FARM 724, P23 OF FARM 724, P7 OF FARM 942, RE OF FARM 474, P3 OF FARM 474 AND P4 OF FARM 474)

JULY 2025

PREPARED FOR
CAPEWINELANDS AERO (PTY) LTD

PREPARED BY
PHS CONSULTING

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REVIEWER	Paul Slabbert	2019/1036		03/07/2025

PLEASE NOTE THAT ALL CHANGES FROM THE DRAFT REPORT FOR COMMENT VERSION 1 ARE UNDERLINED IN BLACK AND ALL CHANGES FROM THE DRAFT REPORT FOR COMMENT VERSION 2 ARE UNDERLINED IN RED. GENERAL TEXT CHANGES ARE NOT UNDERLINED

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KEY TERMS AND ABBREVIATIONS

Alien Vegetation Management Plan (AVMP) - A strategic framework designed to control, manage, and reduce the impact of alien invasive plant species in a specific area.

Applicant – Capewinelands Aero (Pty) Ltd. The Applicant who is the landowner, person in control of the land, developer and operator of the airport will be responsible for the overall implementation of the FVMP.

Auditing - A systematic and objective assessment of an organization's activities and services conducted and documented on a periodic basis to a predetermined standard.

Burn Unit – A specific, clearly defined area of land designated for a controlled burn (prescribed burn) during fire management operations.

CPFPA - The Cape Peninsula Fire Protection Association

CWA – Cape Winelands Airport

Crew Leader – A suitably qualified firefighter responsible for overseeing a team of firefighters during both wildfire suppression and controlled burns.

Defensible Space - A carefully maintained natural or landscaped area surrounding a structure, intentionally designed to minimize fire hazards. This space acts as a buffer zone that reduces the risk of wildfire spreading to the structure and provides easier access for firefighting operations.

Department of Environmental Affairs and Development Planning (DEA&DP)– the provincial authority for sustainable environmental management and integrated development planning.

Environmental Auditor – An independent EAP appointed to conduct an audit of the environmental management systems in place for an organization or development.

Environmental Manager (EM) – Head of the CWA Environmental Management Division. The EM will oversee all aspects of the Environmental Management on site. The Environment Manager is responsible for ensuring that the organization meets its environmental policy commitments and improves its environmental performance.

Environmental Management Division (EMD) – Designated entity for overseeing and ensuring environmental compliance throughout the construction and operation of CWA.

Environmental Management Programme (EMPr) - An environmental management tool used to ensure that undue or reasonably avoidable adverse impacts of the construction, operation, and decommissioning of a project are managed, and that positive benefit of the projects are enhanced.

Environmental Control Officer (ECO) – a suitably qualified environmental consultant to be appointed by the Applicant to oversee the implementation of the suite of Environmental Management Plans complied for the site, inclusive of this Veld Fire Management Plan.

Fire Break - A fire break is a gap in vegetation or other combustible material that acts as a barrier to slow or stop the progress of a fire.

Fire Chief / **Fire Control Officer (FCO)**– A suitably qualified firefighter to be appointed by the Applicant to oversee and manage all fire-related operations on-site. The Fire Chief will be responsible for overseeing the implementation of the VFMP, ensuring the firefighting team is operationally prepared, addressing potential fire risks, supervising both preventive and emergency response actions and reporting on such actions.

Fire Danger Rating - A rating system that provides an indication as to the fire risk for a specific area on a specific day. The system evaluates factors influencing fire danger systematically and represent them in the form of fire indices. The fire danger rating is mandated by Chapter 3, Section 9(1) of the National Veld and Forest Fire Act 101 of 1998 and is developed daily by the South African Weather Bureau.

Firefighting Unit – A dedicated team of professionally trained firefighters stationed permanently at CWA to handle all fire-related emergencies. The team will be established under the CWA EMD and will hold the primary responsibility for implementing and maintaining the Veldfire Management Plan (VFMP), ensuring adherence to fire safety protocols and addressing any fire risks that may arise during the development's operational phase.

Fire Protection Association (FPA) - Organization formed by landowners in wildfire-risk areas to prevent, predict, manage, and to assist with the extinguishing of wildfires under the National Veld and Forest Fire Act (Act 101 of 1998). FPAs are co-operative structures established between Local Authorities, the State, private landowners (and their lessees) in areas of high wildfire risk.

National Environmental Management Act (Act 107 of 1998, as amended) (NEMA)– national legislation that provides principles for decision-making on matters that affect the environment.

Site - Area where the proposed development will take place

Veld Fire - The National Veld and Forest Fires Act, Act 101 of 1998 defines a veldfire as a veld (bush), forest or mountain fire.

Veld Fire Management Plan (VFMP) - A document designed to guide the prevention, mitigation, and response to veldfires in fire-prone ecosystems. It outlines strategies for managing fire risks while protecting the ecological integrity of the landscape and minimizing the threat to human life, property, and biodiversity

SECTION 1: CONTEXTUAL INFORMATION

1.1. Project Background

This report aims to supply Veldfire Management Plan (VFMP) for the proposed Cape Winelands Airport (CWA) Development. The development spans across the following cadastral portions (see Figure 1):

- Portion 23 of Farm 724,
- RE of Farm 724,
- Portion 10 of Farm 724,
- Portion 4 of Farm 474,
- RE of Farm 474,
- Portion 7 of Farm 942,
- Portion 3 of Farm 474.

Overview of the proposed development:

The CWA, historically known as Fisantekraal Airfield (FAFK), is located approximately 10.5 km northeast of Durbanville and 25 km northeast of Cape Town International Airport (CTIA) (see Figure 2). Initially constructed around 1943 as a South African Air Force aerodrome during World War II, CWA has since transitioned into a general aviation (GA) airfield. The current 150-hectare site includes four concrete runways, each 90 meters wide and varying in length between 700 meters and 1,500 meters. The facility supports various unscheduled operations such as recreational flying, flight training, aircraft maintenance, charter operations, crop spraying, and aerial banner towing.

The proposed development will expand the existing airport facilities, encompassing five additional cadastral portions, creating a combined area of 885 hectares. Of this area, 470 hectares will be allocated for airport development, including an airside precinct, terminal precinct, services precinct, general aviation precinct and associated landscaping (see Figure 3 & Figure 4). The remaining land will remain as agricultural zones, designated as an agricultural precinct (Figure 3 & Figure 4). This agricultural precinct will feature a combination of dryland agriculture, conservation of botanically sensitive areas, and wetland offsets.

The project envisions a phased development approach, including the realignment of a primary runway to an orientation of 01-19 with a length of 3.5 km. The upgraded CWA is planned to transition from a general aviation airfield into a commercial airport capable of facilitating long-haul, wide-body flights by airlines and unscheduled operators from across the world. The airport's expansion will serve multiple roles within the aviation sector and will

support a variety of industries, including fixed-based operations, private charter services, flight training, helicopter services, aircraft maintenance, hotel and conferencing facilities, retail and food services, warehousing, logistics, and freight operations.

This VFMP forms part of the overarching Environmental Management Programme (EMPr) for CWA and serves as a strategic framework designed to manage the risks associated with veldfires within the CWA premises and guidance on the management of risk from surrounding areas. The plan provides clear policies and guidelines for CWA's approach to veldfire management, covering all phases from prevention and preparedness to response and recovery. It outlines the necessary strategies and assigns responsibilities to ensure that fire risks are minimized, while also aligning the airport's development with environmental best practices.

This VFMP is limited to veldfires only. It does not extend to fires within the built-up areas or relate to other emergencies that may occur on airport premises. Response plans for these eventualities will be provided in the Emergency Response Plan that will be compiled for the proposed development. Furthermore, a complete and detailed Fire Protection Plan, for all the proposed buildings will be submitted during the building plan submission for the project.

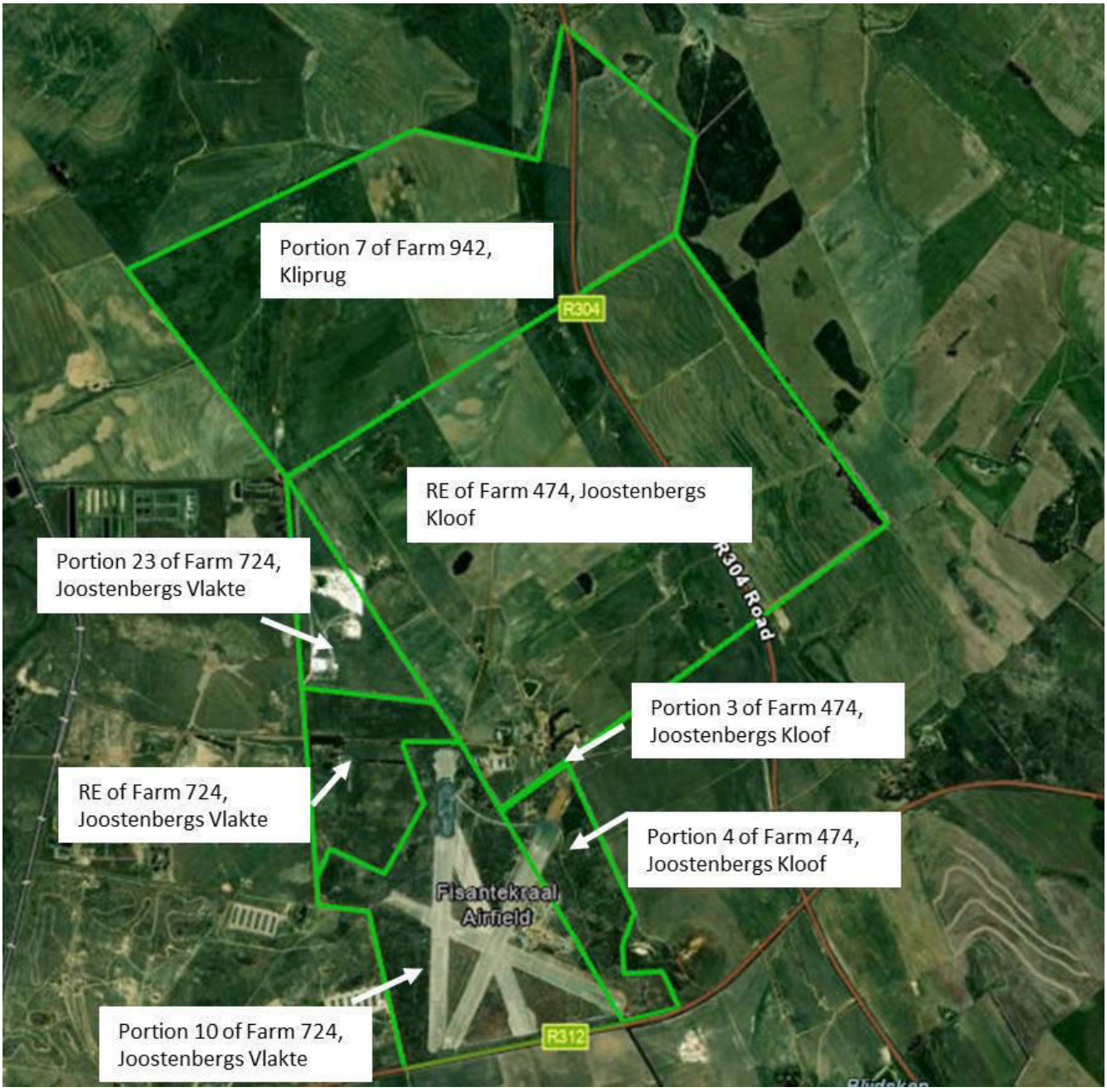

Figure 1: Cadastrals forming part of application area

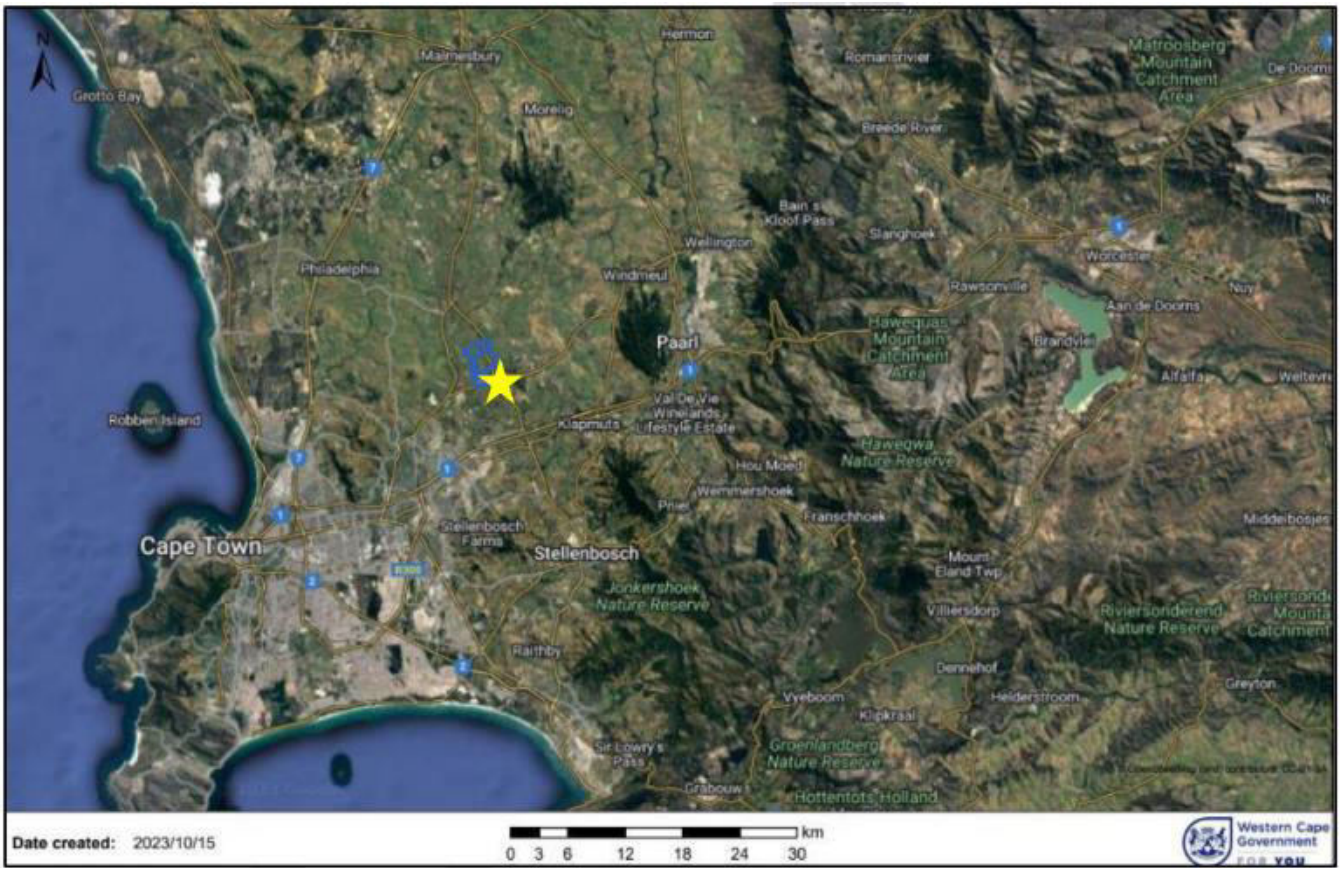

Figure 2: Regional location of CWA (indicated by yellow star and with cadastrals outlined in blue) (PHS Consulting, Oct 2023)

Figure 3: Phase 1 preferred SDP - Precinct Plan (Capex, August 2024)

Figure 4: Phase 2 preferred SDP - Precinct Plan (Capex, January 2025)

1.2. Purpose of the Veldfire Management Plan

The purpose of this VFMP is to ensure the safety of personnel and infrastructure, minimize environmental impact and ensure uninterrupted airport operations. To achieve these goals, the plan focuses on meeting the following objectives:

- **Protect Human Life:** Ensure the safety of all individuals, including staff and tenants, firefighters, and the public.
- **Safeguard Property and Assets:** Protect infrastructure and assets from veldfire damage.
- **Minimize Physical and Environmental Impact:** Reduce the adverse effects of veldfires and fire suppression techniques on both physical structures and the environment.
- **Promote Sustainable and Cost-Effective Protection:** Implement veldfire protection measures in an environmentally responsible and financially efficient manner.
- **Maintain Appropriate Fire Regimes:** Preserve environmental values by managing fire regimes through controlled burns that are suitable and necessary for conservation purposes.

1.3. Management Strategy

This fire management strategy takes a proactive approach to mitigating fire risks, guided by the following steps in the veldfire management cycle:

1. **Prevention:** Activities directed at reducing fire occurrence, including public awareness, law enforcement and the reduction of fire risks.
2. **Preparedness:** All activities designed to protect an area (including life, property, assets and values) from damage by fire.
3. **Response:** All the work and activities connected with fire-extinguishing operations, beginning with discovery and continuing until the fire is completely extinguished
4. **Recovery:** The process of returning a disturbed ecosystem or area as a result of a veldfire to its original state

Management objectives are essential for each stage of the veldfire management cycle. Prevention objectives focus on understanding the causes and potential impacts of veldfires. Preparedness objectives are informed by an

understanding of veldfire behavior. Response and suppression objectives rely on insights into both veldfire behavior and their impact. Finally, restoration objectives are guided by a comprehensive understanding of the aftermath and consequences of veldfires.

1.4. Relevant legislation and policies

The following is a list of the principal legislation for veld fire management in the Western Cape as relevant to the proposed development. All activities on site must ensure compliance with the provisions of the legislation as applicable:

- The Constitution of the Republic of South Africa (Act 108 of 1996)
- Fire Brigade Services Act, Act 99 of 1987
- National Veld and Forest Fire Act, Act 101 of 1998
- GN 1054 of 2005 - The National Fire Danger Rating System in terms of the National Veld and Forest Fire Act, 1998, Act no 101 of 1998
- Disaster Management Act, Act 57 of 2002
- Conservation of Agricultural Resources Act, Act 43 of 198
- National Environmental Management Act (Act 107 of 1998) – NEMA
- National Environmental Management: Air Quality Management Act, Act 39 of 2004
- National Environmental Management: Biodiversity Act, Act 10 of 2004
- Pollution Prevention Act, Act 45 of 1965
- National Water Act, Act 36 of 1998
- Occupational Health and Safety Act (No. 85 of 1993)
- Basic Conditions of Employment Act 75 of 1997

The National Veld and Forest Fire Act, Act 101 of 1998, is of primary relevance to the VFMP. This legislation provides the legal framework for the prevention and control of veld, forest, and mountain fires across South Africa. The Act clearly defines the responsibilities and obligations of landowners to actively prevent and manage veldfires. It establishes minimum enforceable standards, such as the creation and maintenance of firebreaks and ensuring preparedness measures are in place. Compliance with this Act is essential for effective fire risk management on the Cape Winelands Airport premises.

In addition, the development will adhere to the following:

- SANS 10400–T: 2024 and the Community Fire Safety By-law, Provincial Gazette 5832 (as amended 29 June 2007 and 21 August 2015):
    - A Fire Engineer (ECSA Registered) shall be appointed for this project.
    - A Complete and Detailed Fire Protection Plan, for all the proposed buildings are required to be submitted during building plan submission for scrutinizing and approval.
        - Fire hydrants to be provided as per SANS 10400 – T4.35

        - Provide access for emergency vehicles complying with the Community Fire Safety By-law Section 12.
        - Provision of water for Fire Fighting (SANS 10400-W: 2011).
    - Storage and use of Flammable substances shall comply with Chapter 8 of the Community Fire Safety By-law.

1.5. Status of the Veldfire Management Plan

The VFMP must form part of all contractual documents for this project. The Environmental Authorization ascribes legal status to this Management Plan and any subsequent amendments thereto. The approval of the Management Plan by DEA&DP will require that the applicant and all appointed contractors must comply with the requirements herein. Any amendments/ changes/ upgrades to the Management Plan will require submission to and approval by DEA&DP.

This VFMP forms part of the contract identifying and specifying the procedures to be followed by contractors and employees of the facility to eliminate or reduce adverse fire risks associated with the proposed development. Should a contractor or employee persistently fail to observe the provisions of the Management Plan, the Environmental Control Officer (ECO) can recommend that the employee be removed from the site.

1.6. Responsibility and Enforcement of the VFMP

1.6.1. Applicant

The Applicant will be responsible for the overall implementation of the VFMP. The Applicant is accountable for the potential impacts of the activities that are undertaken and is responsible for managing these impacts. The Applicant has the overall environmental responsibility to ensure that the implementation of the operational requirements complies with the relevant legislation. The Applicant must ensure that he/she is fully familiar with the requirements of this VFMP, any relevant Environmental Authorization or any other legally binding documentation.

1.6.2. CWA Environmental Management Division

The CWA Environmental Management Division (EMD) will be established at the start of the construction phase to ensure environmental compliance throughout the project. The CWA EMD will appoint an Environmental Manager (EM) to oversee all aspects of the Environmental Management on site. The Environment Manager is responsible for ensuring that the organization meets its environmental policy commitments and improves its environmental performance. Not only do they monitor performance against and ensure compliance with relevant laws and

regulatory requirements, but they are also proactive in identifying and promoting opportunities to reduce the environmental impact of the organization's activities, products and services.

Led by an Environmental Manager, the CWA EMD will consist of several teams for e.g. landscaping, waste management, alien species control, fire management etc. During the initial phases it could be one multitask team to be split as the tasks increases. Each team will have a Control Officer reporting directly to the EM. In the case of Velf Fires this would be the Fire Chief / Fire Control Officer. The Environmental Manager will oversee the implementation of Environmental Management Plans (EMPr), compliance with regulations, day-to-day environmental management of the site, managing the necessary applications, and overseeing external service providers such as the appointed Environmental Control Officer. Responsibilities also include internal audits and developing strategies for waste minimization and emissions reduction.

1.6.3. CWA Firefighting Unit

The designated onsite firefighting unit will be responsible for the implementation of the VFMP. Upon appointment, all crew members must receive comprehensive training on the VFMP's requirements, with ongoing training provided to any newly appointed team members throughout the operational phase. It is the responsibility of the applicant to ensure that this training is conducted.

A Fire Chief / Fire Control Officer must be appointed must be appointed within the EMD to lead the firefighting team and oversee the implementation of the VFMP. The fire control officer will assume overall responsibility for managing the VFMF, employees and contractors and ensure and oversee the implementation of the VFMP onsite in its entirety. All decisions regarding fire related environmental procedures and protocol must be approved by the fire control officer, who also has the authority to stop any activity in contravention of the VFMP. The role of is interactive and must include daily site visits.

Key Responsibilities of the Fire Control Officer:

- Assume overall command of fire response operations onsite.
- Provide training to all staff on VFMP requirements.
- Conduct regular monitoring of the site to identify potential fire risks.
- Perform routine inspections of firefighting equipment and machinery, documenting the results of each inspection.
- Compile and submit monthly monitoring reports to the ECO.

- Work closely with the ECO, applicant, and contractors to resolve any fire risk issues that arise.
- Maintain detailed records of all fire incidents and responses.

This list of responsibilities is not exhaustive, and the Fire Chief must remain adaptable to additional tasks as necessary for fire safety and compliance.

1.6.4. The Environmental Control Officer (ECO)

The Environmental Control Officer (ECO) is responsible for overseeing and verifying the proper execution of the EMPr during the construction and operational phase. This includes ensuring that various contractors working on-site comply with the waste management plan within their designated areas. During the construction phase, an independent Environmental Assessment Practitioner (EAP) firm must be appointed to serve as the ECO who will work alongside the EM. Once the project transitions fully into the operational phase, this function can be managed by an in-house ECO within the CWA Environmental Management Division who will report to the EM. During the construction and operational phases, monthly ECO reports must be prepared and submitted to the Department of Environmental Affairs and Development Planning (DEADP) during construction and to the EM during operations.

1.6.5. The competent authority

DEA&DP will review the EMPr and on approval they may have the following role to play:

- Review and monitor implementation of the VFMPr;
- Review whether there is compliance by the applicant;
- Perform random control checks;
- Review incident and audit reports;
- Enforce legal mechanisms for contraventions of the VFMP.

1.6.5. Engineers and Contractors

The engineers and contractors, where applicable, are responsible for physically carrying out certain development and maintenance activities. The responsibilities indicated here are also relevant to sub-contractors.
The responsibilities of the engineers and contractors include but are not limited to the following:

- Be conversant with the VFMP, EMPr, any relevant Environmental Authorization or any other legally binding documentation;
- Have a responsibility to adhere to any conditions and recommendations laid out in above mentioned documentation;
- Prevent actions that may cause harm to the environment;
- Be responsible for any remedial activities in response to an environmental incident;

- Review and amend any construction activities to align with the VFMP, EMPr and Best Practice Principles;
- Ensure compliance of all site personnel and / or visitors to the VFMP, EMPr and any other authorisations.

SECTION 2: OVERVIEW OF SITE CONDITIONS

2.1. Climate

The proposed development site is located in a Mediterranean climate zone, with warm dry summers and mild wet winters. During the dry summer months vegetation can become dry and highly flammable, increasing the risk of veldfires. The average annual precipitation for the area is approximately 532mm/annum of which only 94mm (<20%) falls during the summer months (October – March) (GEOSS, Geohydrological Scoping Report, Sept 2023).

2.2. Vegetation and Landcover

The proposed development area forms part of the West Coast Renosterveld bioregion within the Fynbos biome located within what is now known as the Core Region of the Greater Cape Floristic Region (GCFR) (Nick Helme Botanical Surveys, Botanical Impact Assessment, September 2024). GCFR is highly biodiverse with high levels of endemism and is considered a global conservation priority with agriculture, urbanization, and alien plants posing the greatest threat, particularly to lowland habitats.

According to the South African Vegetation Map, the proposed airport precinct would naturally have been dominated by Swartland Granite Renosterveld (Endangered) along with smaller areas of Swartland Shale Renosterveld (Critically Endangered) and a minimal portion of Cape Flat Sand Fynbos (Critically Endangered) (Figure 5). These vegetation types require fire for optimal ecological functioning. Based on field verification, the appointed botanist however is of the opinion that the northern most remaining patch of natural vegetation should be classified as Swartland Silcrete Renosterveld which is Critically Endangered (Nick Helme Botanical Surveys, Botanical Scoping Study, February 2024).

2.2.1. Botanical Sensitivity

The Botanical Impact Assessment undertaken by Nick Helme revealed the following (Nick Helme Botanical Surveys, Botanical Impact Assessment, September 2024):

- About 93% of the site has been heavily disturbed and degraded over a long period of time, with the result that negligible indigenous vegetation is found in these areas, and these areas are of Low botanical

sensitivity. Indigenous plant diversity is very low in the most disturbed parts of the airport precinct, and is low overall, compared to pristine Renosterveld, which would have at least 250 species in a site of this size (if pristine). There is no indigenous plant cover in the large cultivated areas in the agricultural precinct.

- Approximately 7% of the site (about 6.5ha) is deemed to be of Medium, High or Very High botanical sensitivity (Figure 6 - Figure 8).
- Two patches of very high sensitivity, four patches of high sensitivity and eight patches of medium sensitivity have been mapped in the airport precinct (Figure 6 & Figure 7) and two patches of very high sensitivity and two patches of medium sensitivity have been mapped in the agricultural precinct (Figure 8).
- Ideally all areas of Medium, High or Very High botanical sensitivity should be conserved and ideally, they would also all be ecologically connected via rehabilitated Low sensitivity areas. From a botanical perspective most of these areas would be ecologically viable, especially if connected by ecological corridors. Key ecological management interventions required would be ongoing alien vegetation management (pre and post burn) and management burns in the appropriate autumn season (once every 8-12 years).

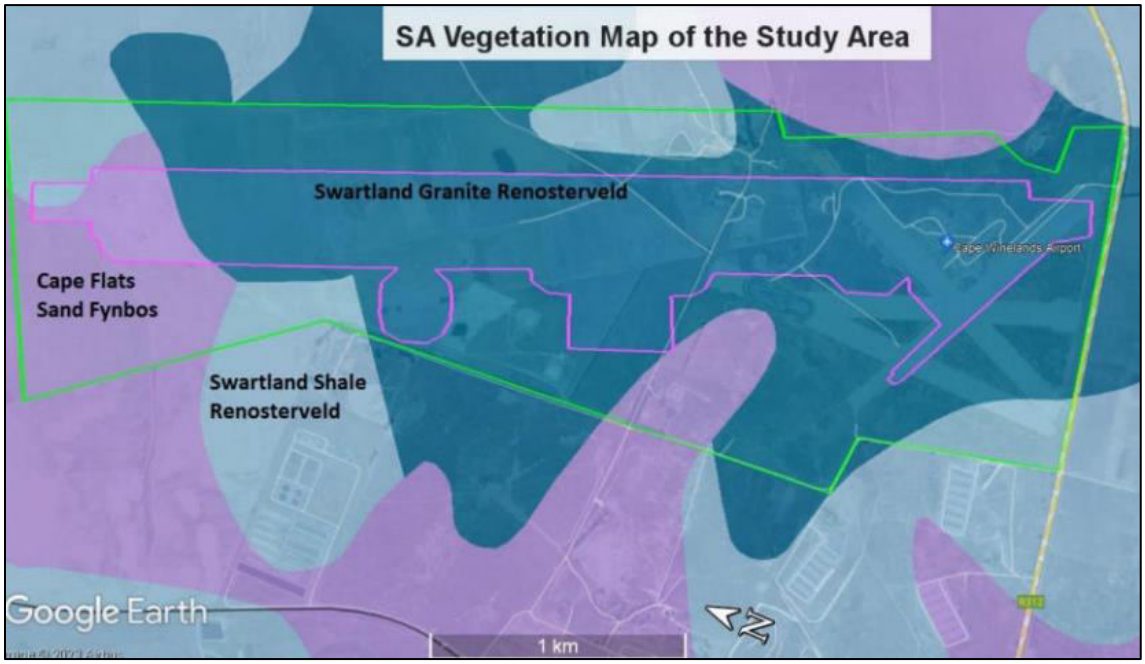

Figure 5: Extract of the SA Vegetation Map (Mucin & Rutherford 2012) showing that three different vegetation types would originally have occurred in the primary study area (excluding the Agricultural Precinct), with Swartland Granite Renosterveld making up the bulk of the site. The green polygon is the study area, and the pink polygon is the airside development footprint (Nick Helme Botanical Surveys, Impact Assessment, September 2024).

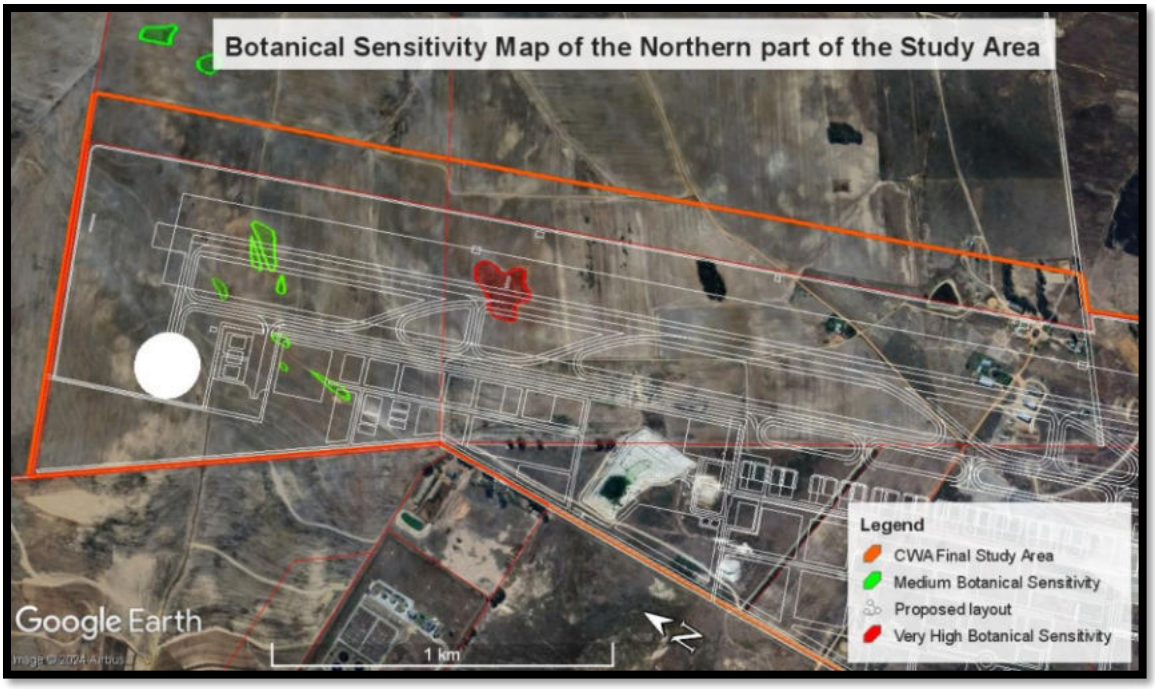

Figure 6: Botanical sensitivity map for the northern part of the airport precinct. All areas not shaded green or red within the study area are of Low botanical sensitivity (Nick Helme Botanical Surveys, Impact Assessment, September 2024).

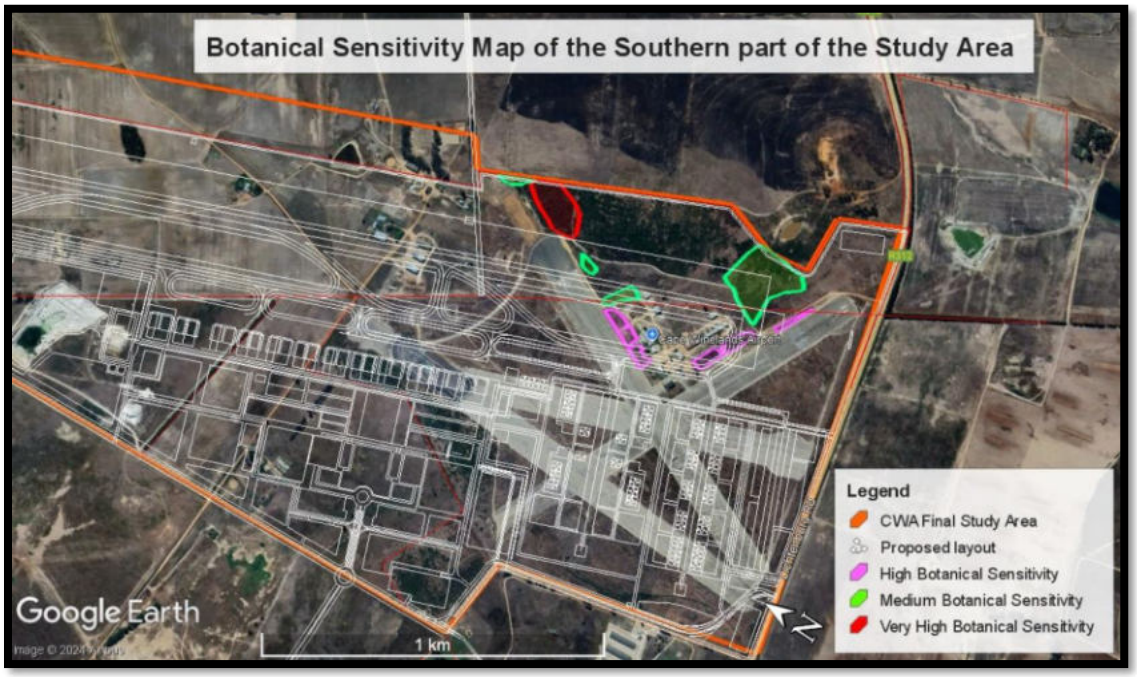

Figure 7: Botanical sensitivity map for the southern part of the study area. All areas within the airport precinct not shaded green, red or pink are of Low sensitivity (Nick Helme Botanical Surveys, Impact Assessment, September 2024).

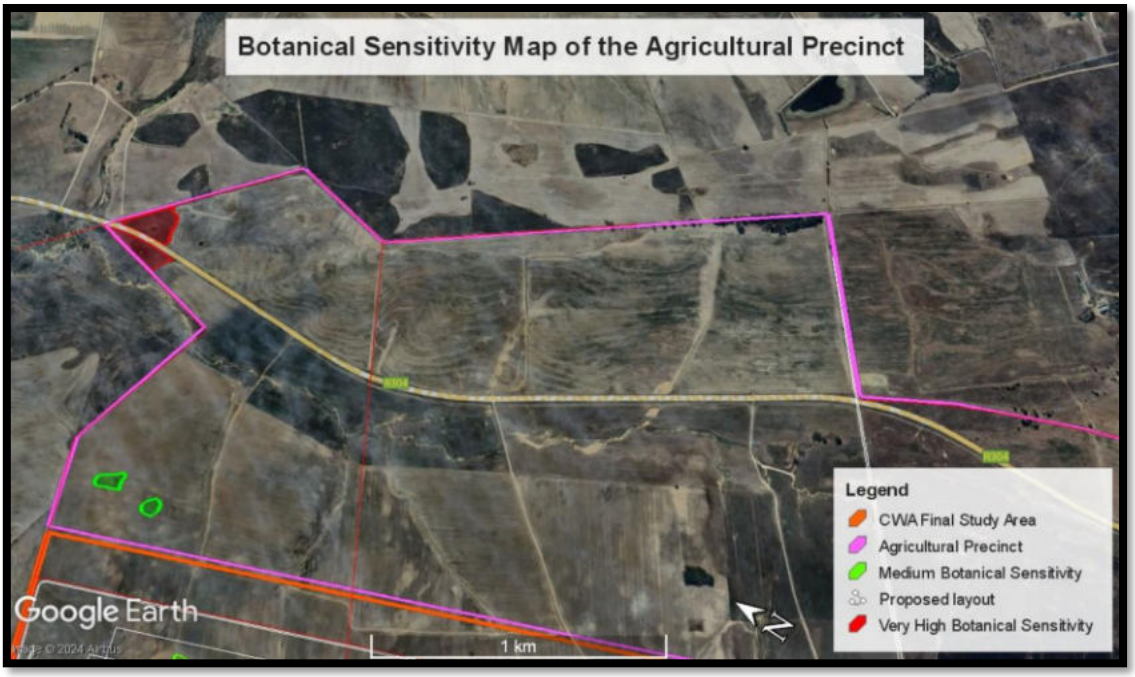

Figure 8: Botanical sensitivity map for agricultural precinct. All areas not shaded green or red within the precinct are of Low botanical sensitivity (Nick Helme Botanical Surveys, Impact Assessment, September 2024).

2.2.2. Current Status of Vegetation

The Botanical Impact Assessment reveals that approximately 93% of the study area and about 88% of the proposed development area has experienced extensive disturbance and degradation over time, leading to very limited indigenous vegetation within these areas (Nick Helme Botanical Surveys, Botanical Scoping Study, February 2024). The remaining natural habitat within the airport precinct is classified as Swartland Silcrete Renosterveld and Swartland Shale Renosterveld. In contrast, the agricultural precinct, currently under cultivation, has no indigenous plant cover.

The proposed development site is currently affected by woody alien invasive species, predominantly *Acacia saligna* (Port Jackson), along with scattered *Leptospermum laevigatum* (Australian myrtle), *Pinus* species (pines), and *Eucalyptus* species (gums). A significant portion of the airport precinct was cleared of invasive woody vegetation in late 2020 and early 2021, with previous invasive coverage ranging from 50% to 100%. Despite the biocontrol fungus infecting many of the Port Jackson trees, leading to reduced seed production and some plant mortality, it is highly probable that a substantial seed bank remains onsite which could result in prolific regrowth following a fire or similar clearing event (Nick Helme Botanical Surveys, Botanical Impact Assessment, September 2024).

2.2.3. Extent of proposed vegetation removal

The proposed development will involve the removal of vegetation across the entire airport precinct, with the exception of three designated conservation patches as outlined in the landscaping plan (Figure 9). These conservation areas include:

- 1.6 hectares of very high conservation value vegetation
- 0.2 hectares of medium conservation value vegetation
- 1.6 hectares of additional medium conservation value vegetation

No additional vegetation removal is planned within the agricultural precinct. Existing cultivated areas will remain dedicated to agricultural use, while certain sections of the precinct will be rehabilitated as part of the wetland offset plan (Figure 10).

Figure 9: Cape Winelands Airport Landscape Concept Plan (Planning Partners, March 2025)

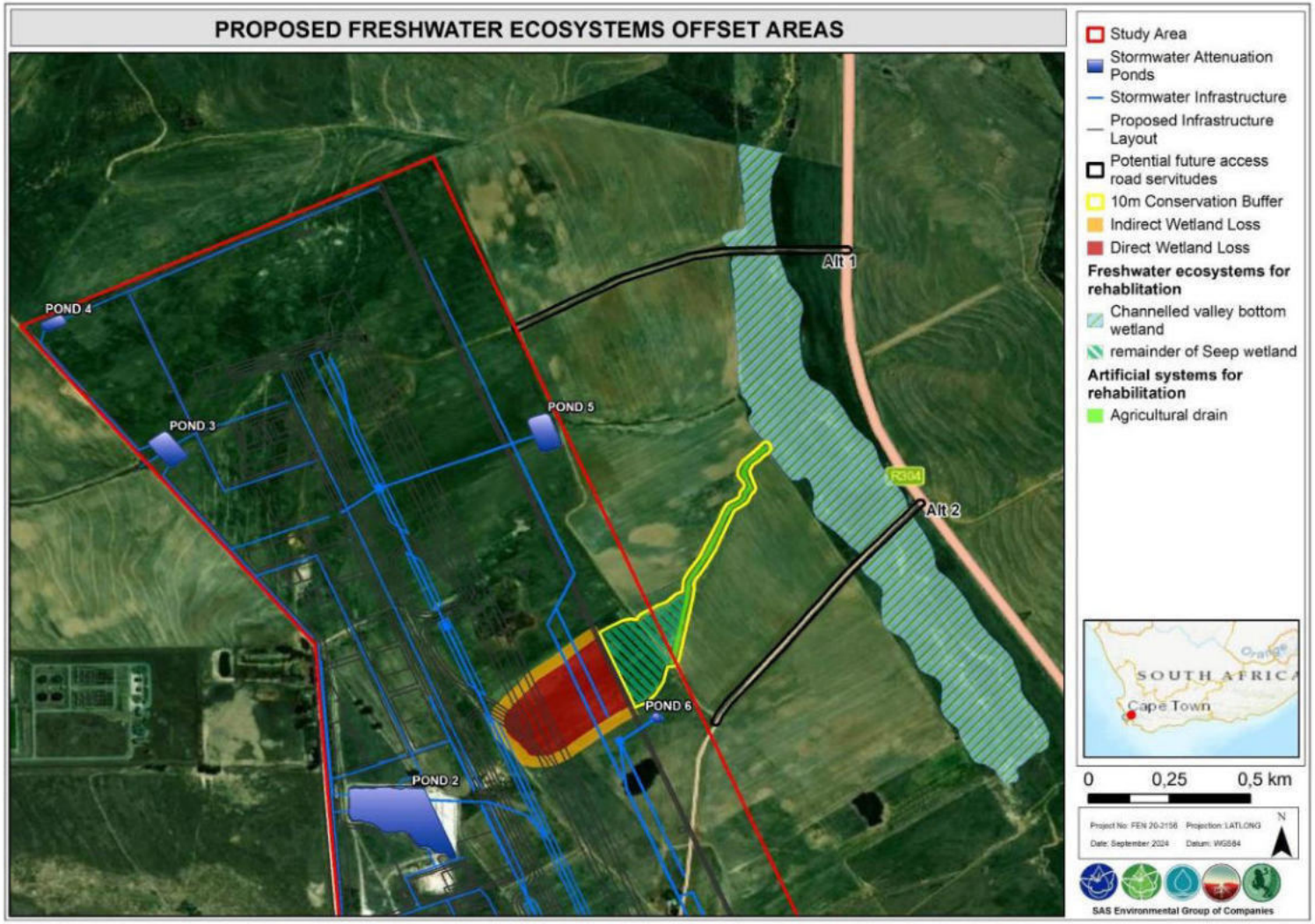

Figure 10: Extent of wetland to be lost (7.44 ha) vs identified wetland areas to be rehabilitated (FEN, Draf Wetland Offset Study and Implementation Plan, September 2024).

2.3. Fire History

Although Renosterveld, the natural vegetation of the area, is a fire-dependent ecosystem requiring burns every 8-12 years for optimal ecological function, the majority of the proposed development area has not experienced a fire in the past 14-25 years, as evidenced by site vegetation and historical satellite imagery dating back to 2004 (Nick Helme Botanical Surveys, Botanical Scoping Study, February 2024). Consequently, much of the indigenous vegetation on site is considered senescent and overdue for a burn. In the absence of fire for over 15-20 years, plant species diversity typically declines rapidly, but can recover dramatically post-fire due to the activation of soil-stored seed banks.

2.4. Landscaping Plan

A comprehensive landscaping plan has been developed for the airport precinct, as shown in Figure 9. The landscaping will incorporate fynbos and renosterveld planting, using specific species to achieve the required vegetation heights for airport operations. The development will also preserve patches of high botanical sensitivity (Figure 6 to Figure 8) and include wetland offsetting within the agricultural precinct (Figure 10).

A key ecological management action for areas landscaped with natural fynbos or renosterveld vegetation, as well as conservation zones, will involve conducting controlled management burns during the appropriate autumn season, approximately every 8-12 years. Further details on these controlled ecological burns are outlined in Section 3.3 of this VFMP.

Firescaping

Firescaping is the practice of creating a defensible space around buildings by incorporating fire-resistant plants, proper spacing, and strategic landscaping techniques. When planning fynbos or renosterveld planting near the building line, firescaping can be applied by incorporating more fire-resistant, succulent species. These include varieties from the Vygie family, such as *Lampranthus, Malephora, Drosanthemum, Delosperma, and Carpobrotus*, all of which have fleshy leaves that are highly resistant to fire. Alternatively, maintaining hand-cut firebreaks for at least 15m around buildings and other structures can also help reduce fire risks.

SECTION 3: FIRE PREVENTION

Fire prevention focuses on preventing the ignition of fires and minimizing the impact of any fires that do occur. Fire prevention is proactive.

3.1. The National Fire Danger Rating System

Chapter 3 of the Veldfire Act provides for the prevention of veldfires through a fire danger rating system. The South African Weather Services (SAWS) each day develops a rating for the day and a prediction for the following day. The Fire Danger Index (FDI) ratings as prescribed by the National Fire Danger Rating System in Terms of the National Veld and Forest Fire Act, 1998(Act No 101 Of 1998) – GN 1054 of 2005 uses 5 categories to rate the fire danger represented by color codes as indicated in Table 1 below.

All on-site firefighting personnel are required to monitor the Fire Danger Index (FDI) daily throughout the construction and operational phase of the development. When the FDI is 'High' or 'Very High' these ratings must be communicated to all relevant contractors, workers, and team leaders active on the site. This protocol will enable all personnel to adjust their activities in line with the prevailing fire conditions. The on-site firefighting teams must leverage the FDI data to implement proactive measures aimed at minimizing the risk of unintended ignitions and enhancing readiness for potential veldfires.

When the FDI rating is classified as 'High' or 'Very High,' the following proactive measures should be actioned:

- Restrict or modify high-risk activities such as:
    - Suspend all outdoor burning and heating
    - Limit the use of ground support equipment that involves combustion or high heat if they are not essential.
    - Delay any activities that involve open flames or high heat sources, including maintenance and construction that could produce sparks such as welding.
    - Implement stringent safety measures and increased supervision during aircraft refuelling operations.
    - Avoid the use of brushcutters for bushclearing or maintenance of fire breaks as this can result in sparks igniting the vegetation.
    - Avoid the use of chainsaws for tree felling as this can result in sparks igniting the vegetation – sparks are usually caused due to poor maintenance of the machine.
- Heightening surveillance across the site.
- Ensuring that all firefighting equipment is fully operational and that personnel are prepared for immediate deployment if a fire occurs.

Additionally, the FDI should inform the firefighting team's assessment of veldfire behaviour, guide control strategies, and determine the necessary actions corresponding to each fire danger level.

Table 1: Fire Danger Ratings

DANGER RATING	INSIGNIFICANT	LOW	MODERATE	HIGH	HIGH - EXTREME
Indicative Colour	*Blue*	*Green*	*Yellow*	*Orange*	*Red*
FIRE BEHAVIOUR	Veldfires are not likely to ignite. If they do, they are likely to go out without suppression action. There is little flaming combustion. Flame lengths generally lower than 0.5 metre. Rates of forward spread less than 2 metres per minute.	Veldfires likely to ignite readily but spread slowly. Flame lengths generally lower than 1.2 metres. Rates of forward spread less than 5 metres per minute.	Veldfires ignite readily and spread rapidly. Flame lengths between 1.2 and 2 metres. Rates of forward spread between 5 and 25 metres per minute.	Veldfires ignite readily and spread very quickly. Local crowning and short-range spotting. Flame lengths between 2 and 5 metres. Rates of forward spread between 25 and 35 metres per minute.	Conflagrations are likely in fynbos, stands of alien invasive trees and plantation forests. Long range fire spotting is likely in these fuel types. Flames lengths between 5 to 15 metres or more. Rates of forward spread of head fires can exceed 60 metres per minute.
FIRE SUPPRESSION DIFFICULTY	Veldfires easily approached and suppressed using hand tools.	Veldfires can safely be approached on foot and suppression is readily achieved through direct manual attack methods.	Direct attack constrained as veldfires are not safe to approach on foot for more than very short periods. Back burning from control lines can be undertaken if prevailing conditions are safe.	Serious control problems where - depending on fuel loads and prevailing weather - direct attack is not always feasible. Control through a combination of direct attack and indirect control measures such as aerial water bombing. Back burning should only be used after careful consideration.	Any form of fire control is likely to be precluded until weather conditions become more favourable. Equipment such as fire tenders should be used to protect properties on the urban edge. Back burning is dangerous and should be avoided.

FIRE PREVENTION AND PREPAREDNESS MEASURES	No precautions are needed	Fires including prescribed burns may be lit, used or maintained in the open air on the condition that persons making fires take reasonable precautions against such fires spreading. Keep a watch for unexpected changes in wind speed and direction.	No fires may be allowed in the open air except in designated fireplaces authorised by a Fire Protection Officer where a Fire Protection Association exists, or elsewhere, the Chief Fire Officer of the local fire service. Extreme caution should be taken when prescribed burning is undertaken.	No fires may be allowed under any circumstances in the open air. Fire Protection Associations and Municipal Disaster Management Centres must invoke contingency fire emergency and disaster management plans.	No fires may be allowed under any circumstances in the open air. All operations likely to ignite fires halted. Householders placed on alert Fire Protection Associations and Provincial Disaster Management Centres must invoke contingency fire emergency and disaster management plans including extraordinary readiness and response plans.
RECOMMENDED ACTIONS	None	None, other than prudent care to ensure that any open-air fires do not escape. Prescribed burning permissible.	Open-air fires should only be permitted in authorised fireplaces. Prescribed burning should be conducted with care, and any prescribed veldfires should be extinguished should the forecast fire danger-rating turn to high.	Ensure all staff and visitors are aware of prevailing high fire danger rating. High risk areas should be put on standby for evacuation, should the fire danger conditions forecasted become worse. All efforts should be made to bring any veldfires under control with maximum effort.	Fire-fighters and equipment placed on stand-by and be dispatch immediately at the first sign of a fire. High risk areas to be evacuated. Equipment such as helicopters and water tenders should concentrate efforts on the protection of houses and other structures.

APPLICATION OF THE NATIONAL VELD AND FOREST FIRE ACT, 101 of 1998			Above precautionary measure to be prescribed and made applicable nationally on days rated moderate.	Section 10(1)(b) of the National Veld and Forest Fire Act applies: no person may light, use or maintain a fire in the open air.	Section 10(1)(b) of the National Veld and Forest Fire Act applies: no person may light, use or maintain a fire in the open air
RELATIONSHIP WITH DISASTER MANAGEMENT				The threat of disastrous wildfires exists at municipal level under these conditions. Municipal Disaster Management Centres must invoke contingency plans and inform Provincial Disaster Management Centre. (Section 49 of the Disaster Management Act, 57 of 2002).	The threat of disastrous wildfires at provincial level exists under these conditions. Provincial Disaster Management Centre must invoke contingency plans and inform National and Disaster Management Centre. (Section 49 of the Disaster Management Act, 57 of 2002).

3.2. Sources of fire

Understanding and managing the various sources of fire is essential to reducing the likelihood of fire outbreaks and minimizing their impact when they do occur. Likely sources of fire at the Cape Winelands Airport can be divided into three areas namely, natural sources, external activities, and onsite activities. Further details of potential fire sources, along with corresponding preventative measures, are provided in Table 2.

Table 2: Overview of potential Fire Sources and Management Actions for Effective Fire Prevention at the Cape Winelands Airport

Source		Risk	Prevention Action
Natural Sources	Lightning strikes when vegetation is dry	Natural ignition	Monitor weather conditions; deploy response teams during high-risk periods.
External Activities	Fire Spreading from Neighboring Properties	Fires from adjacent properties can spread across boundaries, increasing fire risk.	Establish firebreaks along property boundaries; communicate with neighboring landowners; collaborate on fire management.

	Intentional Fire Setting	Intentional fire-setting poses a fire risk.	Implement surveillance systems; promote community reporting; collaborate with law enforcement to detect and prevent arson.
Human Activities Onsite	Construction and Maintenance Work	Sparks from activities like welding and grinding can ignite dry vegetation.	Implement safety protocols, including fire watch personnel and equipment checks and ensure proper ventilation in work areas.
	Vehicle-Related Fires	Sparks from vehicles, especially off-road, can ignite dry vegetation.	Perform regular vehicle maintenance; establish firebreaks along access roads.
	Powerlines	Faulty or downed power lines can spark fires, especially in windy conditions.	Conduct regular inspections and maintenance; create firebreaks under and around power lines.
	Green Waste Stockpiles	Accumulated green waste can spontaneously combust, leading to fires.	Avoid stockpiling large amounts of green waste and ensure regular removal.
	Agricultural & Conservation Practices	Controlled burns can become uncontrolled, leading to wildfires.	Require clear guidelines and permits; closely monitor all burning activities.
	Aircraft Crash	A crash can result in a significant fire, particularly in or near natural areas.	Develop emergency response plans with specific protocols for aircraft-related fires; coordinate with aviation authorities.

3.3. Veld management

Given that natural, fire-adapted and fire-dependent fynbos and renosterveld vegetation will be present within the airport precinct as per the landscaping plan (Figure 9) as well as within the agricultural precinct, veld management will play an important role in the prevention of unplanned veld fires.

3.3.1. Prescribed Burning

Prescribed burning is a critical intervention for managing fire-prone and fire-adapted ecosystems like fynbos. In these environments, controlled burns help reduce fuel loads, minimizing the risk of uncontrolled wildfires while maintaining species diversity and essential ecological functions. The designated onsite firefighting unit will be the implementing agent for any necessary controlled burns within CWA property. Controlled burns must take numerous factors into account, and it is subject to a permitting process as outlined below:

Ecological Considerations

Variability in veldfire management is key to maintaining biodiversity. While there is no single "ideal" fire interval, it is important to vary the frequency of burns between 8 and 20 years, with an optimal range of 12 to 18 years. Burning too often (under 8 years) can harm species that haven't fully matured, while infrequent burns (over 25 years) can result in the loss of other species. Strict rotational burns are not practical, as unplanned wildfires and natural variability in fire intervals play a crucial role in promoting biodiversity. Additionally, veldfire intensity and size of the area burnt are important factors, as they influence species recovery and seed predation. Managing veldfires requires attention to a combination of ecological criteria such as vegetation age, species composition, fuel loads, and prevalence of invasive species to determine whether the ecosystem is ready for a controlled burn.

To effectively manage the natural vegetated areas within the site, it is recommended that an assessment of the veld condition be conducted at least every eight years by a suitably qualified botanist. The condition of areas with a medium, high and very high botanical sensitivity must however be monitored annually by a suitably competent botanist (or CoCT Environmental Management Dept.). The botanist will provide a recommendation on whether the vegetation is in need of a controlled burn and if the next assessment should be delayed or moved forward.

Climatic Considerations

Prescribed burns should be conducted under specific weather conditions to ensure safety and effectiveness while minimizing the risk of uncontrolled fires. Key weather conditions include:

1. **Temperature**: Moderate temperatures, typically between 10°C and 25°C, are preferred. Higher temperatures can increase fire intensity and make it harder to control.
2. **Wind**: Winds should be steady and not too strong, usually between 8 and 20 km/h. Strong winds can spread the fire too quickly, while calm conditions can lead to erratic fire behaviour due to insufficient ventilation.
3. **Fuel Moisture**: Moisture in the vegetation (fuel) should be balanced—not too wet or too dry. Dry fuel burns too intensely, while wet fuel will not ignite easily.

These factors, along with thorough monitoring of the fire danger ratings for the region, should guide the decision to undertake a prescribed burn.

Permitting Procedure

No one may carry out open burning of any material on any land or premises unless the person has first obtained written authorization for open burning from the City's Air Quality Management Unit. Examples of open burning

include biodiversity burns of open veld, burning of agricultural stubble, and stack or fuel load reduction burns of biomass. Should it be determined that a prescribed burn is needed, a burning permit must be obtained by following the following steps:

1. Application Form: Download and complete the 'Open Burn Application Form' from the City of Cape Town or Cape Peninsula Fire Protection Associations website along with all required supporting documents as outlined in the application form. The burn period designated for Prescribed / Ecological / Biodiversity Burns is from 1 February to 30 April and from 1 September to 30 November.
2. Public Participation: Part of the Open Burn Permit application process requires that an applicant notify neighbouring properties regarding their intention to apply for an Open Burn Permit. This can be achieved by:
    - **Emailing notification letter to neighbouring properties**, includes Air Quality officials in the e-mail to serve as proof of the process.
    - **Letter drops**, take photos of letter drops to serve as proof of the process and include photos in submission of application.
    - **Place a notification in the local newspaper**, include a copy of the newspaper article/notification in the submission of application.
3. Submission: The completed and signed Open Burn Permit application form together with supporting documentation must be submitted to the City's Air Quality Management Unit at Bronwyn.Davidson@capetown.gov.za.

    Once the City's Air Quality Management Unit has received your application it will be reviewed followed by a joint site inspection by the Air Quality Management Department and Fire and Rescue Services. The proposed burn site/s should be prepared and ready prior to inspection.

Controlled burns may only be conducted on days with a low fire danger rating. Additionally, before any prescribed burn takes place, CWA must notify local Fire Rescue Services as well as any adjacent landowners to ensure they are informed and prepared for the event.

Controlled burns on neighboring properties

Controlled burns are a common agricultural practice on neighbouring properties. While the frequency of these burns has decreased in recent years, it remains an integral part of local agricultural management, and it is unlikely that the practice will be completely phased out.

Landowners wating to carry out a controlled burn must obtain the necessary permits from the City of Cape Town. Burns are only permitted on days with a low fire danger rating and typically occur between March and mid-April. Prior to conducting a burn, neighbours are required to notify local fire and rescue services. Additionally, should burns be required in close proximity to the airport, neighbours will also inform airport management.

Firebreaks

The western (landside) section of the landscaping plan features fynbos and renosterveld vegetation planted in well-defined blocks, as outlined in Figure 5. These blocks should be treated as individual management units for prescribed burning. Existing roads and pathways between the blocks can act as natural firebreaks. In areas without defined planting blocks, strategic firebreaks must be created by brush-cutting vegetation within each designated burn unit. In all cases, a firebreak—either existing or created through brush cutting—must be established around the perimeter of the designated burn unit before conducting a prescribed burn. This ensures containment and enhances safety during the burn operation.

Standard Operating Procedures

For large, controlled burns on and off site that may affect visibility and disrupt aviation activities, a Standard Operating Procedure (SOP) will need to be developed to ensure effective coordination between aviation operations and airport management teams. This SOP will establish protocols for managing potential risks to visual aviation, outlining clear communication channels between fire management teams, air traffic control, and airport authorities. Developing this SOP will be critical to minimize disruptions to aviation while maintaining safe and effective fire management practices.

High Botanical Sensitivity Arras

Once all alien invasive vegetation has been removed from the conservation areas (as per the Alien Vegetation Management Plan outlined for the site) (Figure 6 - Figure 8) all these areas must be subject to planned (controlled) burn regimes starting the following autumn, as this vegetation needs fire for optimal ecological functioning. The Very High sensitivity areas are the priority areas for ecological burns, which must be undertaken in the period

February – March. Burns should be professionally managed. The botanically sensitive areas will need to be burnt every 8-12 years for optimum ecological functioning.

Prior to the controlled burn firebreaks should be brushcut by hand around the perimeter of the sensitive areas (not within them) using handheld brushcutters.

The condition of all Very High, High and Medium sensitivity areas (Agricultural Precinct and on site) should be monitored every year by a suitably competent botanist (or CoCT Environmental Management Dept.), and they should make recommendations for any management changes or actions (alien clearing, lack of fire, etc.) that are needed in order to achieve optimal ecological functioning in these areas.

Pre-Development Burn

According to the botanical scoping report the majority of the indigenous vegetation on the site is overdue for a burn. To reduce potential fire hazards during the development phase, it is recommended that a controlled burn be conducted prior to the onset of construction.

3.3.2. Alien Vegetation Management

Managing invasive alien vegetation assists in reducing fire risk and preserving the ecological health of natural habitats. Alien species, such as pines and wattles, typically produce more biomass than indigenous fynbos, resulting in denser vegetation that increases fire intensity. Additionally, alien plants can disrupt the natural fire regime, negatively impacting the ecological integrity and biodiversity of native vegetation. To protect these ecosystems, alien vegetation must be continuously removed, following the guidelines outlined in the Alien Invasive Vegetation Management Plan for the site (Annexure 6 to the overall EMPr)

3.4. General Prevention Measures

In addition to the measures mentioned above the following general fire safety practices should be implemented onsite to prevent veldfires from occurring:

- Restrict or regulate outdoor activities that could pose a fire risk, such as smoking or using open flames, to designated areas that are well away from flammable materials and high-risk zones.
- Regularly inspect and maintain ground support equipment and machinery to ensure they are in good working condition and free from faults that could cause sparks or heat.
- Implement strict protocols for the use of equipment that generates heat or sparks, such as grinding or welding tools. Ensure these activities are carried out in designated, fire-safe areas.

- Ensure that fuel storage areas are properly managed, with clear guidelines for safe storage, handling, and disposal of flammable materials.
- Implement a hot work permit system for activities that involve welding, cutting, or other tasks that produce sparks or heat. Ensure these activities are only conducted under controlled conditions.
- Conduct regular patrols of the airport grounds to monitor for potential fire hazards and ensure compliance with fire safety protocols.
- At the onset of the fire season cut long grasses and dense shrubs and remove all dead material.
- Keep gutter free of leaf litter and other combustible materials.
- Trim branches away from power lines and telephone lines

SECTION 4: FIRE PREPAREDNESS

The objective of fire preparedness is to ensure that the airport is equipped to facilitate fast and effective response to any fire incident that may occur on-site or pose a threat to the facility and its operations. The level of preparedness should be based on the daily Fire Danger Rating. Firefighting personal must use Table 1 to understand veldfire behavior and veldfire control actions required for each fire danger rating class. Nevertheless, basic preparedness should be maintained throughout the fire season, irrespective of the Fire Danger Rating.

4.1. Fire Protection Association

Chapter 2 of the National Veld and Forest Fire Act (Act No. 101 of 1998) provides for the establishment of Fire Protection Associations (FPAs) by landowners to predict, prevent, manage, and extinguish veldfires. FPAs are voluntary associations formed by landowners in wildfire-prone areas, but membership is mandatory for municipalities and state landowners within the FPA's jurisdiction.

FPAs support landowners in fulfilling their responsibilities under the Act by offering compliance advice, coordinating fire management plans, distributing the daily fire danger rating to all members during wildfire season, facilitating shared fire breaks, and providing training opportunities. They also serve as a platform for coordinating efforts and sharing resources during large wildfire incidents.

The Cape Peninsula Fire Protection Association (CPFPA), established in 2003, covers the entire Cape Metropolitan area, including the proposed CWA development site. The CWA should become a member of the CPFPA, which is divided into three management wards: the West Ward (Peninsula), the East Ward (Cape Flats, Somerset West, Steenbras), and the North Ward (Durbanville, Klipheuwel, Philadelphia, Atlantis, Mamre). The CWA site is located in the North Ward.

4.2. Firebreaks

Establishing and maintaining effective and permanent firebreaks is essential for controlling veldfires, as they provide critical access points for fire response teams, create safe zones for firefighting efforts, and help prevent the spread of fire. Firebreaks are required to comply with Section 21(1) of the National Veld and Forest Fires Act (No. 101 of 1998), which mandates that every landowner must prepare and maintain a firebreak on their side of the boundary between their land and any adjoining land where a veldfire may start, burn, or spread.

To optimize firebreak effectiveness and site accessibility, the layout of firebreaks should be linked to access roads. This approach minimizes the areas needing preparation while ensuring comprehensive access throughout the development site. Firebreaks are required around the entire property perimeter. At the proposed development site, an internal road will be constructed along the airport precinct's perimeter and will be managed and maintained as a firebreak (Figure 9). This road and firebreak will be carefully designed to avoid all botanically sensitive areas. Additionally, internal roads within the airport precinct should be designed to function as defensible spaces in the event of a fire, with road verges regularly cleared of flammable vegetation. Firebreaks must also be established along the property boundaries within the agricultural precinct, as mandated by the National Veld and Forest Fire Act (No. 101 of 1998). The landscape plan indicates the position of roads that should double as firebreaks (Figure 9). Please note, when conducting prescribed burns, it is essential to establish additional strategic firebreaks, as detailed in Section 3.3.1, to ensure safety.

4.2.1. Firebreak creation and maintenance

All firebreaks established onsite must meet the following requirements:

- With due regard to the weather, climate, terrain and vegetation of the area, firebreaks must be wide and long enough to have a reasonable chance of preventing a veldfire from spreading to or from neighbouring land. A width of 15m, inclusive of the road, is recommended as a guide.
- The establishment and operation of firebreaks must not cause soil erosion. Firebreaks must be cut by means of a bossiekapper or handheld brush cutters in sensitive areas. No burning may be used to establish fire breaks.
- Firebreaks must be maintained reasonably free of flammable plants and fuels, as well as bushy and tall vegetation and trees capable of carrying a veldfire across it. The height of the vegetation within the firebreak must be kept as low as possible.

- Firebreaks must be established and maintained on an annual basis, with the initial establishment occurring prior to the onset of the fire season in early October.
- All required onsite firebreaks must be monitored monthly during the fire season.
- All material removed from the firebreaks must be cleared from the site to prevent it from becoming a fire hazard.
- Firebreaks should not be designed with sharp angles. Where roads serve as firebreaks, the adjacent vegetation must be managed to ensure smooth, continuous lines without abrupt changes in direction.
- Firebreaks should not be established in areas identified as having high ecological sensitivity (e.g. wetlands or areas of botanical significance). Instead, wherever possible, firebreaks should be strategically placed in locations already planned for disturbance, such as along roads or other planned infrastructure. This approach minimizes environmental impact while maintaining the effectiveness of the firebreaks.

These guidelines ensure that firebreaks serve as an effective tool for fire prevention and control, reducing the risk of wildfires spreading across property boundaries and threatening the airport precinct.

4.3. Equipment, facilities & staff

4.3.1. Aircraft rescue and firefighting (ARFF) services

A dedicated firefighting team will be appointed and maintained onsite at all times. For veldfire management, this team should comprise at least 9 firefighters and 1 crew leader. However, additional team members may be required depending on the specific needs of Aircraft Rescue and Firefighting (ARFF) services. The size and composition of the team should align with both veldfire risks and airport operational demands. All appointed firefighters must be appropriately qualified with recognized accreditations. All site operatives must receive training in awareness of the issues of fires, litter, and contaminants and all any staff involved in high fire-risk activities, such as hot work or refueling, must undergo relevant firefighting training to ensure preparedness and safety

The ARFF services will be located directly East of the air traffic control tower, close to the middle of the runway and complies with the ICAO requirements considering the response times of two minutes and not exceeding three minutes, to any point of the operational runway and any other part of the movement area.

4.3.2. Equipment

In accordance with the National Veld and Forest Fires Act equipment, protective clothing and trained personnel must be available on the site to fight and extinguish any fires. The following minimum equipment and tools must be kept on site, at all times:

Hand tools:

- Fire beaters
- Spades
- Rake hoes
- Fire extinguishers (not to be used in natural areas & PFC's should not be used)

Water related:

- 15l Backpack sprayers
- Potable water tanks (mounted on vehicles) ("Bakkie Sakkie" with a minimum of 500l water tank capacity)
- Trailer pump (>1000l)
- Designated fire response vehicles fully equipped with firefighting equipment
- Fire water tanks with access hydrants and pumps

PPE (Personal Protective equipment):

- Fire resistant jacket, pants, gloves
- Flash resistant hoods
- Cotton overalls and t-shirts
- Leather boots
- Goggles
- Breathing masks
- Hard hats

Other equipment:

- Spotlights, and headlamps (minimum of 1 per fire fighter)
- Bolt cutters
- First aid kit with burn shields (minimum 1 per fire fighter)
- Two-way radio's / Cell Phones

The quantity of required firefighting equipment depends on both the size of the property and the number of designated firefighters available. The CPFPA has established minimum standards for equipment, personnel, and protective clothing, as detailed in Tables 3 and 4 below. For properties of this size (101-1000 ha), the maximum thresholds outlined in these tables apply. It's important to note that these requirements are considered the minimum baseline requirements for veldfire management and additional resources may be necessary to ensure adequate fire preparedness and safety.

Table 3: CPFPA Minimum Equipment Requirements

Property Size in Ha.	Fire Beaters	15l rucksack pumps	Rake Hoes	First Aid kit	Cell Phones	Trailer pump, >1000l	Bakkie sakkie fast reaction units – 500l capacity	Compliance	
								YES	NO
1-10 Ha	3	2	3	1	1	-	-		
11-100 Ha	5	4	5	1	1	-	-		
101-1000 Ha	10	5	10	1	1	1	1		

Table 4: CWA Minimum Personnel and Protective Equipment Requirements

Size in Ha.	Fire fighters	Crew leader	Fire Boss	Fire protective clothing (= number of personnel)					Compliance	
				Cotton overalls	Cotton t-shirts	Leather boots	Flashood/Scarf & Goggles	Pair of gloves	YES	NO
1-10 Ha	2	1	-	3	3	3	3	3		
11-100 Ha	4	1	-	5	5	5	5	5		
101-1000 Ha	9	1	-	10	10	10	10	10		

All firefighting equipment must be serviced according to the manufacturer's instructions and no less frequently than the manufacturer's statutory requirements (annually). Firefighting vehicles must be maintained in optimal working condition with regular servicing. Fire extinguishers must be serviced at least once a year. An inspection register for all firefighting equipment must be maintained. Any defects or damages to vehicles or equipment must be reported immediately to the relevant manager.

Equipment should be positioned in readily accessible and clearly visible locations. Only trained employees are authorized to use firefighting equipment. In the case of any welding, grinding or other "hot work" being undertaken onsite, a fire extinguisher is to be readily available to extinguish any fire that may result from these activities. All heavy machinery used onsite should carry fire extinguishers, and all staff should be able to use them if required.

SECTION 5: FIRE RESPONSE

A well-planned and coordinated fire response is crucial. The goal of an effective fire response is to rapidly identify and implement strategies that contain and extinguish fires, minimize environmental impact, and ensure clear communication among all involved authorities throughout the process. Fire Response must be based on the potential threat not the immediate size of the veldfire.

5.1. Communication during a veldfire

Effective communication is essential for efficient response to veldfires. To minimize risk, damage, and costs, it's crucial to establish clear lines of authority and communication from the outset. Every veldfire operation must designate a Fire Chief, who commands the overall firefighting effort, and a Crew Leader, who oversees a team of up to 15 firefighters. For smaller fires, one person may fulfill both roles. Reliable communication tools, such as two-way radios, are necessary to ensure seamless coordination among all crew members involved in firefighting operations.

In all veldfire situations, the Fire Chief must maintain clear and ongoing communication with airport operators and key stakeholders, such as neighboring properties and municipal firefighting teams. This includes providing timely and accurate updates on the fire's location, size, and intensity. Such information is essential for airport operators to make informed decisions regarding the safety of operations, while also allowing other stakeholders to assess and implement any necessary management actions to protect their assets and interests.

Standard Operating Procedures

For large, veldfires on and off site that may affect visibility and disrupt aviation activities, a Standard Operating Procedure (SOP) will need to be developed in association FPA to ensure effective coordination between aviation operations and airport management teams. This SOP will establish protocols for managing potential risks to visual aviation, outlining clear communication channels between fire management teams, air traffic control, and airport authorities. Developing this SOP will be critical to minimize disruptions to aviation while maintaining safe and effective fire management practices.

5.2. Keeping the fire small

A rapid response significantly increases the chances of quickly containing and extinguishing a fire. To ensure this, it is essential to have effective systems in place for fire detection and reporting:

- Fire Spotting: During working hours, CWA ground staff, the control tower, and airport tenants are responsible for monitoring and reporting fires within airport bushland or approaching airport land. Outside of these hours, airport management will depend on remaining onsite staff, such as security personnel, and neighbouring communities for fire detection. To enhance fire detection and response, it is recommended to engage neighbouring communities in understanding the importance of timely fire reporting. Additionally, ensure that essential firefighting contact information is broadly disseminated to nearby landowners and adjacent communities.

- Reporting a fire: Fires originating onsite must immediately be reported to the designated firefighting unit stationed at the airport as well as the Cape Peninsula Fire Protection Association. All onsite and offsite fires must also be reported to the City of Cape Town Fire & Rescue Services Control Room: 021 590 1900, alternatively: 107 (from a landline) or 021 480 7700 (from a cell phone). The onsite firefighting unit must have a designated and publicly available contact number.

5.3. Response procedures

Once an onsite fire is reported to the onsite firefighting personal the appropriate response plan must be enabled as below:

1. Initial Response

1. Dispatch Firefighting Team: Upon receiving a report of a wildfire on airport property, the on-duty Fire Chief must immediately dispatch a firefighting team to the location. The dispatched team should be equipped with all necessary firefighting equipment and PPE.

2. On-Site Assessment and Action Plan

1. Assessment: Upon arrival, the designated Crew Leader will conduct an assessment of the wildfire's size, intensity, and potential threat.
2. Develop Action Plan: In consultation with the Fire Chief, the Crew Leader will formulate an appropriate action plan to effectively extinguish the wildfire. The method used to bring fires under control should be based on the daily Fire Danger Rating. Firefighting personnel must use Table 1 to understand veldfire behaviour and veldfire control actions required for each fire danger rating class.

3. Communication with Affected Parties

1. Inform Stakeholders: Depending on the level of threat, promptly notify all affected parties, including City Fire & Rescue Services, CPFPA, adjacent landowners, airport operators and other relevant stakeholders regarding the level of reaction required

4. Control and Coordination

1. Report Control Status: The Crew Leader must inform the Fire Chief once control of the wildfire has been established and when firefighting resources are being withdrawn from the site.
2. Joint Operations (if needed): If the wildfire is large or severe, coordinate joint operations with the City Fire & Rescue Services or the CPFPA to ensure a unified and effective response.

5. Post-Control Actions

1. Mopping Up: After final control has been established, continue mopping up the area to prevent re-ignition. This process will continue until the Fire Chief confirms that the wildfire is fully extinguished.

SECTION 6: FIRE RECOVERY

Recovery is the process of returning the affected area back to normal after the impact of a fire. The objectives of fire recovery include recording information about the fire and review and updating response and management plans as relevant.

6.1. Immediate recovery

After a veldfire has been brought under control, patrolling and inspections should continue until the Fire Chief is satisfied that the veldfire has been extinguished. Once a veldfire has been extinguished, all equipment should be returned to the correct storage facilities and inspected. Equipment must be cleaned, repaired if needed and prepared for future use.

6.2. Debriefing

After major veldfires, a formal debriefing should be conducted with all relevant agencies and parties involved in the firefighting effort. This debriefing is essential for discussing lessons learned, identifying necessary changes, and improving the response plan's efficiency. To ensure its effectiveness, the debriefing should be scheduled as soon as possible after the event. At this debriefing, the cause of the veldfire should be identified and discussed as this will assist with improved future management.

6.3. Recording the fire

Maintaining comprehensive records of fire extent and impact is crucial for effective fire prevention and bushland management. Furthermore, in accordance with the Veldfire Act, all veldfire incidents occurring on-site must be documented and reported to the relevant Fire Protection Association (see Section 4.1)

These records should include:

- The mapped spatial extent of the area burnt.
- An estimate of the percentage of the vegetation that remained unburnt within the area recorded. Veldfires often burn unevenly, leaving patches or "islands" of unburnt vegetation behind.

- Estimated fire intensity (high, moderate or low), based on the efficiency of fuel consumption in the burnt areas
- Fire origin/cause
- Date and time of the incident
- Method of fire reporting
- Fire Danger Index and weather conditions at the time
- Effectiveness of preparedness measures
- Fire response actions taken and required rehabilitation efforts

An example of a fire report template is provided in Appendix A.

6.4. Post fire fauna and flora management

Post fire rehabilitation requirements will be dependent on a number of factors such as the habitat/vegetation type impacted, the size of the fire, the intensity of the fire, the time of year and the success of natural post-fire regeneration. Alien invasive plant species, which often proliferate from existing seedbanks after a fire, may pose a significant challenge. To address this, monthly monitoring of the burnt area and prompt removal any emerging seedlings should be implemented post fire as outlined in the Alien Invasive Plant Management Plan – Annexure 6 to the overall EMPr.

SECTION 7: MONITORING AND COMPLIANCE

7.1. Monitoring

The implementation of this Veldfire Management Plan (VFMP) falls under the responsibility of the CWA Firefighting Unit. It is critical that all management actions outlined in the plan are strictly adhered to. Regular and thorough monitoring is essential to ensure compliance with VFMP specifications, identify any issues of non-conformance, and implement corrective actions to minimize fire risks and prevent environmental damage.

Monitoring activities should be carried out monthly by the appointed Fire Chief, ensuring that all aspects of the plan are effectively applied. The results from these checks must be documented and reported to the ECO appointed to the site.

Detailed records of all fire incidents, controlled burns, and relevant interventions must be meticulously maintained. These records should be submitted to the CWA Environmental Management Division on a monthly basis. To evaluate the effectiveness of the VFMP, the results will be analysed to develop key performance indicators (KPIs). It

will be the responsibility of the Fire Chief to develop best practices based on these KPIs, ensuring continuous improvement across CWA veldfire management operations.

7.3. Review of the Veldfire Management Plan

The VFMP will be reviewed by the appointed Fire Chief on an ongoing basis. Based on observations during site inspections and issues raised during team meetings, the Fire Chief in collaboration with the CWA Environmental Management Division and appointed ECO will determine whether any procedures require adjustment to enhance the plan's efficiency and applicability. The VFMP must be updated should any significant changes to operations be required. Updates must be guided and supported by a qualified environmental professional to ensure adherence to environmental and ecological best practices. All updates should be appended as an annexure to this document and must be distributed to all relevant stakeholders on site. This ensures that everyone involved is informed of the latest changes and can implement them accordingly to maintain compliance and operational efficiency.

7.4. Environmental Monitoring and Audits

Throughout the construction phase, monthly ECO reports must be compiled and submitted to DEADP. Throughout the operational phase, monthly ECO reports must be compiled and submitted to the site's EM.

During the construction phase a qualified Environmental Auditor, appointed at the Applicant's expense, must conduct six-monthly compliance audits of the EMPs in place for the site, including the VFMP. Once the project transitions fully to the operational phase, annual compliance audits of the same EMP suite, including the VFMP, must be undertaken. Internal audits should be undertaken on a regular basis as determined and managed by the site's EM.

The audit should aim to:

1. Assess compliance with the key components of the EMPrs.
2. Identify critical areas requiring attention.
3. Recommend priority actions for improvement.

The audit must cover a range of issues, including the implementation of environmental controls, environmental management practices, and environmental monitoring.

Audit findings should guide any necessary updates or additions to the EMPrs to address new or unresolved environmental issues on site. National, provincial, and local authorities must be provided access to the facility for audit or inspection upon request.

7.5. Record Keeping

The Applicant should keep records of the following:

- Monthly monitoring reports submitted by the onsite Fire Chief / Fire Control Officer
- 6-monthly audit reports
- Annual audit reports
- Reviews and amendments of the VFMP
- Incident reports for all fire related incidents that occur onsite

Records should be kept and must be made available for review on request, based on adequate motivation.

APPENDIX A: FIRE REPORT TEMPLATE

Fire Report

Name:	**File reference number:**
Date & time of Fire:	**FDI on date of Fire:**
Reporting method:	**Weather on date of Fire:**

Section 1: Description of the fire (Location, time taken to control, fire intensity (high, medium or low) based on the efficiency of fuel consumption in burnt areas, effectiveness of preparedness measures)

Section 2: Response actions taken and remedial action required

Section 3: Mapped spatial extent of the area burnt & percentage of area burnt

Section 4: Steps to prevent recurrence

Section 5: Signatures

Fire Chief:	Date: .....
ECO:	Date: .....
Applicant:	Date: .....

ANNEXURE 6: ALIEN VEGETATION MANAGEMENT PLAN

DEA&DP IN-PROCESS NR: 16/3/3/2/A5/20/2046/24

ALIEN VEGETATION MANAGEMENT PLAN FOR THE PROPOSED EXPANSION OF THE CAPE WINELANDS AIRPORT

(P10 OF FARM 724, RE OF FARM 724, P23 OF FARM 724, P7 OF FARM 942, RE OF FARM 474, P3 OF FARM 474 AND P4 OF FARM 474)

JULY 2025

COVER IMAGE NOT REPRESENTATIVE OF THE PROJECT SITE
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PREPARED FOR
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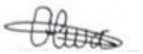
AUTHOR	Olivia Brunings	2023/6743 (Candidate)		03/07/2025
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PLEASE NOTE THAT ALL CHANGES FROM THE DRAFT REPORT FOR COMMENT VERSION 1 ARE UNDERLINED IN BLACK. GENERAL TEXT CHANGES ARE NOT UNDERLINED

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KEY TERMS AND ABBREVIATIONS

Alien Vegetation Control Officer (ACO) – A suitably qualified team leader responsible responsible for managing the Alien Vegetation Management Unit and monitoring their progress.

Alien Vegetation Management Plan (AVMP) - A strategic framework designed to control, manage, and reduce the impact of alien and invasive plant species in a specific area

Alien Vegetation Management Unit – A dedicated team stationed permanently at CWA responsible for implementing and maintaining the Alien Vegetation Management Plan. This team ensures effective control and management of invasive species, aligning all activities with the plan's requirements.

Applicant – Capewinelands Aero (Pty) Ltd. The Applicant who is the landowner, person in control of the land, developer and operator of the airport will be responsible for the overall implementation of the AVMP.

Auditing - A systematic and objective assessment of an organization's activities and services conducted and documented on a periodic basis to a predetermined standard.

CWA – Cape Winelands Airport

Department of Environmental Affairs and Development Planning (DEA&DP)– the provincial authority for sustainable environmental management and integrated development planning.

Environmental Auditor – An independent EAP appointed to conduct an audit of the environmental management systems in place for an organization or development.

Environmental Manager (EM) – Head of the CWA Environmental Management Division. The EM will oversee all aspects of the Environmental Management on site. The Environment Manager is responsible for ensuring that the organization meets its environmental policy commitments and improves its environmental performance.

Environmental Management Division (EMD) – Designated entity for overseeing and ensuring environmental compliance throughout the construction and operation of CWA.

Environmental Management Programme (EMPr) an environmental management tool used to ensure that undue or reasonably avoidable adverse impacts of the construction, operation, and decommissioning of a project are managed, and that positive benefit of the projects are enhanced.

Environmental Control Officer (ECO) – a suitably qualified environmental consultant to be appointed by the Applicant to oversee the implementation of the suite of Environmental Management Plans complied for the site, inclusive of this Alien Vegetation Management Plan.

IAP – Invasive Alien Plants

Management Unit – A specific, clearly defined area of land designated for alien and invasive vegetation management according to a pre-determined schedule.

National Environmental Management Act (Act 107 of 1998, as amended) (NEMA)– national legislation that provides principles for decision-making on matters that affect the environment.

Site - Area where the proposed development will take place

SECTION 1: CONTEXTUAL INFORMATION

1.1. Project Background

Overview of the proposed development:

The Cape Winelands Airport (CWA), historically known as Fisantekraal Airfield (FAFK), is located approximately 10.5 km northeast of Durbanville and 25 km northeast of Cape Town International Airport (CTIA) (see Figure 1). Initially constructed around 1943 as a South African Air Force aerodrome during World War II, CWA has since transitioned into a general aviation (GA) airfield. The current 150-hectare site includes four concrete runways, each 90 meters wide and varying in length between 700 meters and 1,500 meters. The facility supports various unscheduled operations such as recreational flying, flight training, aircraft maintenance, charter operations, crop spraying, and aerial banner towing.

The proposed development will expand the existing airport facilities, encompassing five additional cadastral portions (see Figure 2), creating a combined area of 885 hectares. Of this area, 470 hectares will be allocated for airport development, including an airside precinct, terminal precinct, services precinct, general aviation precinct and associated landscaping (see Figure 4). The remaining land will remain as agricultural zones, designated as an agricultural precinct (Figure 4). This agricultural precinct will feature a combination of dryland agriculture, conservation of botanically sensitive areas, and wetland offsets.

Alien vegetation management:

Invasive alien plants pose a significant environmental challenge in South Africa, affecting nearly 10 million hectares of land (8.28% of the country). These species, introduced from regions such as Australia, the Americas, Europe, and Asia, were originally brought for various purposes—ranging from commercial use to ornamental planting and dune stabilization. Others have been introduced accidentally. Invasive alien vegetation outcompetes native plants, reduces biodiversity, adds to the fuel load increasing the fire frequency and intensity, transforms the riparian zones, affects the functioning of aquatic ecosystems by altering water quality and flow, and unnaturally supports an increase in some fauna.

The proposed Cape Winelands Airport (CWA) development site is notably impacted by invasive species such as *Acacia saligna* (Port Jackson), *Pinus* species (pines), and *Eucalyptus* species (gums) among others. While initial efforts to clear invasive vegetation from the original CWA site began in 2020 along with the development of an Alien Invasive Management Plan (AIMP), the redevelopment and expansion of the CWA

necessitates an updated and comprehensive plan to address the broader site area. The current Alien Vegetation Management Plan (AVMP) has been developed to cover the entire CWA. This AVMP integrates the existing AIMP (October 2022) and will replace it, ensuring a unified approach to vegetation management across the expanded area.

Landowners are under a legal obligation to control invading alien plants occurring on their properties. This Alien Vegetation Management Plan forms part of the overarching Environmental Management Programme (EMPr) for the expansion and operation of the proposed CWA and serves as a strategic framework for managing invasive alien species on the entire CWA property. It covers all phase of the process, from targeted, systematic removal to ongoing management and control. The plan also establishes long-term, structured approaches for continued management and monitoring, ensuring the ecological integrity of the site both during and after the development process.

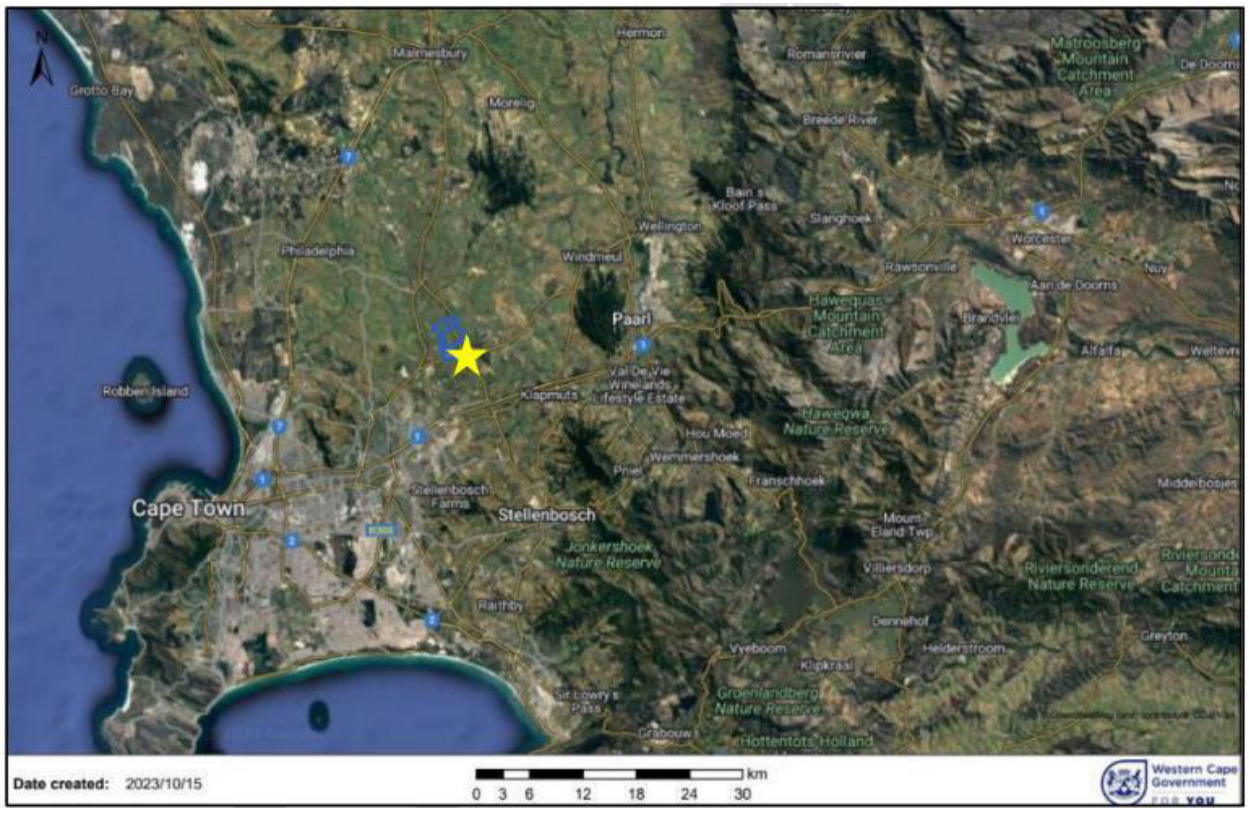


Figure 1: Regional location of CWA (indicated by yellow star and with cadastrals outlined in blue) (PHS Consulting, Oct 2023)

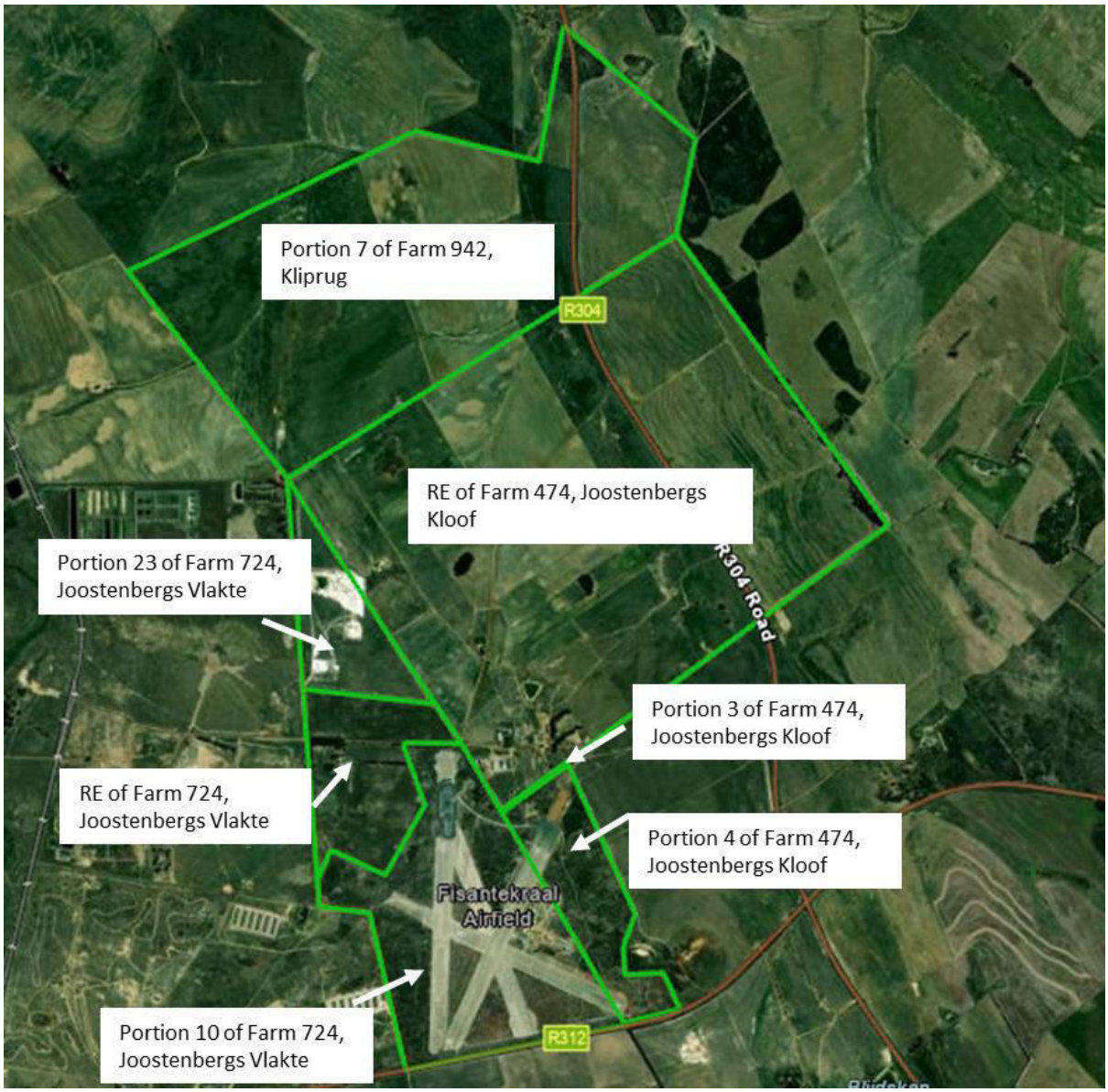


Figure 2: Cadastrals forming part of application area

Figure 3: Phase 1 preferred SDP - Precinct Plan (Capex, August 2024)

Figure 4: Phase 2 preferred SDP - Precinct Plan (Capex, January 2025)

1.2. Purpose of the Alien Vegetation Management Plan

The purpose of this Alien Vegetation Management Plan is to outline a comprehensive strategy for the complete eradication of alien invasive plants and the long-term maintenance of the site in an alien-free condition. This plan aims to ensure compliance with airport safety standards, restore ecological functioning, and improve habitat quality, particularly in areas of botanical sensitivity and ecological importance.

To achieve these goals, the plan focuses on meeting the following objectives:

- Identify and confirm areas for alien vegetation clearing.
- Establish methods for effective alien clearing, including necessary follow-up actions.
- Provide a realistic program with clear targets for the clearing process.
- Promote the conservation of indigenous plant species within the property.
- Support job creation and skills development in local communities.
- Ensure the sustainable reuse of cleared biomass to maximize environmental benefits.

1.3. Management Strategy

The Alien Vegetation Management Strategy is designed to ensure a structured, continuous, and effective approach to eradicating and managing invasive alien plants on the site. The strategy focuses on phased clearing, proper resource allocation, and collaboration between the in-house team and contractors during construction.

Before initiating the clearing of any section, it is essential to recognize that once the program begins, it must be carried through to completion. Ad hoc clearing without a structured follow-up plan is ineffective and provides little value. To achieve the desired outcomes, the program must be implemented in a phased, systematic manner, as detailed in this document. This approach ensures long-term success and sustainable management of the cleared areas.

1. Appointment of Alien Clearing Team

A trained and experienced team is essential to the success of follow-up efforts. The applicant must appoint an experienced in-house alien clearing team. This team should ideally be sourced from the local community and be knowledgeable in alien clearing techniques. Where necessary, training must be provided to ensure all workers can

perform their duties effectively. The size of the team should be aligned with the scale of the site and the extent of the infestation. The team must include:

- At least one qualified supervisor with demonstrated experience in alien vegetation management. The supervisor will be responsible for managing the team and monitoring their progress and will be known as the Alien Vegetation Control Officer (ACO).
- Trained team members: All team members must undergo training upon appointment to ensure they are familiar with both the alien clearing methods and the specifics of this management plan. The following roles will need to be fulfilled:
    - Chainsaw operators for felling and cutting of invasive vegetation.
    - Herbicide applicators (where necessary) to ensure effective treatment of regrowth.
    - General workers to assist with various tasks.

The team should be fully briefed on the specific needs of the site, including any sensitive areas that require special attention or avoidance, the targets and schedule for follow-up events, and the immediate priority zones where urgent clearing is necessary.

2. Construction Phase: Contractor Responsibilities

   Once construction begins, contractors will be responsible for alien vegetation management within their assigned work areas. The following guidelines apply:

   - Contractors must actively remove alien plants throughout all construction activities to prevent their spread within work zones. Hand-pulling seedlings is the most effective method for removal. Following initial clearing efforts, it is advisable for contractors to allocate a few minutes weekly for their teams to engage in hand-pulling seedlings, thereby maintaining control over emerging invasive plants.
   - Construction activities disrupt soil and vegetation, increasing the risk of alien plant establishment. Therefore, clearing efforts must prioritize areas experiencing disturbance, such as excavated or cleared zones, to prevent the rapid spread of alien species in these high-risk areas.
   - The requirement for alien vegetation management must be included in the tendering process to ensure that contractors allocate the necessary resources.

- Contractors must be supervised by the ECO to ensure compliance with the ongoing alien vegetation management during construction.

3. Construction Phase: In-House Alien Clearing Team

   Once construction in the airside precinct commences, the in-house team should concentrate primarily on this extensive area, ensuring it remains free of alien vegetation. Before this phase begins, the team can assist in other areas as required, depending on available capacity and specific requests from contractors.

4. Post-construction Phase: In-house Alien Clearing Team Responsibility

   Once construction is completed in a given area and handed over by the contractors, the in-house team will assume full responsibility for managing alien vegetation. This includes ongoing follow-up activities throughout the operational phase of the development. As the project advances, the in-house team must establish management units across the property and develop a clearing schedule to monitor initial clearing and follow-up efforts, ensuring alignment with the requirements of the management plan.

1.4. Relevant legislation and policies

The following is a list of the principal legislation for alien invasive vegetation management as relevant to the proposed development. All activities on site must ensure compliance with the provisions of the legislation as applicable:

- Conservation of Agricultural Resources Act (Act No. 43 of 1983)
- National Environmental Management Act, 107 of 1998
- National Environmental Management: Biodiversity Act, 2004 (Act No.10 of 2004)
- National Environmental Management: Biodiversity Act, 2004 (Act No. 10 Of 2004): Alien and Invasive Species Lists, 2020 (GN1003 of September 2020)
- National Environmental Management: Biodiversity Act, 2004 (Act No. 10 Of 2004) Alien and Invasive Species Regulations (GN R1020 of September 2020)
- Fertilizer, Farm Feeds, Agricultural Remedies and Stock Remedies Act (Act No. 36 of 1947)
- National Water Act, Act 36 of 1998
- Section 31A of the Environment Conservation Act, 73 of 1989;
- Municipal by-laws and the National Veld and Forest Fire Act 101 of 1989
- Occupational Health and Safety Act (No. 85 of 1993)
- Basic Conditions of Employment Act 75 of 1997

Landowners are under legal obligation to control invading alien plants occurring on their properties by removing any listed invasive species. A listed invasive species means any species, which is listed in terms of section 70 of the National Environmental Management Biodiversity Act (NEMBA), whose establishment and spread occurs outside of its natural distribution range. In accordance with Section 70 of NEMBA Alien and Invasive Species lists have been published in Government Notice GN1003 of September 2020. All invasive species listed are classified into 4 categories to which specified regulations apply as detailed in GNR1020, in summary:

- Category 1a: These invasive species require compulsory control, and eradication is legally required. No permits are issued for these species.
- Category 1b: Invasive species requiring compulsory control as part of an invasive species control program. Remove and destroy. They have such high invasive potential that infestations may qualify for government-sponsored management. No permits are issued.
- Category 2: These species are regulated by area, requiring a demarcation permit to import, grow, possess, or trade. Category 2 plants are prohibited in riparian zones.
- Category 3: These species are regulated by activity, and individual permits are required for any restricted activities such as possession, sale, or cultivation. Like Category 2, Category 3 species are prohibited in riparian zones.

Species regulated under the Conservation of Agricultural Resources Act (CARA) (Act 43 of 1983), which are listed as weeds or invader plants, are exempt from NEMBA. In such cases, CARA's provisions take precedence over those of NEMBA.

1.5. Status of the Alien Vegetation Management Plan

The AVMP must form part of all contractual documents for this project. The Environmental Authorization ascribes legal status to this Management Plan and any subsequent amendments thereto. The approval of the Management Plan by DEA&DP will require that the applicant and all appointed contractors must comply with the requirements herein. Any amendments/ changes/ upgrades to the Management Plan will require submission to and approval by DEA&DP.

1.6. Responsible persons

1.6.1. Applicant

The Applicant will be responsible for the overall implementation of the AVMP. This includes ensuring adherence to all stipulations within the plan and appointing the necessary personnel to facilitate its complete execution. Furthermore, the Applicant must provide all principal contractors with a copy of the AVMP as part of the tender and contract documentation, allowing contractors to factor the plan's requirements into their respective construction contracts.

The Applicant also holds the overarching environmental responsibility to ensure that both construction and operational activities comply with relevant legislation. This entails a thorough understanding of the AVMP, any Environmental Authorizations, or other legally binding documentation associated with the project, to guarantee compliance at every stage.

1.6.2. CWA Environmental Management Division

The CWA Environmental Management Division (EMD) will be established at the start of the construction phase to ensure environmental compliance throughout the project. The CWA EMD will appoint an Environmental Manager (EM) to oversee all aspects of the Environmental Management on site. The Environment Manager is responsible for ensuring that the organization meets its environmental policy commitments and improves its environmental performance. Not only do they monitor performance against and ensure compliance with relevant laws and regulatory requirements, but they are also proactive in identifying and promoting opportunities to reduce the environmental impact of the organization’s activities, products and services.

Led by an Environmental Manager, the CWA EMD will consist of several teams for e.g. landscaping, waste management, alien species control, fire management etc. During the initial phases it could be one multitask team to be split as the tasks increases. Each team will have a Control Officer reporting directly to the EM. In the case of Alien Vegetation this would be the Alien Vegetation Control Officer. The Environmental Manager will oversee the implementation of Environmental Management Plans (EMPr), compliance with regulations, day-to-day environmental management of the site, managing the necessary applications, and overseeing external service providers such as the appointed Environmental Control Officer. Responsibilities also include internal audits and developing strategies for waste minimization and emissions reduction.

1.6.3. CWA Alien Vegetation Management Unit

The designated CWA Alien Vegetation Management Unit will be responsible for the overall implementation of the AVMP. Upon appointment, all team members must receive comprehensive training on the AVMP's requirements, with ongoing training provided to any newly appointed team members throughout the operational phase. It is the responsibility of the applicant to ensure that this training is conducted.

A designated Alien Vegetation Control Officer must be appointed within the EMD to lead the alien vegetation management and oversee the implementation of the AVMP. The alien vegetation control officer will assume overall responsibility for managing the AVMP, employees and contractors and ensure and oversee the implementation of the AVMP onsite in its entirety. All decisions regarding alien vegetation related environmental procedures and protocol must be approved by the alien vegetation control officer, who also has the authority to stop any activity in contravention of the AVMP. The role of is interactive and must include daily site visits.

Key Responsibilities of the Alein Vegetation Control Officer:

- Assume overall command of alien vegetation removal operations onsite.
- Provide training to all staff on AVMP requirements.
- Conduct regular monitoring of the site to identify high priority areas for clearing.
- Compile and submit monthly monitoring reports to the ECO.
- Work closely with the ECO, applicant, and contractors to resolve any alien vegetation related issues that arise.

1.6.4. The Environmental Control Officer (ECO)

The Environmental Control Officer (ECO) is responsible for overseeing and verifying the proper execution of the EMPr during the construction and operational phase. This includes ensuring that various contractors working on-site comply with the waste management plan within their designated areas. During the construction phase, an independent Environmental Assessment Practitioner (EAP) firm must be appointed to serve as the ECO who will work alongside the EM. Once the project transitions fully into the operational phase, this function can be managed by an in-house ECO within the CWA Environmental Management Division who will report to the EM. During the construction and operational phases, monthly ECO reports must be prepared and submitted to the Department of Environmental Affairs and Development Planning (DEADP) during construction and to the EM during operations.

1.6.5. The Competent Authority

DEA&DP will review the AVMP and on approval they may have the following role to play:

- Review and monitor implementation of the AVMP;
- Review whether there is compliance by the Applicant;
- Perform random control checks;
- Review incident and audit reports;
- Enforce legal mechanisms for contraventions of the AVMP.

1.6.6. Engineers and Contractors

The engineers and contractors, where applicable, are responsible for physically carrying out certain development and maintenance activities. The responsibilities indicated here are also relevant to sub-contractors.
The responsibilities of the engineers and contractors include but are not limited to the following:

- Be conversant with the AVMP, EMPr, any relevant Environmental Authorization or any other legally binding documentation;
- Have a responsibility to adhere to any conditions and recommendations laid out in above mentioned documentation;
- Prevent actions that may cause harm to the environment;
- Be responsible for any remedial activities in response to an environmental incident;
- Review and amend any construction activities to align with the AVMP, EMPr and Best Practice Principles;
- Ensure compliance of all site personnel and / or visitors to the AVMP, EMPr and any other authorisations.

SECTION 2: OVERVIEW OF SITE CONDITIONS

2.1. Regional Context

The proposed development site is situated within the West Coast Renosterveld bioregion, part of the Fynbos biome and the Core Region of the Greater Cape Floristic Region (GCFR). The GCFR is one of six global floristic regions, and notably, it is the only one primarily confined to a single country, South Africa. Despite covering just 0.2% of the world's land surface, the GCFR hosts approximately 11,500 plant species, half of South Africa's total plant diversity. The region is characterized by a high degree of endemism, with many species being found nowhere else. However, extensive habitat loss from agriculture, urbanization, and alien plant invasions has led to severe conservation

challenges. Around 67% of South Africa's threatened plant species are located in the southwestern Cape, making it a national and global conservation priority.

The West Coast Renosterveld bioregion is defined by high winter rainfall, fertile soils, low topographic diversity, large urban areas, intense agriculture and high levels if invasive vegetation. Due to this combination of factors, over 90% of the region's natural vegetation has been lost, resulting in one of the highest concentrations of threatened plant species globally. The lowland regions of the Cape metropole (stretching from Atlantis in the north, southeast to near Somerset West), generally known as the Cape Flats, is under enormous pressure in terms of its biological diversity. The study area lies just outside the northeastern fringes of what is normally considered the "Cape Flats".

2.2. Vegetation of the property

In order to plan for vegetation clearance, one needs to understand and record what types of vegetation occur in what areas on site. According to the South African Vegetation Map, three different vegetation types would have occurred in the study area before human disturbance (Figure 5).

Swartland Granite Renosterveld originally covered much of the site and is considered Endangered at both national (Government of South Africa, 2022) and regional levels (Holmes et al., 2008). Approximately 15% of the greater study area was historically Swartland Shale Renosterveld, which is classified as Critically Endangered on both national and regional scales. In the northern part of the site, Cape Flats Sand Fynbos, classified as Critically Endangered, was initially identified on the South African Vegetation Map. However, based on field verification, the remaining natural vegetation in this area has been identified as Swartland Silcrete Renosterveld, another Critically Endangered vegetation type (Nick Helme Botanical Surveys, Botanical Impact Assessment, September 2024).

2.2.1. Botanical Sensitivity

The Botanical Impact Assessment undertaken by Nick Helme revealed the following (Nick Helme Botanical Surveys, Botanical Impact Assessment, September 2024):

- About 93% of the site has been heavily disturbed and degraded over a long period of time, with the result that negligible indigenous vegetation is found in these areas, and these areas are of Low botanical sensitivity. Indigenous plant diversity is very low in the most disturbed parts of the airport precinct, and is low overall, compared to pristine Renosterveld, which would have at least 250 species in a site of this size (if pristine). There is no indigenous plant cover in the large, cultivated areas in the agricultural precinct.

- Approximately 7% of the site (about 6.5ha) is deemed to be of Medium, High or Very High botanical sensitivity (Figure 6 - Figure 8).
- Two patches of very high sensitivity, four patches of high sensitivity and eight patches of medium sensitivity have been mapped in the airport precinct (Figure 6 & Figure 7) and two patches of very high sensitivity and two patches of medium sensitivity have been mapped in the agricultural precinct (Figure 8).
- Ideally all areas of Medium, High or Very High botanical sensitivity should be conserved and ideally, they would also all be ecologically connected via rehabilitated Low sensitivity areas. From a botanical perspective most of these areas would be ecologically viable, especially if connected by ecological corridors. Key ecological management interventions required would be ongoing alien vegetation management (pre and post burn) and management burns in the appropriate autumn season (once every 8-12 years).

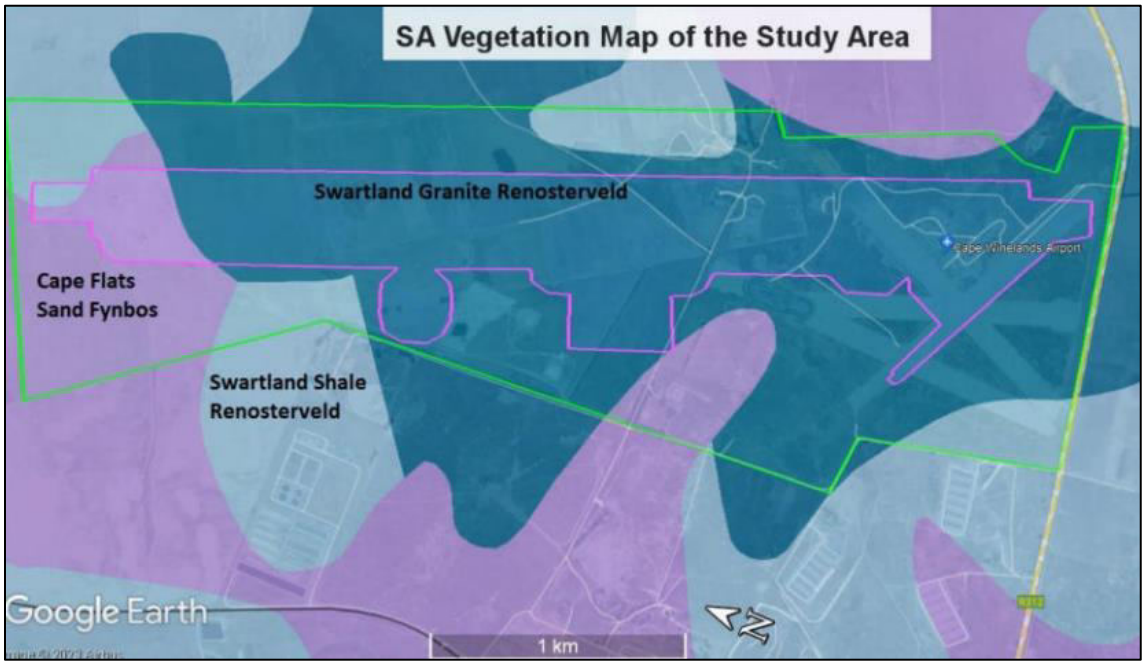


Figure 5: Extract of the SA Vegetation Map (Mucin & Rutherford 2012) showing that three different vegetation types would originally have occurred in the primary study area (excluding the Agricultural Precinct), with Swartland Granite Renosterveld making up the bulk of the site. The green polygon is the study area, and the pink polygon is the airside development footprint (Nick Helme Botanical Surveys, Impact Assessment, September 2024).

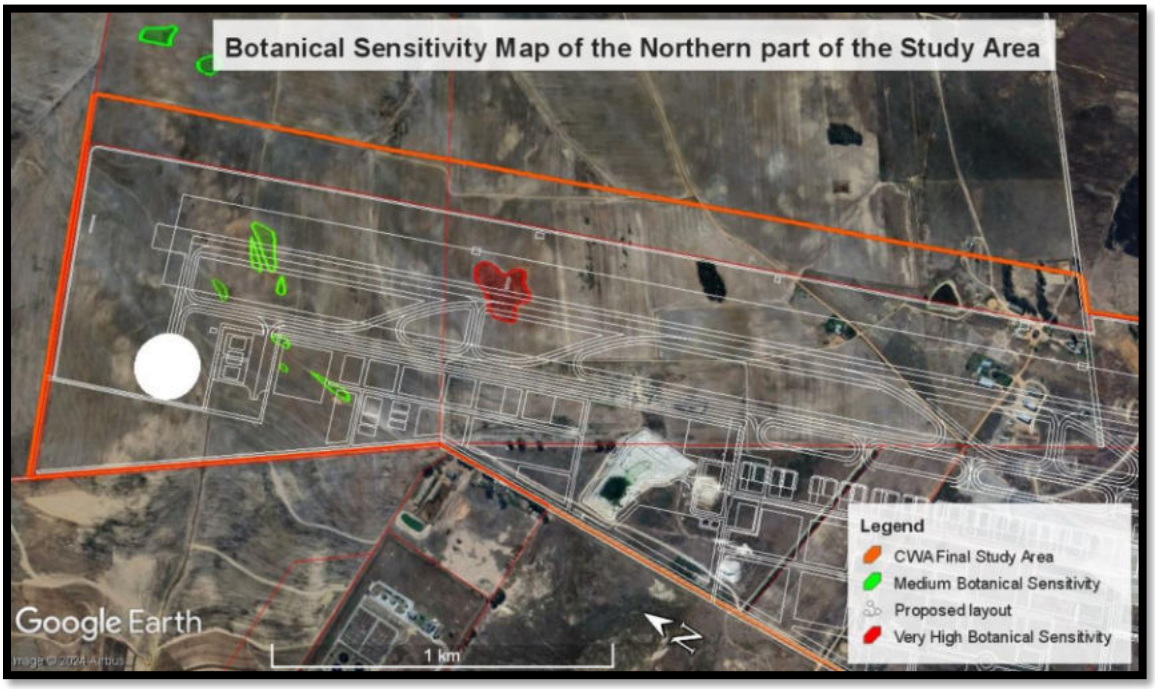


Figure 6: Botanical sensitivity map for the northern part of the airport precinct. All areas not shaded green or red within the study area are of Low botanical sensitivity (Nick Helme Botanical Surveys, Impact Assessment, September 2024).

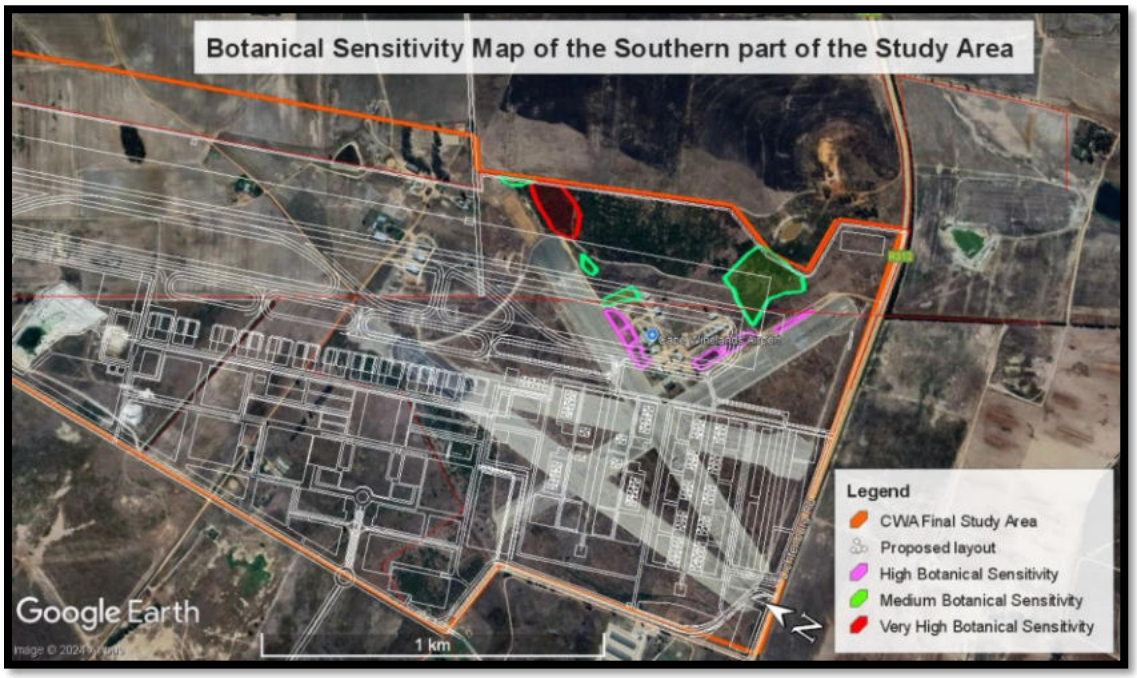


Figure 7: Botanical sensitivity map for the southern part of the study area. All areas within the airport precinct not shaded green, red or pink are of Low sensitivity (Nick Helme Botanical Surveys, Impact Assessment, September 2024).

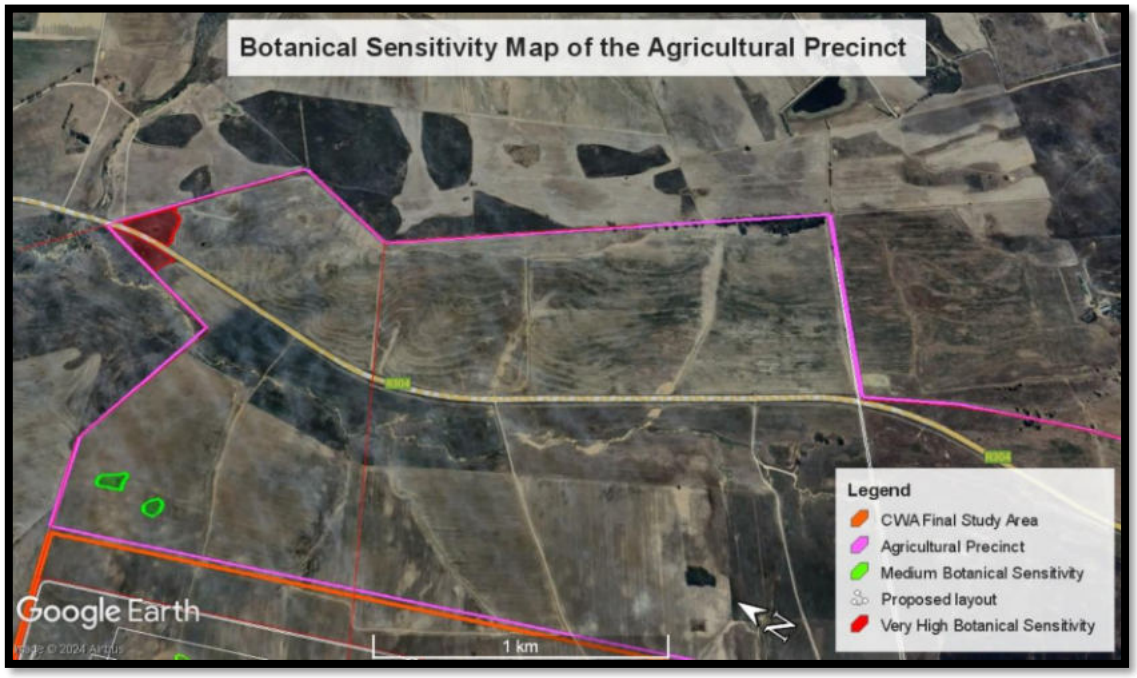


Figure 8: Botanical sensitivity map for agricultural precinct. All areas not shaded green or red within the precinct are of Low botanical sensitivity (Nick Helme Botanical Surveys, Impact Assessment, September 2024).

2.2.2. Alien and Invasive Vegetation Onsite

The airport precinct has been heavily infested with woody alien invasive vegetation, predominantly *Acacia saligna* (Port Jackson), with occasional occurrences of *Leptospermum laevigatum* (Australian myrtle), *Pinus spp*. (pines), and *Eucalyptus spp*. (gums). Prior to the clearance efforts in late 2020 and early 2021, the cover of woody alien invasive species ranged from 50% to 100%, averaging around 75%. Although the biocontrol fungus has significantly impacted Port Jackson, reducing seed production and even killing some plants, a substantial seedbank persists. This seedbank is likely to germinate following fire or other clearing methods, as demonstrated by past occurrences.

The dense cover of woody alien invasives is primarily a result of prior soil disturbances, which include cultivation, ferricrete quarrying in some areas, and extensive disturbances related to airfield development and maintenance. Even areas that appear undisturbed have been colonized by alien species through seed dispersal.

In these disturbed areas, the understorey is dominated by alien invasive herbs and grasses, including *Plantago lanceolata* (ribwort plantain), *Echium spp.* (Patterson's curse), *Erodium spp.* (cranesbill), *Lolium spp.* (ryegrass), and *Avena spp*. (wild oats).

2.4. Landscaping Plan

A comprehensive landscaping plan has been developed for the airport precinct, as shown in Figure 9. The landscaping will incorporate fynbos and renosterveld planting, using specific species to achieve the required vegetation heights for airport operations. An essential ecological management strategy for areas landscaped with natural fynbos or renosterveld vegetation is the continuous management and removal of all alien invasive species.

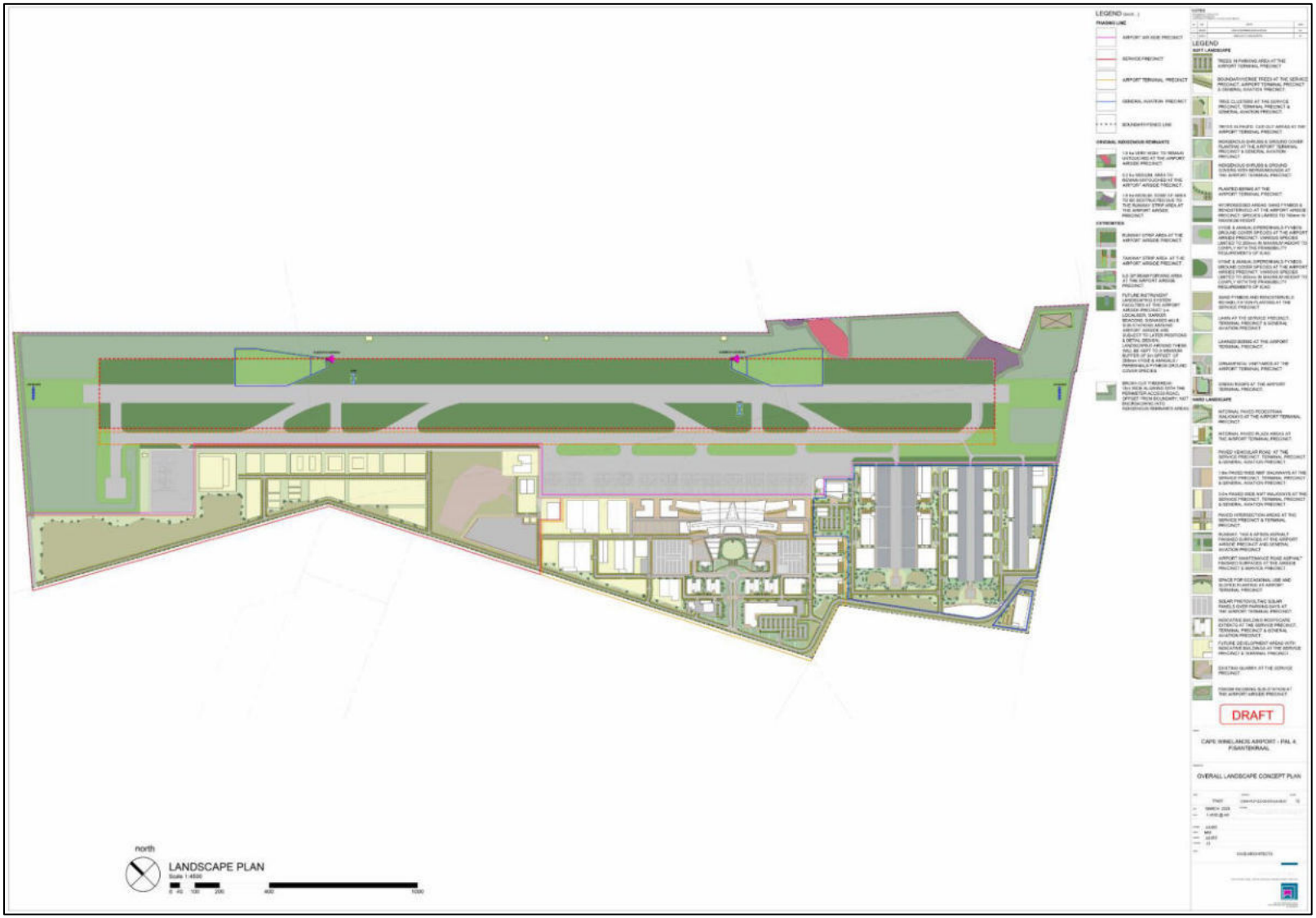


Figure 9: Cape Winelands Airport Landscape Concept Plan (Planning Partners, March 2025)

SECTION 3: CONTROL GUIDELINES

3.1. Priority Areas for Clearing

During the construction phase, the entire proposed development area should be systematically cleared of alien vegetation as per Section 1.3. to ensure that, once operational, ongoing maintenance will be the primary focus. Initial clearing will occur across the entire site, with priority given to areas where construction activities or ground disturbances are taking place. Wherever disturbance occurs during construction, alien vegetation clearing will be prioritized to prevent the spread of invasive species.

Once the site transitions to the operational phase, the following areas will be prioritized for clearing and ongoing maintenance:

1. Safety buffer Area Around the Runway: For safety reasons, the buffer area surrounding the runway will be cleared and maintained as the co-top priority.
2. Areas of Medium, High, and Very High Botanical Sensitivity (Figure 6- Figure 8) & Wetland Offset Areas (Figure 10). These ecologically significant areas will be cleared and maintained to protect sensitive vegetation and preserve critical habitats as the co-top priority.

   All invasive alien vegetation in the conservation areas on site must be removed within one year of any project approval, using appropriate methodology (see Martens et al 2021), by qualified personnel. Ongoing annual alien vegetation removal must be undertaken.

   No spraying of herbicide should be undertaken in any conservation areas.
3. Firebreaks: Maintaining firebreaks will be critical to reducing fire risk and ensuring compliance with fire management regulations.
4. Onsite Areas Planted with Indigenous Vegetation: Priority will be given to maintaining areas where indigenous vegetation has been planted to support local biodiversity and prevent the re-establishment of alien species.
5. Remainder of the Site: Any other areas on the site will be addressed after higher-priority zones have been cleared and maintained.

This phased and prioritized approach ensures effective alien vegetation control during both construction and operational phases, aligning with environmental best practices and safety requirements.

Please note: During the operational phase, any maintenance, landscaping, or other activities that cause disturbance should be flagged as focus areas for follow-up alien vegetation clearing.

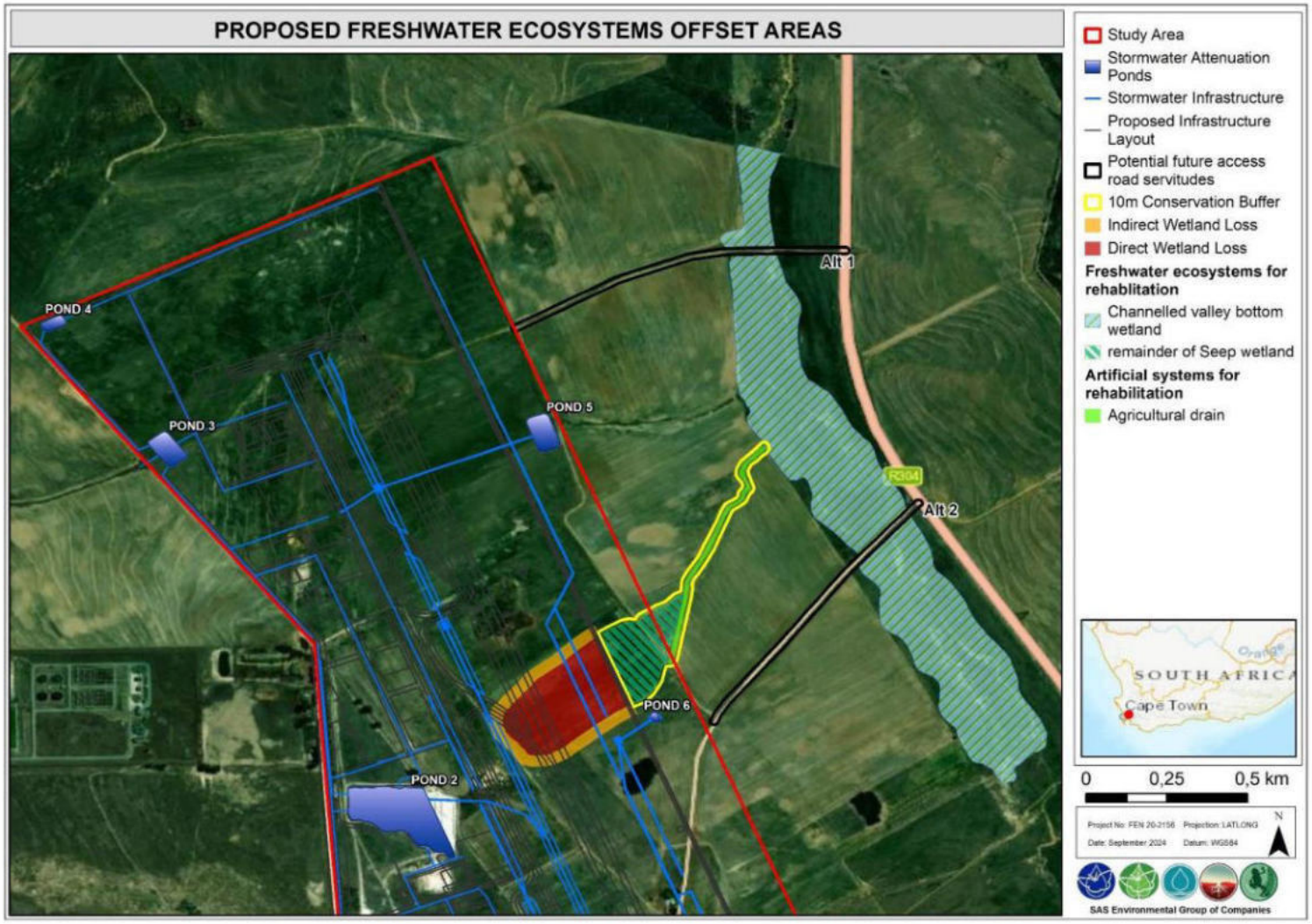


Figure 10: Extent of wetland to be lost (7.44 ha) vs identified wetland areas to be rehabilitated (FEN, Draf Wetland Offset Study and Implementation Plan, September 2024)

3.3. Construction Phase Activities Required

All contractors are responsible for alien vegetation management as per this plan within their designated work areas. To minimize soil and vegetation disturbance and reduce the risk of invasive alien plants establishing on site during the construction phase, the following actions are required:

Action	Frequency
Clearing of alien invasive vegetation should be undertaken as the work front progresses. Mass clearing should not be implemented unless the entire cleared area is to be developed immediately thereafter.	Weekly
For large areas of land clearance, soil stabilization methods, such as using packed brush, must be implemented. Organic matter used for stabilization should not be sourced from outside the site. Additionally, resprouting alien invasive vegetation must not be used as packed brush.	As required
Continuous follow-up monitoring and management, including hand-pulling emerging seedlings, must be practiced throughout the construction phase within active work areas.	Weekly
Care must be taken to avoid the introduction of alien invasive plant species to the site. Particular attention must be paid to imported material such as building sand or dirty earth-moving equipment. Stockpiles should be checked regularly and any weeds emerging from material stockpiles should be removed.	Weekly
ECO to conduct monthly surveys of all construction work areas to monitor the implementation of alien vegetation removal as required by the contractors.	Monthly
Independent audits of the AVMP implementation must be conducted every six months.	Every 6 months

3.4. Operational Phase Activities Required

Upon the completion of construction in a given area and the handover by contractors, the in-house team will resume full responsibility for alien vegetation management throughout the operational phase of the development. The following management actions are aimed at maintaining cleared areas free of invasive alien species:

Action	Frequency
Ongoing alien vegetation clearing follow-ups will be required in areas where primary clearing has taken place. Initial follow-up should take place four months after the area was initially cleared. Thereafter follow up should take place after year one of the initial clearing and continue on a dedicated annual basis thereafter.	Initial follow-up: 4 months after clearing Thereafter, annually.
Areas of natural vegetation that need to maintained or managed to reduce plant height or biomass, should be controlled using methods that leave the soil protected	As required

If disturbance (such as maintenance activities, landscaping, or fire) occurs within natural areas during the operational phase, these areas must be prioritized for follow-up clearance within one month of the disturbance.	Within 1 month of disturbance.
ECO to conduct monthly surveys of all vegetated areas to monitor the implementation of alien vegetation removal as required by the team.	Monthly
Independent audits of the AVMP implementation must be conducted annually.	Annually

3.5. General Alien Clearing Recommendations

The following priorities should be implemented at the onset of alien clearing activities:

- Areas identified in Section 3.1 to be cleared sequentially.
- Areas requiring follow-up treatment take precedence over areas which still require initial clearing. This is to reduce the time and cost required for follow-up.
- One should always consider the natural gradient of the area being cleared - all operations should follow the slope or drainage lines to minimize erosion.
- Less dense areas should then be targeted to prevent the build-up of species and the development of dense alien clumps. This will also help prevent the buildup of seed banks.
- Dense stands should be left for last, as these areas are unlikely to further increase in density. Dense stands also require dedicated and expensive follow-up treatments to prevent re-establishment.
- Areas around existing infrastructure should be cleared to reduce the fire risk.
- Disturbed footprint areas should be kept as small as possible when removing alien plant species.
- No vehicles should be allowed to drive through designated sensitive freshwater ecosystems areas during the eradication of alien and weed species.
- To prevent the spread of seeds and spores alien clearing operations should not be conducted in high wind conditions.

SECTION 4: CONTROL METHODS

4.1. General Management Methodology

The areas identified in Section 3.1 shall be cleared sequentially by implementing the following management methods where appropriate, the management team should instruct the clearing team regarding the appropriate methods to apply in a specific area:

4.1.1. Mechanical Control

This entails damaging or removing the plant by physical action. The following mechanical techniques could be used:

Hand pulling

Use: Seedlings with a stem diameter of <2cm

Hand pulling should be implemented as the preferred clearing technique as far as possible, since the entire plant is removed quickly and there is no chance of resprouting. When implemented correctly, this method is extremely effective, yet its application is limited to seedlings. Thus, regular monitoring and follow-up treatments are important to ensure successful and economical eradication using this technique. The procedure to be implemented is as follows:

1. Wearing gloves, grip the plant firmly at the base of the stem and pull hard to remove the entire plant, including the rootstocks.
2. If the roots of the plant break off during removal, use a spade to dig them out.
3. Shake the excess sandy material from the plant to ensure a higher mortality rate and make the plant easier to stockpile and lighter to transport.

Tree Popping

Use: Seedlings/Saplings with a stem diameter of approximately 2-5cm

This technique is used for medium tree specimens and involves the use of an implement commonly marketed as a "Tree-Popper". This tool consists of a base plate and a leaver that are joined to form a small pair of jaws. The tree is placed in the jaws of the tool and the leaver is used to pull the entire tree, including the roots, out. This tool is extremely useful for trees that are too large to be effectively removed by hand pulling yet are not yet large enough

to require felling. The method to be used is similar to that outlined for hand pulling, however, the Tree-Popper is used instead of hands only.

Cutting / Felling

Use: Trees with a stem diameter of >5cm

Once the stems of trees reach a diameter of greater than 5cm, felling will need to be implemented to remove the individual. Felling can be undertaken using chain saws and/or bow saws. Trees must be cut with a neat straight cut to reduce the chance of resprouting and improve the effectiveness of stump herbicide treatment. Trees must be cut down as close to the ground as possible (between 5cm and 30cm above the ground). Felling must be undertaken by appropriately trained individuals that possess and make use of the required Personal Protective Equipment (PPE) for the task at hand. In the case of resprouting species, felling must be combined with chemical treatment of the cut stumps as detailed below.

Ring barking

Use: Stems with diameters greater than 15cm, where the time taken to fell, de-branch and stack would be excessive

Since this method means the tree is left standing, it is recommended only for single large trees or very low-density invasions, not for stands. Ring barking on smaller diameter stems is ineffective and it would be quicker to just cut the tree down. Basal bark treatment could be considered as an alternative in some cases.

- Slashers or axes should be used for debarking.
- Remove the bark and cambium (outer rings where the trunk grows) in a continuous band around the trunk of the tree at least 25 cm wide, starting as low as possible.
- Where clean debarking is not possible due to crevices in the stem or where exposed roots are present, a combination of bark removal and basal stem treatments should be carried out.

4.1.2. Chemical Control

Chemical control makes use of herbicides to kill target Invasive Alien Plants (IAPs). Chemical methods are a good choice when the IAPs are still seedlings or young. At this stage of a plant's life, it is growing fast, so herbicides will be quickly translocated through the plant to reach the roots. The leaves and stem are young and green with a large surface area, allowing for good absorption of the herbicide. Chemical control should not be applied when it is raining. It is important to note that herbicide can also harm many non-target species and must always be used with the greatest care.

Herbicide Stump Treatment

Use: Resprouting species that have undergone felling treatment

Certain species, such as *Acacia saligna* ,are known to resprout from the stump or roots after felling. To prevent this an herbicide treatment needs to be applied post-felling. Once the tree has been cut down to create a smooth surface that exposes the outer rings of the stem where the trunk grows (the cambium) a died 3% Tryclopyr herbicide solution must be applied to the freshly cut surface. All side branches should also be removed from the stump and treated with herbicide. The herbicide treatment should be applied as soon as possible after felling (preferably within 3 minutes) to ensure effective treatment. Where trees with a diameter of greater than 10cm are felled, only the outer rings need to be treated with herbicide. When using a product that is mixed with penetrant oil, the entire stump and exposed roots must be treated.

Foliar treatment

Foliar treatment is when herbicide is applied to the leaves of the plant, usually by spraying.

- Spray herbicide with a knapsack sprayer, mist-blower or high-pressure sprayer firefighting unit, e.g. a bakkie-sakkie.
- The correct choice of nozzle is important to achieve an even spray cover.
- The best results can be expected in the active growing season (but some species are more susceptible to chemical absorption when they are sprayed in summer).

Blanket Spraying

Use: Young, dense, uniform stands of IAPs.

Blanket spraying, or broadcast spraying, is when herbicide is sprayed across an entire area of over 70% infestation. While this method is recognized, it should be used with a high level of caution due to the significant environmental risk. It is the most cost-effective way to eradicate young, dense, uniform stands of IAPs. Some IAPs, like introduced acacias, germinate by the thousands after fire. The first line of attack to reduce these numbers is the use of broadcast spraying. Calibration is crucial to ensure even distribution of herbicide over the target area

Aerial application

Use: Large-scale & inaccessible infestations of alien invasive vegetation

Aerial application is spraying either large-scale infestations or targeted inaccessible plants from an aircraft. While aerial application is a recognized method of IAP control, it is still under development and should be used with a

high level of caution due to the significant environmental risk. Aerial spraying can only be done by registered and certified operators according to strict regulations. The pilot must ensure that the spray mixture is distributed evenly over the target area and that the wastage of herbicide, as well as drift onto indigenous species, is kept to a minimum. It is essential that the following criteria be met:

- Inform your neighbors well in advance before spraying commences.
- Use only an aerial registered product. Port Jackson (*Acacia saligna*) and Rooikrans (*Acacia cyclops*) have herbicides registered for aerial application.
- Adult Port Jackson and Rooikrans must be sprayed in summer (i.e. November–March) for optimum results.

4.1.3. Biological Control

Biological control using species-specific insects and diseases from the alien plant's native region has been implemented in South Africa, with 76 biocontrol agents released to target 40 invasive weed species. While active biocontrol is not recommended at this stage due to the severity of the current infestation, it remains a potential option for future management. Notably, a biocontrol fungus already present in South Africa has had a significant impact on Port Jackson plants at the site, reducing seed production and even killing some individuals.

4.2. Species Specific Methodology

4.2.1. *Acacia Saligna* (Port Jackson)

Seedlings

Hand-pulling or tree-popping should be employed, depending on site sensitivity. For chemical control, apply a foliar spray of Mamba (Glyphosate) as a spot treatment at 1.5% concentration, using 2-4 litres per hectare. Alternatively, a mixture of 50 ml of Garlon 4 or Viroaxe (Triclopyr Ester) with 10 litres of water can be applied at 1.5 litres per hectare. However, avoid using Garlon or Viroaxe in areas where pioneer grass seedlings are present. Touchdown (Glyphosate Trimesium) can also be applied at 2-4 litres per hectare where appropriate.

Young Trees and Saplings

Hand-pulling or tree-popping is effective. In less sensitive areas away from water bodies, Touchdown (Glyphosate Trimesium) can be used at the same rate of 2-4 litres per hectare.

Large Trees

These should be felled as close to ground level as possible, with stump treatment using Timbrel. Frilling, combined with Timbrel application, is also recommended.

The most effective approach combines mechanical methods with herbicide application. Follow-up weeding is necessary when seedlings reach 15-40 cm in height to ensure long-term control.

4.2.2. Gum trees (Eucalyptus spp.)

Seedlings

To ensure maximum success, all seedlings should be hand-pulled

Mature Trees

- Ring Barking and Stem Frilling: For effective control of mature trees, ring barking or stem frilling is recommended. A 10 cm wide cut should be made around younger trees, while mature trees may require a cut up to 30 cm wide. Strip barking is another viable method. Applying Timbrel to the frilled stem has proven effective, resulting in dead standing trees.
- Felling: Felling is commonly used for both mature trees and saplings, but it is essential to treat the stump with herbicide to prevent regrowth.

4.3. Herbicide Use Policy

1. Storage

All storage facilities are to comply with the requirements of AVCASA (Association of Veterinary and Crop Associations of South Africa) including the following:

Isolation

- Storage should be in a separate building and not sited near dwellings, livestock buildings, fodder or flammable materials. If located in a complex a completely sealed store is required.
- All stores to be located away from rivers, dams or boreholes
- The store should be located in a area which can be supervised

Accessibility

- Ease of delivery is important

- Accessibility from all sides in fire situations

2. Store construction

Store construction must adhere to specific requirements to ensure safety and functionality. Floors should be non-permeable, with screeded concrete preferred, though steel-sealed containers are acceptable. Walls should be made of brick or concrete and include air bricks for ventilation. Proper ventilation is essential, with vents placed either 200 mm from the floor or at roof level, and containers are permissible if they provide adequate airflow. The roof must be leak-proof and ventilated to manage temperatures. Steel doors with secure locking systems are required, while wooden doors should be reinforced with security gates. Windows must provide enough natural light to read product labels, or sufficient artificial lighting should be installed. Sanitation facilities with running water, soap, and towels must be readily available to staff, along with an eye wash station. Additionally, a shower facility is recommended to enhance safety standards.

3. Equipment

A table should be provided for decanting and measuring purposes. Measuring jugs, funnels, pumps and buckets should be available and used for herbicides only. A broom, spade and a dry fine absorbent material to contain spills should also be available.

4. Handling

Suitable protective clothing must be available and made compulsory. Chemical resistant aprons, gloves and eye protection must be worn when handling concentrates. Adequate hygiene aids such as running water, soap, towels and eyewash must also be available. Spill control methods should be in place. Concentrates should be decanted in a prescribed area and not in the field. All containers into which herbicides are decanted should be clearly marked with a copy of the original label secured to this container.

5. In field handling

Spray mixtures to be leak and spill proof, and kept away from personal belongings, food stuff etc. Containers should stand on suitable absorbent materials (Hessian sack) and out of direct sunlight, containers to be kept at least 20m away from water bodies, storage areas in the field should be marked with hazard tape. Filling sites should be pre-determined to prevent damage to sensitive vegetation. Cleaning of containers to take place at store and not in the field. Suitable protective clothing is required for all handlers.

6. Transportation

Herbicide to be carried on separate vehicle to labor or part of the vehicle which is isolated from people, food and clothing. Vehicles should carry absorbent material for any spillage. Materials should not be left unattended.

7. Disposal of containers

Designated officer to be responsible for correct disposal in accordance with AVCASA guidelines. All containers are to be suitably disposed of and not reused in domestic scenarios.

8. Public safety:

Warning signs should be erected where exposure to the general public can occur. Herbicides to be used in line with label recommendations. Treatment of areas within 50m of habitations or public areas should be avoided and done in consultation with the effected parties.

9. Environmental Safety

Area contamination must be minimised by careful and accurate application with a minimum amount of herbicide to achieve good control. All care must be taken to prevent contamination of any water bodies. This includes care in storage, application, cleaning equipment and disposal of containers, product and spray mixtures. Equipment should be washed where there is no danger of contaminating water sources and washings carefully disposed of in a suitable site. To avoid damage to indigenous or other desirable vegetation, product should be selected that will have the least effect on non-target vegetation (Coarse droplet nozzles should be fitted to avoid drift onto neighbouring vegetation).

10. Application

Equipment to be regularly inspected for leaks and irregular application devices. Rates of application and precautions and the use of adjuvant and water sources for mixing must be known and monitored.

11. Weather

Applications should not be undertaken in unfavorable conditions. Label recommendations for suitable application weather to be followed.

12. Mixing

To be conducted as per label.

13. Calibration

All equipment has to be correctly calibrated and maintained to achieve correct mix ratios.

**Source: Working for Water Program Herbicide Policy*

4.4. Personal Protective Equipment (PPE)

The use of Personal Protective Equipment (PPE) by staff controlling invasive alien plants in the field is a legal requirement. The PPE specifications differ for the different types of control. The use of chainsaws and brush cutters and will require slightly different PPE from someone hand pulling seedlings. Minimum PPE requirements are as follows: Overall, gloves, safety boots, hard hat, safety glasses, face mask,

4.5. Alternative Approaches for Biomass Clearance

The removal of alien vegetation biomass after clearing is just as critical as the clearing process itself, though often overlooked. Alternative approaches for the use of the biomass of alien vegetation material should be explored for the site in order to prevent the accumulation of debris and dense seed stores in this debris. Accumulated leaf litter and upper foliage not only harbor seeds but also increase fire risk on the site.

For large alien trees, the biomass can be repurposed as firewood, providing local communities with an opportunity to collect and sell it for additional income. Given the size of the property, investing in a chipper should be considered. Chipping the material allows it to be used as mulch or in brushwood packing with de-seeded branches as part of the rehabilitation program. Additionally, chipped material can be utilized for gardening, though care must be taken to avoid spreading alien seeds through the movement of chipped material across the site.

In cases where firewood collection and chipping are insufficient, controlled burns may be necessary, however this should be seen as a last resort. Controlled burns should only be conducted with the appropriate permits, under strict supervision, and with trained personnel and fire-fighting equipment on hand as outlined within the Veld Fire Management Plan compiled for the site (Annexure 5 to the overall EMPr).

Cut material can either be stockpiled for later removal or repurposed as erosion barriers. When larger plants are removed, the branches should be cut into smaller pieces such that they can be carried rather than dragged to their intended stockpile or reuse located. This minimizes disturbance and the potential spread of any seed that may be

present on the plants. Small, hand-pulled stems that do not pose a risk of resprouting can be left on the ground to decompose into mulch or be chipped for further use. Seed-bearing material, once chipped, should be left to compost or allowed to germinate before being considered for reuse. However, stockpiled biomass presents a significant fire hazard due to its high flammability. To mitigate this risk, biomass should not remain on-site for more than a month before being properly utilized or removed entirely.

SECTION 5: MAINTENANCE AND FOLLOW-UP

Effective management of alien invasive vegetation requires not only the initial clearing but also diligent follow-up and maintenance to ensure long-term success. Given the substantial seed bank present in the area, ongoing germination of invasive species is expected to persist for years, demanding strict follow-up measures. Without consistent follow-up, costs and time required to achieve the ultimate clearing goals will escalate significantly. The maintenance and follow-up program are outlined as follows:

5.1. Timing and Frequency of Follow-Up

Initial Follow-Up: The first follow-up clearing should occur four months after the initial clearing. This period is critical to address seedling emergence and early regrowth of invasive vegetation.

Subsequent Follow-Up: After the four-month follow-up, the next intervention should take place one year after the initial clearing. Thereafter, follow-up treatments should occur on an annual basis to prevent re-establishment.

Continuous Rotational Management: Due to the vast size of the site, follow-up activities will need to be carried out on a rotational basis. This will ensure that all sections of the site are revisited within the required timeframes while maintaining steady progress.

As the project advances, the in-house team must establish management units across the property and develop a clearing schedule to monitor initial clearing and follow-up efforts, ensuring alignment with the requirements of the management plan.

5.2. Focus of Follow-Up Treatments

Seedling and Coppice Control: Follow-up efforts will primarily target seedlings and coppice regrowth from stumps or root systems. Controlling these early-stage regrowth is more cost-effective and efficient compared to dealing with fully re-established vegetation.

Short Intervals for Effectiveness: Close attention must be paid to the intervals between follow-up treatments, especially during the first year after initial clearing. Delays in follow-up will result in increased time and labor required, as the vegetation will have had time to re-establish.

5.3. Resource Allocation and Funding

Periodic clearing operations must be ongoing and adequately funded by the Applicant, who holds responsibility for the management of the site. A dedicated and well-planned budget should be set aside to ensure that follow-up work is carried out consistently (see Section 6).

5.4. General Monitoring Requirements

In general, the following principles apply for monitoring:

- Photographic documentation should be maintained for all areas to be cleared. This includes images taken before work begins, as well as at regular intervals during the initial clearing activities. Similarly, photographs should be taken before and after any follow-up clearing, and the progress of rehabilitation efforts should also be documented.
- Basic records must be kept of daily operations. This includes the specific areas or locations cleared, the number of labor units involved, and, if herbicide is used, the quantity applied.
- If invasive alien plants are detected during monitoring, immediate action must be taken to address the issue.

SECTION 6: BUDGETING

Successful alien clearing requires an ongoing and long term approach and is labor and time intensive and therefore becomes a costly exercise. When planning a budget for alien vegetation management, several key factors must be considered to ensure effective and sustainable control:

Vegetation

- Species – require different methods or control applications
- Density – coverage / stems per ha (for woody species)
- Area (ha)
- Height (m)
- Growth stage – vegetative, flowering, fruiting
- Location

Terrain

- Slope / Access
- Carrier volume for herbicides
- Transport (c/km)
- Equipment
- Method

Labour

- Type – skilled / unskilled
- Number
- Task Rate (person days/ha)
- Unit cost
- Availability

Technique

- Chemical(Spot treatment, Frilling, Stump treatment)
- Mechanical (Stem treatment, Ringbarking, Hand pulling)
- Biological (Soil treatment , bio control)
- Overall – Foliar / Soil Felling Compliments

Equipment

- Knapsacks, Foam sprayer, Stem injection, Nozzles
- Manual / mechanical (Slashers / Brush cutters)
- Maintenance (cost)

Herbicide

- Type
- Rate Spray volume (1/ha or %)
- Carrier
- Technical limits, Environment, Climatic factors, Timing

Costs

- Salaries / wages
- Other benefits / bonuses
- Training
- Overheads - Transport (c/km), Maintenance
- Other
- Allowance for downtime
- Environmental factors – slope, accessibility (WT), obstructive vegetation

Programme

- Duration
- Number of treatments
- Total cost for programme
- Budgeted cost / treated ha / situation / season

SECTION 7: MONITORING AND COMPLIANCE

7.1. Reporting and Record Keeping

The appointed ACO is responsible for submitting monthly reports to the ECO overseeing the site. The ECO should conduct a monthly site inspection of the site. These reports must detail the following (refer to temple provided in Appendix A):

- A summary of all clearing undertaken during the month, specifying whether it involved initial clearing or follow-up treatments.
- Clear identification of the areas on the site where clearing has taken place.
- The total area (in hectares or square meters) that was cleared.
- The specific clearing methods employed (e.g., mechanical clearing, manual removal, herbicide application).
- The number of workers involved in the clearing activities.
- Any difficulties or problems faced during the clearing operations (e.g., access issues, safety concerns, or weather delays).

In addition to the monthly reports, the applicant is required to maintain comprehensive records of all reports submitted by the ACO. These records should also include documentation of any reviews or amendments to the AVMP. This documentation is essential for tracking progress, ensuring compliance with the management plan, and adjusting strategies as needed. Records should be kept and must be made available for review on request, based on adequate motivation.

7.2. Environmental Monitoring and Audits

Throughout the construction phase, monthly ECO reports must be compiled and submitted to DEADP. Throughout the operational phase, monthly ECO reports must be compiled and submitted to the site's EM.

During the construction phase a qualified Environmental Auditor, appointed at the Applicant's expense, must conduct six-monthly compliance audits of the Environmental Management Plans (EMPs) in place for the site, including the AVMP. Once the project transitions fully to the operational phase, annual compliance audits of the same EMP suite, including the AVMP, must be undertaken.

The audit should aim to:

1. Assess compliance with the key components of the EMPrs.

2. Identify critical areas requiring attention.
3. Recommend priority actions for improvement.

The audit must cover a range of issues, including the implementation of environmental controls, environmental management practices, and environmental monitoring.

Audit findings should guide any necessary updates or additions to the EMPrs to address new or unresolved environmental issues on site. National, provincial, and local authorities must be provided access to the facility for audit or inspection upon request.

7.3. Record Keeping

The Applicant should keep records of the following:

- Monthly monitoring reports submitted by the onsite ACO
- 6-monthly audit reports
- Annual audit reports
- Reviews and amendments of the VFMP
- Incident reports for all fire related incidents that occur onsite

Records should be kept and must be made available for review on request, based on adequate motivation.

APPENDIX A: ALIEN VEGETATION CLEARING REPORT TEMPLATE

Alien Vegetation Clearance Report

Name:	**File reference number:**
Reporting Period:	
Total area (in ha) cleared/followed-up during reporting period:	
Number of workers involved in the clearing activities:	

Section 1: Provide a summary of all clearing undertaken during the month, specifying whether it involved initial clearing or follow-up treatments.

Section 2: Provide a map indicating the areas on the site where clearing has taken place.

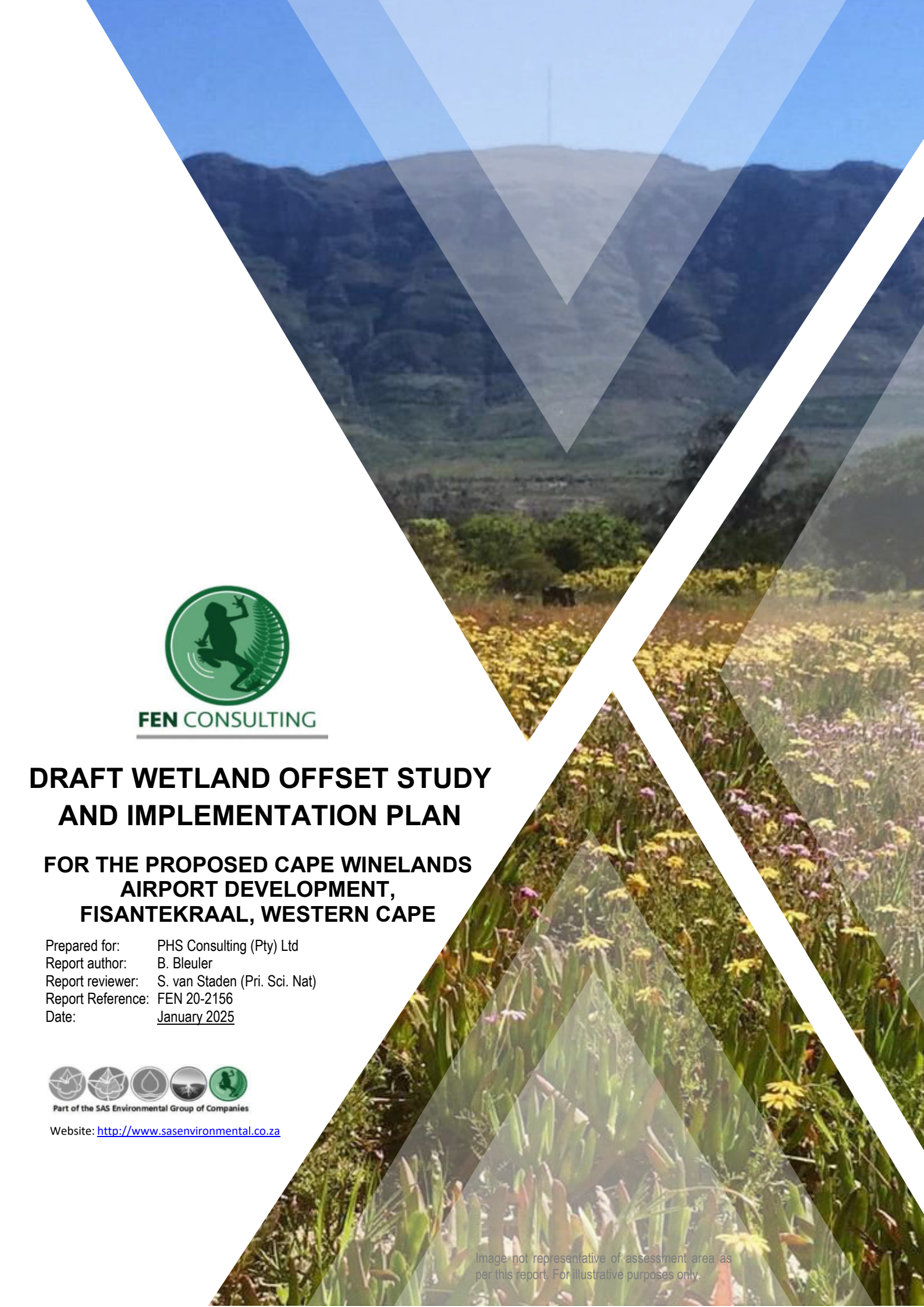
Section 3: Outline the clearing methods employed (e.g., mechanical clearing, manual removal, herbicide application).

Section 4: Any difficulties or problems faced during the clearing operations (e.g., access issues, safety concerns, or weather delays).

Section 5: Signatures

ACO:	Date: .....
ECO:	Date: .....

ANNEXURE 7: WETLAND OFFSET STUDY AND IMPLEMENTATION PLAN



FEN CONSULTING

DRAFT WETLAND OFFSET STUDY AND IMPLEMENTATION PLAN

FOR THE PROPOSED CAPE WINELANDS AIRPORT DEVELOPMENT, FISANTEKRAAL, WESTERN CAPE

Prepared for: PHS Consulting (Pty) Ltd
Report author: B. Bleuler
Report reviewer: S. van Staden (Pri. Sci. Nat)
Report Reference: FEN 20-2156
Date: January 2025

Part of the SAS Environmental Group of Companies

Website: http://www.sasenvironmental.co.za

EXECUTIVE SUMMARY

Freshwater Ecologist Network (FEN) Consulting (Pty) Ltd was appointed to develop a wetland offset initiative and associated rehabilitation and management plan for the proposed Cape Winelands Airport (CWA) development in Fisantekraal, Western Cape Province. The proposed development activities will result in the infill and transformation of a seep wetland located within the study area.

During the offset initiative preparation, it was determined that 6.74 hectares (ha) (but with a total loss of 7.44 ha which accounts for indirect impacts) of wetland habitat would be lost due to the proposed CWA development. This loss translates into a residual impact of 3.97 functional hectare equivalents (HaE) and 13 habitat HaE of wetland to meet the no net loss objective. The assessment of these impacts highlighted the need for an on-site wetland offset to ensure that the ecological balance of the area is maintained.

The remaining seep wetland habitat (3.68 ha) in the eastern part of the study area along with a channelled valley bottom (CVB) wetland (36.2 ha) further east of the study area into which the seep wetland drains (via an agricultural drain), have been identified as suitable for rehabilitation and offset purposes. The offset strategy has been designed to compensate for the residual loss of wetland habitat, ensuring no net loss of wetland functionality. The target offset area will contribute 4.1 functional HaE and 30.5 habitat HaE, adequately offsetting the impacts of the proposed CWA development. The suitability of these systems is further reinforced by the significant potential for ecological restoration through targeted rehabilitation activities, particularly given their current status as largely to seriously modified wetlands.

The proposed rehabilitation plan focuses on restoring the hydrological regime drivers and geomorphological processes of the wetlands to ensure that ecological functions required to maintain a balanced ecosystem is supported. This is particularly of importance considering the extensive erosion that is evident in the CVB wetland. This will include the removal of dumped waste from the CVB wetland, land surface modification to facilitate natural water flow, and the planting of native vegetation to stabilize the soil and enhance wetland functionality. The implementation of these measures will improve the ecological condition of the wetlands, contributing to a net gain in wetland ecosystem services and habitat quality. In addition, the agricultural drain connecting the seep wetland to the CVB wetland was also earmarked for rehabilitation as efforts to remedy the CVB wetland may be futile if the erosion present in the agricultural drain is not addressed as well.

The rehabilitation and management plan developed as part of this report has been budgeted for, with the total budget amounting to R9,993,756.00, excluding VAT but including contingencies. The proponent has committed to funding the aftercare and maintenance of the rehabilitated wetland for a further period of thirty years, ensuring the long-term success of the offset initiative.

In conclusion, the proposed offset initiative is expected to significantly contribute to positive wetland resource management and conservation in the region. The offset strategy aligns with national and local biodiversity offset guidelines, and the selected offset site more than adequately offsets the residual impacts associated with the project. It is recommended that the proposed offset be approved by the relevant competent authorities as part of the development authorization process.

Note that all changes to the October 2024 version of the offset report are underlined.

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GLOSSARY OF TERMS

Alien vegetation:	Plants that do not occur naturally within the area but have been introduced either intentionally or unintentionally. Vegetation species that originate from outside of the borders of the biome -usually international in origin.
Biodiversity:	The number and variety of living organisms on earth, the millions of plants, animals and micro-organisms, the genes they contain, the evolutionary history and potential they encompass and the ecosystems, ecological processes and landscape of which they are integral parts.
Buffer:	A strip of land surrounding a wetland or riparian area in which activities are controlled or restricted, in order to reduce the impact of adjacent land uses on the wetland or riparian area.
Catchment:	The area where water is collected by the natural landscape, where all rain and run-off water ultimately flow into a river, wetland, lake, and ocean or contributes to the groundwater system.
Delineation (of a wetland):	To determine the boundary of a wetland based on soil, vegetation and/or hydrological indicators.
Ecoregion:	An ecoregion is a "recurring pattern of ecosystems associated with characteristic combinations of soil and landform that characterise that region".
Facultative species:	Species usually found in wetlands (76%-99% of occurrences) but occasionally found in non-wetland areas
Hydromorphic soil:	A soil that in its undrained condition is saturated or flooded long enough to develop anaerobic conditions favouring the growth and regeneration of hydrophytic vegetation (vegetation adapted to living in anaerobic soil).
Hydrology:	The study of the occurrence, distribution and movement of water over, on and under the land surface.
Indigenous vegetation:	Vegetation occurring naturally within a defined area.
Watercourse:	In terms of the definition contained within the National Water Act, a watercourse means: • A river or spring; • A natural channel which water flows regularly or intermittently; • A wetland, dam or lake into which, or from which, water flows; and • Any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse; • and a reference to a watercourse includes, where relevant, its bed and banks
Wetland Vegetation (WetVeg) type:	Broad groupings of wetland vegetation, reflecting differences in regional context, such as geology, climate, and soil, which may in turn have an influence on the ecological characteristics and functioning of wetlands.

ACRONYMS

ACA	Additional Conservation Actions
AIP	Alien and Invasive Plant
AIPCP	Alien and Invasive Plant Control Plan
BBOP	Business and Biodiversity Offsets Programme
CBA	Critical Biodiversity Area
CoCT	City of Cape Town
CVB	Channelled valley-bottom
CWA	Cape Winelands Airport
DEA	Department of Environmental Affairs
DEA&DP	Western Cape Department of Environmental Affairs and Development Planning
DFFE	Department of Forestry, Fisheries and the Environment
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMPr	Environmental Management Programme
EO	Environmental Officer
ESA	Ecological Support Area
FEN	Freshwater Ecologist Network Consulting (Pty) Ltd
GIS	Geographic Information System
GN	Government Notice
GPS	Global Positioning System
HaE	Hectare Equivalents
HGM	Hydrogeomorphic
m	Meter
NBA	National Biodiversity Assessment
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
NEMBA	National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004)
NFEPA	National Freshwater Ecosystem Priority Areas
NPI	Net Positive Impact
NWA	National Water Act, 1998 (Act No. 36 of 1998)
PES	Present Ecological State
RE	Remaining Extent
REC	Recommended Ecological Category
RMO	Recommended Management Objective
RQIS	Research Quality Information Services
RQS	Resource Quality Services
SACNASP	South African Council for Natural Scientific Professions
SAIAB	South African Institute of Aquatic Biodiversity
SANBI	South African National Biodiversity Institute
SA RHP	South Africa River Health Programme
SCC	Species of Conservation Concern
SDP	Spatial Development Plan
STS	Scientific Terrestrial Services (Pty) Ltd
VAT	Value added tax
WetVeg Groups	Wetland Vegetation Groups
WRMP	Wetland Rehabilitation and Management Plan
WULA	Water Use License Application

Note that all changes to the October 2024 version of the offset report are underlined.

1 INTRODUCTION

1.1 Background

The CapeWinelands Aero (Pty) Ltd Limited proposes to upgrade the existing Cape Winelands Airport (CWA) on Portions 3, 4 and Remaining Extent (RE) of Farm 474, Joostenbergs Kloof, Portions 23, 10 and the RE of the Farm 724 Joostenbergs Vlakte, and Portion 7 of Farm 942, Kliprug, in Fisantekraal, Western Cape Province (hereafter referred to as the "proposed CWA development"). The location and extent of the study area on which the proposed CWA development will be developed are illustrated in Figure 1 and Figure 2.

Based on the project layout plans (Figure 3), it is proposed that the freshwater ecosystems on site, more particularly a portion of the seep wetland in the central east portion of the study area, will be developed, and stormwater attenuation and detention ponds will be developed which will convey treated stormwater to the freshwater ecosystems downgradient of the proposed CWA development. The proposed CWA development will result in the loss of 6.74 ha of wetland habitat as delineated in the Freshwater Scoping Report conducted by Freshwater Ecologist Network (FEN) Consulting, dated 2024 (FEN, 2024).

1.2 Purpose of Study

The proposed loss can only be mitigated through implementation of a formal offset if a no net loss of wetland is to be achieved. As such, FEN was appointed to compile a wetland offset strategy and an associated Wetland Rehabilitation and Management Plan (WRMP) for the proposed development activities. Due to the above, an investigation into the freshwater ecosystems and wetland offset was launched for the proposed project. This strategy compensates for the residual loss of wetland habitat resulting from the proposed CWA development.

1.3 Scope of Work

The Scope of Work as part of this wetland offset strategy comprised of the following key components:

- To gather all relevant spatial data pertaining to wetlands and conduct a comprehensive review of the available wetland assessment reports for the project;
- To quantify the residual wetland losses by converting the area of wetland loss into two distinct values:
  - **Functional Hectare Equivalents**: this will be calculated to quantify the loss of regulating ecosystem services and water resource management; and
  - **Habitat Hectare Equivalents**: this will be determined to quantify the loss to biodiversity and ecosystem conservation;
- To identify, select, and screen potential offset options within the applicable property and/or greater region and evaluate these options to determine their suitability for meeting offset requirements using the guidelines provides by Macfarlane *et al.* (2016) for wetland offsets; and
- To attend meeting(s) with relevant stakeholders to identify and evaluate potential offset alternatives;
- Based on the findings and feasibility discussions, on-site and off-site options for wetland offsets were assessed in the surrounding area with preference given to offset areas with the highest probability of success;
- To conduct a site visit to ground-truth ecological conditions within the proposed recipient offset sites and address mitigation requirements to improve the functionality of these systems commensurately with the offset quantum required;
- To define the objectives and targets for the wetland offset strategy and describing the actions/ interventions needed together with the relevant stakeholders;

- To undertake a risk assessment using the Government Notice (GN) 4167 promulgated in terms of the National Water Act, 1998 (Act No. 36 of 1998) as amended (NWA) to identify the impacts imposed to the target offset sites as a result of the rehabilitation measures proposed;
- To prepare a comprehensive report documenting the findings and recommendations of the offset strategy. This report includes an evaluation of potential offset sites, the proposed measures for achieving the required offset targets, and a detailed rehabilitation and management strategy to ensure the long-term success and sustainability of the offset; and
- To develop a confirmatory Memorandum of Understanding describing the commitment of the proponent (CWA) to undertake and implement the offset plan.

1.4 Assumptions and Limitations

The following assumptions and limitations are applicable to this report:

- It was assumed that the proponent will receive authorisation from the relevant provincial and/or national authorities (including the Department of Water and Sanitation (DWS), and/or the Western Cape Department of Environmental Affairs and Development Planning (DEA&DP)) for the proposed CWA development. The provided WRMP does not seek to replace the Environmental Management Programme (EMPr) but has rather been designed in a manner that supports the EMPr through specific guidance of rehabilitation, monitoring and management of the offset areas. The WRMP however does not address mitigation measures required for the proposed CWA development;
- With regards to freshwater ecosystems and their delineation:
  - The ground-truthing and delineation of the freshwater ecosystem boundaries and the assessment thereof at the study area as part of the freshwater assessment, was confined to two site visits undertaken on the 17th of January 2022 and the 25th of April 2022 (Scoping Report dated 2024 – FEN, 2024);
  - Global Positioning System (GPS) technology is inherently somewhat inaccurate and some inaccuracies due to the use of handheld GPS instrumentation may occur, however, the delineations as provided in this report are deemed accurate enough to fulfil the authorisation requirements as well as implementation of the mitigation measures provided;
  - Freshwater ecosystems and terrestrial zones create transitional areas where an ecotone is formed as vegetation species change from terrestrial to obligate/facultative species. Within this transition zone, some variation of opinion on the freshwater ecosystem boundaries may occur. However, if the DWAF (2008) method is followed, all assessors should get largely similar results;
  - With ecology being dynamic and complex, certain aspects (some of which may be important) may have been overlooked. However, it is expected that the proposed development activities have been accurately assessed and considered, based on the field observations and the consideration of existing studies and monitoring data in terms of wetland ecology;
  - The assessment of the freshwater ecosystems for offsetting purposes was confined to one of the three identified target recipient sites due to the significantly higher likelihood of rehabilitation success of the target recipient site. The assessment of the target recipient site was limited to a single site visit undertaken during April 2024;
  - Use was made of aerial photographs, digital satellite imagery as well as provincial and national wetland databases to identify areas of interest prior to the field survey of both the study and recipient target offset areas. Although all possible measures were undertaken to ensure all freshwater ecosystems and drainage features were assessed and delineated, some features may have been overlooked;
  - Based on the desktop assessment, it is clear that historical anthropogenic aspects (including extensive agricultural activities etc.) have impacted the hydrology,

geomorphology and vegetation structure of the wetlands. Despite this, the wetland delineations are fairly accurate given these limitations;

- All effort was made to understand the requirements for offset as best possible, however information on Critical Biodiversity Areas (CBAs) and on specific species of concern is often not available. Thus, best professional knowledge and best technological solutions, with special mention of GIS were used to best understand these aspects;
- The WRMP provided in this report is intended to provide a general direction for which the proponent can achieve the desired ecological state of the acquired offset area in the future. The strategy thus provides high-level context and principles for which implemented actions must adhere to. In-depth rehabilitation (including alien and invasive plant (AIP) control, earthwork activity plans, etc.) will need to be developed (at the appropriate time) under the guide of suitably trained specialists;
- As much effort as possible was made to liaise with relevant stakeholders and obtain indications of willingness to take part in the initiative, within budget constraints and within timeframes;
- This wetland offset study focuses on the high-level planning and overall wetland offset requirements, in addition to a high-level rehabilitation plan to be implemented at the target offset area; and
- A risk assessment was conducted for the wetlands associated with the target offset area.

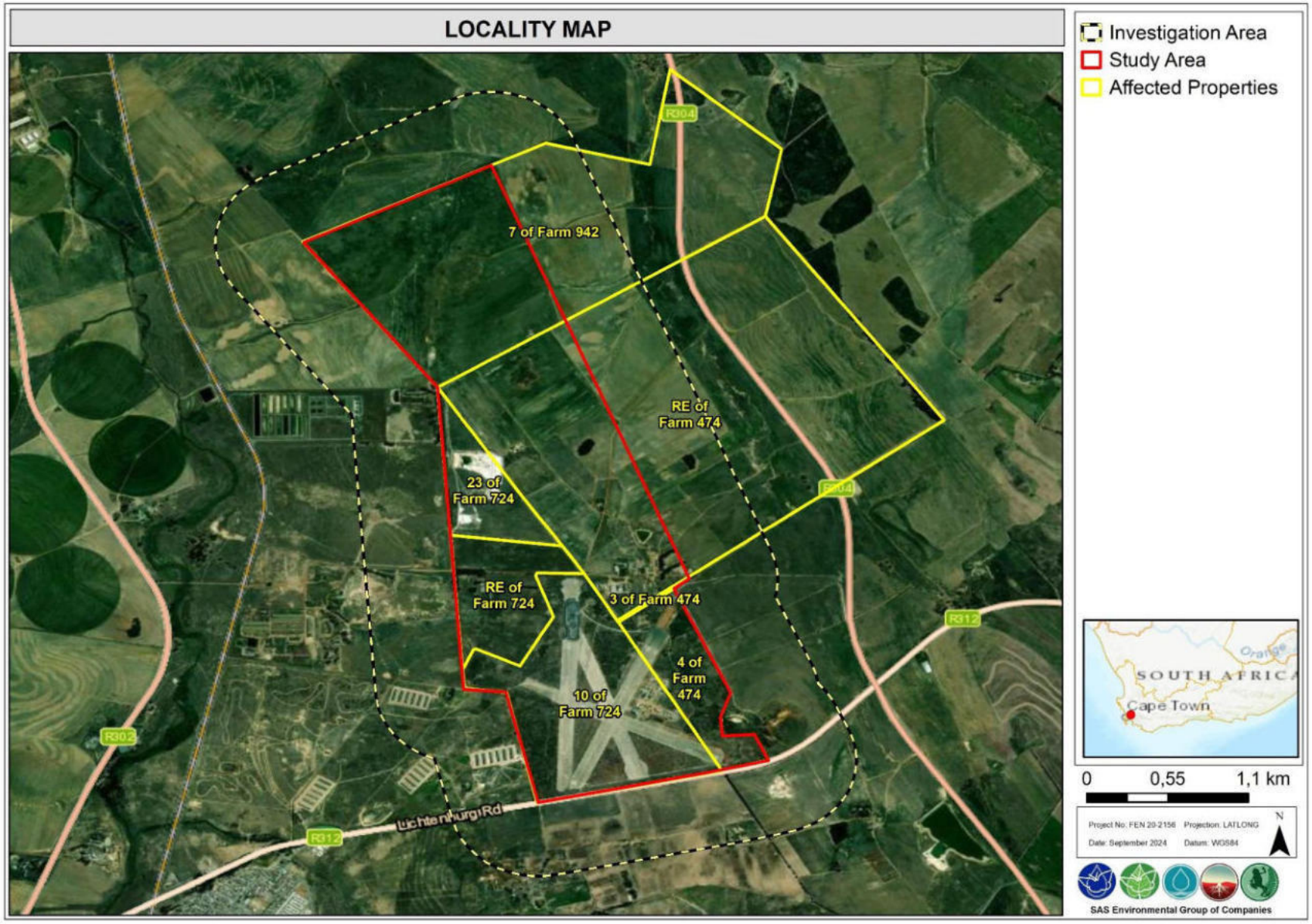


Figure 1: Digital satellite imagery of the study and investigation areas in relation to the surrounding environment.

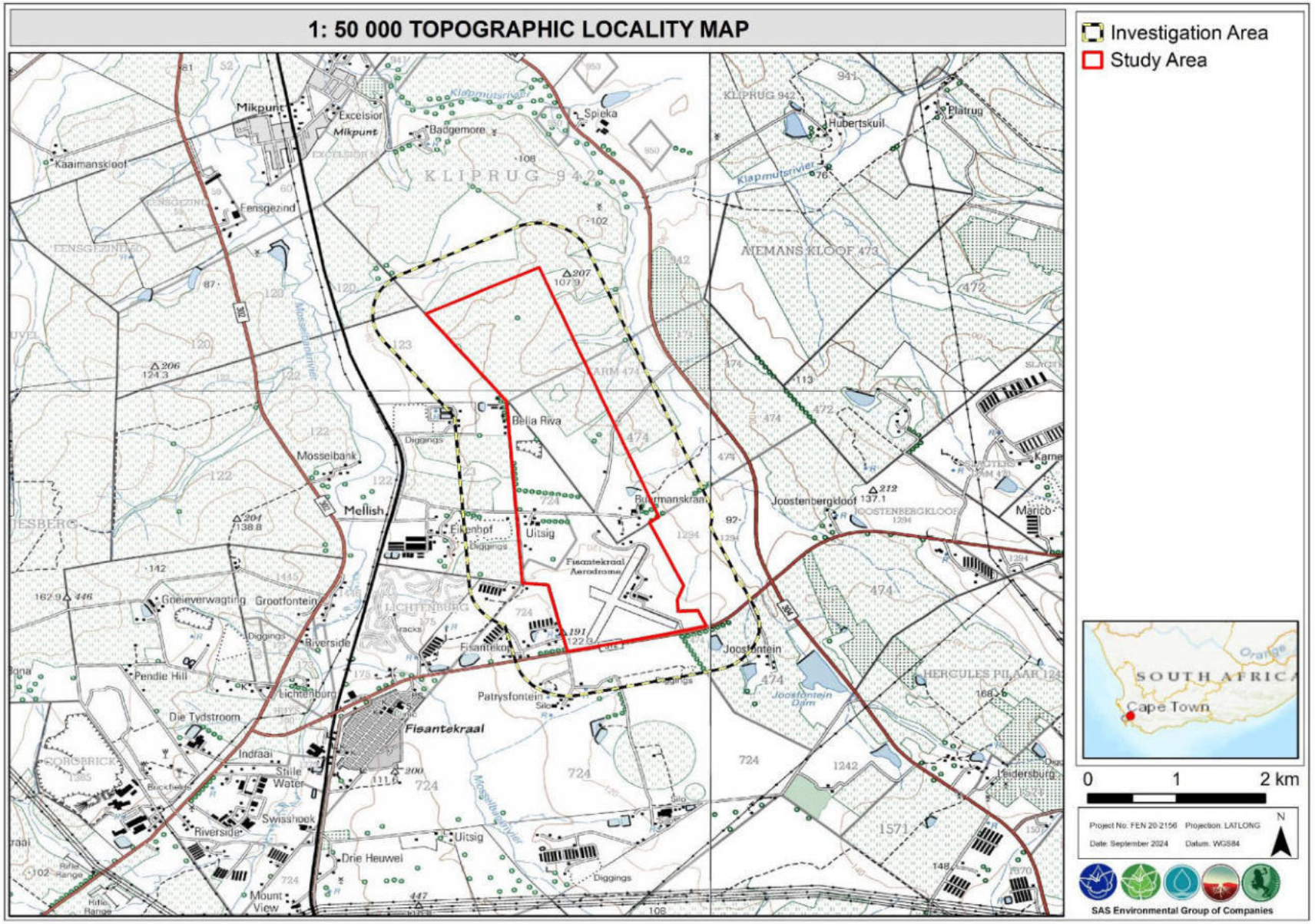


Figure 2: Location of the study and investigation areas depicted on a 1:50 000 topographical map, in relation to the surrounding area.

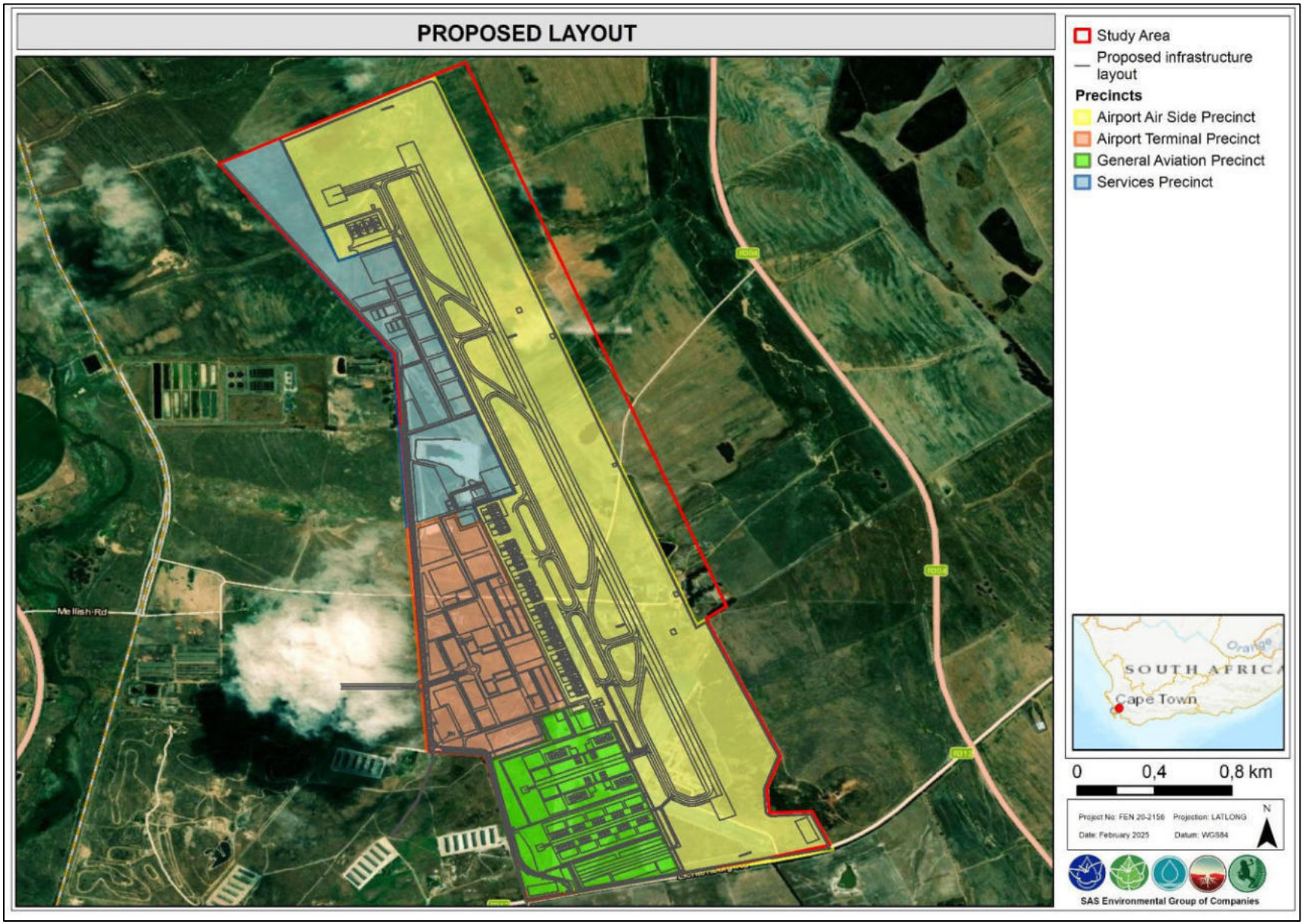


Figure 3: Proposed layout of the CWA development during Phase 2.

1.5 Applicable Legal Framework and Definitions

The following legislative documents were considered:

- The National Environmental Management Act, 1998 (Act No. 107 of 1998) as amended (NEMA);
- National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA);
  - GN 2747 (Gazette Number 47526): The revised National list of Ecosystems that are Threatened and in need of Protection, dated 18 November 2022, as it relates to the NEMBA;
  - GN R.1020: Alien and Invasive Species Regulations, 2020, in Government Gazette 43735 dated September 2020 as it relates to the NEMBA;
  - GN 1003: Alien and Invasive Species Lists, 2020, in Government Gazette 43726 dated 18 September 2020, as it relates to the NEMBA;
  - GN 3009: Regulations Pertaining to Threatened or Protected Terrestrial Species and Freshwater Species in Government Gazette 47984 dated 3 February 2023, as it relates to the NEMBA;
  - GN 3569: National Biodiversity Offset Guideline, in government Gazette 48841 dated 23 June 2023, as it relates to the NEMBA;
  - GN 3012: List of Terrestrial and Freshwater Species that are Threatened or Protected, Restricted Activities that are Prohibited, and Restricted Activities that are Exempted, in Government Gazette 47984 dated 3 February 2023, as it relates to the NEMBA;
- The National Water Act, 1998 (Act No. 36 of 1998) (as amended) (NWA);
  - GN 4167 as published in the Government Gazette 49833 of 2023 as it relates to the National Water Act, 1998 (Act No. 36 of 1998); and
  - Section 21 of the NWA lists the following activities as water uses that are applicable to the rehabilitation of freshwater ecosystems:
    - Section 21 (c): impeding or diverting the flow of water in a freshwater ecosystem; and
    - Section 21 (i): altering the bed, banks, course, or characteristics of a freshwater ecosystem.

Please refer to Appendix B for additional legislative requirements.

The 2016 best-practice wetland offset guidelines (SANBI and DWS, 2016) were also consulted during the development of this Wetland Offset Strategy report.

As part of this memorandum, the following definitions as per the NWA are of relevance:

- **Watercourse** means (a) a river or spring, (b) a natural channel in which water flows regularly or intermittently, (c) a wetland, lake or dam into which, or from which water flows, and (d) any collection of water, which the Minister may, by notice of the Gazette, declare a watercourse;
- **Wetland** means “land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil”;
- **Riparian habitat** means “the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent areas”; and
- **Regulated area of a watercourse** means (a) the outer edge of the 1 in 100-year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam, (b) in the absence of a determined 1 in 100 year flood line or riparian area the area within 100 m from the edge of a

watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench, or (c) a 500 m radius from the delineated boundary (extent) of any wetland or pan.

2 OVERVIEW: WETLAND OFFSETS

Offsets are implemented as part of a mitigation hierarchy and are specifically intended to mitigate or compensate for the residual environmental impacts of development (often referred to as "compensatory mitigation") after all viable measures have been taken to first avoid or prevent, minimize or reduce, and remediate or rehabilitate those impacts (SANBI and DWS, 2016; Figure 4). Following the mitigation hierarchy, the following is applicable with respect to offsetting:

- First, the proposed development should try to avoid or prevent negative impacts on biodiversity and ecosystem services by seeking alternative types of development, or alternative locations, different scales of development, different layouts and siting of development components, etc.;
- Secondly, if the above-mentioned alternatives have been exhausted, every effort should be made to minimize negative impacts and to rehabilitate or remediate affected areas; and
- 'Residual impacts' are what will remain after minimizing impacts and rehabilitation. These residual impacts would then need to be compensated for, and this may involve the specific application of an offset.

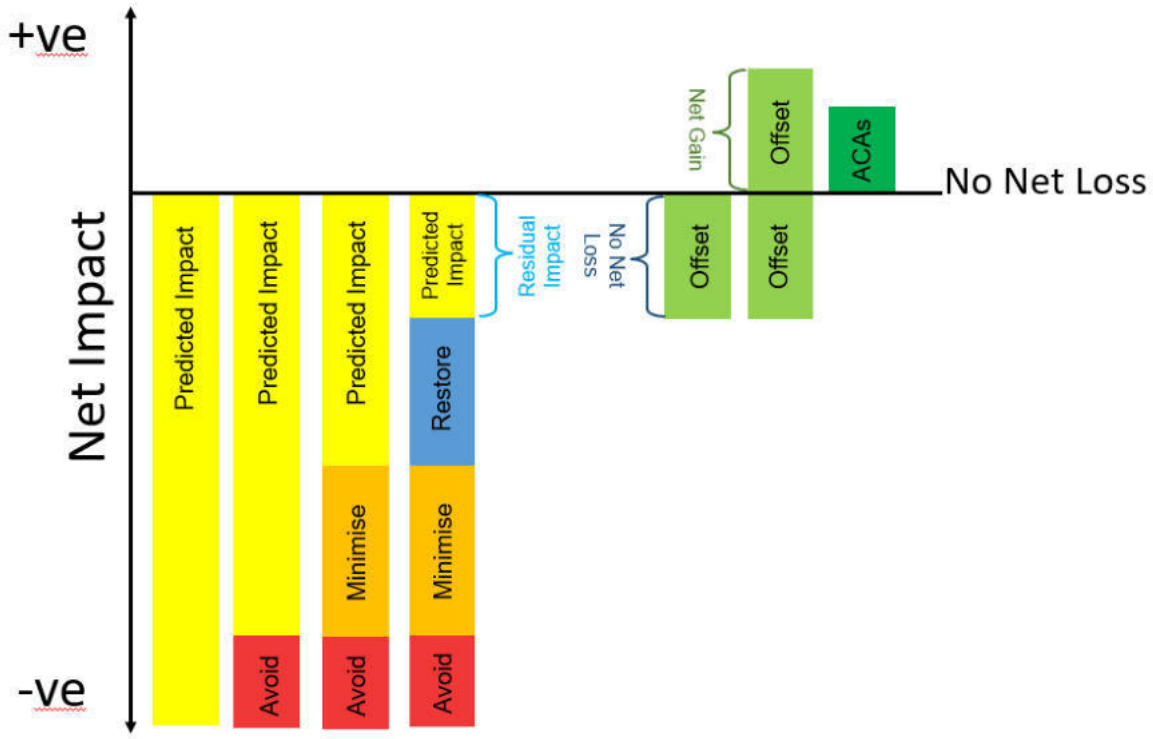


Figure 4: Depiction of the mitigation hierarchy and where offsets and additional conservation actions (ACAs) fit into the overall goal of achieving a net positive impact (NPI). Image adapted from Temple *et al*., (2012).

Environmental offsetting provides a means by which to slow – and possibly even reverse – "ecological deficit" by counterbalancing the degradation, destruction, and depletion of natural resources through protection, rehabilitation, restoration and replenishment.

The offsetting of impacts on freshwater systems is a critical component of biodiversity conservation and ecosystem management. According to the 2023 National Biodiversity Offset Guidelines, offsetting is necessary to counterbalance residual impacts on biodiversity that remain after all other mitigation measures, such as avoidance, minimization, and rehabilitation, have been applied. These guidelines emphasize that freshwater ecosystems, alongside terrestrial ecosystems, play a vital role in maintaining biodiversity and providing essential ecosystem services.

Freshwater systems are particularly susceptible to degradation due to development activities, necessitating a structured approach to mitigate these impacts. The guidelines stipulate that offsets should only be considered when significant residual impacts remain, underscoring the need for such measures to be a last resort. This approach ensures that offsets contribute to the long-term security and ecological integrity of biodiversity priority areas, including wetlands, rivers, and other freshwater habitats.

The stated goal of wetland offsets is to achieve no net loss and preferably a net gain on the ground with respect to water resources, ecosystem and habitat objectives, and species of special concern. This involves focusing on the importance of wetlands in supporting water resource management objectives, as well as recognizing the cultural values and uses of wetlands by people. Additionally, offsets should meet national and local objectives for habitat protection, avoid exacerbating the threat status of ecosystems, and prioritize the conservation of threatened, rare, or keystone wetland species (SANBI and DWS, 2016).

Effective offsetting for freshwater systems involves securing suitable offset sites that maintain or enhance the ecological conditions of similar habitats. This includes implementing comprehensive management plans and monitoring programs to ensure that the desired ecological outcomes are achieved and sustained over time. The 2016 Wetland Offset Guidelines (SANBI and DWS, 2016) further elaborate that wetland offsets should aim for "No Net Loss" and preferably a net gain concerning the full spectrum of functions and values provided by wetlands. These functions include water resource management, ecosystem services, and the protection of species of conservation concern (SCC).

Furthermore, wetland offsets are increasingly seen as a crucial tool in safeguarding against the rapid decline of wetland areas, which are under significant pressure from ongoing urban and industrial expansion. The guidelines emphasize the importance of adhering to a mitigation hierarchy, where offsets are applied only after exhaustive efforts have been made to avoid, minimize, and rehabilitate impacts. Wetland offsets cannot be applied as the only or first option and should be considered only once all other measures have been exhausted (SANBI and DWS, 2016). This approach is essential in preserving the critical ecosystem services provided by wetlands, such as water purification, flood regulation, and habitat for a wide range of species, including those that are rare or threatened.

By adhering to these principles, the offsetting process can provide measurable and lasting benefits to freshwater biodiversity, supporting the overall goal of no net loss of these critical ecosystems. Wetland offsets thus play an indispensable role in maintaining ecological balance and ensuring that development activities do not irreparably harm the natural environment.

According to the National Best Practice Guidelines (SANBI and DWS, 2016), the general wetland offset process should unfold as follows:

- Identification of issues and options to avoid and/or prevent residual negative impacts;
- Check if residual impacts would be offsetable;
- Draft preliminary offset proposal if offsets are feasible, and could and would be implemented;
- Discuss and obtain formal consent from biodiversity conservation agency/authority and competent authority to pursue detailed investigation of a wetland offset;
- Investigate wetland offset options, involving relevant specialists; and
- Where the environmental authorisation is conditional on a wetland offset, secure necessary legal agreements to implement offset, and to undertake monitoring, auditing and adaptive management.

3 ENVIRONMENTAL CHARACTERISATION OF THE STUDY AREA

3.1 Characterisation of the Freshwater Environment associated with the Study Area

FEN (2024) conducted a freshwater assessment in which all freshwater ecosystems within the study area were identified and described. The freshwater assessment confirmed the presence of a seep wetland (referred to in FEN, 2024 as seep wetland 1) in the central eastern portion of the study area (Figure 7). Numerous artificial features including impoundments and agricultural drains were also noted within the study area (Figure 7). Channelled valley bottom (CVB) wetlands were also identified within the northern and north-eastern extent of the investigation area.

The seep wetland is located on the side-slopes of a valley draining towards the larger CVB wetland located north east of the study area. The wetland has been modified as a result of impacts associated with extensive cultivation in the wetland's catchment, which has contributed to the modification of wetland vegetation composition of the seep wetland as well as the erosion of soil. The vegetation composition of the seep wetland has been replaced by ruderal and opportunistic AIPs such as *Cenchrus clandestinus*, which is heavily grazed. From a hydropedological point of view, the hydropedological processes are predicted to remain largely unmodified in the post development scenario, and the functionality of the wetlands identified within the catchment area will likely remain unchanged, provided that stormwater is appropriately managed (ZRC, 2024). Nevertheless, the proposed development will lead to the irreversible residual loss of the 6.74 ha of the seep wetland. As such, the loss of wetland habitat can only be managed by the highest level in the mitigation hierarchy, namely by means of a wetland offset.

In line with the mitigation hierarchy, as advocated by the Department of Environmental Affairs (DEA) *et al.* (2013) the following were considered as part of the investigation for the CWA development:

Table 1: Mitigation hierarchy considered as part of the CWA development.

Avoid/Prevent Impact	As part of the assessment, no other alternatives were deemed feasible due to the existing operation of the CWA at its current location. Selecting an alternative site to construct the CWA development was not considered feasible, therefore limiting areas where the expansion of the CWA could be undertaken.
Minimise Impact	The impacts on the freshwater ecosystems were minimized as far as feasibly possible by strategically placing particular development components outside and away from. Numerous discussions were undertaken between the freshwater specialist, the Environmental Assessment Practitioner (EAP) and the project engineers to determine how best to minimize the impacts of the CWA development on the surrounding freshwater environment, including strategically placing stormwater attenuation ponds outside wetland areas. The proposed CWA development initially would have included development on all of the subject properties indicated in Figure 1, which may have resulted in additional impacts to other CVB wetlands. The study area was however reduced to its current extent as indicated in Figure 1. Furthermore, the proposed CWA development would have resulted in an approximate 9 ha seep wetland loss if the entire study area footprint was to be developed, however this has also been significantly reduced to the current 6.74 ha. Lastly, as part of the layouts received for the EIA report, it was proposed to construct one of the attenuation ponds within the area considered as part of the offset investigation. The attenuation pond's location has subsequently been moved outside the offset site, to prevent any further wetland habitat loss and minimise further impacts to the wetland.

Rehabilitate/ Offset the Impact	Based on the CWA development design, approximately 6.74 ha of wetland habitat would still be lost as a result of direct impacts associated with the proposed CWA development. An ~ 40 ha area of the freshwater ecosystems and agricultural drain will be rehabilitated on site as part of the offset investigation/ requirements. Sections 4-10 below provides all relevant mitigation measures and rehabilitation actions that will be implemented.

Table 2 below presents the findings of the ecological assessment of the seep wetland within the study area.

Table 2: Summary of results of the field assessment of the seep wetland (FEN, 2024).

Freshwater Ecosystem	PES	Ecoservices	EIS
Seep wetland	Category D (Largely modified)	Very Low	Low

In addition to the seep wetland, the CVB wetland 1 into which seep wetland 1 drains (via an agricultural drain) was also assessed. The CVB wetland (termed CVB wetland 1 in FEN, 2024) was indicated to be in a seriously modified state (PES Category E) and indicated to have a moderate Ecological Importance and Sensitivity (EIS), based on the following assumptions:

- The wetland is within Critically Endangered terrestrial and wetland vegetation types, and very rare, although limited natural vegetation in the wetland remains;
- The wetland is a tributary of the Klapmuts River, which drains surface runoff from the adjacent agricultural areas toward the Klapmuts River in the north-eastern portion of the focus area;
- According to Scientific Terrestrial Services (STS; 2023a), *Grus paradisea* (Blue Crane - Vulnerable) is considered likely to pass through or utilise this CVB wetland for foraging while breeding likely takes place in adjacent cultivated fields; and
- The PES of the wetland is estimated to be seriously modified.

Figure 5: Representative photographs of CVB wetland. (Top) The topographical setting of the CVB wetland (blue dashed line) in a valley bottom position; (Bottom left) *Juncus sp.* and AIPs

including *Cenchrus clandestinus* found in the wetland; (Bottom right) Active grazing by cattle within the CVB wetland.

The WET-EcoServices model determined a moderately low to moderate supply importance for sediment trapping, nutrient and toxicant assimilation, food for livestock and cultivated foods, whereas the demand importance for regulating services, particularly sediment trapping and nutrient assimilation is considered high (Figure 6). This is attributed to the current land use of the greater area in which the CVB wetland is located, which is predominantly agricultural. The demand for biodiversity maintenance is moderate as a result of the critically endangered vegetation type in which the CVB wetland is located. The moderately high carbon storage demand importance of the CVB wetland stems from the potential of the wetland to store carbon.

After integrating the supply and demand importance scores for the central wetland, the model determined an overall moderate importance for sediment trapping and a moderately low to low importance for nutrient and toxicant assimilation, and food for livestock, yet a very low ecoservice provision for cultural and other provisioning services.

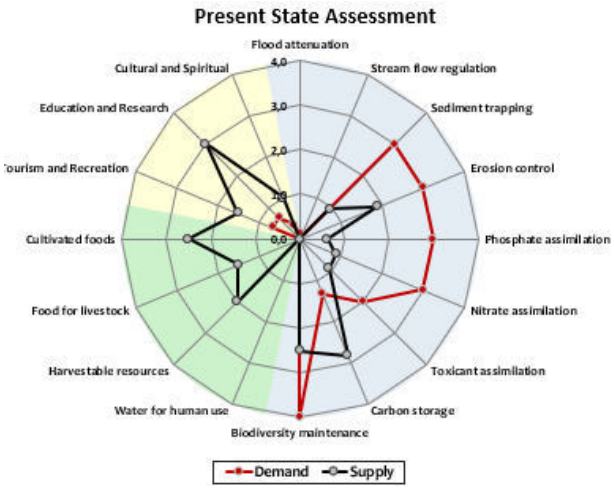


Figure 6: Results of the WET-EcoServices model for the CVB wetland, indicating the current ecosystem service provision.

The details pertaining to the methodology used to assess the CVB wetland is available in Appendix C of this report.

A risk assessment was conducted to identify the likely impacts of the development on the identified seep wetland (and downgradient wetlands in the investigation area as indicated in Figure 7), and a third site assessment was conducted on 24 April 2024, focussing on the offset considerations. The methods and results of the risk assessment associated with the offset are appended to this report as Appendix D and Appendix E, respectively.

3.2 Species of Conservation Concern associated with the Study Area

No SCC were identified during the site inspections undertaken by FEN Consulting in August and September 2022 or in April 2024. High levels of disturbance within the project footprint have significantly reduced the habitat available that could have supported floral and faunal SCC.

According to STS (2023b), no mammal or amphibian SCC were identified during the site investigations. However, two reptile SCC were identified. According to STS (2023b), numerous bird SCC may utilise the study area, although only one (Blue Crane, *Grus paradisea*) was noted on site during the field investigation in February and August 2022. STS (2023a&b) reported that the following faunal (including avifaunal, but not invertebrates) SCC are considered likely to utilise or pass through areas surrounding the proposed CWA development, and the freshwater ecosystems within and

surrounding the study area, inclusive (species indicated with an asterisk (*) are known to inhabit and/or utilise freshwater ecosystems – although some only for foraging purposes):

- Cape Sand Snake (*Psammophis leightoni*; Vulnerable);
- Cape Dwarf Chameleon (*Bradypodion pumilum*; Vulnerable);
- Blue Crane* (*G. paradisea*; Near Threatened);
- Greater Flamingo* (*Phoenicopterus roseus;* Near Threatened);
- Lesser Flamingo* (*Phoenicopterus minor;* Near Threatened);
- Verreaux's Eagle* (*Aquila verreauxii*; Vulnerable);
- Great White Pelican* (*Pelecanus onocrotalus*; Vulnerable);
- Maccoa Duck* (*Oxyura maccoa*; Near Threatened);
- Secretary Bird* (*Sagittarius serpentarius*; Vulnerable);
- Black Harrier* (*Circus maurus*; Vulnerable);
- African Marsh-Harrier* (*Circus ranivorus*; Vulnerable); and
- Lanner Falcon* (*Falco biarmicus*; Vulnerable).

Numerous other faunal species were identified during the site assessments by STS. Refer to STS (2023a&b) for more information.

SCC identified by the botanist (Nick Helme Botanical Surveys, 2024) are listed below, although it is noted that none of these species are considered freshwater ecosystem adapted plants.

- *Babiana odorata* (Endangered);
- *Drosanthemum hispifolium* (Vulnerable);
- *Ficinia* sp nov. (Not yet assessed);
- *Gladiolus watsonius* (Near Threatened);
- *Lampranthus leptaleon* (Endangered);
- *Leucadendron verticillatum* (Critically Endangered);
- *Leucospermum grandiflorum* (Endangered);
- *Metalasia octoflora* (Vulnerable);
- *Muraltia macropetala* (Vulnerable);
- *Muraltia trinervia* (Near Threatened);
- *Podalyria microphylla* (Critically Endangered);
- *Restio duthieae* (Vulnerable);
- *Restio rigoratus* (Endangered); and
- *Xiphotheca lanceolata* (Vulnerable).

As none of these species have been identified within the seep wetland to be lost by neither the botanical nor the faunal specialists, the component of SCC was not included as part of the offset assessment. Should any of the above SCC or other indigenous vegetation be found within the rehabilitation area or offset area, these should be identified (and marked) prior to the commencement of rehabilitation activities and avoided during rehabilitation activities. Rehabilitating the CVB wetland however may provide more suitable habitat for avifaunal SCC such as the blue crane and flamingos to forage.

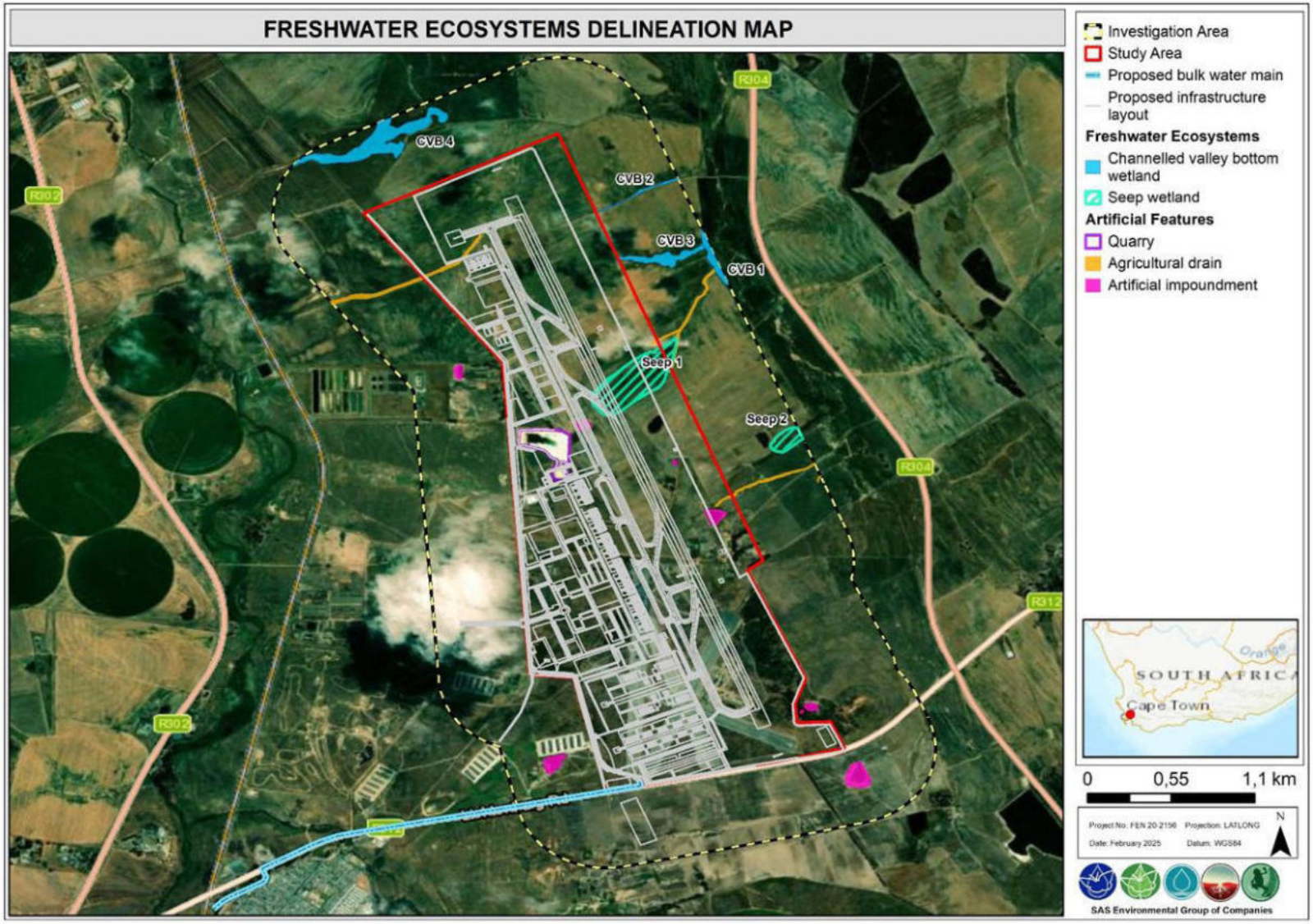


Figure 7: Map representing the delineated extent of the freshwater ecosystems and artificial features associated with the study and investigation areas and preliminary Spatial Development Plan (SDP).

4 OFFSET DETERMINATION METHODOLOGY

This section outlines the methods involved in the development of the Wetland Offset Strategy. Most of the outlined methodology is provided in Appendix F; where relevant, reference to this Appendix and the appropriate figures and/or tables is defined in the sub-sections below.

4.1 Residual Impact Assessment

Residual impacts are those impacts remaining after measures to minimise and rehabilitate/ remediate harm have been implemented. As wetland offsets are implemented to address significant residual impacts resulting from development projects (after appropriate avoidance, minimization, and rehabilitation measures have been considered), it is essential to quantify the residual impacts associated with development activities. The best-practice wetland offset guidelines (SANBI and DWS, 2016) suggest that the following key components be evaluated when assessing residual impacts. These components include (Figure 8):

- Water resource and ecosystem services;
- Ecosystem/habitat conservation; and
- SCC.

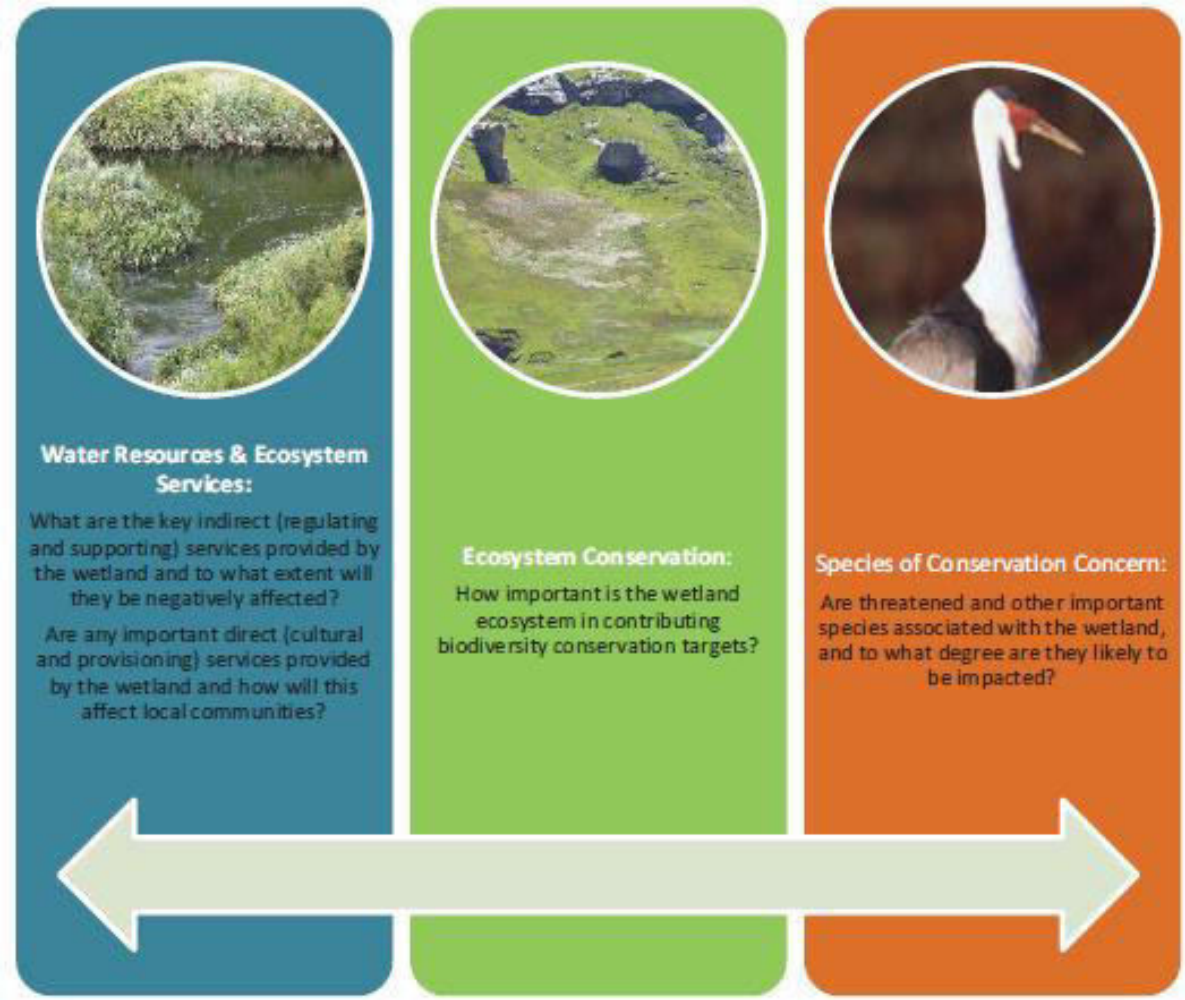


Figure 8: Key components to be considered when determining wetland offset requirements (image taken from the Wetland Offsets: best practice guidelines (SANBI and DWS, 2016)).

For the purposes of this residual impact assessment, all wetland losses were converted into the following quantities:

- **Functional hectare equivalents** in support of water resource management and disaster risk management. 'Functional hectare equivalents' are the equivalent area of wetland providing a measurable level of regulating ecosystem services (calculated as wetland area multiplied by functional value);
- **Habitat hectare equivalents** in support of ecosystem conservation. 'Habitat hectare equivalents' are the equivalent area of wetland with intact vegetation and habitat (calculated as wetland area multiplied by habitat value); and
- **Species offset ratios** in support of SCC. Ratios should be guided by factors such as threat status and the importance of the wetland in meeting species protection targets. Importantly, if no SCC make use of the wetland being investigated, then this assessment is not required (which applies to this offset strategy, refer to Section 3.2 above).

Please refer to Appendix F for methodology outlining how functional hectare equivalents and habitat hectare equivalents were calculated.

4.2 Determination of Offset Requirements and Targets

A summary of the key aspects used to calculate offset targets is provided here:

- Impacts to regulating ecosystem services in support of water resource management: Targets are set by multiplying the loss in functional hectare equivalents by the functionality importance ratio (set as 1:1 unless there are exceptional circumstances that would justify a higher ratio[1]);
- Impacts to carbon storage services in support of climate mitigation and adaptation: Targets are set by multiplying the loss in carbon hectare equivalents by the functionality importance ratio (set as 1:1 unless there are exceptional circumstances that would justify a higher ratio); and
- Impacts to ecosystem conservation: targets are set by modifying the residual impact calculations (habitat hectare equivalents) based on (i) ecosystem status, (ii) regional and national conservation context and the local context of the site.

Wetland offset targets for the three residual impact categories were calculated using wetland offset target calculators developed as part of the National Wetland Offsets Guideline (SANBI and DWS, 2016) as well as the Wet-EcoServices (Version 2) tool (Kotze *et al*., 2020). Refer to Appendix F for further details.

4.3 Site Selection and Screening

The meeting of functional (regulating ecosystem services) targets requires a gain in wetland functionality through the rehabilitation and management of a degraded site or a site under threat before protection is considered (SANBI and DWS, 2016). Functional offset targets are typically achieved through the following means (as detailed in the provided WRMP (Section 6)):

- Rehabilitation actions / interventions that reinstate ecosystem functioning and integrity and the processes to drive the supply of regulating services;

[1] Allocation of functional importance ratios for key ecosystem services (as per Wet-EcoServices (Version 2) tool (Kotze *et al*., 2020)) are defined as: 0.75 (demand between 0 – 1.0) for wetlands located within a context where they provide very limited benefits to society, 1 (demand between 1.1 – 2.0) for wetlands that are quite poorly placed to address key water-resource challenges, 1.25 (demand between 2.1 – 3.0) for wetlands that are well positioned to address key water-resource challenges, and 1.5 (demand > 3) for wetland located in critical areas, where wetland functions are particularly important .

- Actions that avert the loss of a wetland that is likely to degrade in the future (i.e. a headcut is migrating upstream through a wetland) (referred to as averted loss'); and/or
- The creation of a new artificial wetland referred to as 'establishment'.

In the first phase of the offset study, several *offset candidate sites* are considered. Candidate sites may include both on-site and off-site wetland offset options. A suite of site selection criteria has been identified by the National Wetland Offset Guidelines (DWS and SANBI, 2016), and are summarised in Table F6 (Appendix F). Final offset site selection must ensure that suitable compensation for the loss of freshwater features due to the proposed development is achievable, while addressing the suitability of a site in terms of meeting Water Resource and Ecosystem Service requirements (as per criteria listed in Table F6 (Appendix F).

The potential wetland offset candidate sites were screened in terms of the site selection criteria (Table F6, Appendix F). The offset candidate sites included the screening of numerous wetlands within the greater Fisantekraal and Durbanville area, including on-site and off-site wetlands. The desktop screening involved assigning scores to each of the selection criteria and the integration of these scores in the structured way for prioritisation purposes and the evaluation of the potential outcomes of identified preliminary offset options at a desktop level using applicable assessment tools and guidelines.

5 OFFSET RESULTS

The sections below provide the results pertaining to the offset strategy.

5.1 Residual Impact Assessment and Wetland Offset Targets

The wetland located within the study area is 10.42 ha in extent. The extent of the wetland to be lost as a result of development activities is 6.74 ha (an additional 0.7 ha wetland loss was also included in the offset calculations to account for indirect impacts, resulting in a total 7.44 ha area to be lost as a result of the proposed CWA development), whereas the remaining 3.68 ha of wetland will remain (Figure 9).

The following **residual impacts** were calculated for the seep wetland:

- Loss of **3.97 functional hectare equivalents (HaE)** of wetland (Table 3); and
- Loss of **1.86 habitat HaE** of wetland (Table 4).

Table 3: Summary of findings of the offset calculations for functional hectare equivalents.

Integrating scores to assess Functional Value & Hectare Equivalents		
Function / Service Groups	**Weighting (%)**	**Present State**
Flood Attenuation	10%	0.7
Streamflow Regulation	10%	1.0
Sediment Trapping & Erosion Control	20%	1.3
Water Quality Enhancement	60%	1.3
Weighted Supply Score		1.2
Realistic Reference score		3,2 (default)
Functional Value (%)		38.1 %
Wetland Area (Ha)		10,42
Functional Hectare Equivalents (Unadjusted)		**3.97**

Table 4: Summary of findings of the offset calculations for habitat hectare equivalents.

Ecosystem Conservation Targets			
Impact Assessment	Prior to development	Wetland size (ha)	7.44 (includes a 32m indirect impact)
		Habitat intactness (%)	25
	Post development	Habitat intactness (%)	0
		Change in habitat intactness (%)	25
	Development Impact (Habitat hectare equivalents)		1.86

The following **functional offset targets** were calculated:

- The functional offset target is to gain and secure **3.97 functional HaE** in the region through the rehabilitation and protection of wetlands (3.97 multiplied by the functional importance ratio of 1 = 3.97); and
- The ecosystem conservation target is to secure and protect **13 habitat HaE** of intact and representative wetland habitat, within the West Coast Shale Renosterveld wetland vegetation region (Table 5).

Table 5: Summary of findings of the offset target calculations for ecosystem conservation.

Ecosystem Conservation Targets				
Determining offset ratios	Ecosystem Status	Wetland Vegetation Group (or type based on local classification)	West Coast Shale Renosterveld	
		Threat status of wetland	Threat status	CR
			Threat status Score	15
		Protection level of wetland	Protection level	Not Protected
			Protection level Score	2
		Ecosystem Status Multiplier		30
	Regional and National Conservation context	Priority of wetland as defined in Regional and National Conservation Plans	Not specifically identified as important	0.5
		Regional & National Context Multiplier		0,5
	Local site attributes	Uniqueness and importance of biota present in the wetland	Low biodiversity value	0,5
		Buffer zone integrity (within 500m of wetland)	Buffer compatibility score	0,2
		Local connectivity	Moderate connectivity	0,75
		Local Context Multiplier		0,5
	Ecosystem Conservation Ratio			6.98
Offset Calculation	Development Impact (Habitat hectare equivalents)		1.9	
	Ecosystem Conservation Ratio		7.0	
	Ecosystem Conservation Target (Habitat hectare equivalents)		13.0	

It should be noted that rehabilitating only the remainder of the seep wetland (3.68 ha) will not be sufficient to achieve the 3.97 HaE wetland functionality and 13 HaE ecosystem conservation target. A CVB wetland which is fed by the seep wetland via an agricultural drain was therefore also investigated to achieve the offset target.

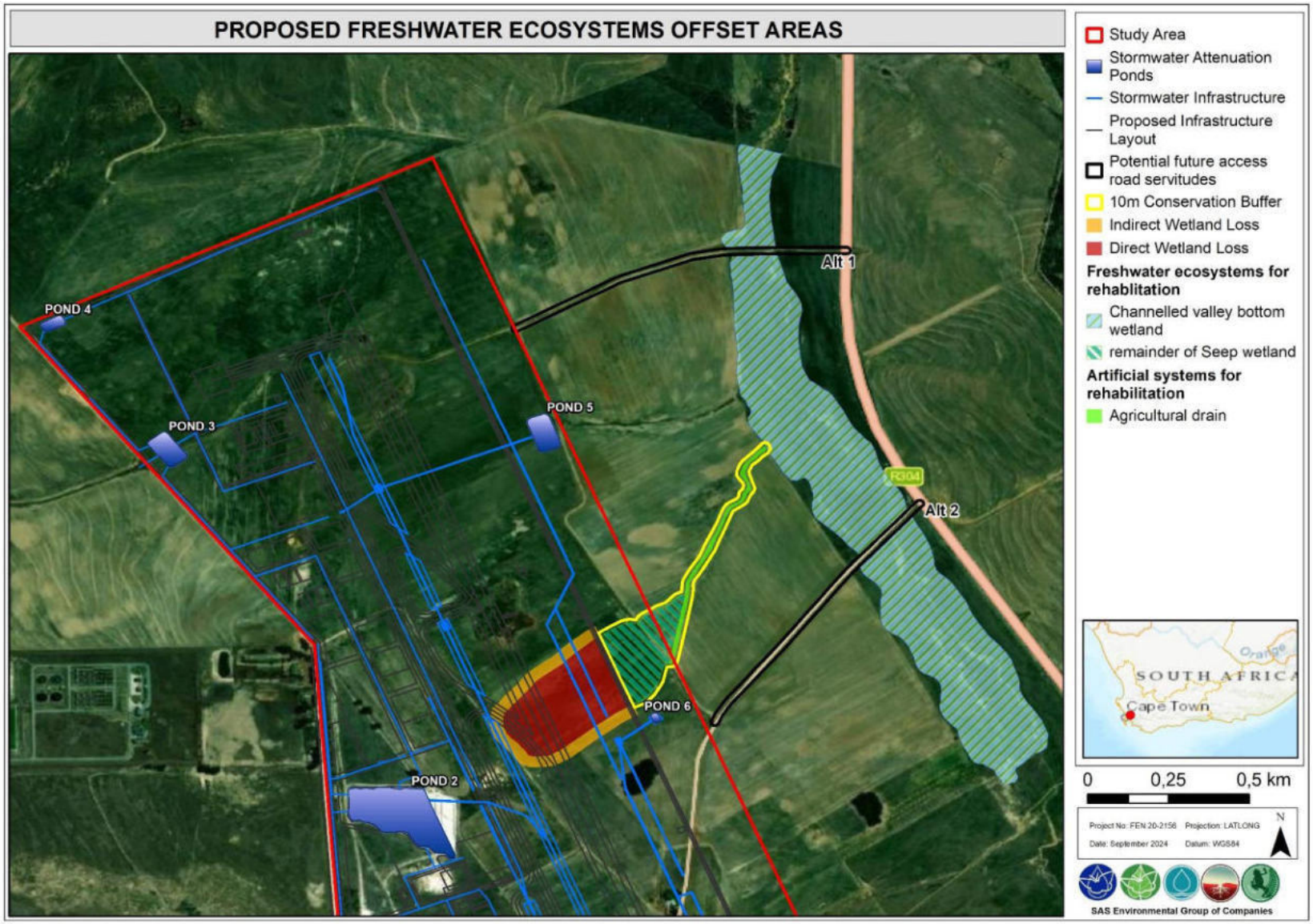


Figure 9: Extent of wetland to be lost (7.44 ha) *vs* identified wetland areas to be rehabilitated.

5.2 Site Selection and Screening Results

During meetings held with various officials, including the City of Cape Town, Cape Nature, the DEA&DP and the DWS, various offset options were discussed. A consensus was reached that an on-site offset would be beneficial to the area, particularly on the Remaining Extent (RE) of Farm 474, Joostenbergs Kloof and Portion 7 of Farm 942, Kliprug (Figure 1). This is based on the “like for like” concept, where biodiversity offsets generally target features or areas with similar biodiversity as that impacted by the proposed CWA development. As indicated by the offset calculator tool, in order to compensate for the 6.74 ha loss (combined loss of 7.44 ha) of the seep wetland, 3.97 HaE of wetland functionality and 13 HaE of ecosystem conservation has to be achieved. As a result, offsetting only the remainder of the seep wetland (3.68 ha) will not be sufficient to achieve the 3.97 HaE wetland functionality and 13 HaE ecosystem conservation target. A CVB wetland which is fed by the seep wetland via an agricultural drain was therefore also investigated to achieve the offset target.

During the project brief provided to the DWS, it was also discussed that future development in the form of constructing access roads through the CVB wetland may be necessary and has already been incorporated into future development planning by the Western Cape Government (see Figure 10 and Figure 11 for the preliminary Access Management Plan) for future development from the R304 situated east of the study area. Based on the Access Management Plan (ITS Engineers, 2012), some access road alternatives are being considered of which two may traverse the potential offset area (see Alt 1 and Alt 2 in Figure 9). During discussions of the Access Management Plan with the Environmental Assessment Practitioner (EAP), it was recommended that existing access roads be upgraded rather than constructing new roads, resulting in new impacts. During the meetings with the authorities it was discussed that only one of the road alternatives are to be utilised and/or formalised while the other is rehabilitated. Subsequent to the meetings, it was discussed and a consensus was reached with the project team that both road alternatives (Alt 1 and Alt 2) will remain or be formalised. Both road alternatives are subject to the necessary environmental authorisation processes prior to them potentially being developed in the future and as such, the two access roads that may traverse the CVB wetland offset area were incorporated into the offset calculations to account for the future use of the roads. General control measures applicable to roads are provided in Appendix E. If Alt 1 will be constructed or formalised, CVB wetland 2 north of the road is to be rehabilitated.

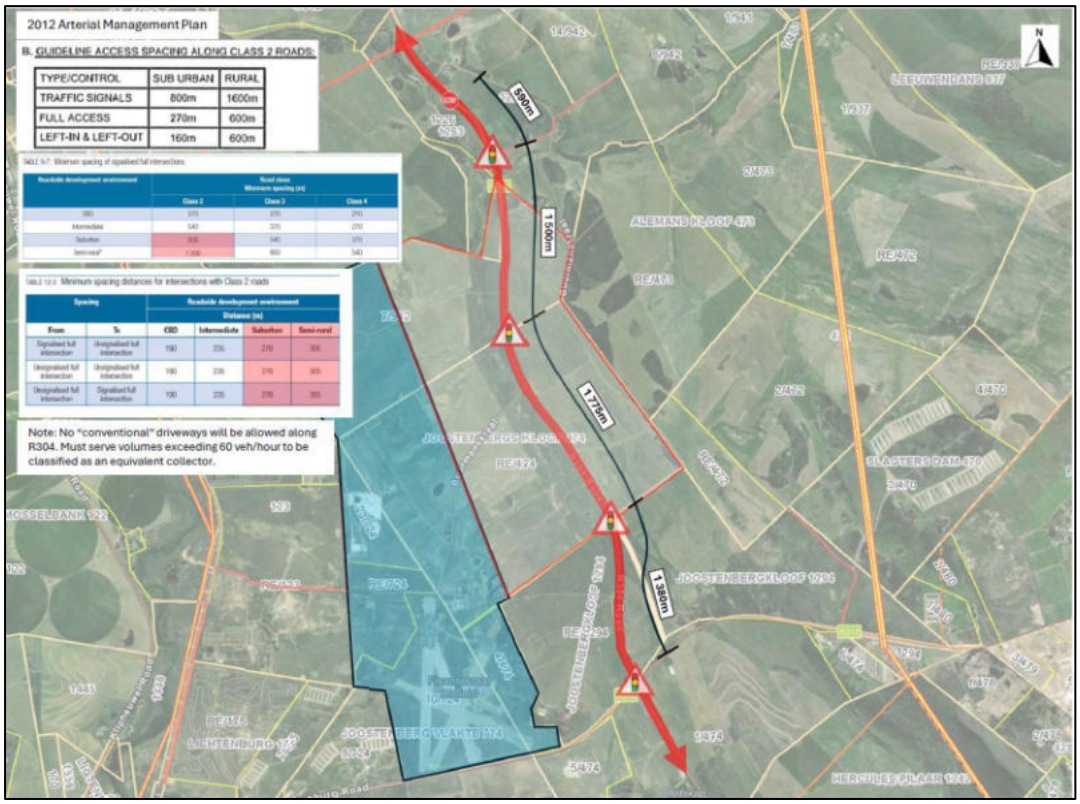


Figure 10: Draft Arterial Management Plan for the R304 (provided by the EAP).

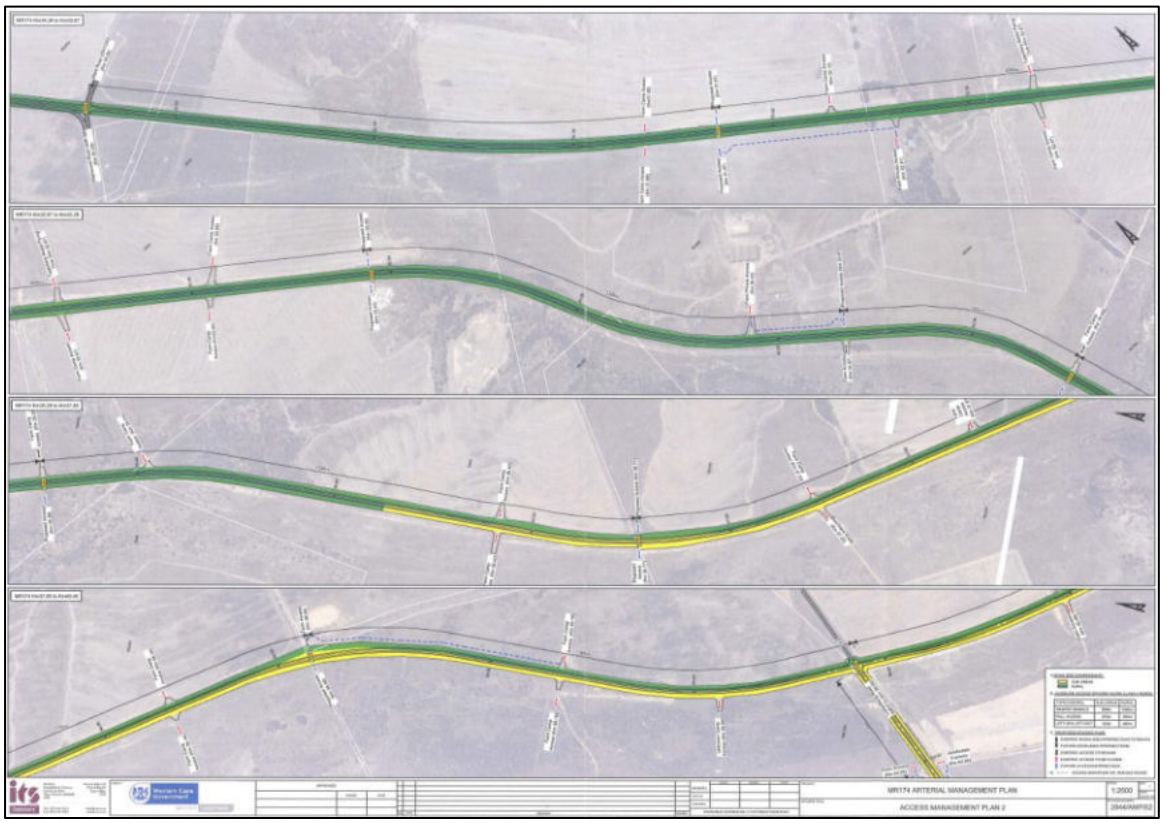


Figure 11: Draft Access Management Plan for the R304 (ITS Engineers, 2012).

The remaining wetland habitat east of the study area as well as the CVB wetland were thus selected as an on-site wetland offset (Figure 9) as these features have good rehabilitation potential and is already owned and/or managed by the proponent (Table 6). This reduces the risk of unsuccessful implementation of the offset significantly.

Table 6: Summary of preliminary screening assessment of potential candidate offset sites. Refer to Table F6 for further details on the various selection criteria.

Offset Site	Wetland habitat & HGM type	Landscape / Conservation planning	Wetland condition	Local biodiversity value	Ecological viability	Land-legal Issues	Downstream demand	Rehabilitation opportunities
Remaining seep wetland within the study area	Ideal	May be acceptable	Ideal	Acceptable	Potentially acceptable	Acceptable	Acceptable	Ideal
CVB wetland	Acceptable						Ideal	Acceptable

The key reasons of the decision to pursue the remainder of the seep wetland and the CVB wetland as the only option for wetland offset are:

- The land on which the offset site is located is owned and controlled by the CWA, which simplifies management of the wetlands and offset contribution as the community conflict risk in terms of land use is very low;
- Like-for-like offset will be achieved since the WET-VEG type of the development site and the offset area is the same, i.e. West Coast Shale Renosterveld (as indicated in Table 6);
- Offsetting ~40 ha of wetland area to compensate for the loss of 6.74 ha of seep wetland is considered a meaningful conservation and restoration effort which will create awareness to the public and private sectors with regards to the importance of wetland conservation; and
- The financial contribution to offset ~40 ha of wetland area will not amount to amount to wasteful expenditure as the CWA will manage the wetlands in perpetuity (at least for 30 years).

As part of the wetland offset investigation, various government officials and other relevant stakeholders were consulted to determine whether the above rehabilitation actions are deemed sufficient to offset the 6.74 ha seep wetland within the study area. During meetings held on 7 June 2024 and 16 September 2024, it was confirmed that all parties involved in the discussion support the rehabilitation of the seep wetland and CVB wetland hydrogeomorphic (HGM) unit as the target offset area (refer to Appendix J which contains minutes of meetings and the signed Memorandum of Understanding indicating CWA's commitment to undertake the wetland offset).

The following should be noted with regards to the selection of the remainder of the seep wetland and CVB wetland HGM unit:

- From a hydropedological point of view, the operation of the proposed CWA development, including the stormwater from the proposed development that will be released in an attenuated manner into the surrounding environment, will not negatively affect the rehabilitative efforts associated with the offset area, should the rehabilitation plan outlined in this report be implemented. The soils were found to be largely stagnating, characterised by the cemented layers which inhibits free vertical drainage of water and therefore, if water is released in an attenuated manner, it will likely mimic the natural flow of water;
- The bird strike specialist, Mr Albert Froneman, has indicated that the offset site in its current location will not significantly contribute to an increase in potential bird strikes associated with the operation of the proposed CWA development as the creation of open ponds within the offset site that attract large birds for foraging will be avoided (pers. comm.); and
- A wildlife management plan will be compiled for the proposed CWA development, which is to, with consideration of the nature of the CWA development, incorporate the recommendations of this offset plan in the management of wildlife on site and within the offset area.

5.3 Wetland Offset Gains

The selected wetland offset site encompasses ~40 ha which is available for offset purposes, thus offering enough area to fulfil the required offset targets. Specifically, these sites effectively meet the needs for both functional (3.97 ha) and habitat HaE (13 ha; Table 7). The suitability of these sites is further reinforced by the use of a like-for-like HGM unit (seep wetland) and the significant potential for ecological restoration through targeted rehabilitation activities, particularly given their current status as a category D (seep wetland) and category E (CVB wetland) wetlands, respectively. These factors make the selected wetlands an ideal choice for achieving the long-term conservation goals associated with the project.

Table 7: Wetland offset target calculation.

	Wetland offset target (HaE)	Proposed offset area (HaE)	Final offset contribution (ha)*		Comments
			Seep wetland	CVB wetland	
Wetland functionality (HaE)	3.97	4.1 (0.3+3.8)	3.68	36.2	Offset contribution exceeds as what is required by the offset target
Ecosystem Conservation (HaE)	13.0	30.5 (2.8+27.7)			Offset contribution exceeds what is required by the offset target
Species Conservation (HaE)	-	-			Not assessed, however the biodiversity offset along with the wetland offset is regarded as appropriate to address species loss.

* The final offset contribution is the sum of the offset contribution of the respective wetlands, therefore equating to ~40 ha.

6 REHABILITATION AND MANAGEMENT PLAN

To identify and direct an optimal rehabilitation process, or to adopt the best possible/practicable rehabilitation approach, the desired outcomes of rehabilitation should be clear from the start. The designed Rehabilitation Plan is a system that seeks to achieve a required end state and will describe the activities required for the rehabilitation of the portions of the freshwater ecosystems within the study area.

Three key concepts are considered during rehabilitation strategies, e.g., “remediation”, “rehabilitation” and “restoration”, each with slightly different objectives and concepts. Below is a list of important terminology as adapted from McDonald *et al.* (2016) and Hattingh (2019):

- **Remediation** is the environmental clean-up of land and water contaminated by organic, inorganic or biological substances;
- **Rehabilitation** is the transformation of land disturbed from its original condition to a new and beneficial condition that does not necessarily resemble the pre-disturbance condition. Practical rehabilitation should consist of the following phases in best practice:
  - Structural rehabilitation involves the physical rehabilitation of areas, by means of earthworks, potential stabilisation of areas as well as any other activities required to develop a long term sustainable ecological structure;
  - Functional rehabilitation ensures that the functionality of the ecosystem (associated with the affected areas) supports the intended post-closure land uses. This requires monitoring during and after the rehabilitation project;

- Biodiversity reinstatement ensures that a reasonable level of biodiversity is re-instated to a level that supports the proposed post-closure land uses. In this regard special mention is made of re-instating vegetation to levels which will allow the natural climax vegetation community to become re-established or community suitable for supporting the intended land use; and
- Species reinstatement focuses on the re-introduction of any ecologically important species which may be important for socio-cultural, ecosystem functioning and conservation reasons. Species reinstatement need only occur if deemed necessary; and

➢ **Restoration** is defined as "the artificial acceleration of the processes of natural succession by putting back the original ecosystem's function and form" (Hattingh, 2019). The aim of any ecological restoration activity is to achieve ecosystem recovery as far as possible, so that the repaired ecosystem resembles an appropriate local native model.

Rehabilitation and restoration are a hierarchical and iterative process. Efficient planning of a rehabilitation or ecological restoration project involves clearly defining what terminology will be used to describe desired outcomes. Additionally, it is useful to have a hierarchy of those terms to efficiently organise planning and create timeframes in which certain outcomes from project efforts are to be achieved. Figure 10 is a hypothetical example of a hierarchy of terms to define and guide the rehabilitation and restoration initiative (adapted from McDonald *et al.,* 2016) which defines the level of detail of planning at each point in the hierarchy. Refer to Appendix G for additional information on the rehabilitation framework approach.

Vision:
Vision for the post rehabilitated landscape

Target:
Specific Target Ecosystems. Key ecosystem attributes for monitoring

Principles:
Finer level of focus. Status of target to achieve in long term. Broadly defines how desired target status will be achieved

Strategy & Objectives:
The changes and intermediate outcomes required to achive project goals. These need to be specific, measurable, achievable, realistic and time-bound. Makes use of quantifiable indicators

Criteria:
Includes indicators of restorative success/failure, e.g: Cessation of livestock grazing and weed dumping within 1 year. Criteria will include collecting data on the six key ecosystem attributes

Figure 12: Example of the hierarchy of terms to assist in achieving long term and short-term rehabilitation goals.

6.1 Rehabilitation Vision, Targets and Objectives

6.1.1 Vision

The vision for the post-rehabilitated seep and CVB wetland ecosystems is presented in the box below (note that the remainder of the seep wetland and the portion of the CVB wetland to be rehabilitated is collectively referred to as the 'freshwater ecosystems' in the box below):

WETLAND VISION

To ensure that the freshwater ecosystems are protected and rehabilitated, it is necessary to restore them to a structure and degree of functionality that offsets the loss of the western section of the seep wetland. This approach aims to ensure no net loss of ecological and socio-cultural functionality of the affected wetland system in the region. Additionally, it seeks to conserve the remaining portion of seep wetland habitat (and an additional portion of the CVB wetland) for the benefit of present and future generations including use for awareness initiatives pertaining to wetland resource management and offsets.

Should additional offset be required as a result of potential future development (over and above what was assessed as part of this offset investigation which included the future access roads through the CVB wetland) in the vicinity of the CWA, the vision is to further improve the ecological functionality of the freshwater ecosystems from the current target of 56% for the seep wetland and 54% for the CVB wetland HGM unit to closer to 70%, thereby further improving the ecological condition and functionality of the freshwater ecosystems by between 14 and 16% to moderately modified (Category C) systems. This would allow additional compensation and offset of future impacts that may arise as the CWA precinct develops, but may require extensive intervention. Long-term monitoring will also be required to inform the extent and nature of the required intervention.

6.1.2 Targets

The overarching target for rehabilitation has been defined as a point in the restoration continuum where the ecosystem function of the wetland hydrogeomorphic units proposed for conservation / rehabilitation has been restored to a point where the no net loss of wetland functionality and habitat occurs and ecoservice provision of the wetland hydrogeomorphic units improves without further human intervention to compensate for the direct impact and loss of functionality as a result of the proposed CWA development.

6.1.3 Objectives

The rehabilitation objectives for the wetland offset areas were determined to be:

- Re-establishment of hydrological drivers and geomorphological processes and associated improvement of wetland habitat to a functional state that ensures no net loss from the pre-development conditions including ecological importance and sensitivity and goods and services provision of regional wetlands;
- Improve stormwater management from the surrounding areas (especially since stormwater from the proposed CWA will be released into the seep wetland and considering the extensive erosion observed in the agricultural drain and CVB wetland) in a manner that supports the hydrological and geomorphological processes supporting the wetlands; and
- AIP species removal within the wetland hydrogeomorphic units proposed for conservation / rehabilitation, where required.

Table 8 summarises the broad rehabilitation objectives defined for the developed offset. It is important to note that because the rehabilitation process and associated framework is iterative, these rehabilitation objectives may be updated as part of the adaptive management components of the framework.

Table 8: Key rehabilitation objectives identified.

Aspect	Rehabilitation objective
Wetland	
Surface landform design	• To re-slope disturbed areas within parts of the CVB wetland reach and the agricultural drain to ensure that the natural wetland drainage regime is restored;

Aspect	Rehabilitation objective
Wetland	
	• To restore disturbed areas within parts of the seep wetland and CVB wetland reach and their associated catchments to ensure that the wetland functionality is improved; and • To reduce the impacts of soil erosion and maximise the probability of vegetation establishment.
Water (quantity and quality) – Stormwater inputs	• To implement appropriate stormwater-related management controls to ensure that stormwater emanating from the catchment of the seep wetland is managed so that it does not result in hydrological, geomorphological and water quality-related impacts in the landscape. This is partly included in the Stormwater Management Plan of the CWA (Zutari, 2024).
Alien Invasive Plant Control	• To remove identified AIP species within the wetlands and agricultural drain using best practise methods, as and when required; and • To monitor priority AIP areas and implement corrective actions.

6.2 Rehabilitation Process Outline

The proposed rehabilitation framework is represented in the diagram below (Figure 13). The process is described in Sections 7 to 10 that follow.

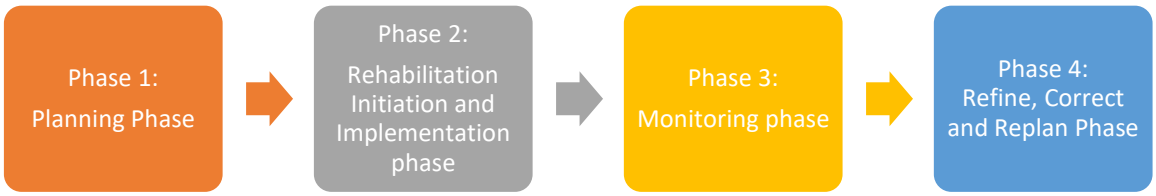


Figure 13: Rehabilitation framework for the proposed offset associated with the proposed CWA development.

7 PHASE 1 – PLANNING PHASE

This section sets out the necessary steps required for initial rehabilitation practices. It focuses on planning and identifying the need for concurrent rehabilitation activities (that can be set out in conjunction with construction and operational activities) as well as the requirements for long term rehabilitation planning in preparation for closure.

The provided rehabilitation plan serves as a management tool for the wetlands to be offset, designed to compensate for the anticipated wetland loss due to the proposed development activities. This ensures no net loss of remainder of the seep wetland and CVB wetland and, as much as possible, maintains the socio-cultural functionality and ecoservices provided by the affected wetland ecosystems. This will be achieved by rehabilitating and restoring the remaining seep wetland area and CVB wetland located in the east of the study area.

The developed WRMP presented in this report aims to improve the ecological integrity of the remaining (undeveloped) seep wetland habitat, a portion of the CVB wetland and the agricultural drain connecting the seep to the CVB wetland. It outlines how proposed development activities, which will directly impact a seep wetland within the study area, will be compensated through rehabilitation, management, and monitoring efforts. The plan also identifies the responsible parties and relevant timeframes for implementing these measures. The rehabilitation is envisaged to take no more than one year with minor potential aftercare and maintenance subsequently where interventions took place.

7.1 Principles

The principles of the planning phase are associated with the rules and principles that are set in place for successful rehabilitation to be achieved. A principle is a fundamental 'truth or law' that defines the direction or reasoning for a particular action. For rehabilitation planning, rehabilitation principles are used to define site-specific rehabilitation objectives and actions.

The principles associated with the proposed rehabilitation framework for the proposed CWA development offset are discussed in their relative components in the Table 9. These principles will need to be enforced throughout the proposed rehabilitation plan.

Table 9: Key principles identified for the offset and rehabilitation framework to be implemented for the wetlands associated with the CWA development offset.

Component	Principle/s
Financial Provision	• Sufficient financial resources must be set aside for the rehabilitation actions, including capital expenditure for procurement of required equipment and workforce and for ongoing and adaptive maintenance and management, as well as for required monitoring.
Regulatory Compliance	• Rehabilitation planning must be in accordance with legal compliance. • All proposed rehabilitation objectives and associated implementations will not conflict with local legislation. All rehabilitation objectives and associated activities will aim to comply with all relevant legal bodies, and where possible, go beyond legal compliance and add additional ecological value. • Approvals for work in sensitive habitats such as the threatened vegetation types, CBAs, and ecological support areas (ESAs) in terms of the NEMA.
Contractor Appointment	• Appointment of a suitably qualified Contractor(s) to undertake the required work: - Appointment of an implementing agent to audit and monitor the rehabilitation activities as well as to undertake the required post rehabilitation monitoring. - Should the Contractor not have the appropriate expertise for implementation of this plan then it is the responsibility of the Contractor to appoint a suitably qualified specialist ecologists to manage and oversee the implementation.
Stakeholders	• All stakeholders that will be affected by the rehabilitation measures will be identified and involved in the rehabilitation planning throughout the project lifecycle (as required). • Rehabilitation planning will be informed and accordingly adjusted based on stakeholder views, cultures and/or customs, possible uses and needs of the landscape.
Alien and Invasive Plant Clearing	• AIP species clearing will occur concurrently throughout the construction and operational phases of the CWA development, including in the development footprint and in the downstream reach of the wetlands to be rehabilitated. • Burning permits for AIP clearing will be required (if stack burning is to be utilized).
Monitoring	• Monitoring will be initiated at the first implementation of any rehabilitation activity. • Monitoring of the rehabilitated areas will be conducted progressively throughout the development's lifecycle and in conjunction with concurrent rehabilitation activities. • Data obtained from ongoing monitoring practices will be regularly assessed to identify trends that can demonstrate the success and/or failure of implemented rehabilitation activities. • The monitoring process will be linked to corrective, adaptive management practices.
Adaptive management	• An adaptive management protocol will be employed on-site, thus allowing for the implementation of alternative and improved rehabilitation activities and strategies so that corrective action can be implemented where required.

8 PHASE 2 – REHABILITATION INITIATION AND IMPLEMENTATION PHASE

This phase involves the rehabilitation activities needed to reach rehabilitation targets. This phase involves the in-field rehabilitation context of the rehabilitation plan set out in the planning phase, i.e., the on-site implementation of rehabilitation activities (e.g. surface landform design activities, AIP clearing etc., as set out during the planning phase).

8.1 Site-Specific Wetland Rehabilitation

A detailed site-specific WRMP has been developed for the target wetland areas located within the east of the study area.

Successful rehabilitation depends upon cogent conceptual planning, research and design flexibility. The proposed site-specific mitigation measures for the rehabilitation of the target offset areas are listed in Table 10. Note that the mitigation measures outlined in the Freshwater Impact Assessment report (FEN, 2024) remain applicable and must be implemented within the study area.

It is the opinion of the freshwater specialist that fairly extensive works need to be undertaken within the CVB wetland, agricultural drain and surrounding area, as part of the proposed rehabilitation and reinstatement to ensure the required ecoservice provision is maintained/improved and a PES of at least Category D (as per the requirements of the Wetland Offset) is achieved over the long-term. Rehabilitation works required for the seep wetland however does not require as extensive works as that of the CVB wetland and agricultural drain. The following main activities were identified, and the following sections provide relevant mitigation and rehabilitation requirements to address the activities required for the respective freshwater ecosystems:

- Removal of vegetation (AIPs and harvesting suitable wetland plants for revegetation);
- Remediation of gully and headcut erosion and resloping sections of CVB wetland and agricultural drain;
- Revegetation of the reinstated wetland footprint areas and agricultural drain; and
- Stormwater management from the study area.

Table 10 below summarises the rehabilitation requirements described above, which is elaborated on in Sections 8.2 to 8.5.

Table 10: Specific mitigation measures related to the freshwater ecosystems of the target offset areas to be implemented during the rehabilitation of the wetlands.

Specific Mitigation Measures for the target offset areas				
Rehabilitation Phase				
Responsible Persons				
Proponent	**Project Manager**	**Civil Engineer**	**ECO**	**Contractor**
Objective/ Requirement	**Control measures**			
Rehabilitation of impacted areas within the wetland target offset area proposed for conservation / rehabilitation.	**AIP clearing**			
	• The AIPs found within the study area and target offset area must be removed during the initial phases of the rehabilitation of the target offset area, which includes: o The target offset area must be monitored for alien and invasive vegetation encroachment and all alien vegetation/weeds must be removed according to the alien vegetation control plan as described in Section 8.2 of this report. This is to include freshwater (i.e. aquatic/ water-related) invasive species, should these be detected within the waterbodies. Annual follow up should be undertaken for at least 3 years post construction to prevent further spread of AIPs in the target offset area; and o Where applicable for the eradication of AIPs, care should be taken with the choice of herbicide to ensure that no additional impact and loss of indigenous plant species occurs due to the herbicide used and water contamination is avoided.			
	Remediation of gully and headcut erosion (particularly within the CVB wetland and agricultural drain)			
	• Following completion of the construction activities associated with the CWA development, particularly given the increased risk of runoff, headcut erosion is of concern. Extensive headcut erosion is prevalent within the agricultural drain and CVB wetland, which if left unmanaged, such erosion will result in increased wetland habitat loss. It is thus imperative that headcuts and associated gullies be remediated as detailed in Section 8.3 below. below (when/if the need arises). This will involve:			

Specific Mitigation Measures for the target offset areas				
Rehabilitation Phase				
Responsible Persons				
Proponent	**Project Manager**	**Civil Engineer**	**ECO**	**Contractor**
Objective/ Requirement	**Control measures**			
	○ Resloping and re-grading the outer perimeter of the agricultural drain to a maximum of a 1:3.5 slope thereby creating a gradual slope which will improve flow patterns within the agricultural drain; and ○ Resloping and re-grading the outer perimeter of the CVB wetland in portions to a maximum of a 1:4 slope thereby creating a gradual slope towards the boundary of the CVB wetland area and creating temporary and seasonal wetland zones.			
	Rehabilitation of natural flow patterns within the wetlands, agricultural drain and its immediate catchment			
	• Rehabilitation of natural flow paths can be achieved through the following: ○ The construction of bioswales at stormwater exits to support downgradient wetland areas (more specifically the seep wetland) with water released in an attenuated and polished manner; ○ Modify the land surface particularly within the vicinity of the CVB wetland and agricultural drain to create a gentle slope that facilitates natural water flow into and through the CVB wetland to encourage spreading of flow and infiltration; and ○ Plant native vegetation that is adapted to local hydrological conditions in the seep wetland, CVB wetland and agricultural drain. Vegetation can help slow down water flow, increase infiltration, and reduce erosion. It should be noted that stormwater ponding should be avoided to, where possible, prevent attracting larger birds from foraging, thereby reducing potential bird strikes during the operation of the CWA. An avifaunal specialist must be appointed to provide input into the design and must oversee the rehabilitation activities to ensure that areas suitable for ponding is not created. Refer to Section 8.4 for more detail. A suitably trained specialist should be consulted to guide on species selection and species propagation and planting techniques.			
	Stormwater management and wetland recharge practices			
	• Appropriate stormwater management can be used to recharge the remaining seep wetland. ○ Considering the type of development (runway) and the bird strike potential, the stormwater management plan (Zutari, 2024) makes provision for dry attenuation ponds and dry swales, which does not support the ecological requirements of freshwater ecosystems' flora and fauna. As per Zutari (2024), stormwater from the study area will be treated via an infiltration process and only during a stormwater event larger than a 1 in 50 year event will stormwater be released into the remainder of the seep wetland as overland flow; ○ Ensure stormwater and associated runoff does not create erosive supercritical flows that would otherwise alter the natural hydrological regime, particularly considering the above; and ○ Design stormwater management infrastructure to mimic natural hydrological processes as far as possible; for example, ensure outlets at the dry swales are equipped with flow dissipating structures such as cobbles.			
Post Rehabilitation Phase				
Long-term monitoring and maintenance	• Establish a monitoring program to regularly check water quality and hydrological parameters. Maintenance plans should be in place to address any issues that arise, e.g., blockages in stormwater infrastructure or changes in vegetation health, etc. The monitoring program is to include wetland health and driver and receptor monitoring to ensure the maintenance and where possible improvement of wetland condition, particularly after the implementation of the offset activities; and • Develop an adaptive management plan that allows for adjustments in key areas (e.g., stormwater management practices, AIP or erosion control, etc.) based on monitoring results and changing environmental conditions.			

8.2 Alien and Invasive Plant Species Clearing

To allow for appropriate management interventions, AIPs within the target offset area need to be appropriately managed. Control of AIPs within the target offset area is important as these areas can act as a source for AIPs to spread if left uncontrolled. The control of AIPs will be most effective if it proceeds in phases. The three most important phases to consider during AIP control are:

- Phase 1: Initial control.
  AIPs must be removed from the target offset area. Although very few AIPs were identified within the target offset area, Nick Helme Botanical Surveys (2024) have reported numerous AIPs within the study area, including *Acacia saligna* (Port Jackson), *Leptospermum laevigatum* (Australian myrtle), *Pinus* sp. (Pines) and *Eucalyptus* sp. (gums) which may encroach into the wetland systems if unmanaged. Furthermore, considering the cultivated nature of the area surrounding the target offset area, some invasive herbs and grasses have also been identified, which includes *Plantago lanceolata* (ribwort plantain), *Echium* spp. (Pattersons curse), *Erodium* spp. (cranesbill), *Lolium* spp. (ryegrass) and *Avena* sp. (oats) (Nick Helme Botanical Surveys, 2024), which have all been found within the study area. AIPs of significance in the target offset area include *Cenchus clandestinus* and *A. saligna*;
- Phase 2: Follow-up control.
  Control of seedlings, root suckers and coppice growth. Mechanical and chemical control of AIPs are effective short-term solutions. Rigorous follow-up control is needed to sustain an AIP control plan over the medium-term. The aim is to deplete the seed bank and specific tactics for seed bank management can be employed. Follow-up control should be done on a minimum of two to three follow-ups per growing season, especially within the first year of control. This is of particular importance for *C. clandestinus*; and
- Phase 3: Maintenance control.
  Sustain low alien plant numbers with biannual to annual control. Continuous monitoring and maintenance of all areas where AIPs have been removed should continue during the management activities of the target offset area, with an additional five-year, annual control to be implemented to combat re-sprouting, and as an effort to deplete the existing alien species seedbank. It is very difficult and often expensive to completely eradicate alien species, which is why there is a need to maintain a control program over several years. Thereafter, the need for AIP control should be regularly assessed based on the need for control (adaptive management).

8.2.1 On-site AIP Control

On-site control should be implemented in line with the general principles and objectives set out in this report (Table 10) as well as any additional requirements as stipulated by the appointed Environmental Control Officer (ECO) (refer to Appendix H for further information).

General recommendations for AIP control and management are described below. Table 11 indicates the recommended control measures to be implemented as part of the rehabilitation plans. Recommended herbicides and active ingredients are also indicated in Appendix H2; however, the use of such herbicides should be regularly updated and provided in the regularly updated AIP control plan. It is important to note that AIP control must be conducted from the outer sections inwards in order to contain the existing AIP and prevent the further spread of AIP species.

Kikuyu grass (*C. clandestinus*) does not have to be completely eradicated from the areas to be rehabilitated. Instead, it should be managed through careful monitoring of the extent thereof to prevent its further spread. After the wetlands have been rehabilitated, the extent of *C. clandestinus* should be mapped. Follow up monitoring should be conducted quarterly for the first year and annually thereafter for the following three years to determine how far it has spread and should be eradicated from these

areas. *C. clandestinus* management measures are discussed in Table 11 below (under the heading Species Specific Treatment).

Table 11: Relevant objectives and control measures to be implemented as part of the AIP species clearing.

Objectives or requirements	Control Measures
Initial Control	
General good housekeeping	**Waste and Litter Problems** ➢ Suitable ablution facilities need to be provided for all personnel; ➢ Waste and litter should be cleared and be disposed of at a registered and approved disposal site; ➢ Suitable general waste receptacles must be provided; and ➢ Dumping of waste or litter must be prohibited within the target offset area and all freshwater ecosystems. Any waste noted must be cleared immediately.
Mechanical Control	➢ Methods to be used to control AIP species within the rehabilitated areas include hand pulling (herbaceous species and saplings), frilling, ringbarking and tree felling, after which an applicable herbicide should be applied (see below), as and where applicable. It should be noted that no alien trees (with the exception of a few *A. saligna* saplings) were noted within the target offset area; as such AIP control should prioritise herb and grass species removal and control; ➢ Individual weeds can be uprooted or hoed out. However, in areas where weed density is high, uprooting is not recommended, as this will result in soil and seed bank disturbance, which will likely result in return flushes and germination of alien seedling growth; ➢ Acacia sp. saplings and seedlings where observed should be uprooted and where required, brush-cut and treated with the appropriate herbicides; and ➢ As invasive species density within the target offset site is low, burning of AIP stacks can be kept to a minimum. It is however noted that the area in which the target offset area is located, regular burning for indigenous species regrowth is required (Nick Helme Botanical Surveys, 2024).
Chemical Control	➢ Dense seedling growth must be controlled with knapsack sprayers with a flat fan nozzle; ➢ Suitable dye must be used to limit over- or under spray of areas; ➢ Chemical control will entail limited usage of registered herbicides for a specific species and one must adhere to the measurements on the product label; and ➢ **Label instructions may not be exceeded due to negative impacts on surrounding flora and fauna for the use of herbicides containing Glyphosate, Diquat and Paraquat in the identified freshwater ecosystems associated with the rehabilitated areas. These chemicals may only be used in the terrestrial zone of the rehabilitation areas.**
Species Specific Treatment	The following are species specific treatment for the main AIPs noted within the target offset area. Use of these listed chemical treatments should occur after or during the mechanical removal process and may be used on other common weeds, as deemed appropriate by the ECO. **Treatment of Kikuyu Grass** (*Cenchrus clandestinus)* ➢ A herbicide with active ingredient Glyphosate*, dalapon or haloxyfop-P methyl ester should be used. Plants should be sprayed during their active growing season (autumn). It is to be noted that Glyphosate* or haloxyfop herbicides may not be used within the freshwater ecosystems where water is free flowing as it is known to be toxic to aquatic life. ➢ Haloxyfop-P Methyl Ester is deemed to have a minimal environmental impact (although on an acute basis is toxic to aquatic life) and is not expected to leach into groundwater. Furthermore, it has been identified to degrade in soils under normal environmental conditions[2]. ➢ It is highly recommended that extensive areas of *C. clandestinus* not be mown as a management action as the creation of artificial lawn areas can create habitat for hazardous bird species (A. Froneman, pers. comm.). **Treatment of Patterson's Curse** (*Echium* sp) ➢ Hand pull plants. No herbicide is needed. ➢ Chemical control can be used with active ingredients chlorsulfuron, mesulfuron methyl, triasulfuron or Glyphosate* to control seed sets during the flowering season. Use of these listed chemical treatments should occur after or during the mechanical removal process.

[2] The DOW Chemical Company. 2011. Product Safety Assessment: haloxyfop-P Methyl Ester

Objectives or requirements	Control Measures
	Treatment of Port Jackson (*Acacia saligna*) ➢ Hand pull seedlings. No herbicide is needed. ➢ Lop/ prune young plants and treat them by means of a foliar spray of 50ml of Triclopyr Ester* mixed with 10l of water. Apply at a rate of 3 l/ha. Use of these listed chemical treatments should occur after or during the mechanical removal process. ➢ First cut adult plants down to a stump and frill them before treating with 300ml of Triclopyr Amine salt* mixed in 10 l of water and applied at a rate of 1.5 l/ha. Additionally, a Triclopyr Ester* solution can also be applied to approximately 0.6m length of stump. Use of these listed chemical treatments should occur after or during the mechanical removal process. ➢ Transport all branches that have been mechanically removed off site to a designated dumping facility. Cut branches should not be left in stockpiles as the seeds will likely germinate. **Treatment of Blue Gum** (*Eucalyptus* sp.*)* ➢ According to Ecoguard and Working for Water (2003), *Eucalyptus* seedlings can be cut at the stump and treated with Timbrel Access, whereas adult trees should be treated by means of foliar spray using Mamba. Other treatment methodologies have also been recommended by (SASRI, n.d.). According to SASRI (n.d.), mechanical treatment (without chemical treatment is also suitable for seedlings.
Planned burning	➢ Fire is not recommended as a control mechanism for AIPs and encroacher species, due to the risk of an uncontrolled fire occurring; ➢ Fire should therefore only be used in approved burn sites to burn materials removed from the rehabilitation areas and transported to the designated burn sites. These burn sites may be set-up within already disturbed areas such as recently cultivated areas or previously ploughed/mowed areas where the risk of an unplanned fire spreading to the surrounding vegetation is limited. The exact locations of such must be identified by the Contractor, in liaison with the ECO and relevant landowners/tenants; ➢ Access to and from these burn sites should be marked out by the Contractor; and ➢ Personnel responsible for the burn sites must be sufficiently trained on how to handle the burn sites and what the protocol is should a fire become uncontrolled.
Follow-up Control	
Follow-up AIP treatment	➢ Follow-up control is essential to control alien saplings, seedlings and coppice regrowth to achieve and sustain the progress that was made in the initial phase. If the follow up control phase is neglected, the alien infestation will become worse and denser than before the eradication process started; ➢ Follow-ups must be done for a minimum of three (3) times a year during the growing season (September – April) for the first three (3) years and thereafter a minimum period of four (4) years on an annual basis to ensure that new AIP and/or encroacher species infestation does not occur within the rehabilitated areas, after which the follow-up period should be re-assessed based on the need; ➢ An annual assessment before mobilisation of the clearing crew should be undertaken to determine equipment and personnel requirements to secure the necessary funding; ➢ After initial control operations dense regrowth may arise as new regrowth will sprout in the form of stump coppice, seedlings, and root suckers. The following should therefore be applied: • Plants that are less than 1m in height must be controlled by foliar application; and • Areas with dense seedlings should not be uprooted or hoed out, as these areas will result in soil disturbance and will in return promote flushes and germination of alien seedling growth.

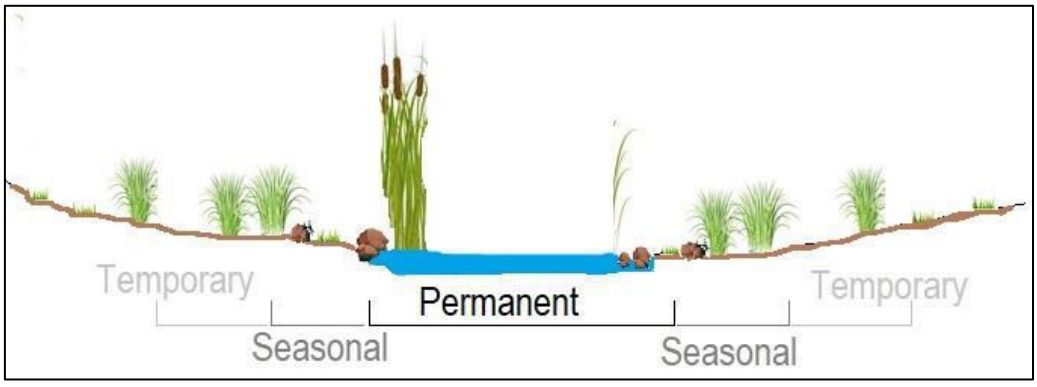
Species-specific control measures are provided in Appendix H2 and should be incorporated into an AIP control plan (which must be updated on a regular basis by a suitably trained individual). An example of a field form for monitoring alien vegetation which is to be completed by the relevant Contractor and/or the Implementing Agent is available in Appendix H3 of this report. Note that is only an example and should be modified based on the aspect of the rehabilitation area assessed. This form should be completed during the annual follow-up prior to mobilisation of any clearing teams to inform the planning of equipment, personnel and thus required funding.

In addition to the above, should any freshwater AIPs (i.e. water-related/ aquatic invasives) be detected within waterbodies within either the study area or the offset area, the removal of such species must form part of the alien invasive management activities. The removal of freshwater AIPs must be in line with the appropriate treatment methodologies for the particular plant species. The general control measures outlined in Table 11 above are also applicable to the freshwater AIPs; however, the use of machinery must be avoided so to not damage or alter the watercourses or receiving freshwater environment. If herbicides are essential for control, it is vital to ensure that only those approved herbicides listed by Working for Water as safe for waterbodies are utilised.

8.3 Remediation of Headcuts and Gullies (and the precursors thereof)

Active headcut erosion was noted within the CVB wetland and agricultural drain. Furthermore, continued grazing of the wetlands by resident cattle has led to soil disturbances and vegetation loss which has left the wetlands vulnerable to erosion. It is likely that the operation of the R304 and R312 roads east and south of the study area as well as the surrounding predominantly agricultural land use of the greater catchment has further contributed to the erosion observed in the CVB wetland.

In order to ensure that the geomorphology and hydrological regime of the CVB wetland (and the agricultural drain) is improved, the outer perimeter of the systems should be sloped to create seasonal and temporary wetland zones. This can be achieved by re-grading the perimeter of sections of the CVB wetland footprint to a 1:4 ratio, thereby creating a gradual slope towards the boundary of the footprint area (creating seasonal and temporary wetland zones) (Figure 14). The same approach is to be followed for the agricultural drain, but with a 1:3.5 ratio grading. The CVB wetland (and agricultural drain) footprint should not be uniformly levelled/excavated to increase the presence and diversity of niche habitats (Figure 14). In the case of the remaining seep wetland habitat, wetland zonation is also encouraged which can be achieved through the infilling of portions of the wetland to create the desired zonation. Oversight from a freshwater specialist and avifaunal specialist is recommended for this component of the rehabilitation phase to ensure the hydrological retention of the systems are not adversely altered and larger birds are not attracted to the rehabilitation areas. The avifaunal specialist should also be consulted to recommend suitable vegetation that could aid in deterring larger bird species.



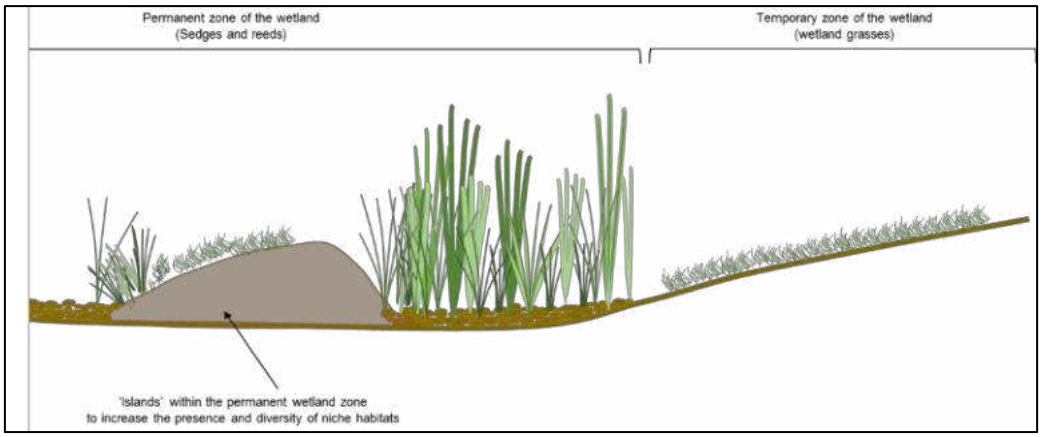


Figure 14: (Top) Schematic diagram of wetland zonation that must be recreated as part of the rehabilitation and reinstatement of the seep and CVB wetlands. (Bottom) Cross section of the footprint area of a wetland, indicating the desired zonation. Note that the creation of a permanent zone is not practical as the CVB wetland is a seasonal system. The image is for illustrative purposes only.

Re-sloping the CVB wetland and agricultural drain will ensure that the systems are free draining, and that no concentration or artificial ponding of flow occurs, thereby reducing the potential for an increased presence in large waterfowl which could result in an increased bird strike risk during the operational phase of the CWA. The slopes will also ensure that the inflow of stormwater from the seep wetland flows through the agricultural drain (in an easterly direction) into the CVB wetland, contributing to the hydrological drivers of the CVB wetland. Where possible, the re-sloping should be done manually, particularly within the active channel of the CVB wetland. It is advisable that machinery is only used within the seasonal and temporary zones. Should machinery be required for re-sloping, install sediment traps downstream of the proposed rehabilitation works to prevent sedimentation of the downstream reach and contain any spillage. A risk assessment (with mitigation measures) has been conducted for the proposed rehabilitation works within the seep and CVB wetlands, and is provided in Appendix E.

Sections within the wetlands and agricultural drain that are presently devoid of vegetation (particularly wetland adapted plants) should be appropriately rehabilitated by active planting of vegetation obtained from nearby nurseries or through hydroseeding with a veld reclamation mix. Strategies to ensure protection from the effects of flowing water, and the possible dislodging of individuals before root structures have developed enough, should be implemented. Vegetation reinstatement is elaborated on in Section 8.4. No botanical survey has been conducted in the area surrounding the target offset site to be rehabilitated. As such, should any SCC or other indigenous vegetation be found in these areas, these should be identified (and marked) prior to the commencement of rehabilitation activities and avoided during rehabilitation activities.

Certain general principles apply to all work within the wetland habitat (in the removal / rehabilitation of headcuts, gullies, drains and impounding features):

- The timing of the works is of critical importance. The undertaking of rehabilitation works during the wetter winter months when the wetland areas will be most inundated / saturated is strongly discouraged, as movement of equipment required for certain tasks is rendered more difficult with an associated increased risk of damage to wetland soils and vegetation, especially by tracked vehicles. Accordingly, rehabilitation actions must be timed to occur in the early spring to summer when conditions in the wetlands are drier. Undertaking works at this time would also limit the amount of time before the onset of the next growing season for vegetation to promote wetland vegetation regrowth as a key aspect of rehabilitation.
- Even during the dry summer season, certain parts of the wetlands (particularly the CVB wetland) in which rehabilitation works are required to be undertaken may potentially be saturated. In such cases, the on-site Environmental Officer (EO) and independent ECO must

determine the measures that are required to be implemented to ensure that the access of construction crews, and machinery is undertaken in a manner that does not result in damage to wetland soils and vegetation. In this case the following mitigation measures must be considered and implemented if deemed necessary by the ECO and EO:

- Careful consideration must be given to the point of access into the wetlands to complete works, and acknowledgement given to access for rehabilitation from both the western and eastern sides of the wetland in the case of the CVB wetland, and the northern and southern side of the seep wetland. The point of access with the least risk of damage to wetland habitat must be determined by the ECO and EO and works planned accordingly.
- Light machinery (such as a Bobcat excavator) must be utilised within the CVB wetland and agricultural drain rather than heavier tracked machinery such as excavators and TLBs. Under no circumstances are machinery allowed in the seep wetland;
- If temporary stockpiles are required with the works area (e.g. to stockpile small volumes of excavated soils to infill drains), the stockpiles must be placed outside the wetland footprint, preferably not within 10 m of the wetland footprint. Where possible, the stockpiles should be covered to limit the foraging of birds; and
- Once rehabilitation works are completed at a certain location, all foreign and excess material must be removed from the wetlands and agricultural drain.

8.4 Rehabilitation of natural flow patterns within the wetlands, agricultural drain and its immediate catchment

Effective rehabilitation of natural flow patterns in the wetland and its immediate catchment can be achieved through the following actions:

- Removal of Dumped Waste and Rubble: The first step in restoring the wetland's natural flow is the removal of all dumped waste and rubble (where applicable). To ensure this, contractors should use appropriate machinery and methods that minimize soil disturbance and avoid unnecessary compaction or erosion, with removal by hand being the most preferred option. Any compacted areas are to be ripped and reseeded;
- Land Surface Modification: Modifying the land surface is essential to facilitate the natural water flow into and through the wetlands. This process may involve filling in deep channels or excavating shallow areas to encourage water to spread evenly across the wetlands. Contractors should work closely with hydrological and ecological specialists to design a gentle slope that mimics natural topography, ensuring that water distribution supports wetland functions. Attention should be paid to maintaining soil integrity and preventing erosion during these activities. The recommendations outlined in Section 8.3 are to be used as a starting point; and
- Planting of Native Vegetation: Restoring vegetation is a key component of the rehabilitation process. Contractors should plant native vegetation species that are well-adapted to the local hydrological conditions. These plants will help slow down water flow, increase infiltration, and reduce erosion, contributing to the stabilization and ecological recovery of the wetland. A suitably trained specialist should be consulted to guide the selection of species, as well as techniques for propagation and planting. The specialist can also provide advice on the timing of planting to align with seasonal conditions that will maximize survival and growth rates. As a guide, several suitable species have been provided in Table 12 (a suitably trained specialist can provide guidance on the appropriate quantities to plant, in combination with other species as recommended by the specialist). The following must be noted:
    - Propagation and purchasing of the required species should have been undertaken as part of the Planning (Phase 1) and must be ready and available for transplantation into the seep and CVB wetland as soon as the AIP clearing and re-sloping activities have been completed. This is also applicable to the agricultural drain. The following points are of key importance for re-vegetation:

- Planting must start as soon as possible after soil profiling so as to reduce the duration of bare ground being exposed, which could lead to erosion and sedimentation of the area, and to establish ecological habitats. Furthermore, all disturbed areas as part of the rehabilitation, as well as where AIP have been removed should also be re-instated with native vegetation. For the seep wetland and agricultural drain, this (AIP control and revegetation) includes a 10 m buffer around the systems;
- Considering that the wetlands and surrounding area is currently actively grazed by resident cattle, prior to the commencement of revegetation, areas to be rehabilitated are to be demarcated as no-go areas to prevent revegetation efforts being compromised as a result of further grazing by cattle;
- Re-instatement of native vegetation should be undertaken in early May for the larger specimens (growing season) and early spring (August/September) for the smaller saplings. This will ensure that the hot summer months are avoided, and that species will be planted prior to the onset of winter rainfall, which will maximize growth and early establishment;
- Water will need to be made available for irrigation purposes for the first season after native vegetation has been planted. It is recommended that all planted specimens within the seasonal and temporary zone be watered during the first summer. It is anticipated that there will be a loss of some planted saplings. Additional specimens should be planted one year after the rehabilitation works, prior to the rainy season to maximise success for long-term proliferation;
- Should the Contractor not have the relevant expertise on planting of specimens, they should appoint a suitably qualified botanist or landscape architect to assist with the re-vegetation; and
- Saplings must be replanted annually during the winter period for the first 3 years after completion of construction, to maximise the success rate of revegetation. Since vegetation loss is common during re-establishing activities, provisioning of additional saplings will ensure a higher success rate.

The following criteria is recommended to be used to inform the selection of wetland plant species for the wetland footprint area and the agricultural drain:

- Plants must be hardy, and ideally able to withstand:
  - Occasional high sediment inputs due to disturbances in the catchment;
  - Periods of low oxygen, depending on zonation;
  - Periodic inundation (it is assumed that inundation is likely during the rainy season);
  - Plants must be readily available;
  - Plants must establish rapidly to restore wetland functionality as quick as possible; and
  - Plants should ideally be locally indigenous and no plants that are alien and invasive (e.g. Port Jackson) should be planted or allowed to remain in the area surrounding the proposed CWA development and target offset area.

It is important to note that the Contractor must ensure a variety of plants be used within the wetlands and consideration must be given to the wetland zonation (the wetlands are predominantly seasonal and temporary) when selecting plant species. It is noted that *C. clandestinus* has already invaded the area and regular maintenance will be required until the reinstated vegetation is self-sustaining.

The below list was compiled through the use of the field guide titled “Easy identification of some South African Wetland plants (Grasses, restios, sedges, rushes, bulrushes, Eriocaulons and Yellow-eyed grasses)” (van Ginkel *et al.*, 2011) where plant species were cross referenced with the broader investigation area. Additionally, wetland species as listed for the Southwest Sand Fynbos and West Coast Shale Renosterveld vegetation types in the book titled “Vegetation of South Africa, Lesotho and Swaziland” (Mucina and Rutherford, 2006) were added. Additional plant species can be sourced from

the Cape Flats LIFE locally indigenous fynbos exchange list available in Appendix I (plants marked with an asterisk "*" can be sourced from Cape Flats). The below list provides recommended species that can be planted in the rehabilitated areas.

Table 12: Species that are suitable for use within the wetland during rehabilitation processes.

Growth Form	Species
Herbs and Succulents	*Sarcocornia* spp. (already found in the CVB wetland)
	Zantedeschia aethiopica
Rushes and Sedges	*Bolboschoenus maritimus*
	*Carex clavata**
	Carpha glomerata
	Cyperus congestus
	Cyperus denudatus
	Cyperus fastigiatus
	Cyperus thunbergii
	Epischoenus gracilis
	Epischoenus quadrangularis
	Ficinia capillifolia
	Isolepis cernua
	Isolepis diabolica
	Isolepis digitata
	Isolepis hystrix
	Isolepis incomtula
	Isolepis levynsiana
	Isolepis marginata
	Isolepis natans
	*Isolepis prolifera**
	Isolepis setacea
	Juncus dregeanus
	*Juncus effusus**
	*Juncus lomatophyllys**
	*Juncus lomatophyllys**
	Pycreus mundtii
	Pycreus nitidus
	Pycreus polystachyos
	Restio spp.
	Xyris capensis
Trees	*Psoralea pinnata**

By implementing these measures, contractors can significantly enhance the effectivity of the rehabilitation efforts, ensuring the wetland's natural flow patterns are restored and its ecological integrity is maintained.

8.5 Stormwater Management and Wetland Recharge

To address how appropriate stormwater management following the construction of the proposed CWA development and associated stormwater infrastructure could be used to recharge the remainder of the seep wetland, the proponent should consider the following measures:

- Appropriate stormwater management can be a valuable tool for recharging the remaining seep wetland without causing adverse effects. The design of stormwater infrastructure should ensure that runoff is directed to the wetland in a controlled manner that avoids waterlogging, which could otherwise disrupt the natural hydrological regime. This can be achieved by designing stormwater systems to mimic natural hydrological processes. For instance, the use of flow dissipating structures at the stormwater ponds' outlets with appropriate vegetation of the outlet area can slow down and filter stormwater before it reaches the wetland, allowing for gradual infiltration and reducing the risk of erosion. The tie-in of the stormwater attenuation ponds into seep wetland must be managed in such a way that turbulent and/or supercritical flows are not created. Where possible, the tie-ins should be widened to allow diffuse flow through the system;
- As recommended in the freshwater report (FEN, 2024), to minimise the risk of erosion and sedimentation, the base of the outlet structures of the stormwater attenuation ponds should be lined with pebbles and small rocks and should be in line with the beds of the freshwater ecosystem (and not below the ground level). This will also aid with flood attenuation (by increasing the surface roughness) and with the establishment of vegetation and prevent the establishment of a monoculture of reeds. Wetland vegetation suitable for seasonal saturation must also be established to bind the soil of the bed, and to prevent erosion. This will also diffuse flow and lower the velocity of water into the seep wetland (Figure 15);

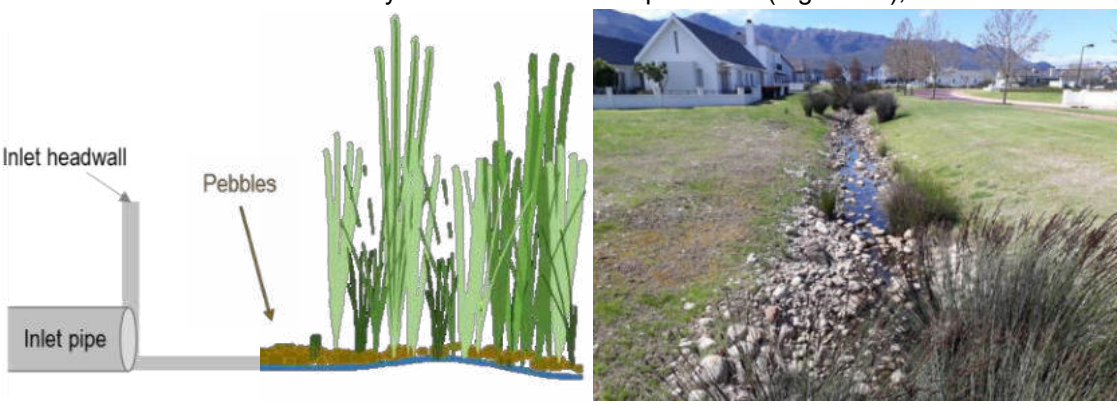


Figure 15: (Left) Schematic of the stormwater channel and tributary design. (Right) Example of a stormwater swale.

- Additionally, the stormwater management plan compiled for the CWA development (Zutari, 2024) should be amended to incorporate stormwater management of the offset area and should support the ecological requirements of the wetland's flora and fauna. Infrastructure should be designed to prevent abrupt changes in water levels, ensuring that habitat conditions remain stable and conducive to the survival of wetland species. By implementing these strategies, the proponent can enhance the ecological function of the wetland while managing stormwater effectively;
- The design of stormwater management systems that aim to recharge a nearby wetland should be undertaken by a qualified hydrological or civil engineer with experience in wetland and stormwater management. A stormwater management plan for the proposed CWA development has been compiled by Zutari (2024) which should be consulted. This specialist would be responsible for ensuring that the infrastructure is designed to mimic natural hydrological processes, such as those described above; and
- Additionally, a degree of ongoing monitoring is essential to ensure that the runoff does not negatively impact water quality or lead to excessive water entering the wetland system, which could disrupt its natural balance. This monitoring should focus on both water quantity and quality, as well as the health of the wetland's flora and fauna. An environmental specialist or ecologist should be involved in this monitoring process to assess the long-term impacts on the wetland ecosystem and to recommend any necessary adjustments to the stormwater management plan.

9 PHASE 3 – MONITORING PHASE

Prudent monitoring of the rehabilitated areas within the wetlands to be conserved or rehabilitated is of utmost importance, as this will ensure a continual flow of data, enabling all parties involved to accurately assess and manage the progress of the rehabilitation interventions and any arising issues. To ensure the accurate gathering of data, the following techniques and guidelines should be followed:

- Site walk through surveys should be applied as the preferred method of monitoring (at specified frequencies) with specific focus on:
  - Erosion monitoring (for the duration of the raining season);
  - Sedimentation (for the duration of the raining season);
  - Alien and invasive vegetation proliferation (at the start and end of the growing season).
- General habitat unit overviews as well as specific monitoring of wetland integrity (utilising wetland tools such as WET-Health and WET-Ecoservices), drivers and functionality should be undertaken;
- All data gathered should be measurable (qualitative and quantitative);
- Monitoring actions should be repeatable;
- Data should be auditable; and
- Reports should present and interpret the data obtained.

The monitoring plan comprises but is not limited to the following:

- Identification of areas of concern. These are areas that are affected by disturbances such as:
  - Erosion;
  - Waste dumping;
  - Alien vegetation species encroachment;
  - Soil compaction;
- Ensuring that the management/rehabilitation measures as stipulated in Sections 7 and 8 of this report are adhered to;
- A list of all alien vegetation species must be compiled as well as possible control methods such as manual, chemical or mechanical;
- Monitoring the rehabilitation areas from an avifaunal perspective, particularly identifying ponding in rehabilitation areas;
- Gathering all equipment required for the monitoring process; and
- Compiling a monitoring report.

For monitoring purposes of ecological integrity, it is recommended that a fixed-point monitoring method is implemented to ensure repeatability of assessments for better comparison. Selection of the fixed monitoring points should aim to achieve a comprehensive coverage of the target offset area as well as provide an indication of the impacts associated with high levels of anthropogenic activities on the floral community and the surrounding environment. Table 13 presents the monitoring actions associated with the rehabilitation plan for the wetland habitat. This monitoring plan must be implemented by a competent person and the findings of the plan must be submitted to the responsible authority for evaluation.

Table 13: Relevant objectives and control measures to be implemented as part of the rehabilitation of the wetlands associated with the target offset area (including the agricultural drain).

Aspect	ID	Offset/ Rehabilitation Measure	Responsible	Implementation Timeframe	Monitoring Methods	Performance Indicators
Planning						
Authorisations	1.	Ensure that all required licences and permits have been obtained before the start of rehabilitation.	➢ Implementing Agent	➢ Prior to the commencement of rehabilitation activities.	➢ Keep record of all permits, licences and authorisations.	➢ Required licences/ permits on file.
Site Establishment and Access Control	2.	Only undertake the rehabilitation works and the reinstatement of wetland habitat towards the end of the construction of the proposed CWA development. Dust generated from the construction works may smother new re-instated vegetation, specifically saplings and smaller species (e.g. *Isolepis* spp).			➢ Visual inspection.	➢ Limited rehabilitation works during construction of the proposed CWA development.
	3.	Implement access control for the potential recipient areas for all vehicles to ensure that no unauthorised persons are onsite.				➢ Access control is limited to the required vehicles and persons on site.
	4.	Clearly demarcate wetland zone boundaries with temporary fencing or similar in or near areas of active work. No personnel or vehicles are to be permitted to enter demarcated wetland zones unless essential.				➢ Rehabilitation areas demarcated. ➢ Access to demarcated wetland areas restricted.
	5.	Demarcate each rehabilitation area with danger tape prior to commencing rehabilitation activities, in order to control access and ensure that rehabilitation activities occur in the correct area. At no point should construction equipment extend past the designated construction site (unless for the required rehabilitation works). Demarcating rehabilitation areas must also ensure access to the rehabilitated wetlands by resident cattle is prohibited.				
	6.	Place adequate signage (in the appropriate languages commonly spoken in the area) around the planned rehabilitation areas.				➢ Signage is present.
	7.	Locate dedicated rehabilitation camp, laydown areas and parking areas for vehicles away from all identified sensitive areas.				➢ No camps, laydown areas, parking areas in sensitive areas.
	8.	Plan and demarcate all access roads to the relevant rehabilitation areas. Use of existing roads must be favoured.				➢ No evidence of tracks in sensitive areas.

Aspect	ID	Offset/ Rehabilitation Measure	Responsible	Implementation Timeframe	Monitoring Methods	Performance Indicators
Indigenous Plant Harvesting and Propagation	9.	Reinstate indigenous wetland species within the wetland habitat and the newly reinstated wetland areas (and agricultural drain) as part of the proposed rehabilitation plans. As such, make plans for where the species are to be sourced and include budgetary allowances for the purchasing of various species.	➢ Implementing Agent/ Contractor	➢ Throughout rehabilitation.	➢ Visual inspection of safely transporting and revegetating propagules and seeds, if and where required.	➢ Indigenous wetland species reinstated. ➢ Species sourced locally from nurseries such as Cape Flats LIFE.
	10.	Obtain indigenous plant species from a nursery such as the Cape Flats LIFE (plant list available in Appendix I).				
	11.	Secure the availability of species before rehabilitation activities commence to ensure that plants are ready and available for re-vegetation, so as not to leave areas exposed and vulnerable to erosion and incision.				➢ Sufficient quantity of seeds and propagules secured prior to commencement of revegetation. ➢ Suitable service provider appointed, if necessary.
	12.	Consider utilizing seeds and cuttings from indigenous vegetation found within the areas to be rehabilitated for revegetation. Removing entire plants from the CVB wetland is prohibited, considering that very few native vegetation remains in the wetland.				
Alien and Invasive Plants	13.	Ensure that AIP control planning takes place prior to commencement of other rehabilitation activities. Due to the extent of AIP proliferation within the potential recipient sites, it is suggested that AIP clearing takes place concurrently with the other rehabilitation measures outlined in this report.	➢ Contractor	➢ Prior to revegetation.	➢ No revegetation prior to AIP clearing.	➢ Date of commencement of initial AIP clearing.
	14.	Establish a period contract to allow for annual maintenance and removal of newly germinated plants for a minimum period of three years following rehabilitation. Long-term AIP control must be secured, as the success of the entire program will depend on it.		➢ Prior to rehabilitation.	-	➢ Record of contract.
Rehabilitation Plans	15.	Cost calculations must be performed for each area and addressed according to priority.		➢ Prior to commencement with rehabilitation.		➢ Rehabilitation cost calculated.
	16.	Create timetables for the control operations. Care must also be taken to include time when operations fall behind due to unfavourable weather conditions or labour strikes.				➢ Timetables created.
	17.	Divide the areas to be cleared into specific control areas through the use of man-made or natural boundaries to specify specific areas e.g. roads, fences. Each area must be numbered to simplify record keeping.			➢ Visual inspection	➢ Areas divided into manageable sections.

Aspect	ID	Offset/ Rehabilitation Measure	Responsible	Implementation Timeframe	Monitoring Methods	Performance Indicators
Rehabilitation Plans	18.	Should the Contractor and/or the Implementing Agent not have the expertise to identify and mark the AIPs, it is the responsibility of the Contractor or Implementing Agent to appoint a suitably qualified botanist to assist.	➢ Contractor / Implementing Agent	➢ Throughout rehabilitation.	➢ Botanist appointed, if required.	-
	19.	Schedule all wetland rehabilitation work (Section 8.3 of the report) to commence during the drier summer season to limit the impact on the wetlands. Timeframes must thus be properly planned. This is also applicable to the agricultural drain.		➢ Prior to commencement of rehabilitation.	➢ Schedule only reflects rehabilitation during drier summer months.	➢ Record of schedule.
	20.	Make water available for irrigation purposes for the first season after indigenous vegetation has been planted. It is recommended that all planted specimens be watered during the first summer.		➢ Throughout rehabilitation, after revegetating, as and when required.	➢ Visual inspection of rehabilitated areas.	➢ Record of plant survivors.
	21.	Re-sloping the CVB wetland and agricultural drain to ensure that the systems are free draining, and that no concentration or artificial ponding of flow occurs that encourages foraging by larger bird (high-risk bird strike) species		➢ Throughout rehabilitation and throughout the life of the project	➢ Avifaunal monitoring of rehabilitated areas	➢ No evidence of open area ponding and of high-risk bird strike species
Unplanned Fire Management	22.	Unplanned fires can occur within the potential recipient sites and surrounds, particularly during summer. Thus, preventative measures should be implemented by the Implementing Agent in order to reduce the likelihood of fires. This includes: ➢ Restricted access to vulnerable areas; and ➢ Awareness - Contractors working on site must be made aware of how their actions may result in the ignition of wild fires and must be adequately prepared to suppress any fires that may start whilst they are working. Informational signage around the recipient site should be erected to promote vigilance and reporting of veldfires, and to indicate that no fires are to be permitted outside of designated burn sites, if any. Such burn sites must not be within the delineated wetland boundaries.		➢ Throughout rehabilitation.	➢ Visual inspection restricted areas. ➢ Inspect attendance register for training sessions.	➢ Restricted access areas implemented. ➢ Record of environmental awareness training. ➢ Number of fire incidents.

Aspect	ID	Offset/ Rehabilitation Measure	Responsible	Implementation Timeframe	Monitoring Methods	Performance Indicators
General						
Good housekeeping	23.	Provide suitable ablution facilities for all personnel.	➢ Implementing Agent/ Contractor	➢ Prior to commencement of rehabilitation. ➢ Throughout rehabilitation.	➢ Visual inspections. ➢ Record of waste disposal.	➢ Number of incidents of staff not using facilities. ➢ Number of pollution incidents.
	24.	Clear waste and litter and dispose thereof at a registered and approved disposal site.				
	25.	Provide suitable general waste receptacles.				
	26.	Prohibit the dumping of waste or litter within the offset site and all watercourses. Any waste noted must be cleared immediately.				
AIP Clearing						
Chemical Control as part of Initial Control	27.	Control dense seedling growth with knapsack sprayers with a flat fan nozzle.	➢ Contractor	➢ Throughout rehabilitation and AIP clearing.	➢ Visual inspection of areas where chemical control is applied. ➢ Visual inspection of content of herbicides used in chemical control.	➢ Incidence of use of herbicide with Glyphosate, Diquat and Paraquat.
	28.	Chemical control will entail limited usage of registered herbicides for a specific species, and one must adhere to the measurements on the product label.				
	29.	Use suitable dye to limit over- or under spray of areas.				
	30.	Take care as to not exceed label instructions of herbicides containing Glyphosate, Diquat and Paraquat within the identified watercourses associated with the rehabilitation area as these herbicides can have negative impacts on surrounding flora and fauna. These chemicals may only be used in the terrestrial zone of the rehabilitation areas.				
Species Specific Treatment – Port Jackson	31.	Hand pull seedlings. No herbicide is needed.			➢ Visual inspection.	➢ Appropriate treatment implemented.
	32.	Lop/ prune young plants and treat them by means of a foliar spray of 50ml of Triclopyr Ester* mixed with 10l of water. Apply at a rate of 3 l/ha. Use of these listed chemical treatments should occur after or during the mechanical removal process.				
	33.	First cut adult plants down to a stump and frill them before treating with 300ml of Triclopyr Amine salt* mixed in 10 l of water and applied at a rate of 1.5 l/ha. Additionally, a Triclopyr Ester* solution can also be applied to approximately 0.6m length of stump. Use of these listed chemical treatments should occur after or during the mechanical removal process.				
	34.	Transport all branches that have been mechanically removed off site to a designated dumping facility. Cut branches should not be	➢ Contractor	➢ Throughout rehabilitation and	➢ Record of disposal.	➢ No removed branches observed on site.

Aspect	ID	Offset/ Rehabilitation Measure	Responsible	Implementation Timeframe	Monitoring Methods	Performance Indicators
		left in stockpiles as the seeds will likely germinate.		AIP clearing.		
Species Specific Treatment – Kikuyu Grass	35.	Use an herbicide with active ingredient Glyphosate*, dalapon or haloxyfop-P methyl ester. Spray plants during their active growing season (autumn). It is to be noted that Glyphosate* or haloxyfop herbicides may not be used within the watercourses where water is free flowing as it is known to be toxic to aquatic life. Use of these listed chemical treatments should occur after or during the mechanical removal process. *Note: Haloxyfop-P Methyl Ester is deemed to have a minimal environmental impact (although on an acute basis is toxic to aquatic life) and is not expected to leach into groundwater. Furthermore, it has been identified to degrade in soils under normal environmental conditions*[3].			➢ Visual inspection of areas where chemical control is applied. ➢ Visual inspection of content of herbicides used in chemical control.	➢ Incidence of use of herbicide with Glyphosate, Diquat and Paraquat.
Species Specific Treatment – Patterson's Curse	36.	Hand pull plants. No herbicide is needed, however, chemical control can be used with active ingredients chlorsulfuron, mesulfuron methyl, triasulfuron or Glyphosate* to control seed sets during the flowering season. Use of these listed chemical treatments should occur after or during the mechanical removal process.			➢ Visual inspection.	➢ Appropriate treatment implemented.
Follow-up AIP treatment	37.	Follow-up control is essential to control alien saplings, seedlings and coppice regrowth to achieve and sustain the progress that was made in the initial phase. If the follow up control phase is neglected, the alien infestation will become worse and denser than before the eradication process started.	➢ Implementing Agent/ Contractor	-	-	-
	38.	Conduct follow-ups for a minimum of three (3) times a year during the growing season (September – April) for the first three (3) years and thereafter a minimum period of four (4) years on an annual basis to ensure that new AIP infestation does not occur within the rehabilitated areas, after which the follow-up period should be re-assessed based on the need.		➢ 3 times yearly for the first 3 years. ➢ Annually for a minimum of 4 years thereafter.	➢ Visual inspection.	➢ Record of follow ups implemented.

[3] The DOW Chemical Company. 2011. Product Safety Assessment: haloxyfop-P Methyl Ester

Aspect	ID	Offset/ Rehabilitation Measure	Responsible	Implementation Timeframe	Monitoring Methods	Performance Indicators
	39.	Undertake an annual assessment before mobilisation of the clearing crew to determine equipment and personnel requirements to secure the necessary funding.	➢ Implementing Agent/ Contractor	➢ Annually.	➢ Assessment undertaken.	➢ Number of equipment and personnel available for follow up control.
	40.	After initial control operations, dense regrowth may arise as new regrowth will sprout in the form of stump coppice, seedlings and root suckers. The following should therefore be applied: ➢ Plants that are less than 1m in height must be controlled by foliar application; and ➢ Areas with dense seedlings should not be uprooted or hoed out, as these areas will result in soil disturbance and will in return promote flushes and germination of alien seedling growth.		➢ As and when required.	➢ Visual inspection.	➢ Record of alien vegetation removed. ➢ Correct clearing method implemented.
Site Specific Rehabilitation						
General	41.	No construction equipment or personnel may enter the wetlands to be rehabilitated, unless authorised as part of the rehabilitation interventions. The remaining extent of the portions of the wetlands to be rehabilitated are to be pegged by a suitably qualified freshwater ecologist or ECO (although fencing is preferred). Construction equipment is allowed in the area designated for the CVB wetland and agricultural drain's rehabilitation (during reshaping only), and this is to be limited to the Western Cape summer period.	➢ Contractor	➢ Throughout rehabilitation.	➢ Visual inspection.	➢ No unauthorized access in wetlands.
	42.	Do not store any equipment within the delineated wetlands while not in use. Any designated storage and parking bays must be located no closer than 32m of the envisaged extent of the wetlands.				➢ No stationary equipment in wetlands.
	43.	Should the ECO not have the relevant expertise, it is recommended that the rehabilitation be overseen by a suitably qualified wetland specialist to ensure maximum service provision is achieved over the long-term in terms of hydrology, geomorphology, water quality and biota.			➢ Wetland specialist appointed, if required.	-
Earthworks	44.	Conduct all rehabilitation work during the drier summer months leading up to the rainy season (November to May) to reduce contamination of surface water and ensure maximum survival of new plant species (see section below of re-vegetation). Some watering of plants during the first dry season may be necessary to ensure survival.	➢ Implementing Agent / Contractor	➢ Throughout rehabilitation.	➢ Visual inspection.	➢ Rehabilitation confined to summer months.

Aspect	ID	Offset/ Rehabilitation Measure	Responsible	Implementation Timeframe	Monitoring Methods	Performance Indicators
	45.	Keep footprint areas for equipment as small as possible to reduce unnecessary disturbances of soils and vegetation.				➢ Size of disturbed areas.
	46.	Any topsoil moved should be stockpiled and re-instated as indigenous vegetation seeds will be present within the soil. Topsoil will have a high density of alien invasive seeds which will need to be controlled into the operational phase. Where possible, topsoil stockpiles should be covered to prevent birds from foraging for unearthed invertebrates.				➢ Topsoil stored correctly.
	47.	All excess material removed as part of the rehabilitation activities that cannot be reused on site must be removed from site. At no point may this material be disposed on site or within any of the other freshwater ecosystems identified within the surrounding area.				➢ Excess material disposed of properly and at suitable waste management facilities.
	48.	Install sediment traps downstream of rehabilitation works to prevent sedimentation of downstream areas and to contain spillage from contaminating the downstream reach of the CVB wetland.	➢ Implementing Agent / Contractor	➢ Prior to commencement of earthworks.	➢ Visual inspection.	➢ Little to no sediment observed in downstream freshwater ecosystems.
Machinery and vehicle management	49.	Where possible, utilize existing roads. Keep vehicular disturbance footprint as small as possible when accessing the rehabilitation sites.		➢ Throughout rehabilitation.		➢ Vehicle access limited to what is essential.
	50.	Limit construction equipment within the freshwater ecosystems to what is essential.				
	51.	Undertake regular maintenance of vehicles and machinery to identify and repair minor leaks and prevent equipment failures.		➢ Weekly during rehabilitation works.		➢ Leaks and spillages reported to ECO.
	52.	Refuelling must take place outside of the delineated wetlands and 32m NEMA ZoR and must take place on a sealed surface area to prevent ingress of hydrocarbons into the topsoil.		➢ Throughout rehabilitation.	➢ Visual inspection.	➢ No refuelling in close proximity to freshwater ecosystems.
	53.	Maintain all machinery and vehicles used during rehabilitation to prevent oil leaks.				➢ Little to no hydrocarbon or oil spillage.
	54.	Undertake any on-site refuelling and maintenance of vehicles and machinery in designated areas (preferably at the construction site camp) and away from the watercourses. Install oil traps and line these areas with an impermeable surface.				
	55.	Use appropriately sized drip trays for all refuelling and/or repairs done on machinery. Ensure that drip trays are strategically placed				

Aspect	ID	Offset/ Rehabilitation Measure	Responsible	Implementation Timeframe	Monitoring Methods	Performance Indicators
		for capture any spillage of fuel, oil, etc.				
	56.	Immediately clean up any spills through containment and removal of free product. Appropriately dispose of contaminated soil.		➢ Upon observation of spills.		➢ Safety disposal slips indicating quantity and location where contaminated soils were disposed of.
	57.	If breakdowns occur these must be towed offsite to the designated areas/workshops. This will ensure that incidental oil spills and leakage are minimised onsite and thus limit any opportunities of water contamination and water quality deterioration.		➢ As and when required.		-
Vegetation clearance	58.	In order to construct the proposed CWA development, vegetation will need to be cleared within and surrounding the seep wetland in the eastern portion of the study area. With the exception of suitable wetland vegetation that can be reused during rehabilitation, all vegetation removed (especially since many of the current vegetation is identified as AIP) must be disposed of at a suitable disposal facility.		➢ Prior to commencement of rehabilitation activities.		➢ Vegetation disposed of at a suitable disposal facility.
Erosion Prevention and Topsoil Management	59.	Inspect rehabilitated areas for erosion.		➢ Weekly during rehabilitation activities. ➢ After every major rainstorm and/ flood for the first wet season post rehabilitation.		➢ ECO report provides feedback on erosion.
	60.	Immediately rehabilitate any area where active erosion is observed in such a way as to ensure that the surface hydrology of the area is re-instated to conditions which are as natural as possible.	➢ Implementing Agent / Contractor	➢ Upon observation of erosion.	➢ Visual inspection.	➢ Visual surface erosion cleared.
	61.	Actions to be taken to prevent any further erosion from occurring within the rehabilitated areas are as follows (to be implemented as and when required): ➢ Re-vegetating the disturbed and rehabilitated areas (see below); ➢ Stabilise the soil through the use of geotextiles, especially effective with growing vegetation; and ➢ Apply a layer of mulch to the rehabilitated areas to allow the soil				

Aspect	ID	Offset/ Rehabilitation Measure	Responsible	Implementation Timeframe	Monitoring Methods	Performance Indicators
		to slowly soak up the water and reduce the impact of rain on bare soil.				
Waste management	62.	Remove all litter observed in the wetlands and the agricultural drain and dispose thereof at an appropriately licensed waste management facility.	➢ Contractor	➢ Upon observation of waste.		➢ Waste disposed of properly and at a suitable waste management facility. ➢ Waste management included in ECO reports.
Indigenous Species Re-vegetation	63.	Planting must start as soon as possible after site preparations (re-sloping) have been concluded to minimise the duration of bare ground being exposed which could lead to erosion and sedimentation of the area, and to establish ecological habitats. Furthermore, all disturbed areas as part of the rehabilitation, as well as where AIPs have been removed should also be re-instated with native vegetation.		➢ After AIP removal and site preparations.		➢ Record of commencement of revegetation. ➢ Photographic record of revegetation.
	64.	Re-instate native vegetation in late autumn (April). This will ensure that vegetation is allowed to become established prior to the onset of the winter rains, and prior to the onset of the dry summer period, which will maximize growth and early establishment.				
	65.	Appoint a suitably qualified botanist to assist with re-vegetation, should the Contractor not have the relevant expertise on planting of specimens.			➢ Botanist appointed, if required.	-
Monitoring						
Administrative and Financial Monitoring	66.	Develop detailed budgets prior to the implementation of the program. This will include that all expenditure is accounted for and audited annually in accordance with the Public Finance Management Act, 1999 (Act No 1 of 1999).	➢ Contractor	➢ Prior to commencement of rehabilitation.	-	➢ Record of approved budget.
	67.	Monitor compliance with all relevant legislation (as outlined in this report, and any additional Acts which may be relevant in terms of corporate governance) and include this as part of the auditors' Terms of Reference.	➢ Sub-contracted auditor	➢ Prior to and throughout rehabilitation.	➢ Compliance against EA and WULA conditions.	➢ Record of non-compliances.
	68.	Regular communication with all stakeholders must take place.	➢ Implementing Agent	➢ Throughout the life of the project.	➢ Stakeholders' communication maintained.	➢ Record of communication with stakeholders.

Aspect	ID	Offset/ Rehabilitation Measure	Responsible	Implementation Timeframe	Monitoring Methods	Performance Indicators
Wetland Health	69.	Monitor all wetland areas earmarked for conservation and rehabilitation annually during the winter period.	➢ Implementing Agent / suitably appointed contractor	➢ Annually for the first three years post-rehabilitation.	➢ PES of systems maintained/ improved.	➢ Annual monitoring report compiled. ➢ Condition of the wetlands have not degraded since initial rehabilitation efforts have concluded.
AIP control	70.	Take a baseline assessment capturing densities and species of AIPs prior to the initial AIP clearing.	➢ Contractor	➢ Prior to AIP clearing.	➢ Screen the entire rehabilitation area(s). ➢ Log locations of any newly coppiced species to be treated/removed.	➢ Baseline report compiled.
	71.	Re-record AIP densities after the initial clearing, including all methods and chemicals used.		➢ After initial AIP clearing.		➢ Report compiled.
	72.	To ensure long-term maintenance measures are effective, quarterly assess and record densities and locations of newly coppiced AIPs during the first year post rehabilitation and annually during the growing season for the second and third year. Annual reports should include information from before and after mobilisation of follow-up clearing teams.		➢ For four years post AIP clearing.		➢ Quarterly report during first year of rehabilitation. ➢ Annual reports during the following three years post AIP clearing.
Re-vegetation	73.	Monitor the areas revegetated to ensure plant survival and ensure that no AIPs are outcompeting native species. Compile the following reports: ➢ Compile a report listing existing species as well as any endangered species that may need to be rescued prior to rehabilitation. Appoint a suitable botanist to assist, should the Contractor not have the expertise to undertake this list. ➢ Compile monthly reports for 6 months after the re-instatement. ➢ Compile annual reports during each growing season, for at least 3 years post rehabilitation.		➢ Prior to rehabilitation activities. ➢ Monthly for 6 months after re-instatement of vegetation. ➢ Annually during the growing season for at least three years post rehabilitation.	➢ Visual inspection	➢ Reports compiled.

***Note: This monitoring plan must be implemented by a competent person and submit the findings to the responsible authority for evaluation.**

10 PHASE 4 – REFINE, CORRECT AND REPLAN PHASE

This phase involves a “refine-correct-re-plan” approach that ensures that the rehabilitation plan is continuously being updated and improved so to effectively achieve the rehabilitation targets set out in the planning phase. Only once, on-site rehabilitation has started will this phase become significant.

Progressive rehabilitation is recommended as a management strategy for environmental liability. The proponent should be cognisant of the rehabilitation objectives and integrate as much of the rehabilitation activities into its processes, as possible.

Should the proponent require or not be capable of implementing the offset plan as outlined in this report, an implementing agent will be appointed to manage the offset area.

11 WETLAND OFFSET INITIATIVE BUDGET

For any conservation initiative to be successful, adequate funding needs to be put in place to ensure follow through of the project. A budget estimate was developed considering the cost of purchasing the land, as well as implementation aspects including:

- Rehabilitation and restoration activities (within the remainder of the seep wetland and a portion of the CVB wetland located east of the study area). This will be directed by the proponent;
- AIP control;
- Erosion management and control; and
- Budgetary requirements for monitoring and auditing purposes.

A budget estimate was developed considering the cost to develop the offset initiative as well as to provide budget to facilitate the implementation thereof. The budget has been developed to cover costs for a period of 30 years post rehabilitation. All budget estimates were developed on a Net Present Value basis in 2024.

The total budget for the Wetland Offset Initiative is **R11,493,000 (rounded)** for the restoration work to be done to support the rehabilitation and offset. A detailed cost breakdown for each phase is presented in the table below. The provided budget also includes the budget for the 30-year maintenance phase of **R1,206,000 (rounded)** for the entire period however this will largely fall within the proposed CWA development management budget and will be an additional cost to the CWA. It should be noted that the below budget does not allow for the management of the offset site. It is assumed that forms part of the biodiversity offset costs.

Table 14: Budget Summary for the Wetland Offset and Ecological Compensation Initiative.

BUDGET COST ESTIMATE AS FOR THE IMPLEMENTATION OF THE WETLAND OFFSET FOR CAPE WINELANDS AIRPORT

WETLAND OFFSET

	REVISION 0				**September 2024**
	DESCRIPTION	**UNIT**	**QTY.**	**RATE**	**TOTAL**
	SECTION 1 :LAND ACQUISITION AND MANAGEMENT				
1.1	Land acquisition costs	sum	0	R 0,00	R 0,00
1.2	Contractor Establishment	Rate	3	R 25 000,00	R 75 000,00
1.3	Contractor Safety File	Rate	3	R 12 000,00	R 36 000,00
1.4	Proffesional Oversight and management	Rate	36	R 10 000,00	R 360 000,00
					R471 000,00
	SECTION 2 : PREPARATION				
2.1	Alien and invasive species removal (trees)	m²	3000,0	R 2,77	R 8 310,00
2.2	Alien and invasive species removal (grasses)	m²	90000,0	R 1,88	R 169 200,00
2.3	Removal of waste and litter from wetland areas	sum	1	R 32 000,00	R 32 000,00
2.4	Temporary stormwater management measures including sediment traps	m	2000	R 38,56	R 77 120,00
2.5	Resloping/ shaping of areas where steep banks are present to 1:4 slopes prior to covering with erosion control blanket	m²	27000	R 5,50	R 148 500,00
2.6	Ripping and scarifying of areas to be planted and reseeded	m²	40000	R 2,75	R 110 000,00
	Total Preparation				**R545 130,00**
	SECTION 3 : PLANTING				
3.1	*Hydroseed with indigenous reclamation mixture suitable for wetland areas*	m²	90000	R 9,00	R 810 000,00
3.2	planting with specific wetland sedges and forbs		200000	R 27,00	R 5 400 000,00
	Total Planting				**R6 210 000,00**
	SECTION 4: OTHER				
4.1	(500m²)	roll	250	R 700,00	R 175 500,00
	Total Other				**R175 500,00**
	TOTAL COMPENSATION DEVELOPMENT COST				**6 930 630,00**
	SECTION 5: MAINTENANCE (rate per annum for a period of 30 years for alien control and revegetation)				
5.1	Proffesional Oversight and management	Sum	1,0	R 25 000,00	R 750 000,00
5.2	Annual follow up of alien vegetation control in the form of weeding of recruits (trees)	m²	200,0	R 5,00	R 30 000,00
5.3	Annual follow up of alien vegetation control (grasses and forbs)	m²	5000,0	R 1,88	R 282 000,00
5.4	Follow up reseeding where required *An acceptable cover means that not less than 75% of the re-vegetated area is to be covered with indigenous species and that there will be no bare patches of more than 10 x 10 mm in maximum dimension.*	m²	4000	R 12,00	R 144 000,00
	Total Maintenance				**R1 206 000,00**
	Sub Total (ex VAT)				**R 8 607 630,00**
	Preliminaries and General (10%)				R 693 063,00
	Contingencies (10%)				R 693 063,00
	Total (ex VAT)				**R 9 993 756,00**
	Total (incl. VAT)				**R 11 492 819,40**

NOTES:
1. The rates are to include site establishment as well as the supply of all plant, labour and materials to carry out the work.
2. Hydroseeding and planting is not to take place during the growing season only.
3. Water to be made available for the initial establishment phase of revegetated areas.

12 CONCLUSION

FEN was appointed to develop a wetland offset plan and associated WRMP for the proposed CWA development in Fisantekraal, Western Cape Province. Given that the complete destruction of on-site freshwater habitats will not occur, an on-site offset was considered, with the remaining portion of the seep wetland being selected as the preferred offset. However, considering that rehabilitating only the remainder of the seep wetland (3.68 ha) will not be sufficient to achieve the 3.97 HaE wetland functionality and 13 HaE ecosystem conservation target, and as such a CVB wetland which is fed by the seep wetland via an agricultural drain was therefore also investigated to achieve the offset target. This approach is ecologically optimal, offering a significant, high impact offset that supports greater biodiversity and ecosystem functionality.

The offset plan includes the rehabilitation of ~40 ha of wetland habitat which will compensate for the 7.44 ha total wetland loss resulting from the proposed CWA development. The impacts of the project require 3.97 functional HaE and 13 habitat HaE to be offset. The target offset area (remainder of the seep wetland and a portion of the CVB wetland as well as the agricultural drain feeding the CVB wetland) will provide these requirements, effectively compensating for the loss. The planned restoration is expected to improve the PES of the wetlands, contributing to a net gain in wetland functionality and elevating its ecological status, ensuring that the offset delivers a positive contribution to the region's wetland conservation efforts.

The total budget for the offset and its management is **R11,492,814.40**, which includes implementation, rehabilitation, and long-term management costs.

The developed offset initiative is expected to significantly contribute to positive wetland resource management and conservation in the region. The offset strategy aligns with national and local biodiversity offset guidelines, and the selected offset site more than adequately offsets the residual impacts associated with the project. It is recommended that the proposed offset be approved by the relevant competent authorities as part of the development authorization process.

13 REFERENCES

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APPENDIX A – Indemnity and Terms of Use

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APPENDIX B – Legislative Requirements

The Constitution of the Republic of South Africa, 1996	The environment and the health and well-being of people are safeguarded under the Constitution of the Republic of South Africa, 1996 by way of section 24. Section 24(a) guarantees a right to an environment that is not harmful to human health or well-being and to environmental protection for the benefit of present and future generations. Section 24(b) directs the state to take reasonable legislative and other measures to prevent pollution, promote conservation, and secure the ecologically sustainable development and use of natural resources (including water and mineral resources) while promoting justifiable economic and social development. Section 27 guarantees every person the right of access to sufficient water, and the state is obliged to take reasonable legislative and other measures within its available resources to achieve the progressive normalization of this right. Section 27 is defined as a socio-economic right and not an environmental right. However, read with section 24 it requires of the state to ensure that water is conserved and protected and that sufficient access to the resource is provided. Water regulation in South Africa places a great emphasis on protecting the resource and on providing access to water for everyone.
National Environmental Management Act, 1998 (Act No. 107 of 1998)	The National Environmental Management Act, 1998 (Act No. 107 of 1998) and the associated Regulations as amended in 2021, states that prior to any development taking place within a wetland or riparian area, an environmental authorisation process needs to be followed. This could follow either the Basic Assessment Report (BAR) process or the Environmental Impact Assessment (EIA) process depending on the scale of the impact. Provincial regulations must also be considered.
National Water Act , 1998 (Act No. 36 of 1998)	The National Water Act, 1998 (Act No. 36 of 1998) recognises that the entire ecosystem and not just the water itself in any given water resource constitutes the resource and as such needs to be conserved. No activity may therefore take place within a watercourse unless it is authorised by the Department of Water and Sanitation (DWS). Any area within a wetland or riparian zone is therefore excluded from development unless authorisation is obtained from the DWS in terms of Section 21 (c) & (i). A watercourse is defined as: a) A river or spring; b) A natural channel in which water flows regularly or intermittently; c) A wetland, lake or dam into which, or from which water flows; and d) Any collection of water which the minister may, by notice in the Gazette, declare a watercourse.
Government Notice 4167 as published in the Government Gazette 49833 of 08 December 2023 as it relates to the NWA (Act 36 of 1998) as amended	GN 4167 outlines the parameters and process of a General Authorisation (GA), which replaces the need to apply for a licence in terms of Section 40 of the NWA, provided that the water use is within the limits and conditions of the GA. The notice **replaces GN 509 of 2016.** The GA sets out the need to determine the regulated area of a watercourse, as well as the degree of risk posed by an activity/ies related to a particular water use. In accordance with GN 4167 of December 2023, the regulated area of a watercourse for section 21c and 21i of the NWA, 1998 is defined as: a) the outer edge of the 1 in 100-year flood line or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake, or dam; b) in the absence of a determined 1 in 100-year flood line or riparian area the area within 100 m distance from the edge of a watercourse where the edge of the watercourse (excluding flood plains) is the first identifiable annual bank fill flood bench; or c) In respect of a wetland, a 500 m radius around the delineated boundary (extent) of any wetland, including pans. The GA only applies to the use of water in terms of Section 21(c) and (i) of the NWA where the risk class is **Low** as determined through the application of the Risk Matrix as prescribed in the Notice. The GA also does not apply where other Section 21 water uses are triggered, does not apply for most sewage infrastructure and pipelines carrying hazardous materials, water uses associated with hazardous materials, water uses associated with water and wastewater treatment works, and for most mining-related water uses. The GA may be exercised as follows: i) Section 21(c) or (i) water use activities that are determined to pose a LOW Risk as determined through the application of the Risk Matrix as prescribed in the Notice can be undertaken subject to the general conditions of the GA; ii) Section 21(c) or (i) water use activities set out in Appendix D1 of the Notice can be undertaken *without* being subject to the requirement of a risk assessment and subject to the general conditions of the GA. Such water use activities in Appendix D1 include *inter alia* emergency river crossings, fence erection, solar renewable infrastructure that has no direct impact on watercourses and mini-scale hydropower developments; iii) Prescribed water use activities undertaken by certain State Owned Entities as detailed in Appendix D2 of the Notice can be undertaken *without* being subject to the requirement of a risk assessment and subject to the general conditions of the GA;

	iv) Maintenance work associated an existing lawful water use in terms of section 21(c) or (i) of the Act that has a LOW risk class as determined through the Risk Matrix can be undertaken; v) River and stormwater management activities including maintenance of infrastructure as contained in a river management plan or similar management plan, may be conducted subject to the approval of such a plan by the relevant DWS regional office or catchment management agency; vi) Rehabilitation of wetlands or rivers where such rehabilitation activities have a LOW risk class as determined through the Risk Matrix can be conducted; and vii) Emergency work arising from an emergency situation and or incident associated with the persons' existing lawful water use entitlement can be undertaken, provided that all work is executed and reported in the manner prescribed in the Emergency protocol contained in Appendix C of the GA. A General Authorisation (GA) issued as per this notice will require the proponent to adhere with specific conditions, rehabilitation criteria and monitoring and reporting programme. Furthermore, the water user must ensure that there is a sufficient budget to complete, rehabilitate and maintain the water use as set out in this GA. Upon completion of the registration, the responsible authority will provide a certificate of registration to the water user within 30 working days of the submission. On written receipt of a registration certificate from the Department, the person will be regarded as a registered water user and can commence within the water use as contemplated in the GA.

APPENDIX C – Method of Assessment

1. Desktop Study

Prior to the commencement of the field assessment, a background study, including a literature review, was conducted in order to determine the ecoregion and ecostatus of the larger aquatic system within which the freshwater ecosystems present in close proximity of the construction and proposed borehole abstraction are located. Aspects considered as part of the literature review are discussed in the sections that follow.

1.1 National Freshwater Ecosystem Priority Areas (NFEPA; 2011)

The NFEPA project is a multi-partner project between the Council of Scientific and Industrial Research (CSIR), Water Research Commission (WRC), South African National Biodiversity Institute (SANBI), DWA, South African Institute of Aquatic Biodiversity (SAIAB) and South African National Parks (SANParks). The project responds to the reported degradation of freshwater ecosystem condition and associated biodiversity, both globally and in South Africa. It uses systematic conservation planning to provide strategic spatial priorities of conserving South Africa's freshwater biodiversity, within the context of equitable social and economic development.

The NFEPA project aims to identify a national network of freshwater conservation areas and to explore institutional mechanisms for their implementation. Freshwater ecosystems provide a valuable, natural resource with economic, aesthetic, spiritual, cultural and recreational value. However, the integrity of freshwater ecosystems in South Africa is declining at an alarming rate, largely as a consequence of a variety of challenges that are practical (managing vast areas of land to maintain connectivity between freshwater ecosystems), socio-economic (competition between stakeholders for utilisation) and institutional (building appropriate governance and co-management mechanisms).

The NFEPA database was searched for information in terms of conservation status of rivers, wetland habitat and wetland feature present in the vicinity of the construction and proposed borehole abstraction.

1.2 *Department of Water and Sanitation (DWS) Resource Quality Information Services (RQIS) Present Ecological State / Ecological Importance and Sensitivity (PES/EIS) Database (2014)*

The PES/EIS database as developed by the DWS RQIS department was utilised to obtain background information on the project area. The PES/EIS database has been made available to consultants since mid-August 2014. The information from this database is based on information at a sub-quaternary catchment reach (subquat reach) level with the descriptions of the aquatic ecology based on the information collated by the DWS RQIS department from all reliable sources of reliable information such as SA RHP sites, Ecological Water Requirements sites and Hydro Water Management System sites. The results obtained serve to summarise this information as a background to the conditions of the freshwater ecosystem traversed by the proposed linear development.

2. Classification System for Wetlands and other Aquatic Ecosystems in South Africa (2013)

All wetland or riparian features encountered within the investigation area was assessed using the Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland systems, hereafter referred to as the "Classification System" (Ollis, Snaddon, Job, & Mbona, 2013). A summary on Levels 1 to 4 of the classification system is presented in the tables below.

Table C1: Classification System for Inland Systems, up to Level 3.

WETLAND / AQUATIC ECOSYSTEM CONTEXT		
LEVEL 1: SYSTEM	**LEVEL 2: REGIONAL SETTING**	**LEVEL 3: LANDSCAPE UNIT**
Inland Systems	DWA Level 1 Ecoregions OR	Valley Floor
		Slope

	NFEPA WetVeg Groups OR Other special framework	Plain
		Bench (Hilltop / Saddle / Shelf)

Table C2: Hydrogeomorphic (HGM) Units for the Inland System, showing the primary HGM Types at Level 4A and the subcategories at Level 4B to 4C.

FUNCTIONAL UNIT		
LEVEL 4: HYDROGEOMORPHIC (HGM) UNIT		
HGM type	Longitudinal zonation/ Landform / Outflow drainage	Landform / Inflow drainage
A	**B**	**C**
River	Mountain headwater stream	Active channel
		Riparian zone
	Mountain stream	Active channel
		Riparian zone
	Transitional	Active channel
		Riparian zone
	Upper foothills	Active channel
		Riparian zone
	Lower foothills	Active channel
		Riparian zone
	Lowland river	Active channel
		Riparian zone
	Rejuvenated bedrock fall	Active channel
		Riparian zone
	Rejuvenated foothills	Active channel
		Riparian zone
	Upland floodplain	Active channel
		Riparian zone
Channelled valley-bottom wetland	(not applicable)	(not applicable)
Unchannelled valley-bottom wetland	(not applicable)	(not applicable)
floodplain wetland	Floodplain depression	(not applicable)
	Floodplain flat	(not applicable)
Depression	Exorheic	With channelled inflow
		Without channelled inflow
	Endorheic	With channelled inflow
		Without channelled inflow
	Dammed	With channelled inflow
		Without channelled inflow
Seep	With channelled outflow	(not applicable)
	Without channelled outflow	(not applicable)
Wetland flat	(not applicable)	(not applicable)

Level 1: Inland systems

From the classification system, Inland Systems are defined as **aquatic ecosystems that have no existing connection to the ocean**[4] (i.e. characterised by the complete absence of marine exchange and/or tidal influence) but **which are inundated or saturated with water, either permanently or periodically.** It is important to bear in mind, however, that certain Inland Systems may have had a historical connection to the ocean, which in some cases may have been relatively recent.

Level 2: Ecoregions & NFEPA Wetland Vegetation Groups

For Inland Systems, the regional spatial framework that has been included in Level 2 of the classification system is that of the DWA's Level 1 Ecoregions for aquatic ecosystems (Kleynhans *et. al.,* 2005). There is a total of 31 Ecoregions across South Africa, including Lesotho and Swaziland. DWA Ecoregions have most commonly been used to categorise the regional setting for national and regional water resource management applications, especially in relation to rivers.

The Vegetation Map of South Africa, Swaziland and Lesotho (Mucina & Rutherford), 2006) groups' vegetation types across the country, according to Biomes, which are then divided into Bioregions. To categorise the regional setting for the wetland component of the NFEPA project, wetland vegetation groups (referred to as WetVeg Groups) were derived by further splitting Bioregions into smaller groups through expert input (Nel *et al*., 2011). There are currently 133 NFEPA WetVeg Groups. It is envisaged that these groups could be used as a special framework for the classification of wetlands in national- and regional-scale conservation planning and wetland management initiatives.

Level 3: Landscape Setting

At Level 3 of the classification system for Inland Systems, a distinction is made between four Landscape Units (Table C1) on the basis of the landscape setting (i.e. topographical position) within which an HGM Unit is situated, as follows (Ollis, Snaddon, Job, & Mbona, 2013):

- **Slope:** an included stretch of ground that is not part of a valley floor, which is typically located on the side of a mountain, hill or valley;
- **Valley floor:** The base of a valley, situated between two distinct valley side-slopes;
- **Plain:** an extensive area of low relief characterised by relatively level, gently undulating or uniformly sloping land; and
- **Bench (hilltop/saddle/shelf):** an area of mostly level or nearly level high ground (relative to the broad surroundings), including hilltops/crests (areas at the top of a mountain or hill flanked by down-slopes in all directions), saddles (relatively high-lying areas flanked by down-slopes on two sides in one direction and up-slopes on two sides in an approximately perpendicular direction), and shelves/terraces/ledges (relatively high-lying, localised flat areas along a slope, representing a break in slope with an up-slope one side and a down-slope on the other side in the same direction).

Level 4: Hydrogeomorphic Units

Seven primary HGM Types are recognised for Inland Systems at Level 4A of the classification system (Table C2), on the basis of hydrology and geomorphology (Ollis, Snaddon, Job, & Mbona, 2013), namely:

- **River:** a linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water;
- **Channelled valley-bottom wetland:** a valley-bottom wetland with a river channel running through it;
- **Unchannelled valley-bottom wetland:** a valley-bottom wetland without a river channel running through it;
- **floodplain wetland:** the mostly flat or gently sloping land adjacent to and formed by an alluvial river channel, under its present climate and sediment load, which is subject to periodic inundation by over-topping of the channel bank;

[4] Most rivers are indirectly connected to the ocean via an estuary at the downstream end, but where marine exchange (i.e. the presence of seawater) or tidal fluctuations are detectable in a river channel that is permanently or periodically connected to the ocean, it is defined as part of the estuary.

- **Depression:** a landform with closed elevation contours that increases in depth from the perimeter to a central area of greatest depth, and within which water typically accumulates;
- **Wetland Flat:** a level or near-level wetland area that is not fed by water from a river channel, and which is typically situated on a plain or a bench. Closed elevation contours are not evident around the edge of a wetland flat; and
- **Seep:** a wetland area located on (gently to steeply) sloping land, which is dominated by the colluvial (i.e. gravity-driven), unidirectional movement of material down-slope. Seeps are often located on the side-slopes of a valley, but they do not, typically, extend into a valley floor.

The above terms have been used for the primary HGM Units in the classification system to try and ensure consistency with the wetland classification terms currently in common usage in South Africa. Similar terminology (but excluding categories for "channel", "flat" and "valleyhead seep") is used, for example, in the recently developed tools produced as part of the Wetland Management Series including WET-Health (Macfarlane *et. al*., 2008), WET-IHI (DWAF, 2007) and WET-EcoServices (Kotze, Marneweck, Batchelor, Lindley, & Collins, 2009).

3. Wet-Ecoservices (2020)

The WET-Ecoservices (v2) method by Kotze *et al.* (2020) provides an overall importance score to each of the ecoservices listed below (Table C4). The overall importance score of each ecoservice is calculated by integrating its respective supply and demand scores (Table C3). Each ecoservice supply and demand score in turn is calculated using an algorithm that has been designed to reflect the relative importance and interactions of the attributes represented by indicators that characterise that ecoservice.

The supply of an ecoservice is related to the innate ability of the wetland to provide a particular service, tying to its PES, while the demand on an ecoservice is founded on the wetland's catchment context (e.g. toxicant sources upstream), the number of beneficiaries and their level of dependency.

The WET-Health (v2) summary thus enables the reader to gauge both the relative importance of the individual ecoservice supply and demand scores and combined (overall) ecoservice importance.

➢ Flood attenuation	➢ Biodiversity maintenance
➢ Stream flow regulation	➢ Provision of water for human use
➢ Sediment trapping	➢ Provision of harvestable resources
➢ Phosphate assimilation	➢ Food for livestock
➢ Nitrate assimilation	➢ Provision of cultivated foods
➢ Toxicant assimilation	➢ Cultural and spiritual experience
➢ Erosion control	➢ Tourism and recreation
➢ Carbon storage	➢ Education and research

Table C3: Integration of ecoservice supply and demand scores to derive overall importance

Integrating scores for supply & demand to obtain an overall importance score						
		Supply				
		Very Low	Low	Moderate	High	Very High
Demand		0	1	2	3	4
Very Low	0	0.0	0.0	0.5	1.5	2.5
Low	1	0.0	0.0	1.0	2.0	3.0
Moderate	2	0.0	0.5	1.5	2.5	3.5
High	3	0.0	1.0	2.0	3.0	4.0
Very High	4	0.5	1.5	2.5	3.5	4.0

Table C4: Ecoservice importance categories and descriptions based on integration of supply and demand scores.

Importance Category		Description
Very Low	0-0.79	The importance of services supplied is very low relative to that supplied by other wetlands.
Low	0.8 – 1.29	The importance of services supplied is low relative to that supplied by other wetlands.
Moderately-Low	1.3 – 1.69	The importance of services supplied is moderately-low relative to that supplied by other wetlands.
Moderate	1.7 – 2.29	The importance of services supplied is moderate relative to that supplied by other wetlands.
Moderately-High	2.3 – 2.69	The importance of services supplied is moderately-high relative to that supplied by other wetlands.
High	2.7 – 3.19	The importance of services supplied is high relative to that supplied by other wetlands.
Very High	3.2 - 4.0	The importance of services supplied is very high relative to that supplied by other wetlands.

4. Ecological Importance and Sensitivity (EIS) (Rountree & Kotze, 2013)

The purpose of assessing importance and sensitivity of freshwater ecosystems is to be able to identify those systems that provide higher than average ecosystem services, biodiversity support functions or are especially sensitive to impacts. Freshwater ecosystems with higher ecological importance may require managing such freshwater ecosystems in a better condition than the present to ensure the continued provision of ecosystem benefits in the long term (Rountree & Kotze, 2013).

In order to align the outputs of the Ecoservices assessment (i.e. ecological and socio-cultural service provision) with methods used by the DWA (now the DWS) used to assess the EIS of other freshwater ecosystem types, a tool was developed using criteria from both WET-Ecoservices (Kotze *et, al.,* 2009) and earlier DWA EIA assessment tools. Thus, three proposed suites of important criteria for assessing the Importance and Sensitivity for wetlands were proposed, namely:

- Ecological Importance and Sensitivity, incorporating the traditionally examined criteria used in EIS assessments of other freshwater ecosystems by DWA and thus enabling consistent assessment approaches across freshwater ecosystem types;
- Hydro-functional importance, taking into consideration water quality, flood attenuation and sediment trapping ecosystem services that the wetland may provide; and
- Importance in terms of socio-cultural benefits, including the subsistence and cultural benefits provided by the wetland system.

The highest of these three suites of scores is then used to determine the overall Importance and Sensitivity category (Table C5) of the wetland system being assessed.

Table C5: Ecological Importance and Sensitivity Categories and the interpretation of median scores for biota and habitat determinants (adapted from Kleynhans, 1999).

EIS Category	Range of Mean	Recommended Ecological Management Class
Very high Wetlands that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these wetlands is usually very sensitive to flow and habitat modifications.	>3 and <=4	A
High Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these wetlands may be sensitive to flow and habitat modifications.	>2 and <=3	B
Moderate Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications.	>1 and <=2	C
Low/marginal	>0 and <=1	D

Wetlands that are not ecologically important and sensitive at any scale. The biodiversity of these wetlands is ubiquitous and not sensitive to flow and habitat modifications.		

5. General Habitat Integrity

The general habitat integrity of each site was discussed based on the application of the Index of Habitat Integrity (Kleynhans *et al.* 2008). It is important to assess the habitat at each site in order to aid in the interpretation of the results of the community integrity assessments, by taking habitat conditions and impacts into consideration. This method describes the Present Ecological State (PES) of both the in-stream and riparian habitat at each site. The method classifies habitat integrity into one of six classes, ranging from unmodified/natural (Class A) to critically modified (Class F), as indicated in Table C7 below.

Table C7: Classification of Present State Classes in terms of Habitat Integrity [Kleynhans *et al.*, 2008]

Class	Description	Score (% of total)
A	Unmodified, natural.	90 - 100
B	Largely natural with few modifications. The flow regime has been only slightly modified and pollution is limited to sediment. A small change in natural habitats may have taken place. However, the ecosystem functions are essentially unchanged.	80 - 89
C	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.	60 - 79
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40 – 59
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.	20 – 39
F	Critically / Extremely modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.	0 - 19

6. The Riparian Vegetation Response Assessment Index (VEGRAI)

VEGRAI is designed for qualitative assessment of the response of riparian vegetation to impacts in such a way that qualitative ratings translate into quantitative and defensible results (Kleynhans *et al.*, 2007a). Results are defensible because their generation can be traced through an outlined process (a suite of rules that convert assessor estimates into ratings and convert multiple ratings into an Ecological Category).

Riparian vegetation is described in the National Water Act (Act No. 36 of 1998) as follows: 'riparian habitat' includes the physical structure and associated vegetation of the areas associated with a freshwater ecosystem which are commonly characterised by alluvial soil, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas.

Table C8: Descriptions of the A-F ecological categories.

Ecological category	Description	Score (% of total)
A	Unmodified, natural.	90-100
B	Largely natural with few modifications. A small change in natural habitat and biota may have taken place but the ecosystem functions are essentially unchanged.	80-89
C	Moderately modified. Loss and change of natural habitat have occurred, but the basic ecosystem functions are still predominately unchanged.	60-79
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40-59
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.	20-39
F	Critically modified. Modifications have reached a critical level and the lotic system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances, the basic ecosystem functions have been destroyed and the changes are irreversible	0-19

7. Recommended Management Objective (RMO) and Recommended Ecological Category (REC) Determination

"A high management class relates to the flow that will ensure a high degree of sustainability and a low risk of ecosystem failure. A low management class will ensure marginal maintenance of sustainability but carries a higher risk of ecosystem failure" (DWA, 1999).

The RMO (table below) was determined based on the results obtained from the PES, reference conditions and EIS of the freshwater ecosystems (sections above), with the objective of either maintaining, or improving the ecological integrity of the freshwater ecosystem in order to ensure continued ecological functionality.

Table C9: Recommended management objectives (RMO) for freshwater ecosystems based on PES & EIS scores.

PES			Ecological Importance & Sensitivity (EIS)			
			Very High	High	Moderate	Low
	A	Pristine	A Maintain	A Maintain	A Maintain	A Maintain
	B	Natural	A Improve	A/B Improve	B Maintain	B Maintain
	C	Good	A Improve	B/C Improve	C Maintain	C Maintain
	D	Fair	C Improve	C/D Improve	D Maintain	D Maintain
	E/F	Poor	D* Improve	E/F* Improve	E/F* Maintain	E/F* Maintain

***PES Categories E and F are considered ecologically unacceptable (Malan and Day, 2012) and therefore, should a freshwater ecosystem fall into one of these PES categories, an REC class D is allocated by default, as the minimum acceptable PES category.**

A freshwater ecosystem may receive the same class for the REC as the PES if the freshwater ecosystems are deemed in good condition, and therefore must stay in good condition. Otherwise, an

appropriate REC should be assigned in order to prevent any further degradation as well as enhance the PES of the freshwater ecosystem.

Table C8: Description of Recommended Ecological Category (REC) classes.

Class	Description
A	Unmodified, natural
B	Largely natural with few modifications
C	Moderately modified
D	Largely modified

8. Freshwater ecosystem Delineation

For the purposes of this investigation, a wetland is defined in the National Water Act, 1998 (Act No. 36 of 1998) as “land which is transitional between terrestrial and aquatic systems where the water table is at or near the surface, or the land is periodically covered with shallow water, and which in normal circumstances supports or would support vegetation typically adapted to life in saturated soil”.

The wetland zone delineation took place according to the method presented in the DWAF (2005) document “A practical field procedure for identification and delineation of wetlands and riparian areas. An updated draft version of this report is also available and was therefore also considered during the wetland delineation (DWAF, 2008). The foundation of the method is based on the fact that wetlands and riparian zones have several distinguishing factors including the following:

- The position in the landscape, which will help identify those parts of the landscape where wetlands are more likely to occur;
- The type of soil form (i.e. the type of soil according to a standard soil classification system), since wetlands are associated with certain soil types;
- The presence of wetland vegetation species; and
- The presence of redoxymorphic soil feature, which are morphological signatures that appear in soil with prolonged periods of saturation.

By observing the evidence of these features in the form of indicators, wetlands and riparian zones can be delineated and identified. If the use of these indicators and the interpretation of the findings are applied correctly, then the resulting delineation can be considered accurate (DWAF, 2005 and 2008).

Riparian and wetland zones can be divided into three zones (DWAF, 2005). The permanent zone of wetness is nearly always saturated. The seasonal zone is saturated for a significant period of wetness (at least three months of saturation per annum) and the temporary zone surrounds the seasonal zone and is only saturated for a short period of saturation (typically less than three months of saturation per annum), but is saturated for a sufficient period, under normal circumstances, to allow for the formation of hydromorphic soil and the growth of wetland vegetation. The object of this study was to identify the outer boundary of the temporary zone and then to identify a suitable buffer zone around the wetland area.

APPENDIX D – Risk Assessment Methodology

In order for the proponent to allow for sufficient consideration of all environmental impacts, impacts were assessed using a common, defensible method of assessing significance that will enable comparisons to be made between risks/impacts and will enable authorities, stakeholders and the client to understand the process and rationale upon which risks/impacts have been assessed. The method to be used for assessing risks/impacts is outlined in the sections below.

The first stage of the risk/impact assessment is the identification of environmental activities, aspects and impacts. This is supported by the identification of receptors and resources, which allows for an understanding of the impact pathway and an assessment of the sensitivity to change. The definitions used in the impact assessment are presented below.

DWS Risk Assessment Matrix (2023)

- An **activity** is a distinct process or task undertaken by an organisation for which a responsibility can be assigned. Activities also include facilities or infrastructure that is possessed by an organisation;
- **Environmental impacts** are the consequences of these impacts on environmental resources or receptors of particular value or sensitivity, for example, disturbance due to noise and health effects due to poorer air quality. In the case where the impact is on human health or wellbeing, this should be stated. Similarly, where the receptor is not anthropogenic, then it should, where possible, be stipulated what the receptor is;
- **Receptors** can comprise, but are not limited to, people or human-made systems, such as local residents, communities and social infrastructure, as well as components of the biophysical environment such as wetlands, flora and riverine systems;
- **Resources** include components of the biophysical environment;
- **Intensity** refers to the degree of change to the receptor status in terms of the reversibility of the impact; sensitivity of receptor to stressor; duration of impact (increasing or decreasing with time); controversy potential and precedent setting; threat to environmental and health standards;
- **Spatial scale** refers to the geographical scale of the impact; and
- **Duration** refers to the length of time over which the stressor will cause a change in the resource or receptor.

The significance of the impact is then assessed by rating each variable numerically according to the defined criteria (refer to the table below). The purpose of the rating is to develop a clear understanding of influences and processes associated with each impact. The intensity, spatial scale and duration of the impact together comprise the consequence of the impact and when summed can obtain a maximum value of 75. The likelihood of the impact occurring is determined by assigning a likelihood score of between 20% and 100%. The values for likelihood and consequence of the impact are then read off a significance rating matrix and are used to determine whether control is necessary[5].

The model outcome of the impacts was then assessed in terms of impact certainty and consideration of available information. The Precautionary Principle is applied in line with South Africa's National Environmental Management Act, 1998 (Act No. 107 of 1998) in instances of uncertainty or lack of information, by increasing assigned ratings or adjusting final model outcomes. In certain instances, where a variable or outcome requires rational adjustment due to model limitations, the model outcomes have been adjusted.

[5] Some risks/impacts that have low significance will however still require control

"RISK ASSESSMENT KEY" (Based on DWS 2023 publication: Section 21 c and i water use Risk Assessment Protocol)

Table D1: Intensity (What is the intensity of the impact on the resource quality - hydrology, water quality, geomorphology, biota?)

Negative impacts	
Negligible / non-harmful; no change in PES	0
Very low / potentially harmful; negligible deterioration in PES (<5% change)	+1
Low / slightly harmful; minor deterioration in PES (<10% change)	+2
Medium / moderately harmful; moderate deterioration in PES (>10% change)	+3
High / severely harmful; large deterioration in PES (by one class or more)	+4
Very high / critically harmful; critical deterioration in PES (to E/F or F class)	+5
Positive impacts	
Negligible; no change in PES	0
Very low / potentially beneficial; negligible improvement in PES (<5% change)	-1
Low / slightly beneficial; minor improvement in PES (<10% change)	-2
Medium / moderately beneficial; moderate improvement in PES (>10% change)	-3
Highly beneficial; large improvement in PES (by one class or more) and/or increase in protection status	-4
Very highly beneficial; improvement to near-natural state (A or A/B class) and/or major increase in protection status	-5

*PES of affected watercourses must be considered when scoring Impact Intensity

Table D2: Spatial Scale (How big is the area that the activity is impacting on, relative to the size of the impacted watercourses).

Very small portion of watercourse/s impacted (<10% of extent)	1
Moderate portion of watercourse/s impacted (10-60% of extent)	2
Large portion of watercourse/s impacted (60-80%)	3
Most or all of watercourse/s impacted (>80%)	4
Impacts extend into watercourses located well beyond the footprint of the activities	5

Table D3: Duration (How long does the aspect impact on the resource quality).

Transient (One day to one month)	1
Short-term (a few months to 5 years) OR repeated infrequently (e.g. annually) for one day to one month	2
Medium-term (5 – 15 years)	3
Long-term (ceases with operational life)	4
Permanent	5

Table D4: Likelihood of impact (What is the probability that the activity will impact on the resource quality).

Improbable / Unlikely	20%
Low probability	40%
Medium probability	60%
Highly probable	80%
Definite / Unknown	100%

Table D5: Rating Classes.

RATING	CLASS	MANAGEMENT DESCRIPTION
1 – 29	(L) Low Risk	Acceptable as is or with proposed mitigation measures. Impact to watercourses and resource quality small and easily mitigated, or positive.
30 – 60	M) Moderate Risk	Risk and impact on watercourses are notable and require mitigation measures on a higher level, which costs more and require specialist input. Licence required.
61 – 100	(H) High Risk	Watercourse(s) impacts by the activity are such that they impose a long-term threat on a large scale and lowering of the Reserve. Licence required.

A low risk class must be obtained for all activities to be considered for a GA

Table D6: Calculations.

Intensity = Maximum Intensity Score (negative value for positive impact)	MAX = 5
Severity = Intensity + Spatial Scale + Duration (<Intensity - Spatial Scale - Duration> for positive impact)	MAX = 15 (MIN = -15 for +ve impacts)
Consequence = Severity X Importance rating	MAX = 75
Significance\Risk = (Consequence X Likelihood) X (100/75)	MAX = 100

The following points were considered when undertaking the assessment:

- Risks and impacts were analysed in the context of the *project's area of influence* encompassing:
  - Primary project site and related facilities that the client and its contractors develops or controls;
  - Areas potentially impacted by cumulative impacts for further planned development of the project, any existing project or condition and other project-related developments; and
  - Areas potentially affected by impacts from unplanned but predictable developments caused by the project that may occur later or at a different location.
- Risks/Impacts were assessed for construction phase and operational phase; and
- Individuals or groups who may be differentially or disproportionately affected by the project because of their disadvantaged or vulnerable status were assessed.

Control Measure Development

The following points present the key concepts considered in the development of control measures for the proposed construction:

- Control and performance improvement measures and actions that address the risks and impacts[6] are identified and described in as much detail as possible. Controlling measures are investigated according to the impact minimisation hierarchy as follows:
  - Avoidance or prevention of impact;
  - Minimisation of impact;
  - Rehabilitation; and
  - Offsetting.
- Measures and actions to address negative impacts will favour avoidance and prevention over minimisation, control or compensation; and
- Desired outcomes are defined and have been developed in such a way as to be measurable events with performance indicators, targets and acceptable criteria that can be tracked over defined periods, wherever possible.

Recommendations

Recommendations were developed to address and control potential impacts on the ecology of the freshwater and riparian ecosystems traversed by or in close proximity of the proposed infrastructure.

[6] Control measures should address both positive and negative impacts

APPENDIX E – Risk Assessment and Summary of Impacts of the Cape Winelands Airport Development

RISK ANALYSIS: CONSIDERATION OF IMPACTS AND APPLICATION OF MITIGATION MEASURES

The results of the risk assessment are summarised below, including key mitigation measures for each activity. There are four key ecological impacts on the watercourses that are anticipated to occur namely:

- Loss of freshwater ecosystem habitat and ecological structure;
- Changes to the sociocultural and service provision;
- Impacts on the hydrology and sediment balance of the freshwater ecosystem; and
- Impacts on water quality.

Overall, the construction activities as it relates to the required rehabilitation activities associated with the target offset area are deemed to pose a 'Low' risk significance to both the remainder of the seep and the CVB wetland. The only exception is when rehabilitation is required outside the Western Cape dry season, when a coffer dam may need to be constructed to ensure continued flow of water into the downgradient reaches of the CVB wetland, resulting in a 'Medium' risk significance to the CVB wetland. Ongoing AIP control within the target offset area is considered to pose a 'Low' risk significance to the wetlands, whereas the operation of the rehabilitated wetlands will provide a positive impact once rehabilitative measures have been implemented.

General construction management and good housekeeping practices

Impacts which generally affect the freshwater ecology and biodiversity, and will likely occur as a result of this proposed development, which take place in close proximity to the proposed activities may impact on the receiving environment. Mitigation measures for these impacts are highlighted below and are relevant to the freshwater ecosystems identified in this report:

Development footprint and site establishment

- Keep development footprint areas as small as possible and limit vegetation clearing to what is absolutely essential;
- Limit the rehabilitation footprint to the footprint as included in the environmental authorisation / water use licence;
- Clearly define the boundaries of footprint areas, including contractor laydown areas and ensure that all activities remain within defined footprint areas. Edge effects will need to be extremely carefully controlled;
- Establish contractor laydown areas and stockpiles outside of the delineated wetlands and the 32m NEMA ZoR in consultation with the appropriate authority. Where possible use of existing disturbed areas along / through the wetlands should be utilised to gain access to the rehabilitation areas;
- Clearly demarcate the assessed wetlands and 32m NEMA ZoR with danger tape with input from an ECO and mark these areas as a 'no-go' area where no rehabilitation activities are planned;
- Provide appropriate sanitary facilities for the life of the construction phase and remove all waste to an appropriate waste facility; and
- No fires should be permitted in or near the construction area.

Future access road construction

- The access roads must be designed in such a way that the hydraulic connectivity and ecological condition of the CVB wetland is not further impacted, and that the rehabilitative effort invested into the offset site is not in vain. This may include, but not be limited to, the installation of culverts or the construction of causeways;

- Utilize existing roads or the proposed access roads to be upgraded to gain access to the construction site with no construction vehicles permitted to indiscriminately move through open areas and especially the wetland areas;
- Vehicles to be serviced and refuelled at the designated contractor laydown area;
- The construction footprint must be limited to the servitude area only and all areas outside the development footprint are to be rehabilitated on completion of construction;
- All proposed activities associated with the construction of the access roads over the CVB wetland will potentially result in bank destabilisation, particularly the construction of culverts within or causeways over the CVB wetland, and an increase in bank incision and sedimentation of the wetland. Therefore, sediment control devices must be constructed in situ prior to construction activities;
- Should construction works not be finalised during the dry season, an appropriately sized coffer dam area can be created and dewatered around the construction area associated with any pillars by using sandbags and cobbles. Water must be diverted into the downstream reaches, around the coffer area. Water must be allowed to recharge the downstream reaches at all times, although sediment traps must be installed upgradient of the wetland to ensure that volumes of sediment entering the wetland are minimised. Sediment traps are to be inspected daily and accumulated sediment to be removed by hand on a weekly basis;
- Ensure that the creation of the diversion (by means of sandbags) does not result in a significant water level difference upstream or downstream of the installation site;
- It is recommended that a suitably qualified freshwater specialist and independent Environmental Control Officer (ECO) should monitor any coffer dam areas created on site as well as sediment traps at least bimonthly during the construction period to monitor the CVB wetland conditions during construction and after the removal of the diversion;
- A suitably qualified hydrologist must provide guidance on the relevant sizes and width requirements of all culvert / causeway crossings;
- During the excavation activities, any soil/sediment or silt removed from the wetland (particularly for the construction of culverts within or causeways over the wetland) may be temporarily stockpiled in the road reserve but outside the wetlands. These stockpiles may not exceed 2 m in height, and their footprint should be kept to a minimum. Stockpiling of removed materials may only be temporary (may only be stockpiled during the period of construction at a particular site) and should be disposed of at a registered waste disposal facility;
- Should causeways be constructed, these structures should ideally be constructed within the seasonal or temporary zone of the wetland;
- Culverts, if applicable, must be installed to be in line with the beds of the wetland (not below the ground level) and erosion protection/outlet stabilisation structures such as a riprap or a concrete apron are recommended at the culvert outlets. The outlet channels of the proposed culverts must be lined with cobbles and revegetated with indigenous species to assist with water dispersal and reduction of water velocities prior to entering the wetland;
- The soil surrounding the construction areas must be suitably loosened on completion of construction activities and revegetated to prevent erosion;
- All embankments must be adequately sloped, ripped, topsoil reinstated and vegetated with indigenous wetland vegetation species;
- The CVB wetland 2 is to be rehabilitated as part of the access road construction, should an access road alternative adjacent to CVB wetland 2 be considered;
- Fresh asphalt, concrete and cement mortar should not be mixed near the watercourses. Mixing of cement may be done within the construction camp, however it may not be mixed on bare soil, and must be within a lined, bound or bunded portable mixer. Consideration must be taken to use ready mix concrete;
- No mixed concrete or asphalt shall be deposited directly onto the ground or within the freshwater ecosystems. All concrete and/or asphalt must be brought in via a cement mixing truck which must remain within the road reserve, and cement/asphalt must be piped down to the proposed road footprint. Any areas that require manual application of cement/asphalt require that the mixed road surfacing materials be placed on a batter board or other suitable platform/mixing tray until it is deposited;
- A washout area should be designated outside of the freshwater ecosystems, and wash water should be treated on-site or discharged to a suitable sanitation system;
- At no point may batter boards/mixing trays or cement trucks be rinsed off on site and run-off water be allowed into the freshwater ecosystems;
- Cement bags (if any) must be disposed of in the demarcated hazardous waste receptacles and the used bags must be disposed of through the hazardous substance waste stream;

- Spilled or excess concrete/asphalt must be disposed of at a suitable landfill site. Chain of custody documentation must be provided;
- Adequate stormwater run-off measures must be put in place during the operation of the access roads and no stormwater may be directly released into the wetland. Attenuation ponds and/or sustainable drainage systems must be installed to assist with water "polishing" and reducing the velocity of water before entering the wetland. This will ensure no erosion or scouring occurs as a result of stormwater inputs;
- Hot spots for the build-up of debris and excess sediment must be identified and when necessary, debris/excess sediment must be removed by hand to prevent future flooding and potential damage to infrastructure. In this regard, special mention is made of periods following high rainfall and subsequent high instream water volumes. Removal of debris must be undertaken in line with the above listed construction mitigation measures; and
- Any erosion or gully formation must be identified on an ongoing basis and re-profiled and revegetated accordingly.

Waste management

- Store all hazardous chemicals as well as stockpiles on bunded surfaces in an appropriately designated area and away from the freshwater ecosystem and have facilities constructed to control runoff from these areas;
- Ensure that an adequate number of waste and "spill" bins are provided will also prevent litter and ensure the proper disposal of waste and spills;
- Ensure that all hazardous storage containers and storage areas comply with the relevant SABS standards to prevent leakage; and
- All waste is to be removed from the site and disposed of at a registered facility.

Vehicle access and maintenance

- Where possible, utilise existing roads. Keep vehicular disturbance footprint as small as possible when accessing the rehabilitation sites;
- Limit construction equipment within the wetlands to what is essential;
- Undertake regular maintenance of vehicles and machinery to identify and repair minor leaks and prevent equipment failures;
- Maintain all machinery and vehicles used during rehabilitation to prevent oil leaks;
- Use appropriately sized drip trays for all refuelling and/or repairs done on machinery. Ensure that drip trays are strategically placed for capture any spillage of fuel, oil, etc.;
- Immediately clean up any spills through containment and removal of free product. Appropriately dispose of contaminated soil;
- If breakdowns occur these must be towed off site to the designated areas/workshops. This will ensure that incidental oil spills and leakage are minimised onsite and thus limit any opportunities of water contamination and water quality deterioration.

Vegetation

- Removal of the alien and weed species encountered on the target offset area must take place in order to comply with existing legislation (amendments to the regulations under the Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983) (CARA) and Section 28 of the National Environmental Management Act, 1998 (Act No. 107 of 1998)) (NEMA). Removal of species should take place throughout the relevant project phases;
- Species specific and area specific eradication recommendations:
    - Care should be taken with the choice of herbicide to ensure that no additional impact and loss of indigenous plant species occurs due to the herbicide used;
    - Footprint areas should be kept as small as possible when removing alien plant species; and
    - No vehicles should be allowed to drive through designated sensitive wetland areas during the eradication of alien and weed species;
- Stockpile the removed vegetation outside of the delineated boundary of the wetlands. The footprint areas of these stockpiles should be kept to a minimum. Should the vegetation not be suitable for reinstatement or be alien/invasive vegetation species, where material cannot be reused as feed for livestock, all material must be disposed of at a registered garden refuse site and may not be burned or mulched on site;

- Retain as much indigenous vegetation as possible, and where possible remove native vegetation from areas where extensive earthworks using machinery are required;
- The clearing of vegetation must remain within the planned rehabilitation footprint only and may not extend beyond this area. No unnecessary disturbance within the wetlands that is outside the rehabilitation footprint will be tolerated.

Soil

- As far as possible, all construction activities, particularly earthworks, should occur in the low flow season, during the drier summer months;
- Should rehabilitation not be finalised during the dry season, a coffer dam area can be created and dewatered around the rehabilitation area by using sandbags and cobbles. Water must be diverted into the downstream reaches, around the coffer area. Water must be allowed to flow to the downstream reaches at all times. Water may only be released from the coffer dam, should it be necessary, once suitable water quality parameters for turbidity and pH have been met (water quality parameters to be determined by a freshwater specialist);
- All proposed activities will potentially result in bank destabilisation and sedimentation of the wetland downgradient of the rehabilitation works. Therefore, sediment control devices must be constructed in situ prior to rehabilitation activities;
- Sediment traps must be installed every 20 m downstream for any works for a length of 100 m;
- Ensure that the creation of the diversion (by means of sandbags) does not result in a significant water level difference upstream or downstream of the installation site;
- It is recommended that a suitably qualified freshwater specialist and ECO should monitor any diversion structures created on site as well as sediment traps at least bimonthly during earthworks to monitor the CVB wetland conditions during rehabilitation activities and after the removal of the diversion;
- As much vegetation growth as possible (of indigenous floral species) should be encouraged to protect soil;
- No stockpiling of topsoil is to take place within the recommended buffer zone around the watercourses, and all stockpiles must be protected with a suitable geotextile to prevent sedimentation of the wetland;
- All soil compacted as a result of construction activities as well as ongoing operational activities falling outside of project footprint areas should be ripped and profiled;
- A monitoring plan for the development and the immediate zone of influence should be implemented to prevent erosion and incision;
- With regards to excavation and soil compaction activities within the wetlands:
    - During the excavation activities, any soil/sediment or silt removed from the wetlands must be temporarily stockpiled outside the wetlands. These stockpiles may not exceed 2 m in height, and their footprint should be kept to a minimum. Stockpiling of removed materials may only be temporary (may only be stockpiled during the rehabilitation at a particular site) and should be disposed of at a registered waste disposal facility if not reused on site;
    - Excavated materials should not be contaminated, and it should be ensured that the minimum surface area is taken up. Mixture of the lower and upper layers of the excavated soil should be kept to a minimum, so as for later usage as backfill material or as part of rehabilitation activities;
    - All exposed soil must be protected for the duration of the construction phase with a suitable geotextile (e.g. Geojute or hessian sheeting) to prevent erosion and sedimentation of the wetlands;
    - The soil surrounding the rehabilitation areas must be suitably loosened on completion of construction activities and revegetated to prevent erosion; and
    - All embankments must be adequately sloped, ripped, topsoil reinstated and vegetated with indigenous wetland vegetation species.

DWS Risk Assessment Matrix (2023)

Table E1: Summary of the Risk Assessment outcomes for the rehabilitation work associated with the proposed CWA development offset.

Phase	No.	Activity	Impact	Potentially affected watercourses			Intensity of Impact on Resource Quality					Overall Intensity	Spatial scale	Duration	Severity	Importance rating	Consequence	Likelihood (Probability) of impact	Significance	Risk Rating	Confidence level
							Abiotic Habitat (Drivers)			Biota (Responses)											
				Name/s	PES	Overall Watercourse Importance	Hydrology	Water Quality	Geomorph	Vegetation	Fauna											
CONSTRUCTION	1	Site access, clearing and preparation for civil works which will involve: • Vehicular transport and access to the site; • Removal of vegetation and associated disturbances to soil; • Removal of topsoil and creation of topsoil stockpiles; and • Miscellaneous activities by construction personnel.	- Exposure of soil, leading to increased runoff and erosion, and thus increased sedimentation of the identified wetlands; - Indiscriminate movement of construction equipment through the wetlands; - Increased sedimentation of the wetlands, resulting in loss of freshwater habitat and ecological structure leading to impacts on biota; - Soil and stormwater contamination from oils and hydrocarbons originating from construction vehicles; - Decreased ecoservice provision; and - Proliferation of alien vegetation as a result of disturbances.	Channelled valley bottom wetland	E	Moderate	2	1	3	3	2	**6**	2	1	**9**	**3**	**27**	80%	**21,6**	**L**	Medium
				Seep wetland	D	Low	1	1	2	3	2	**6**	3	1	**10**	**2**	**20**	80%	**16**	**L**	Medium
	2	Clearing of vegetation (including alien vegetation) and rubble within the wetland habitat for rehabilitation	- Exposure of soil, leading to increased runoff and erosion, and thus increased likelihood for sedimentation of the wetlands; - Increased sedimentation of the wetlands, leading to smothering of vegetation in the downstream reaches; - Proliferation of alien and/or invasive vegetation as a result of disturbances; - Impacts to water quality as a result of the application of herbicides; and - Potential changes to the ecoservice provision of the wetlands.	Channelled valley bottom wetland	E	Moderate	3	3	3	4	2	**8**	2	1	**11**	**3**	**33**	60%	**19,8**	**L**	Medium
				Seep wetland	D	Low	3	2	3	4	3	**8**	3	1	**12**	**2**	**24**	60%	**14,4**	**L**	Medium

Phase	No.	Activity	Impact	Potentially affected watercourses			Intensity of Impact on Resource Quality					Overall Intensity	Spatial scale	Duration	Severity	Importance rating	Consequence	Likelihood (Probability) of impact	Significance	Risk Rating	Confidence level
							Abiotic Habitat (Drivers)			Biota (Responses)											
				Name/s	PES	Overall Watercourse Importance	Hydrology	Water Quality	Geomorph	Vegetation	Fauna										
	3	Groundbreaking and excavations within the wetlands as part of the rehabilitation activities which may include cut, fill and levelling of the side slopes of the wetlands.	- Disturbances of soil leading to ponding of water as a result of over compaction of soil in some areas, increased alien vegetation proliferation, and in turn altered wetland habitat and runoff patterns; - Altered runoff patterns, leading to increased erosion and sedimentation of the downstream wetland habitat; - Potential erosion and formation of preferential flow paths as a result of disturbed soil and inappropriate slopes resulting in sedimentation of the wetland; and - Potential impacts on water quality within the wetlands from leaking equipment.	Channelled valley bottom wetland	E	Moderate	3	3	3	3	2	**8**	3	2	**13**	**3**	**33**	80%	**26,4**	**L**	Medium
				Seep wetland	D	Low	2	2	4	3	2	**8**	3	2	**13**	**2**	**26**	60%	**15,6**	**L**	Medium
	4	Rehabilitation of the CVB wetland and seep wetland - revegetation	- Soil compaction within the wetlands; - Potential sedimentation of the wetlands due to activities within the wetlands	Channelled valley bottom wetland	E	Moderate	2	2	2	3	2	**6**	2	2	**10**	**3**	**30**	60%	**18**	**L**	High
				Seep wetland	D	Low	2	2	2	3	2	**6**	2	2	**10**	**2**	**20**	60%	**12**	**L**	High
OPERATIONAL	5	Functioning of the rehabilitated wetlands	No perceived negative impacts	Channelled valley bottom wetland	E	Moderate	-3	-2	-3	-3	-2	**-6**	3	2	**-11**	**3**	**-33**	100%	**-33**	**+**	High
				Seep wetland	D	Low	-3	-2	-3	-3	-2	**-6**	3	2	**-11**	**2**	**-22**	100%	**-22**	**+**	High

Phase	No.	Activity	Impact	Potentially affected watercourses				Intensity of Impact on Resource Quality						Overall Intensity	Spatial scale	Duration		Severity	Importance rating		Consequence		Likelihood (Probability) of impact		Significance	Risk Rating	Confidence level
				Name/s	PES	Overall Watercourse Importance		Abiotic Habitat (Drivers)			Biota (Responses)																
								Hydrology	Water Quality	Geomorph	Vegetation	Fauna																
	6	Ongoing alien and invasive vegetation removal (if required).	- Compaction of soils and loss of habitat as a result of ongoing disturbance from vehicles and equipment; - Impacts to water quality as a result of the application of herbicides; and - Disturbance of soils which could lead to erosion.	All ecosystems	D	Moderate		1	1	2	2	1		**4**	2	2		**8**	**3**		**24**		40%		**9,6**	**L**	Medium
	7	Functioning of the rehabilitated wetlands post-alien and invasive vegetation removal	No perceived negative impacts	All ecosystems	D	Moderate		-1	-1	-1	-1	-1		**-2**	3	2		**-7**	**3**		**-21**		100%		**-21**	**+**	High

APPENDIX F – Offset Determination Methodology

For the purposes of the residual impact assessment, all wetland losses were converted into the following quantities:

- **Functional hectare equivalents** in support of water resource management and disaster risk management. 'Functional hectare equivalents' are the equivalent area of wetland providing a measurable level of regulating ecosystem services (calculated as wetland area multiplied by functional value);
- **Habitat hectare equivalents** in support of ecosystem conservation. 'Habitat hectare equivalents' are the equivalent area of wetland with intact vegetation and habitat (calculated as wetland area multiplied by habitat value); and
- **Species offset ratios** in support of Species of conservation Concern (SCC). Ratios should be guided by factors such as threat status and the importance of the wetland in meeting species protection targets. Importantly, if no SCC make use of the wetland being investigated, then this assessment is not required (which applies to this offset strategy).

Digital Wetland Offset Calculators were used to calculate the above aspects. All calculations are automatically done in the relevant calculators. The digital calculator available within the WET-EcoServices (Version 2) tool (Kotze *et al*., 2020) was used to calculate the functional hectare equivalents (in support of water resource management), whereas the digital calculator from the Wetland Offset Guidelines (Macfarlane *et al.,* 2016), was used to calculate the habitat hectare equivalents (in support of ecosystem conservation targets) and species offset ratios (in support of SCC (where necessary)).

DETERMINING WATER RESOURCES AND ECOSYSTEM SERVICES OFFSET TARGETS

Calculation of Functional Hectare Equivalents

The functional hectare equivalents associated with each of the wetland units to be lost for the present state scenario were calculated as follows:

- The supply, demand and importance of the regulating ecosystem services provided by the wetland units were assessed using the WET-EcoServices (Version 2) tool (Kotze *et al*., 2020);
- The supply scores (including flood attenuation, streamflow regulation, sediment trapping and erosion control, and water quality enhancement; out of maximum score of 4) for each of the regulating services were then integrated into a single weighted supply score. This was done by assigning each of the regulating services a relative importance percentage based on the assessed demand for such services, and then aggregating these weighted scores. These weightings are used to define the offset currency mix for the study area;
- The weighted supply score was then converted into a functional value percentage by dividing the weighted supply score by the realistic reference state supply score for the relevant region; and
- The area of the relevant wetland unit (in hectares) was then multiplied by the functional value to calculate the functional hectare equivalents.

See Table F1 for a visual representation of the EcoServices interface for the offset calculations.

Table F1: Visual representation of the EcoServices interface for the offset calculations for functional hectare equivalents.

Integrating scores to assess Functional Value & Hectare Equivalents			
Function / Service Groups	**Weighting (%)**	**Present State**	**Future State**
Flood Attenuation	10%		
Streamflow Regulation	10%		
Sediment Trapping & Erosion Control	20%		
Water Quality Enhancement	60%		
Weighted Supply Score			
Realistic Reference score		3,2 (default)	
Functional Value (%)			
Wetland Area (Ha)			
Functional Hectare Equivalents (Unadjusted)			

Wetlands in certain settings may be playing more valuable roles than those in other locations. The loss of these wetlands may thus have a greater relative impact on Water Resources and Ecosystem Services and would require an increased offset target to adequately compensate for the services to be lost. A functional offset ratio is therefore introduced in order to differentiate between systems based on local demand. Loss of wetlands located in critical catchment contexts (high local demand scores) are therefore regarded as more significant (with higher offset requirements) than those located in contexts with low local demand.

The **wetland offset target** was calculated as follows: Functional importance ratios are calculated automatically in the spreadsheet tool based on the local demand scores for the wetland in question and weightings applied to the different Function / Service groups. Following the determination of the functional importance ratio, the *adjusted (final) functional hectare equivalents* can then be calculated by multiplying the *unadjusted functional hectare equivalents* by the functional importance ratio.

DETERMINING ECOSYSTEM CONSERVATION OFFSET TARGETS

Assessing Residual Impacts to Wetland Habitat

An assessment of the impact that wetland loss will have on wetland habitat and the ability to meet wetland conservation targets is necessary to determine Ecosystem Conservation offset targets. To undertake this assessment, use an appropriate tool to assess habitat intactness (condition) of the wetland (i) prior to and (ii) post-development. The residual impact is then calculated by comparing the pre- and post-impact scenarios.

In the absence of more appropriate measures, the vegetation module of WET-Health can be used as a surrogate measure for habitat intactness pre- and post-development. This is regarded as a more appropriate measure than the integrated PES score as the suitability of a wetland to support biodiversity is most strongly linked to vegetation attributes.

The selected habitat intactness measure must be expressed as a percentage (%). A wetland supporting completely natural habitat would therefore score 100% while a wetland that has been completely destroyed and lacks any natural habitat would score 0%. To calculate the change in functional value, the post development score (%) is simply subtracted from the pre-development score (%). The resultant score is then multiplied by wetland area to obtain a measure of the loss in wetland habitat in hectare equivalents.

Calculation of Habitat Hectare Equivalents

In summary, the habitat hectare equivalents associated with the wetland units within the project site for present state scenario were calculated as follows:

- The condition of the vegetation of the wetland units were assessed using the Level 1 WET-Health assessment tool (Macfarlane *et al.*, 2020).
- The vegetation impact scores out of 10 were converted into vegetation condition scores by subtracting the impact score from the maximum impact score of 10. E.g. an impact score of 6 is a condition score of 4. Thereafter, the condition scores were converted onto a habitat value percentage by dividing by the maximum condition score of 10.
- The area of the relevant wetland unit (in hectares) was then multiplied by the habitat value to calculate the habitat hectare equivalents.

Determining Ecosystem Conservation Ratios

Ecosystem Conservation ratios are calculated based on a suite of wetland characteristics that are important in determining conservation value. These include (i) ecosystem status; (ii) regional and national conservation context and (iii) local site attributes. The ecosystem status multiplier acts as the starting point but is adjusted downwards where the wetland has not been prioritised at regional or national level and where local site attributes that affect biodiversity value are sub-optimal.

Ecosystem Status

The significance of wetland loss is linked to the ecosystem threat status and protection levels of a given wetland type. An impact to a wetland with a higher threat status (e.g. Endangered) is therefore regarded as more significant than impacts to a wetland of lower threat status (e.g. Least Threatened) and therefore a higher ratio applies to the former. Similarly, impacts to wetland types that are poorly protected are regarded

The threat status and protection levels of **wetland vegetation groups**[7] should be used. The values are provided in the Wetland Offset Calculator spreadsheet as well summarised in this report. Where more suitable classifications and assessments are available at a regional level, these should be used.

The ecosystem status multiplier is simply calculated by multiplying the individual threat status and protection multipliers. The following scoring guidelines are used for this calculation:

- Threat status:
  Critically Endangered = 15; Endangered = 7.5; Vulnerable = 3; Least Threatened = 1
- Protection level:
  Not Protected = 2; Poorly Protected = 1; Moderately Protected = 0.75; Well Protected =0.25.

Regional and National Conservation Context

Wetlands have been prioritised through a number of systematic conservation planning processes. Maximum offset ratios are applied for priority wetlands, whereas requirements are lower for wetlands not prioritized in national or regional plans. This criterion should be evaluated by reviewing available national and regional datasets and using this to score the criterion using the scoring guideline below (Table F2).

[7] The NFEPA Wetland Vegetation Group GIS dataset is available on SANBIs Biodiversity GIS: http://bgis.sanbi.org/NFEPA/NFEPAmap.asp#wetlandecosystemtypes

Table F2: Criteria for evaluating regional and national conservation context. Importance class Description Ratio

Importance class Description Ratio	Importance class Description Ratio	Importance class Description Ratio
Not specifically identified as important	Not a priority wetland in a local or regional conservation plan. Not identified as a wetland priority or within a River FEPA catchment (FEPA1).	0.5
Moderate importance	ESA (Ecological Support Area) identified in a local or regional conservation plan, or wetlands located within a River FEPA catchment (FEPA1).	0.75
High importance	The wetland is characterised by one or more special habitat or biodiversity attributes that makes the site important for local conservation efforts. This includes wetlands (i) supporting important populations of species of conservation concern; (ii) supporting large populations of wetland-dependant species; (iii) providing important migration, breeding or feeding sites; or (iv) characterised by unusually high natural habitat diversity.	1.0

Integrity of Adjacent Terrestrial Areas and Local Catchment

Recent research has emphasized that relatively undisturbed hinterlands are important for maintaining the populations of many wetland-dependant species. For example, many semi-aquatic species rely on terrestrial habitats for the successful recruitment of juveniles and to maintain optimal adult survival rates.

Adjacent terrestrial areas also screen wetlands from anthropogenic disturbances such as human presence and traffic or indirect impacts, such as noise and light pollution. Adjacent areas also provide potentially useful corridors, allowing the connection of breeding, feeding and refuge sites crucial to maintain the viability of populations of semi-aquatic species.

While adjacent terrestrial areas and local catchments provide important supporting habitat to allow species to carry out various activities, the functional value of such areas is still mostly dependent on the actual habitat value of the wetland. As such, the importance of these areas is secondary to wetland biodiversity attributes.

A weighting of 20% is applied to this criterion when calculating the local site context multiplier. As it is often difficult to precisely delineate the extent of the adjacent terrestrial area that is of importance to a particular wetland, a default 500m buffer (which aligns with DWS regulations) is used as the starting point. However, where local justification and data exists, a more accurately mapped local catchment or area of influence can be used instead. Landcover in the adjacent terrestrial areas should be mapped and assessed according to its ability to support wetland-dependent species.

Table F3 provides broad-level guidance but should be tailored according to available datasets and expert input.

Broad Landcover Category	Compatibility Score
Cultivated lands	0.5
Degraded natural habitat	0.75
Eroded Areas	0.25
Intact natural habitat	1
Forest plantations	0.25
Mines and quarries	0
Urban / built-up areas	0

A weighted average is then calculated as a measure of the compatibility of landuse within the buffer zone to support wetland-dependant biota. Scores calculated must be expressed as a range from 0 (totally incompatible landuse) to 1 (highly compatible landuse). A site level assessment for which the above guidance is followed is required for actual offset calculations. Where a desktop level assessment is being undertaken, the percentage natural habitat within 500m of the wetland can be used as a surrogate. This information is captured as “PERNAT500” in the NFEPA wetlands dataset or determined based on revised landcover mapping and analysis.

Local Connectivity

Landscape connectivity is important for local ecological processes including species movement. Whilst connectivity is regarded as being an important consideration, this is only relevant where a wetland is already able to support wetland dependant biota. It is also recognized that wetlands are able to support biota in the absence of good connectivity in instances where the wetland and buffer zone already provides sufficient suitable habitat. As such, this criterion is down-weighted significantly relevant to the other two site-based criteria. This criterion therefore only contributes 10% towards the local context multiplier.

This is evaluated by assessing the connectivity of the wetland to wetlands and other aquatic resources. Here, consideration should be given to (a) the proximity of wetland and / or riparian habitat (particularly within 500m of the wetland); (b) the level of fragmentation of habitat and therefore connectivity that remains and (c) the condition and associated biodiversity value (as supporting habitat) of adjacent water resources. These aspects can easily be assessed at a desktop level using a GIS or available aerial photography (including Google Earth imagery). Criteria for this evaluation are given in Table F4. For a desktop-level assessment, NFEPA wetland clusters can be used to identify wetlands with good connectivity. For detailed planning, a site-based assessment of connectivity must be undertaken using available information.

Table F4: Criteria for evaluating local connectivity.

Biodiversity Value Class	Description	Multiplier
Low connectivity	The wetland has very little connection with other water resources in the landscape (e.g. Very high levels of fragmentation with few wetlands nearby).	0.5
Moderate connectivity	The wetland is moderately connected with other water resources in the landscape. (e.g. Moderate levels of fragmentation but with reasonable connectivity to intact wetlands and /or riparian zones).	0.75
Good connectivity	The wetland is well connected with other water resources in the landscape. (e.g. Wetland clusters within 1 km of each other and embedded in a relatively natural landscape).	1.0

Calculating Final Ecosystem Conservation Offset Targets

The Ecosystem Conservation Ratio is first calculated by multiplying the (i) Ecosystem Status Multiplier; (ii) Regional and National Context Multiplier and (iii) Local Context Multiplier. The final Ecosystem Conservation offset target is then calculated by multiplying the loss in wetland habitat in hectare equivalents by the Ecosystem Conservation Ratio. All calculations are automatically done in the calculator.

Table F5: Digital Wetland Offset Calculator interface for 'Ecosystem Conservation Targets' as per the Wetland Offset Guidelines (SANBI and DWS, 2016).

Ecosystem Conservation Targets				
Impact Assessment	Prior to development	Wetland size (ha)		
		Habitat intactness (%)		
	Post development	Habitat intactness (%)		
		Change in habitat intactness (%)		
	Development Impact (Habitat hectare equivalents)			
Determining offset ratios	Ecosystem Status	Wetland Vegetation Group (or type based on local clasification)		
		Threat status of wetland	Threat status	
			Threat status Score	
		Protection level of wetland	Protection level	
			Protection level Score	
		Ecosystem Status Multiplier		
	Regional and National Conservation context	Priority of wetland as defined in Regional and National Conservation Plans	Moderate Importance	
		Regional & National Context Multiplier		
	Local site attributes	Uniqueness and importance of biota present in the wetland	Low biodiversity value	
		Buffer zone integrity (within 500m of wetland)	Buffer compatibility score	
		Local connectivity	Moderate connectivity	
		Local Context Multiplier		
	Ecosystem Conservation Ratio			
Offset Calculation	Development Impact (Habitat hectare equivalents)			
	Ecosystem Conservation Ratio			
	Ecosystem Conservation Target (Habitat hectare equivalents)			

CALCULATING SPECIES OF CONSERVATION CONCERN OFFSET TARGETS

The first step involves the identification and screening of species of potential concern that could be impacted by proposed development activities. The potential significance of impacts on species must then be assessed with input from an appropriate biodiversity specialist. Where significant negative residual impacts are anticipated, specific offset targets should then be set for each species using the minimum information requirements outlined below as a guide.

Assessing Residual Impacts to Species of Conservation Concern

An assessment of the predicted impact to species of conservation concern as a result of planned developments are required in order to set appropriate species targets. This assessment requires an appropriate species impact measure to be selected and applied to score the potential impact of planned development activities.

Methodologies for specifically quantifying impacts to threatened species for application in offset negotiations have not yet been developed for the South African context. Specialists undertaking this assessment will therefore need to consider the range of options available and use an appropriate species impact measure for local application. In cases where species requirements are strongly linked to habitat, the area and suitability of relevant habitat of the wetland may be used as a surrogate measure to determine preliminary offset targets (typically expressed as a species habitat measure). It is important to note here that measures may need to be tailored according to the specific habitat attributes of concern (e.g. hectares of core breeding or foraging habitat). In other situations, a composite measure of suitability that considers aspects in addition to habitat condition (e.g. local connectivity) may be relevant. For species whose presence is not strongly linked with measurable ecosystem attributes, a count of the number of individuals or other suitable species population measures such as numbers of breeding pairs may be a more appropriate means of quantifying potential impacts. Whichever measurement system is applied, it is important that the rationale for selection is clearly justified, and that the unit of measurement is clearly communicated. The same units must then be applied to both the impacted site and proposed offset locations. In the same way, it may be necessary to repeat this assessment for a range of different target species.

Once selected, the selected measurement system must be used to score the anticipated impact of planned development activities on species of conservation concern. This should be based on the change in the species impact measure, which is simply calculated by subtracting the post-development score from the predevelopment score.

Determining Offset Ratios

Ratios may be used to increase offset requirements for species of conservation concern in line with the significance of anticipated impacts. There is still very little guidance available for determining offset ratios for species of conservation concern. This should however be guided by factors such as threat status and the importance of the wetland in meeting species protection targets. Species conservation ratios will therefore need to be proposed by the biodiversity specialist and negotiated in consultation with the appropriate conservation agency. Species offset ratios should range from 1:1 (minimum requirement) upwards.

Calculating Final Offset Targets for Species of Conservation Concern

Offset targets for each species of conservation concern are calculated by multiplying the development impact (expressed as an appropriate species measure) by the relevant species conservation ratio. This process is repeated for each species of conservation concern selected.

OFFSET SITE SELECTION

In the first phase of the offset study, several *offset candidate sites* are considered. Candidate sites may include both on-site and off-site wetland offset options. A suite of site selection criteria has been identified by the National Wetland Offset Guidelines (DWS and SANBI, 2014), and are summarised in Table F6. Final offset site selection must ensure that suitable compensation for the loss of freshwater features due to the proposed development is achievable, while addressing the suitability of a site in terms of meeting Water Resource and Ecosystem Service requirements (as per criteria listed in Table F6.

Table F6. Offset site selection and screening tool to meet ecosystem conservation targets.

Criteria	Site attributes	Acceptability Guideline
Like-for-like Habitat Type	**1. Wetland habitat & HGM type – Wetlands selected should ideally be of the same habitat type ('Like for like' principle).**	
	Wetland is of the same habitat in terms of vegetation composition / structure, HGM type and Wetland Vegetation Group: • HGM type: Seeps and depressions • Habitat type: Short and/ or medium height sedgeland and/or hygrophilous grassland habitat. • Vegetation Group: Mesic Highveld Grassland Group 4.	Ideal
	Wetland is a different HGM type but the same vegetation type, within the same Wetland Vegetation Group: • HGM type: Channelled and un-channelled valley bottom wetlands • Habitat type: Medium height sedgeland and / or hygrophilous grassland habitat. • Vegetation Group: Mesic Highveld Grassland Group 4.	Acceptable
	Wetland is a different HGM and habitat type, but within the same Wetland Vegetation Group: • HGM type: Channelled and un-channelled valley bottom wetlands • Habitat type: Medium to tall height herbaceous sedge and/or reed marsh vegetation. • Vegetation Group: Mesic Highveld Grassland Group 4. OR Wetland is the same habitat type, but within a different adjacent Wetland Vegetation Group with a critical need for protection: • HGM type: Seeps and depressions • Habitat type: Short to medium tall sedgeland and/or hygrophilous grassland. • Critically endangered Wetland Vegetation Group adjoining Mesic Highveld Grassland Group 4. with no protection.	Potentially acceptable but generally undesirable i.e. should only be considered if no viable offsets sites that are ideal / acceptable
	Wetland is in another Wetland Vegetation Group (adjoining the Mesic Highveld Grassland Group 4.) of a lower threat status (trading down).	Generally unacceptable
Conservation Planning	**2. Landscape/Conservation planning – Wetland selection should be aligned with regional and national conservation plans where possible.**	
	Wetlands have been identified as being of high importance in national, provincial and municipal conservation plans e.g. Critical Biodiversity Areas (CBAs), Freshwater Priority Areas (FEPAs), and/or within River FEPA catchments.	Ideal
	Wetlands have been identified as moderately important in national, provincial and municipal conservation plans e.g. Ecological Support Areas (ESAs) and/or NFEPA support areas.	Acceptable
	Wetlands have not been specifically identified as important in national, provincial and municipal conservation plans.	Potentially acceptable but generally undesirable
Wetland Condition	**3. Wetland condition – The habitat condition should ideally be in a moderately modified condition with good rehabilitation potential (Class C or D) and good/better than that of the impacted site prior to development.**	
	Post-rehabilitation condition is Class B of higher.	Ideal
	Post-rehabilitation condition is Class C.	Acceptable
	Post-rehabilitation condition is Class D.	Generally unacceptable
Local Biodiversity Value	**4. Local biodiversity value - Wetlands that are unique or that are recognised as having high local biodiversity value should be prioritised for wetland protection.**	
	The wetland is characterised by habitat and/or species of high biodiversity value i.e. presence of unique and noteworthy biodiversity attributes like high species or habitat diversity, rare species or habitat, unique features etc.	Ideal

	The wetland is characterised by habitat and/or species of moderate biodiversity value (i.e. some noteworthy features present).	Acceptable
	The wetland is characterised by habitat and/ species of low biodiversity value.	Generally unacceptable
Long-term Ecological Viability	**5. Ecological viability of site – Ecological connectivity and consolidation with other intact ecosystems together with the potential linkage between protected areas is preferable. Also, catchment land use transformation (current and planned) should be low to moderate to reduce risk of indirect impacts.**	
	The offset provides an opportunity to consolidate / expand existing protected areas. Catchment threats and pressures are low.	Ideal
	The wetland is well connected to other intact natural areas and there are no obvious land use threats to its long-term persistence.	Acceptable
	The wetland is moderately connected to other intact natural areas and there are measurable land use threats to its long-term persistence that can be managed.	Potentially acceptable but generally undesirable
	The wetland is poorly connected with other intact ecosystems/ there are land use threats to its long-term persistence and/or catchment highly transformed / catchment land uses have intense hydrological and geomorphological impacts.	Generally unacceptable
Land-legal Viability	**6. Land-legal Issues — The rezoning of the site to a formal conservation use is legally and practically feasible and does not contradict / is in line with current land use planning.**	
	Wetland is located on privately or state-owned land with no conflicting current or future land use zoning and is located within a single cadastral unit / property.	Ideal
	Wetland is located on privately or state-owned land with no conflicting current or future land use zoning and is located across 2-4 properties.	Acceptable
	Wetland is located on privately or state-owned land with no conflicting current or future land use zoning and is located across 5-8 properties.	Potentially acceptable but generally undesirable
	Wetland is located on privately or state-owned land with conflicting current or future land use zoning or development applications / rights and/or is located across >8 properties and/or the wetland is located within tribal authority land.	Generally unacceptable
Demand for Regulating Services	**7. Downstream demand for regulating ecosystem services — a higher demand for regulating ecosystem services provides an indication of the opportunity for the realisation of the gains in ecosystem services as well as the importance of such.**	
	There is a high to very high demand for regulating ecosystem services by downstream users.	Ideal
	There is a moderate to moderately high demand for regulating ecosystem services by downstream users.	Acceptable
	There is a low demand for regulating ecosystem services by downstream users.	Generally unacceptable
Rehabilitation Opportunities / Potential	**8. Rehabilitation opportunities – sites with a lower cost to benefit ratio for achieving wetland functional gains and with good rehabilitation potential are preferable over sites that require extensive and costly rehabilitation to achieve a PES C or higher.**	
	Wetland has good rehabilitation potential that can be achieved by relatively cost-efficient interventions.	Ideal
	Wetland has good rehabilitation potential that can be achieved by costly and extensive interventions.	Acceptable
	Wetland has poor rehabilitation potential OR Wetland has moderate rehabilitation potential that can be achieved by costly and extensive interventions.	Generally unacceptable

APPENDIX G – Rehabilitation and Management Plan Framework

Standard Practices for Planning, Implementing, and Monitoring Ecological Repair Projects

Important principles of rehabilitation or Ecological Repair project **implementation** include:

- No further or latent damage on natural resources is to be caused by the restoration/rehabilitation works;
- Planned interventions are interpreted and carried out responsibly, effectively and efficiently by suitably qualified, skilled and experienced people or under the supervision of a suitably qualified, skilled and experienced person;
- All interventions are undertaken in a manner that is responsive to natural processes and fosters and protects potential for natural and assisted recovery;
- Corrective changes of direction (to adapt to unexpected ecosystem responses) are facilitated in a timely manner and are ecologically informed and documented;
- All projects exercise full compliance with work, health, and safety legislation; and
- All project operatives communicate regularly with key stakeholders (or as required by funding bodies) to keep them abreast of progress.

The below figure (Figure G1) outlines standard practices used in Ecological Repair project planning where professional staff or contractors are engaged. They can be applied any rehabilitation or restoration project but the degree to which they are applied should be adapted to correspond to the size, complexity, degree of damage, regulatory status, and budgets of the particular project.

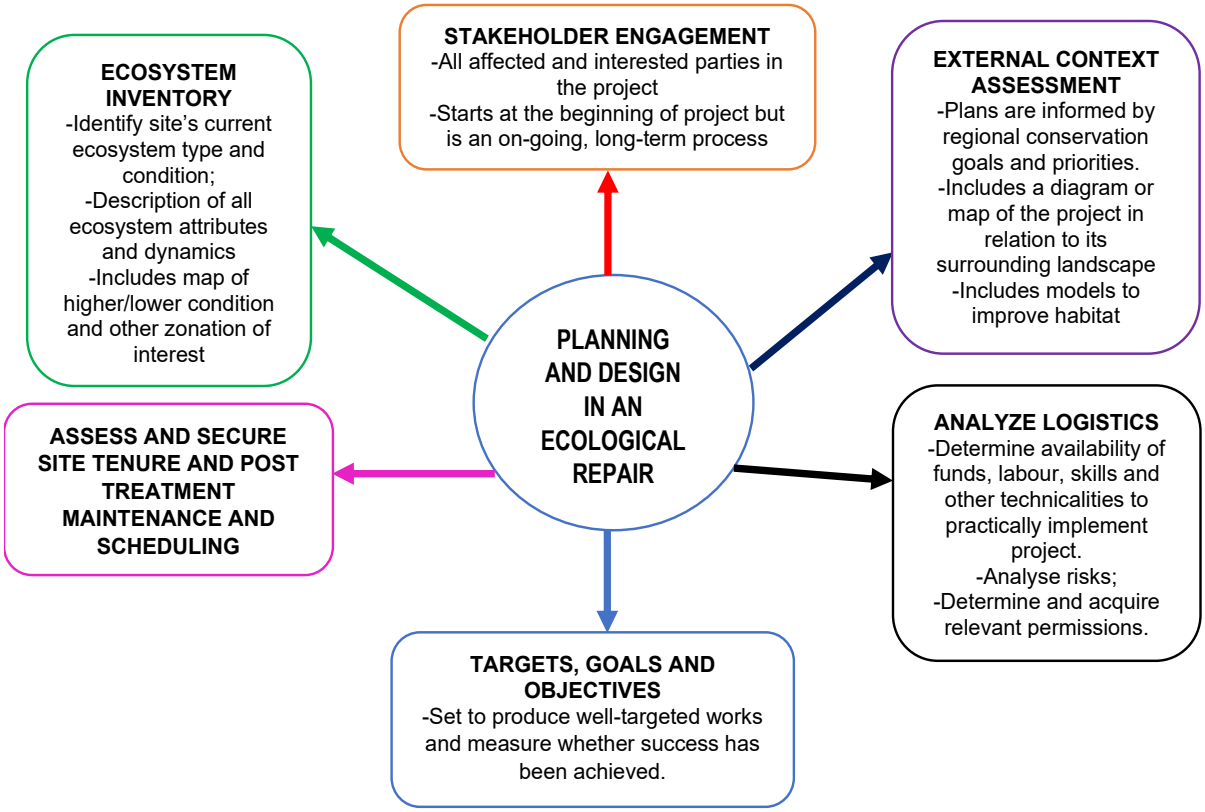


Figure G1: Planning and design process of rehabilitation and ecological restoration projects, according to McDonald *et al.* (2016).

Key Actions in Rehabilitation and Restoration Projects

Rehabilitation activities should be undertaken on a continual basis, with each iteration improving on the previous plan, i.e., in a continuous, cyclic nature. It is crucial that the rehabilitation plan be an ongoing process, where the plan is continually refined and improved. To achieve this, a rehabilitation framework has been proposed. This cyclic framework is divided into four phases, namely a planning phase, an implementation phase, a monitoring phase, and an adaptive management phase (Figure G2). This framework is a modified version of that presented by Hatting *et al.* (2019).

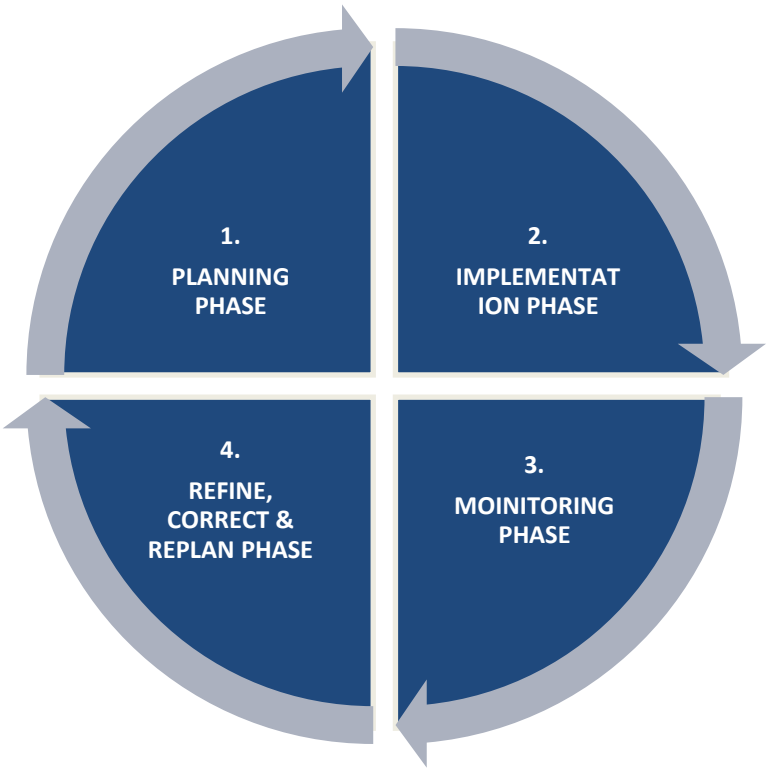


Figure G2: Schematic diagram illustrating the cyclic nature of the proposed rehabilitation framework. Each iteration (i.e., phase) is intended to identify strengths and weaknesses of the framework and implement improvements in the next round of rehabilitation.

The Phases can be summarised as follows (Hatting *et al.,* 2019):

1. Planning Phase: this phase outlines the rehabilitation targets and objectives that rehabilitation activities aim to achieve. It involves setting out a vision and objectives as well as a conceptual rehabilitation plan and design that can be implemented in conjunction with operational mining activities;
2. Implementation Phase: this phase involves the rehabilitation activities needed to reach rehabilitation targets. This phase involves the in-field rehabilitation context of the rehabilitation plan set out in the planning phase, i.e., the on-site implementation of rehabilitation activities (e.g., soil amelioration activities, vegetation trials etc.);
3. Monitoring Phase: this phase provides recommendations on monitoring methods required to successfully evaluate the implemented rehabilitation activities. During this phase the need for refinement of implementation activities is identified; and
4. Adaptive Management Phase: this phase involves a “refine-correct-re-plan” approach that ensures that the rehabilitation plan is continuously being updated and improved so to effectively achieve the rehabilitation targets set out in the planning phase.

Key Action 1: Planning: rehabilitation and restoration practice is based on knowledge of an appropriate local native reference ecosystem, taking environmental change into account.

Establishing the reference ecosystem model can be achieved by using existing reference sites that serve as analogues between the degraded site and its restoration target. When existing reference sites are unavailable, the reference model can be estimated, by collecting ecosystem information on local native plants, animals, other biota, and abiotic conditions from various sources. These sources include extant reference sites, field indicators, historical records, and predictive data. The reference model must account for ecosystem capacity to adapt to existing and anticipated environmental change. As such, the process of selecting a reference model should consider contemporary examples where they exist.

The second key concept underpinning successful Ecological Repair is clearly identifying what site-specific ecosystem attributes must be restored to facilitate ecosystem recovery. This involves dividing broad categories (species composition) into more detailed sub-categories (flora) to inform a given project's goals and objectives. Specific, measurable indicators are then used to evaluate an ecosystem's attributes before and after rehabilitation efforts to determine whether desirable change is being achieved or not. Effective indicators include details of the attribute (e.g.: physical conditions) to be evaluated; desired outcomes, e.g., soil rations; magnitude of the effect, e.g., 40% increase in plant cover) and specific timeframes in which outcomes are to be achieved. Please refer to Table DC below for the six main ecosystem attributes that can be measured in a rehabilitation or restoration project.

Table G1: Six important attributes of a target ecosystem and their goals and objectives, to help measure ER success.

Attribute	Examples of broad goals – for which more specific goals and objectives appropriate to the project would be developed
Absence of threats	Cessation of threats such as overutilization and contamination; elimination or control of invasive species.
Physical conditions	Reinstatement of acceptable topographical landscape features.
Species composition	Presence of desirable plant and animal species and absence of undesirable species.
Structural diversity	Reinstatement of layers, faunal food webs, and spatial habitat diversity.
Ecosystem functionality	Appropriate levels of growth and productivity, reinstatement of nutrient cycling, decomposition, habitat elements, plant-animal interactions, normal stressors, on-going reproduction, and regeneration of the ecosystem's species. Appropriate provision of goods and services to the local community.
External exchanges	Reinstatement of linkages and connectivity for migration and gene flow; and for flows including hydrology, fire, or other landscape scale processes.

Key Concept 2: Implementation (Approaches to ecosystem regeneration):

There are three approaches to facilitating ecosystem regeneration: "natural", "assisted" and "reconstruction". The diagram below describes what each approach entails, and where each approach is warranted, along the trajectory of ecosystem recovery. The more degraded and less functional an ecosystem, greater is the effort that is required to restore it. Reconstruction by means of engineering (e.g., earth works and artificial soil fertilisation) is required when the land has poor capability. However, as abiotic barriers are overcome by reconstructive efforts, natural processes take over and humans involved in the Ecological Repair project, begin to only assist what is naturally occurring by adding biotic factors. The ultimate goal is to get the ecosystem to the point of self/natural regeneration where human inputs are minimal. Refer to Figure G3 below for an illustration of the three approaches to ecosystem regeneration.

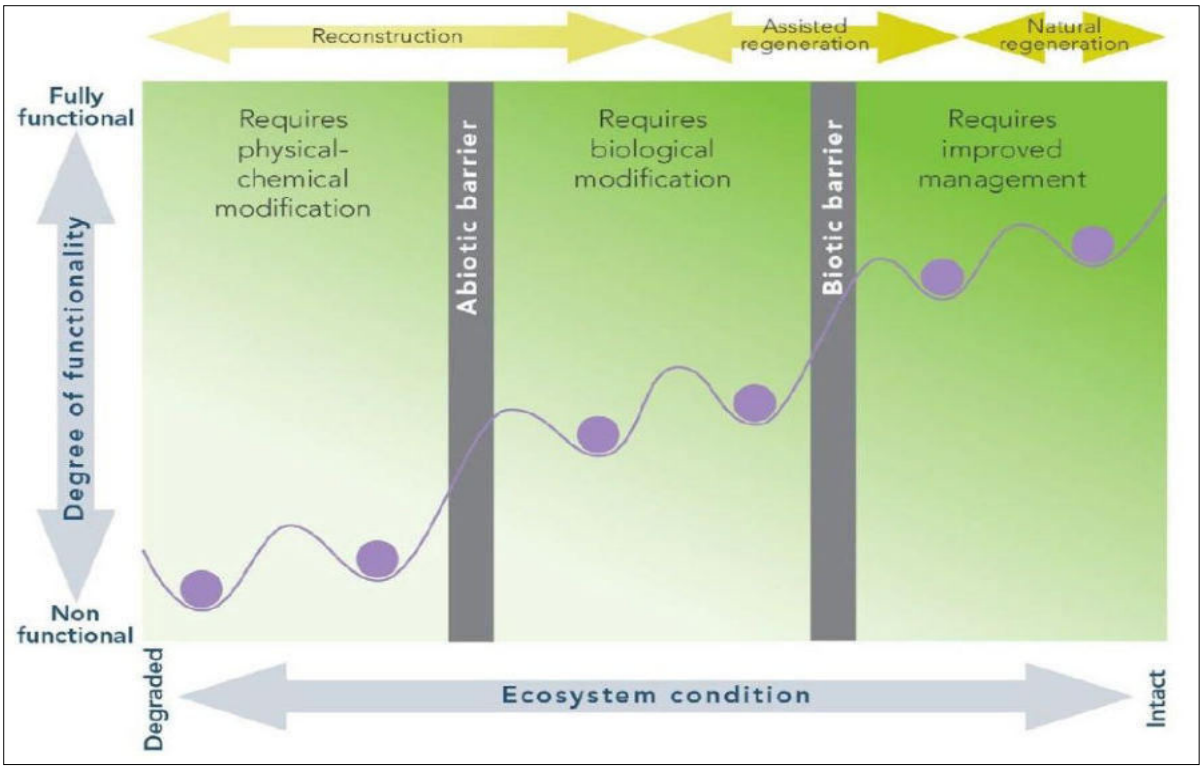


Figure G3: Conceptual model of ecosystem degradation and responses to it through restoration (McDonald *et al.,* 2016).

Key Concept 3 and 4: Maintenance and monitoring.

The next stage in the procession of an Ecological repair project after implementation, **is monitoring and maintenance**. Successful Ecological repair projects rely on well-developed monitoring and maintenance programs. These programs inform managers whether rehabilitation and restoration interventions and treatments are successful and what approaches need to be taken for future work. The management body is responsible for ongoing maintenance to prevent negative impacts and carries out any required monitoring of the site after completing the project. This is to ensure that the site does not regress into an unacceptable state. Comparison with an appropriate reference ecosystem will be ongoing. Important aspects of monitoring are as follows:

- Monitoring evaluated results i.e., determines whether goals and objectives are being achieved or not, and why;
- Collects baseline ecosystem data prior to works, to compare ecosystem before and after interventions and treatment;
- Makes use of appropriate sampling techniques for the area, that are scientifically sound. Sampling design can be simple but should still be scientifically rigorous and produce high confidence in results. In other words, data collection should be repeated at regular intervals, in the same sampling plots, using the same survey techniques. The simplest method that can be used, is fixed-point photography, with accompanying species composition and ecosystem descriptions. Ecological change is however, best expressed when quantified;
- Adequate records of interventions and treatments are maintained to ensure adequate implementation, inform adaptive management and enable future evaluation of results relative to the implemented actions. All treatment data, along with all evaluation monitoring records are maintained for future reference; and
- The management body is responsible for ongoing maintenance to prevent deleterious impacts and carries out any required monitoring of the site after completion of the project to ensure that the site does not regress into an undesirable state. Comparison with an appropriate reference ecosystem will be ongoing.

Ecosystem recovery may take many years to accomplish. As such, managers should adopt strategies of continuous improvement. To help managers track progress towards project goals over time, a star rating tool (5-levels or 'stars') for assessing and ranking degree of recovery over time can be used. Please see Table G2 for an example of how the "five-star" system for recording ecosystem recovery can be used against the six main ecosystem attributes referred to in key concept 2. Alternatively, a recovery wheel depicted in Figure G4 below can be used to track recovery overtime. Some key notes for interpreting the 5-star evaluation system are presented below:

- The system serves to evaluate the progression of an ecosystem along a trajectory of recovery;
- The system represents a conceptual gradient, providing a framework that can be interpreted by managers in more quantitative terms to suit a specific ecosystem;
- Evaluation can only be as rigorous (and therefore as reliable) as the monitoring that it informs; and
- Evaluation using the 5-star system must be site- and scale-specific.

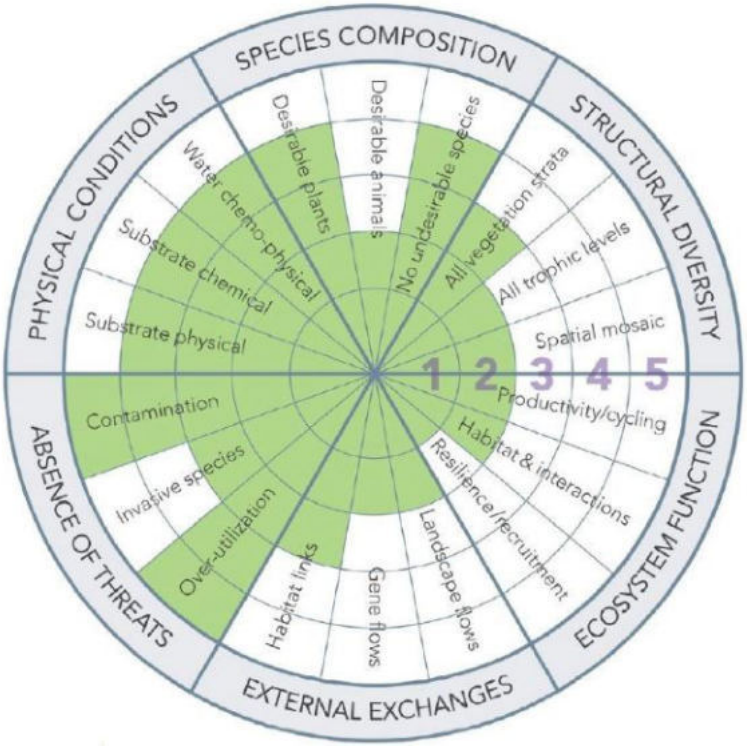


Figure G4: Progress evaluation 'recovery wheel' depicting a hypothetical 1-year old reconstruction project on its way to a 4-star condition. This template allows a manager to illustrate the degree to which the ecosystem under treatment is recovering over time. Note: Sub attribute labels can be adjusted or more added to better represent a particular ecosystem.

Table G2: A generic 1–5-star recovery scale interpreted in the context of the six key ecosystem attributes used to measure progress towards a self-organizing status (McDonald *et al.,* 2016).

ATTRIBUTE	★	★★	★★★	★★★★	★★★★★
Absence of threats	Further deterioration discontinued and site has tenure and management secured.	Threats from adjacent areas beginning to be managed or mitigated.	All adjacent threats managed or mitigated to a low extent.	All adjacent threats managed or mitigated to an intermediate extent.	All threats managed or mitigated to high extent.
Physical conditions	Gross physical and chemical problems remediated (e.g., contamination, erosion, compaction)	Substrate chemical and physical properties (e.g., pH, salinity) on track to stabilize within natural range.	Substrate stabilized within natural range and supporting growth of characteristic biota.	Substrate securely maintaining conditions suitable for ongoing growth and recruitment of characteristic biota.	Substrate exhibiting physical and chemical characteristics highly similar to that of the reference ecosystem with evidence they can indefinitely sustain species and processes.
Species composition	Colonising native species (e.g., ~2% of the species of reference ecosystem). No threat to regeneration niches or future successions.	Genetic diversity of stock arranged and a small subset of characteristic native species establishing (e.g., ~10% of reference). Low onsite threat from exotic invasive or undesirable species.	A subset of key native species (e.g., ~25% of reference) establishing over substantial proportions of the site. Very low onsite threat from undesirable species.	Substantial diversity of characteristic biota (e.g. ~60% of reference) present on the site and representing a wide diversity of species groups. No onsite threat from undesirable species.	High diversity of characteristic species (e.g., >80% of reference) across the site, with high similarity to the reference ecosystem; improved potential for colonization of more species over time.
Structural diversity	One or fewer strata present and no spatial patterning or trophic complexity relative to reference ecosystem.	More strata present but low spatial patterning and trophic complexity, relative to reference ecosystem.	Most strata present and some spatial patterning and trophic complexity relative to reference site.	All strata present. Spatial patterning evident and substantial trophic complexity, developing, relative to the reference ecosystem.	All strata present and spatial patterning and trophic complexity high. Further complexity and spatial pattering able to self-organize to highly resemble reference ecosystem.
Ecosystem functionality	Substrates and hydrology are at a foundational stage only, capable of future development of functions similar to the reference.	Substrates and hydrology show increased potential for a wider range of functions including nutrient cycling, and provision of habitats/resources for other species.	Evidence of functions commencing - e.g., nutrient cycling, water filtration and provision of habitat resources for a range of species.	Substantial evidence of key functions and processes commencing including reproduction, dispersal and recruitment of species.	Considerable evidence of functions and processes on a secure trajectory towards reference and evidence of ecosystem resilience likely after reinstatement of appropriate disturbance regimes.
External exchanges	Potential for exchanges (e.g., of species, genes, water, fire) with surrounding landscape or aquatic environment identified.	Connectivity for enhanced positive (and minimized negative) exchanges arranged through cooperation with stakeholders and configuration of site.	Connectivity increasing and exchanges between site and external environment starting to be evident (e.g., more species, flows etc.).	High level of connectivity with other natural areas established, observing control of pest species and undesirable disturbances.	Evidence that potential for external exchanges is highly similar to reference and long-term integrated management arrangements with broader landscape in place and operative.

APPENDIX H – Alien Plant Species Control and Specific Species Management

Appendix H1 – Alien Plant Species Control

The dominant alien floral species are predominantly associated with agricultural activities and should be identified by the ECO prior to the commencement of construction. An Alien and Invasive Plant (AIP) species control program should be developed for control of these species. The basic principles of a control program are presented below.

AIP control programs must include the following three phases (Campbell, 2000):

- Initial Control Phase: The existing population must be drastically reduced.
- Follow-up Control Phase: Control of coppice regrowth, root suckers and seedlings.
- Maintenance Phase: Low AIP density and numbers with a low annual control cost. During this phase, AIP is no longer considered a problem. It is important to monitor the situation of infestation during the growing season of the plants as to avoid re-infestation and to keep the control cost at a minimum.

1. Control Methods

To control AIP successfully, one must use a number of control methods. When using herbicides, the recommendations that are stated on the label of the specific product must be adhered to (Campbell, 2000).

2. Integrated Control Strategies

A combination of the most suitable and effective methods should be used to control a specific species in a particular situation. The following selection of appropriate control methods should take into account the following (Campbell, 2000):

- Species of alien and invasive weeds;
- The type of growth form (i.e. seedling, sapling, shrub or tree);
- The density of infestation;
- The terrain where the infestation is present;
- Rehabilitation requirements
- What resources are available;
- Speed or urgency that the control of the infestation requires – physical removal and biological control will take longer than chemical control.

2.1 Initial control phase

- **Hand pull:** saplings and seedlings must be pulled out by hand and regrowth must be controlled with herbicide (Campbell, 2000). All guidelines for the application of herbicide listed in this Rehabilitation Plan must be adhered to;
- **Frill:** a cane knife is used to cut frills into the stem. Herbicide must be applied (1-2 mm per frill) and must be done in 30min after frilling;
- **Soil application:** herbicide is applied to the soil and taken up by the plants roots

Integrated Strategies to Control Alien Trees (Standing trees; Campbell, 2000):

- Basal bark: Recommended herbicide is mixed with diesel as carrier and applied to the basal part of the stem;
- Strip bark: Bark is stripped from stem at waist height to ground level;

- Hand pull: Saplings and seedlings must be pulled out by hand and regrowth should also be controlled by hand pulling, or foliar spray;
- Frill: Use a cane knife and make frills into the stem. Herbicide must be applied (1-2mm per frill) and must be done in 30min after frilling;
- Foliar spray: Foliar spray application of specific herbicides; and
- Soil application: Herbicide is applied to the soil by means of foliar spray of specific herbicides and taken up by the plant's roots.

Fell trees – control stumps:

Trees should be felled and as soon as the trees are down, the stumps need to be treated with a registered herbicide mix with suitable dye and applied with a paintbrush, hand sprayers or knapsack sprayers. A low pressure must be used when using the hand- and knapsack sprayers, and a solid cone nozzle, e.g., CE1 or TG1. Wood needs to be removed and areas must be revegetated with grass species occurring naturally in the area (Campbell, 2000).

The following equipment must be used to cut trees and saplings:

- Chainsaw;
- Bow saw;
- Brush cutter;
- Cane knife; and
- Trolley mounted roll saw, e.g., "Bosvreter".

NB: The height of the cut stump must not exceed 15cm.

- **Methods for controlling trees:**
  - Cut stump treatment;
  - Total stump treatment; and
  - Using herbicide plugs.

- **Methods for controlling coppice, saplings and seedlings:**
  AIP infestation can comprise of different growing forms, and some of the growth forms cannot be utilised. These plants need to be cut with a brush cutter and the stumps need to be treated with herbicide that was mixed with a dye to show where treatment was applied. Foliar spray of the coppice tends to be the most effective method to use.

Placement of disposed wood is very important because if a fire breaks out, the brushwood can increase the intensity of the fire. When the fire intensity is too high, soil structure will be broken down and seedbanks in the soil will also be destroyed and bare patches of sterilized ground will be formed. The best practice is to use the branches to control erosion, create habitat or chip and remove for compost, bricketing or even as a fuel source. The utmost care must be taken to prevent any seeds of AIPs from spreading when using branches as brush packing.

Integrated Strategies to Control Alien Shrubs:

- **Alien shrubs that are less than 1m tall (Campbell, 2000):**
  - Registered herbicide must be used for foliar application;
  - Selective broadleaf herbicide that will not negatively impact on grass must be used when foliar application is done. When grass is not present, a selective or non-selective registered herbicide can be used;
  - Whenever dense seedling growth that are of uniform height are present, a flat fan nozzle with knapsack must be used; and
  - Seedling growth that is of uneven height (root suckers, short saplings, and coppice growth) a cone nozzle must be used.
- **Alien shrubs that are taller than 1m (Campbell, 2000):**
  - Shrubs that are taller than 1m must be reduced by using a brush cutter or cane knives; and
  - Mechanical uprooting of shrubs is not always a preferred method because the soil is disturbed, and this increases the risk of alien vegetation infestation. Erosion is also promoted by this activity, and soil loss will occur. Mechanical uprooting can be done in areas that have a dense grass cover, as the roots of the grass will keep the soil intact. After

uprooting the soil must be levelled and, if grass seeds are present, some grass seeds must be placed on these areas to promote grass regrowth.

Integrated Strategies to Control Alien Herbs (Milton, 2016):

Mechanical Control

Obstructive / encroaching indigenous vegetation or AIP species are to be manually or mechanically removed as far as possible. In order to prevent chemical contamination of the watercourses, chemical control should be avoided.

- **Manual removal:**
  - Immature, broad-leaved herbaceous weeds can be removed easily with a hoe or spade; and
  - Should the weeds have seed heads they must be gathered up, put in garbage bags or waste drums, transported and disposed of at a licensed waste disposal facility.

Chemical Control: taken from Safe and Effective Herbicide Use: A handbook for near-water applications. Online available at: https://www.epa.sa.gov.au/files/477387_pesticide_water.pdf**:**

Where manual removal consistently fails to reach control targets of AIP species and chemical control is deemed necessary, the following considerations are important:

- Prior to using herbicides in a watercourse or its edge, ensure you have considered all non-chemical options. If there is no alternative, then ensure that appropriate herbicide and application techniques are selected for the site as per herbicide label information and the Working for Water Herbicide guideline;
- **Pre-emergent herbicides are not suitable for watercourse use** – These herbicides are typically applied before the pest plant germinates and are often residual in the soil for long periods. They are generally not considered to be safe for use near waterbodies and are not recommended for use due to their persistence in the environment;
- **Selective herbicides** are designed to act on only one type of pest plant. Generally, selective herbicides will control either broadleaf species, grasses or woody weeds. These herbicides are useful when the focus may be on controlling a particular weed species. These herbicides may persist as residues in the environment and only registered herbicides for targeted species should be used;
- **Non-selective herbicides, if applied correctly, could have a minimal impact on the environment**. These herbicides are designed to be applied directly to the target pest plant, either through being sprayed onto foliage or applied directly to the cambium layer;
- If herbicide use is deemed necessary, the time of herbicide application needs to coincide with a time when rainfall, and t run-off, is likely to be low so to minimise impacts on aquatic life; and
- Preventing re-establishment will require follow-up control and revegetating the area with native grasses and shrubs.

Integrated Strategies to control alien grasses:

- **Burning**: Not recommended as burning can stimulate alien grasses and lead to in-effective management.
- **Hand clearing**: Not recommended for dense infestations as hand clearing / pulling can lead to significant soil disturbance and, consequently, can promote the establishment of alien grasses or other pioneer alien species.
- **Mowing**: Effective for dense stands of annual grasses if performed where grasses are in flower and seed has not yet set.
- **Chemical control**: Most effective method of controlling alien grasses. Pre-emergent systemic herbicides are most effective. Use within the riparian zone or a watercourse is however not recommended.
  Chemical control to be restricted to registered herbicides only.

3. Follow up control (Campbell, 2000)

Follow-up control is essential to control alien saplings, seedlings and coppice regrowth to achieve and sustain the progress that was made with the initial control work in the initial phase. If the follow-up control phase is neglected, the alien infestation will become worse and denser than before the eradication process started. It is essential to sustain the follow-up phase because it will prevent the suppression of alien seedlings on planted grasses.

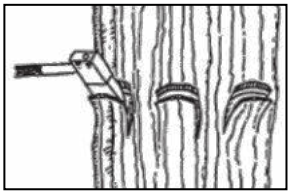
Follow up treatment control must use the following methods:

- Chemical control methods: Only use registered herbicides to control any alien species. Instruction on the herbicide labels must be followed carefully.
- Mechanical control methods
- Biological control methods that are available.

Control methods for dense regrowth: After initial control operations dense regrowth may arise as new regrowth will sprout in the form of stump coppice, seedlings and root suckers.	
Chemical control / foliar application:	• Plants that are less than 1 m in height must be controlled by foliar application. • Dense seedling growth must be controlled with knapsack sprayers with a flat fan nozzle. • If grass is present, the use of a registered selective herbicide must be used so as not to harm the grass, and if grass is not present a registered non-selective or selective herbicide can be used. • Suitable dye must be used at all times to limit over- or under spray of areas.
Mechanical control:	• Areas with dense seedlings should not be uprooted or hoed out, as these areas will result in soil disturbance and will in return promote flushes and germination of alien seedling growth. • When stump density is high, plants should not be cut. This is impractical, and there will be many untreated stumps. Instead cut the stumps in dense areas with brush cutters and remove the top growth. Stumps will start to coppice, and foliar spay must be used to control the coppice regrowth.
Control methods for low-medium density regrowth: Neglecting to control low-medium density regrowth will result in densification and spreading as well as additional control costs.	
Chemical control:	• Cut stump method must be used and stumps must be cut up to a height of 15 cm and must be sprayed within an hour of cutting the plant with a registered herbicide. Herbicide must be applied with knapsack sprayers set to low pressure, using cone nozzles, e.g. TG1 or CE1. Hand sprayers can also be used to apply herbicide. A suitable dye must be used to ensure all stumps are treated. Only the cut surface must be treated with herbicide, and the side of the stumps must not be treated. • Foliar spray can be applied to regrowth that is up to the height of 1m. Herbicide must be applied using knapsacks with solid cone nozzle and must be mixed with a suitable dye to prevent over- or under spraying of treated areas.
Mechanical control:	• Seedlings can be removed from wet soil by hand pulling. Gloves can be used for hand protection during the operation.

Table H1: Manual and Mechanised Methods of Clearing.

Risk to Ecosystem	Infestation density & plant size targeted	Required Tools	Reference Photograph
HAND-PULLING All seedlings Must be pulled out by hand. All root material should be removed to avoid re-sprouting of the plant.			
Safe to use throughout the subject property including watercourses as no chemicals are used. Hand pulling does create soil disturbance, but if the area is sparsely invaded such disturbances are unlikely to be ecologically damaging.	Low or sparse infestation. Aimed at seedlings and saplings: Plants that are small enough to be pulled out with roots intact.	No special tools required Gloves and spade optional.	

Risk to Ecosystem	Infestation density & plant size targeted	Required Tools	Reference Photograph
WRENCH PULLING A weed wrench is a manually operated, all-steel tool designed to remove woody plants by uprooting it.			
Safe to use throughout the subject property including watercourses as no chemicals are used. Wrench pulling does create soil disturbance, but if the area is sparsely invaded such disturbances are unlikely to be ecologically damaging.	Low or sparse infestation. Aimed at saplings: Plants that are small enough to be pulled out with roots intact.	A weed wrench	
RING-BARKING Removal of a ring of bark at least 25 cm wide and pull down to just below ground level. Ring barking interferes with the circulation of the tree and results in tree mortality.			
Low No contamination of watercourses with herbicides as these are applied directly to the tree.	Low or sparse infestation. Aimed at killing large / mature trees.	A cane knife or axe is used to remove the bark of the tree and cambium, in a horizontal band about 30 cm wide (about 50 cm from the ground).	
STRIP-BARKING			
Low No contamination of watercourses with herbicides as these are applied directly to the tree	Low or sparse infestation. Most effective for large / mature trees: The bark of large trees can be stripped completely, from waist height down to the base of the trunk.	Cane knife or axe. ***Herbicide, if used, should be applied to the stripped surface immediately after strip-barking. This is an effective but time-consuming method.*	
FRILLING *more cost-effective than ringbarking or strip-barking. The technique where an axe or cane knife is used to chip/cut around the base of a tree (±2 mm deep) in order to place herbicide into the cuts (cutting not to be as deep as to ringbark). Herbicide to be applied within 30 minutes from frilling.			
Low No contamination of watercourses with herbicides as these are applied directly to the tree	Low or sparse infestation. Most effective for mature trees: Small trees can be frilled by cutting an angled groove into the bark and cambium, right the way around the tree trunk.	Cane knife or axe, depending on how hard the bark and cambium layers of the tree are. Herbicide is then applied into the groove, which kills the tree as it seeps into the cambium tissue.	

Risk to Ecosystem	Infestation density & plant size targeted	Required Tools	Reference Photograph
CUT-STUMPING			
Low No contamination of watercourses with herbicides as these are applied directly to the tree. **Stumping can also imply the treatment of the remaining stump after felling with an appropriate herbicide.	Low or sparse infestation. Most effective for large / mature trees, but works on saplings too: Plants with a stem/ trunk diameter larger than 10 mm can be cut as low to the ground as possible with a saw or cane knife.	Saw or cane knife	
SLASHING			
Low No contamination of watercourses with herbicides as these are applied directly to the tree. ***Care should be taken to prevent plant material and propagules from ending up in surrounding natural areas.*	Low or sparse infestation. The seed stalks/branches of annuals (plants that die each year after they set seed) can be slashed before the seeds have matured.	Slashed with a cane knife, mattock, bill hook or slasher before the seeds have matured. ***Costs are generally low for controlling annuals in this way, as no herbicide is required.*	
BRUSH-CUTTER			
Possible pollution caused by bar oil[8]., spills from refuelling or mixing of oil and fuel.	Dense stands can be cleared. Popular for controlling low-growing thickets of AIPs.	Heavy duty motorised brush-cutters that are usually powered by a small two-stroke engine.	
CHAINSAW			
Possible pollution caused by bar oil, spills from refuelling or mixing of oil and fuel.	Dense stands can be cleared. For felling large trees and can be used to cut logs and branches into shorter lengths.	A chainsaw	

[8] Bar oil is designed to stick to the chain and bar of a chainsaw

Table H2: Manual and Mechanised Methods of clearing, with the application of herbicide (taken from Safe and Effective Herbicide Use: A handbook for near-water applications. Online available at: http://www.epa.sa.gov.au/files/477387_pesticide_water.pdf

Picture reference	Method	Type of Weed	Equipment Required	Notes
	Foliar Spray	Herbs, Bulbs, Woody weeds	Knapsack, Vehicle mounted tank, Herbicide mix	Ensure herbicide is being applied at the right concentration and rate to cover the foliage of the pest plant with fine droplets and avoid run-off. A flat-fan nozzle and low pump pressure will assist in reducing spray drift.
	Cut and Swab	Woody weeds, Shrubs and Trees	Saw, chainsaw, Loppers, Herbicide mix, Bush for herbicide application	Ensure herbicide is applied quickly to cut stump (usually within 30 seconds). Apply during active growing period of plant for best results. Do not apply herbicide to the point of run-off.
	Frill and Paint	Shrubs and Trees	Axe, hatchet, Herbicide mix, Brush for herbicide mix application	Frill trunk thoroughly and treat major surface roots where visible. Expose sapwood and apply herbicide immediately. For deciduous species, apply herbicide during active growth period.
	Drill and Fill	Shrubs and Trees	Drill, Application bottle, injection gun, Herbicide mix.	Drill to sapwood only and apply herbicide to drill hole immediately. Drill and fill major surface roots where appropriate. For deciduous species, apply herbicide during active growth period.
	Scrape and Paint	Woody weeds	Knife or sharp blade, Paintbrush, applicator bottle, Herbicide mix.	Scrape main or major stems of the plant. Apply herbicide immediately after scraping.

Implement Annual Alien and Invasive Control Plan (Campbell, 2000):

- An Annual Operation Plan (AOP) Must be implemented for areas that are of high priority. The following Must be included into the budget for the specific resources e.g., equipment, herbicide and labour. Care Must be taken not to control too large of an area at a time. The following is an approximate indication of how much of the budget Must be dedicated to each aspect:
  - 75% Must be used to follow-up control and also rehabilitation of the previous year's work;
  - 20% Must be used to control new areas; and
  - 5% will be for an emergency e.g., loss of planted grass, mass seed regeneration or coppice.
- Timetables Must be created for the control operations. Care Must also be taken to include the time when operations fall behind due to unfavourable weather or labour strikes; and

- The plan must be set out in such a way that it should be flexible enough as to adjust it, so progress is made.

4. Monitor performance and change actions as necessary

It is important that monitoring of the AIPCP be carried out to determine the efficiency of the plan and to determine the costs and the allocation of time and manpower for such an exercise. Methods to obtain this data could include fixed-point photography as a further means of documenting change. Annual monitoring of AIPs must be performed to determine the extent of an infestation and to monitor if the AIP control program is efficient or not.

Gathering of information (Campbell, 2000):

- The target offset area must be divided into specific control areas. Use man-made or natural boundaries to specify specific areas e.g., roads, fences. Each area Must be numbered to simplify record keeping;
- A detailed AIP survey must be performed in each numbered area, and the following information Must be recorded:
  - AIP species that are present during the survey and their specific growth form e.g., herb, shrub and trees, including any coppice present;
  - Density of infestation Must be recorded in an estimation of percentage (%) cover:
    - 0-5% Scattered infestation;
    - 5-25% Sparse;
    - 25-50% Medium;
    - 50-75% Dense;
    - 75-100% Very dense;
  - These areas Must be ranked Low, Medium or High priority for control of AIP and rehabilitation. The following criteria Must be used to rank the area according to importance: Threat to biodiversity, carrying capacity and water yield; and
  - Suitable grass species for the specific land use Must be determined and grass naturally occurring in the area Must be used to rehabilitate the area.

Prudent AIP fixed monitoring points of the subject property is of utmost importance, as this will ensure a continual flow of data, enabling all parties involved to accurately assess and manage biodiversity-related progress and issues. To ensure the accurate gathering of data, the following techniques and guidelines should be followed:

- Fixed point monitoring (radius transect method) should be applied as the preferred method of monitoring (while the line transect method is an alternative method which can be considered from a site dependant respective);
- All data gathered should be measurable (qualitative and quantitative);
- Monitoring reports should be repeatable and temporally and spatially comparable;
- Data should be auditable; and
- Data, when compared to previous sets, should show spatial and temporal trends.

Fixed monitoring points should form the key aspect of the AIP monitoring plan with each priority area represented by several monitoring points.

5. General Health and Safety Requirements for AIP clearing

All personnel to be provided with the appropriate Personal Protective Equipment (PPE) for clearing of AIPs and/or encroaching indigenous vegetation. The use of PPE by staff controlling AIPs in the field is required by law. The PPE specifications differ for the different types of control. Mechanised control includes the use of a chainsaws and brush-cutters and will therefore require slightly different PPE from someone using manual control (cane knife, slasher, knapsack sprayer, etc.). Tables H3 – H5 below specify the minimum required PPE for AIP clearing.

Table H3: PPE for manual control.

Item	Specification
Overall	100% cotton, two-piece overalls are the best for absorbing perspiration; they last longer and are cooler. However, various cotton/polyester blends are available and suitable.
Rubber gloves	Standard rubber gloves for fieldwork are sufficient. Wrist length gloves are preferable over elbow length gloves for a warm climate.
Leather gloves	Standard wrist length leather gloves are appropriate.
Safety boots	Gumboots or standard safety boots, which support the ankles, are acceptable. Steel toecaps are recommended for workers working with hand tools or with large trees.
Hat – (hardhat/ wide brim hat)	If working with large trees, on steep gradients or if any other safety risks may be present, then wearing a hardhat is advisable. Alternatively, a wide brim hat can be used to protect the worker from the sun.
Safety glasses	Large, clear safety glasses, which allow air to pass through, are acceptable. Glasses with elastics, (e.g., welding glasses) are not acceptable as they tend to fog when a person perspires.
Face mask	A face mask which covers the nose and mouth is essential when mixing herbicides and for foliar application.
Raincoat	A raincoat is necessary in case workers are caught in the rain or can be worn early morning to avoid getting wet from dew.

Table H4: PPE for mechanised control.

Item	Specification
Chainsaw safety pants	Standard long safety chainsaw pants that provide protection against the chainsaw.
Leather gloves	Standard wrist length, leather gloves.
Safety boots with steel cap	Steel toecaps are essential for safety of the workers. Safety boots, not gumboots, are to be worn as they provide support around the ankle.
Hardhat	A hardhat with a visor and earmuffs is necessary for all mechanised control.
Safety glasses	Chainsaw safety glasses provide total cover around the eyes, thus preventing wood chips, stones, etc. entering.
Raincoat	A standard two-piece raincoat. However, it is better not to use mechanised control when it is raining.

Table H5: PPE for chemical control.

Suitable protective clothing must be available and use thereof is compulsory.	- Goggles or face shield to protect the eyes; - Chemical-resistant gloves to protect hands; - Overalls to protect legs, arms, torso and groin; - Respirator with filter cartridges to prevent inhalation of herbicide vapour or mist. Rubber or PVC boots to protect feet. Washable or chemical-resistant hat to protect head and scalp; and - PVC apron for use during mixing.
	NB Adequate hygiene aids must be readily available e.g., plentiful water, soap, towels and eye wash. Dedicated mixing of herbicide must be established, this area must be able to control a possible spill as to not contaminate surrounding areas.

Appendix H2 – Specific Alien Plant Species Management

Table H6: Control options (as provided by Working for Water Alien Species and Herbicide List v2.10 (Sharp 2012)) for Alien and Invasive species that may potentially spread into the target offset area. Hand pull only refers to seedlings. (Campbell, 2000). Care must me given as to not use herbicides containing Glyphosate close to water bodies.

Scientific Name	Common Name	Growth Form	NEMBA Category	Targeted Size Class	Treatment Method	Herbicide
Acacia saligna	Port Jackson	Woody species	1b	Seedling	Hand pull	No herbicide needed Triclopyr (as butoxy ethyl ester)
Cenchrus clandestinus	Kikuyu grass	Grass		Adult	Foliar spray	Glyphosate (as isopropylamine salt)
Echium sp	Pattersons curse	Herbaceous	1b	Young	Foliar spray	Glyphosate (as phosponic acid)
Eucalyptus sp (treatment is species specific)	Blue Gum	Woody species	1b in riparian areas	Seedling	Hand pull	No herbicide needed
				Adult	Cut / frill	Triclopyr (as amine salt)
Leptospermum laevigatum	Australian myrtle	Herbaceous	1b	Seedling	Hand pull	No herbicide needed
Pinus spp.	Pine	Woody species	Species dependent	Adult	Ring bark	Glyphosate (as sodium salt) (species dependent)

Appendix H3 – Example Field Form for Report Content for Alien Invasive Vegetation Monitoring

Proposed field form for report content.

Date:			**Name of recorder:**			
Sensitive area:			**GPS point:**			
AIP control present:	**YES**	**NO**	**AIP regrowth present:**	**YES**	**NO**	
Description of Infestation: (Species, Diversity, Abundance, Density, Extent, level of recruitment and trends.)			**Photo of infestation:**			

APPENDIX I – Cape Flats Fynbos Nursey Stocklist

FynbosLIFE
Locally Indigenous Flora Education

Tel: 082 378 9445
Email: info@fynboslife.com

URBAN REVEGETATION PROJECTS FOR PEOPLE AND WILDLIFE

fynboslife.com fynboslife @fynboslife

Cape Town lowland waterwise and wetland plants supplied by our **Cape Flats Fynbos Nursery**

CAPE TOWN VELD TYPE PLANT LISTS & LANDSCAPING GUIDELINES AUG 2018

Available quantities shown after price, i.e. R8.90 (price) | 10 (quantity available)
Multipot plug size: 7.5cm diameter x 10cm depth (cavities slightly larger than ecotrays)
Minumum 50 plants per order. We do not charge VAT.
Species not currently available can be grown to order. Lead times are species-specific and vary between 3 months and 3 years.
Delivery: 10% for 30km radius and 15% for 60km radius. Minimum delivery fee R150.00.
NURSERY OPEN BY APPOINTMENT ONLY

This species catalogue is alphabetical, with reference to suitable veld types in Cape Town. Veld type landscaping conserves water and wildlife, and supports Cape Town's irreplaceable, highly threatened biodiversity. 19 nationally-recognised vegetation types and 10 of SA's 21 Critically Endangered vegetation types occur within Cape Town's boundaries. 6 are endemic to the City, occuring nowhere else in the world, and 9 are critically under-conserved. Locally indigenous urban biodiversity gardens (LIFE gardens) are thus ecological and educational assets, showcasing our rich natural heritage and promoting stewardship of the broader Fynbos Biome/Cape Floral Kingdom. Every LIFE garden, irrespective of size, counts towards conservation if local forms of species are planted in their original veld type. The horticulturally-viable species listed here represent a fraction of all species in Cape Town. The list is continually expanding as we trial new local plants in cultivation.

Landscapes for LIFE:
L Locally indigenous plants
I Innovation, Infiltration & Interest
F Forage/Food for people & wildlife; frog-friendly (incl. ponds & permeable fencing)
E Education & Ecosystem services

A QUICK GUIDE TO LANDSCAPING BY VELD TYPE IN CAPE TOWN:

1. Planning & Waterscaping
a. Note suburb/location of garden and refer to veld type key (pg 2) and vegetation map in Appendix A to determine the relevant veld type. This will give you an indication of the soil type and original vegetation of the site. Test soil pH and note topsoil consistency/texture (sand, clay, loam) as these may have been altered through disturbance.
b. Consider rainfall, slope/aspect, wind direction and microclimates of the site prior to plant species selection. Waterscape to capture rainfall and slow water loss.

2. Plant Selection
a. Select plants using the veld type key below or the species lists provided in Appendix B.
b. Mimic succession in nature by starting with pioneers and introducing specialist species like ericas and proteas after 3-5 years.
c. Source only forms of species grown from local Cape Town lowland genetic stock. This ensures hyperlocal adaptation and avoids genetic contamination of locally adapted forms. Locally indigenous plants should be re-established within 10km of their source and narrow endemics within 5km. Use pure, naturally-evolved species, avoiding hybrids and cultivars. For part-local part-exotic gardens, rather include non-invasive water-wise exotics than domestic exotics. Domestic exotics pose a threat of hybridisation and invasive spread e.g. Virgilia oroboides subsp. femuginea (from George) and Virgilia divaricata (George to Port Elizabeth) introduced to Cape Town and threatening the local Virgilia oroboides subsp. oroboides.
d. Choose a variety of flower shapes, sizes, colours and scents to sustain a diversity of pollinators.
e. Look for drought-adapted leaves, e.g. succulence, hairy/grey/cobwebby, small, linear, divided, leathery/lignified, waxy.
f. Add edible and aromatic species to supplement or replace thirsty exotic veggie and herb gardens.
g. Avoid tall trees on the Cape Town lowlands, as they would not naturally occur here and require excess water to thrive.
h. For more information on species selection and terminology please consult @fynboslife on Facebook or Instagram for weekly posts on locally indigenous species and how to use them in Cape Town gardens.

3. Ground Preparation & Planting
a. Timing: Plant after the first flush of rains, i.e. early winter (May/June/July) in Cape Town.
b. Keep root disturbance to a minimum during and after planting.
c. Avoid fertilisers and dug-in mulch. Add a thick 10cm surface layer of wood chips around the base of plants. Use very well-decomposed compost if necessary, and apply sparingly on the surface only. Plant a living mulch.

4. Irrigation & Maintenance
a. Drip irrigate every second day for two weeks, then twice a week or as needed until plants are established, and over the first 2-3 summers as required. Restrict greywater to less sensitive species like Helichrysums, Pelargoniums & Salvias.
b. Replenish wood chip mulch in late spring and summer.
c. Prune lightly and regularly to prolong life of plants. Most shrubs listed live for 5-15 years; bulbs and trees are longer-lived.

Prepared by Caitlin von Witt 2018/08/13

VELD TYPE KEY (note this list is not exhaustive and only includes the veld types currently represented by our Cape Flats Fynbos Nursery):	
CFDS	**CAPE FLATS DUNE STRANDVELD** Endangered (coastal, neutral-alkaline sands; mostly water-wise, wind-resistant plants)
CFSF	**CAPE FLATS SAND FYNBOS** Critically Endangered (sandy, nutrient-poor, acidic soils on the Cape Flats; mostly water-wise and wind-resistant plants)
SPGF	**SOUTH PENINSULA GRANITE FYNBOS** Critically Endangered (clay soils on lower S & E slopes of Table Mountain; plants have relatively high water/nutrient needs)
CLFW	**CAPE LOWLAND FRESHWATER WETLAND** Critically Endangered (plants for irrigated applications, retention ponds, eco-pools, wetlands, river beds/banks)
PSR	**PENINSULA SHALE RENOSTERVELD** Critically Endangered (fertile clay soils; mostly water-wise, wind-resistant plants)
SSR	**SWARTLAND SHALE RENOSTERVELD** Critically Endangered (fertile clay soils; mostly water-wise, wind-resistant plants)
PSF	**PENINSULA SANDSTONE FYNBOS** Endangered (nutrient-poor acidic soil; mostly water-wise, wind-resistant plants)
HSF	**HANGKLIP SAND FYNBOS** Vulnerable (acid to neutral sand near the coast; mostly water-wise, wind-resistant plants)
LAF	**LOURENSFORD ALLUVIUM FYNBOS** Critically Endangered (seasonally wet flats near Strand)
ASF	**ATLANTIS SAND FYNBOS** Critically Endangered (sandy, nutrient-poor, acidic soils on the West Coast; mostly water-wise and wind-resistant plants)

SPECIES LISTED ALPHABETICALLY:

Species name (A-Z)	SIZE: 4L/21cm and 2L/15cm	SIZE: Multipot plugs (311ml)	SIZE: 6-pack plugs (90ml)	Description	Veld Type	Image
	PRICE | QUANTITY AVAILABLE					
Agathosma capensis	R23.40 (15cm) | 50			Steenbokbuchu. Evergreen, rounded shrub to 1m. Aromatic leaves and mauve flowers. Good bee forage. Flowering time mainly July-Nov. Suitable for lower clay slopes and sandy coastal flats as a border plant.	SPGF	
Agathosma glabrata **(Endangered)**	R23.40 (15cm) | 1			Lemon-scented buchu. Compact shrub to 50cm with bright purple flowers from July-Dec. Attracts bee and butterfly pollinators. For damp sandy flats and dune slacks.	CFDS, CFSF	
Anthospermum aethiopicum	R18.90 (4L) | 5			Dioecious shrub to 2m; attractive filler shrub for moist areas. Flowering time: Aug-Jan. Suitable for clay or seasonally wet sandy soils.	ASF, PSR, CFSF, SSR, SPGF, LAF	
Arctotheca populifolia	R16.95 (4L) | 5			Creeping, mat-forming perennial groundcover to 20cm. Grey heart-shaped leaves and yellow daisy flowers. Good bee forage. Excellent dune stabiliser for dry, sandy conditons.	HSF, CFDS	
Arctotis incisa	R15.75 (4L) | 25	R8.90 | 0	R4.10 | 24	Sprawling grey-leaved perennial daisy to 40cm. Suitable for dry, sandy conditions.	CFDS, CFSF	
Arctotis stoechadifolia	R15.75 (4L) | 0	R8.90 | 0	R4.00 | 72	Fast-growing groundcover, for dry sandy conditions.	CFDS	
Athanasia crithmifolia	R18.65 (4L) | 40	R8.90 | 0		1.5mx1.5m seasonal wetland shrub. Fast-growing, large yellow flowerheads attract many insect pollinators.	CFSF, PSR, SPGF, SSR, CLFW	

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Athanasia dentata	R18.15 (4L) | 20	R9.00 | 0		1mx1m shrub for dry, sandy and windy conditions. Large yellow daisy flowers and fresh-green toothed leaves.	CFDS CFSF	
Athanasia trifurcata	R16.95 (4L) | 30	R8.90 | 0		1mx1m shrub for dry, sand or clay. Extremely wind- and water-wise. Bee forage.	CFDS PSR CFSF SSR SPGF LAF	
Carex clavata	R15.25 (2L) | 10	R9.00 | 20		50cm tall seasonal wetland sedge with attractive chestnut brown flower spikes	CLFW CFSF SSR	
Carpobrotus edulis		R7.40 | 60	R3.80 | 48	Sour fig, popular edible plant. Fast-growing succulent groundcover to 50cm for coastal conditions. A useful sand stabiliser. Pale yellow flowers.	CFDS HSF CFSF	
Carpobrotus acinaciformis		R7.40 | 20	R3.80 | 24	Sour fig - popular edible plant. Fast-growing succulent groundcover to 50cm for coastal conditions. A useful sand stabiliser. Bright pink flowers.	CFDS	
Chasmanthe aethiopica	R17.60 (4L) | 5			Winter-flowering bulb to 0.5m. Orange tubular flowers pollinated by sunbirds. Sun or semi-shade. Hardy. Sold as clump of approx. 3 shooting bulbs in 4L bag during growing season (May/June/July).	CFDS HSF CFSF PSR SPGF SSR	
Chasmanthe floribunda	R17.60 (4L) | 10			Winter-flowering bulb to 1m. Orange tubular flowers pollinated by sunbirds. Sun or semi-shade. Hardy. Sold as clump of approx. 3 shooting bulbs in 4L bag during growing season (May/June). More robust and floriferous than *C. aethiopica*.	CFSF SPGF	
Chironia baccifera	R19.80 (4L) | 1			Ornamental shrub with starry pink flowers, 40cm-1m. Withstands dry, sandy, windy conditions once established.	CFDS SPGF PSR	
Chrysocoma coma-aurea	R16.95 (4L) | 15	R8.90 | 20		0.6mx0.6m shrub with a mass of yellow button-shaped flowers in spring. For sand or clay in dry, windy conditions. Attracts bees.	CFDS CFSF PSR	
Cliffortia ericifolia **(Endangered)**	R18.15 (4L) | 0	R9.40 | 20		50cm tall shrub with small ericoid glossy green leaves. Suitable as a filler for seasonally wet sands over clays, or acid sands.	CFSF ASF CLFW CFDS	
Cliffortia ferruginea	R16.95 (4L) | 0	R8.90 | 0	R4.15 | 6	Groundcover to 40cm with glossy green leaves for seasonally wet sands. Full sun or semi-shade.	CFSF CLFW ASF	
Cliffortia juniperina var. *juniperina*		R9.50 | 5		Warty caperose. Fine-leaved filler species to 1m for full sun.	CFSF SPGF	

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Cliffortia obcordata	R15.75 (4L) | 20	R8.90 | 0		1.2mx1.5m shrub for dry, sandy and windy conditions.	CFSF SPGF	
Cliffortia strobilifera	R15.75 (4L) | 80	R8.90 | 20	R4.00 | 0	3mx3m fast-growing wetland shrub with lush green foliage	CFSF CLFW	
Coleonema album	R19.95 (4L) | 2			White confetti bush. 2m tall buchu with small honey-scented flowers. Withstands coastal (dry, sandy, windy) conditions.	CFDS HSF	
Commelina africana	R15.75 (12cm) | 5			Common yellow commelina. Spreading groundcover to 50cm for sandy soil in semi-shade to full sun. Yellow flowers from Oct-Mar.	PSF	
Cotyledon orbiculata	R23.40 (4L) | 10	R9.20 | 0		Pig's ear. 1m tall succulent with silvery grey leaves with a red margin. Orange tubular flowers attract bees and birds. For well-drained soils in semi-shade to full sun. Ideal for rockeries.	CFDS HSF	
Cynodon dactylon			R1.45 (200-plug tray) | 100	Couch grass/kweek. Perennial, water-wise mat forming grass. Full sun to semi-shade.	LAF HSF CFSF PSR SPGF SSR	
Cyperus textilis	R16.95 (4L) | 60	R8.90 | 20	R4.15 | 528	1-3m tall wetland sedge. Provides nesting material for birds. May be used to clean polluted water.	CLFW	
Dasispermum suffruticosum		R9.20 | 0		Dune celery. Sprawling coastal perennial with slightly fleshy stems and leaves. Small white/cream flowers.	CFDS	
Delosperma litorale	R16.95 (4L) | 10		R4.15 | 24	Trailing vygie groundcover with white flowers. Hardy, suited to coastal conditions.	CFDS	
Ehrharta calycina		R8.90 | 0		Perennial grass to 0.7m with rose pink flowerheads. For acidic sandy soils.	ASF CFDS	
Ehrharta villosa var. villosa	R17.60 (4L) | 5			Tall (1-1.5m) perennial grass for alkaline sands. Florets softly silvery hairy.	CFDS HSF ASF	
Elegia nuda	R19.40 (4L) | 0			1m tall upright wetland restio, compact growth. For seasonally wet acid sands.	HSF CFSF ASF	
Elegia tectorum (Fish Hoek)	R19.40 (4L) | 50	R9.30 | 40	R4.35 | 0	1.5m tall seasonal wetland restio. Dwarf form of Elegia tectorum. For seasonally wet neutral sands.	CFDS HSF	

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Eragrostis curvula		R9.00 | 140		Weeping love grass. Perennial tufted grass to 1 (to 1.5)m. Good forage, erosion control and an attractive ornamental grass that provides food for seed-eating birds. For full sun/semi-shade on sandy or clay slopes. Not suitable for seasonally wet flats or near nature reserves as can be invasive.	SPGF	
Erica annectens **(Vulnerable, Cape Peninsula Endemic)**	R21.80 (15cm) | 5			Approx. 60cm-1m tall, erect to spreading dwarf shrub. Orange to red 2cm-long corolla tube attracts nectar-feeding birds. Flowering time: Dec-Feb. Grows on acidic moist rock ledges from Noordhoek to Simonstown.	PSF	
Erica cerinthoides	R21.80 (15cm) | 5			Fire erica. Shrub to 1m for full sun in well-drained acidic sand. Red tubular flowers attract sunbirds.	CFSF PSF SPGF	
Erica curviflora	R21.80 (15cm) | 5			Water heath. Streamside/seepage shrub to 1.6m with showy, curved, tubular orange-red flowers which attract sunbirds. For full sun.	CLFW	
Erica ericoides	R40.00 (15cm) | 2			Compact shrub to 80cm. Small pale pink honey-scented flowers from Jan-Apr. Suitable for acid sand or clay on slopes and flats.	SPGF PSF	
Erica mammosa (white-flowered 'gilva' form)	R40.00 (15cm) | 2			Nine-pin heath. Tall, branching shrub to 2m. 2cm-long tubular white flowers attract bird pollinators. Flowering time: Dec-Apr. For full sun in well-drained acid sands, thrives in sandy seepage areas.	PSF SPGF	
Erica margaritacea **(Critically Endangered Cape Flats Endemic)**	R38.50 (15cm) | 5			Pearl heath. Compact shrub to 50cm. Pearly white-pink flowers in summer attract insect pollinators. Suitable for seasonally wet acid sands in full sun.	CFSF	
Erica subdivaricata	R38.50 (15cm) | 4			Shrub to 1m with small bell-shaped, white flowers that attract insect pollinators. Suitable for damp, partially shady spots.	CFSF	
Erica verticillata **(Extinct in the Wild)**	R40.00 (15cm) | 4			Whorled heath. Tall shrub to 1.5m with mauve-pink flowers from late summer to autumn. Suitable for seasonally wet acid sands in full sun. Attracts nectar-feeding birds.	CFSF	
Eriocephalus africanus	R16.40 (4L) | 60	R8.90 | 0		Wild rosemary, edible herb. 1.2mx1.2m shrub for dry, sandy and windy conditions.	CFDS SSR CFSF HSF PSR	

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Eriocephalus racemosus	R17.40 (4L) | 25			Wild rosemary, edible herb. 1.2m hardy erect shrub for dry, sandy conditions. Less robust than *E. africanus*.	HSF ASF	
Euclea racemosa	R65.00 (10L) | 0			Sea guarrie. Small to medium-sized tree, ideal for hedges. Edible fruit, attracts birds. Dry, sandy and windy conditions.	CFDS ASF SSR HSF	
Euryops pectinatus	R17.40 (4L) | 20	R8.90 | 20		Golden daisy bush. Shrub to 1.5m with divided grey-green leaves and large yellow daisy flowers, free flowering. For sull sun on sandy or clay slopes.	PSF	
Falkia repens	R14.60 (2L) | 10	R8.90 | 40	R4.15 | 48	Fast-growing groundcover for moist areas in sun or shade. Pink trumpet-shaped flowers.	CFDS CFSF	
Felicia filifolia	R16.40 (4L) | 20	R8.90 | 0		1mx1m shrub for dry, sandy and windy conditions. Showy purple daisy flowers in spring.	CFDS PSR SSR	
Ficinia bulbosa	R18.80 (4L) | 80			Sedge with delicate, fresh green culms to 50cm. For irrigated areas.	CFDS ASF CFSF	
Ficinia capitella	R18.80 (4L) | 5			Sedge with fine, pendulous lime-green culms to 30cm. For irrigated areas.	CFDS CFSF	
Ficinia indica	R18.80 (4L) | 0			0.4m tall sedge for seepage areas. Rich chestnut-coloured spikes.	LAF PSF CFSF SPGF	
Ficinia lateralis	R18.80 (4L) | 50			0.6m tall tufted sedge for seasonally wet coastal sands. Wind tolerant.	CFDS	
Ficinia nodosa (Scirpus nodosus)	R16.95 (4L) | 20	R8.90 | 300		1m tall sedge with fresh green stems. For seasonally wet areas. Withstands summer drying. Excellent wetland filtration and soil stabilisation.	CFDS CFSF CLFW	
Freylinia lanceolata	R19.40 (4L) | 50			Small tree to 4m with cream-coloured, honey-scented tubular flowers. Attracts pollinators. For irrigated applications.	CLFW	
Fuirena coerulescens		R9.50 | 0		Delicate sedge to 50cm for damp areas.	CFDS	
Geranium incanum	R14.60 (2L) | 20	R8.90 | 20	R4.10 | 24	Groundcover for damp sandy soils. Delicate pale pink/white flowers.	CFDS CLFW CFSF SSR HSF	

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Gladiolus angustus	R18.20 (15cm) | 0		R4.25 | 72	Marsh painted lady. Bulbous plant, spring flowering. Sold as clump of approx. 3 shooting bulbs in 15cm pot during growing season.	CFDS, CLFW	
Gnidia pinifolia	R16.95 (15cm) | 5			Pine-leaf saffron bush. Shrub to 1m with long tubular flowers which are fragrant at night, attracting moth pollinators. Flowers all year round. For full sun on lower slopes and sheltered sandy flats.	SPGF, ASF	
Gnidia squarrosa	R16.40 (15cm) | 5			Aandbossie. Lax shrub, 1-2m. Cream flowers from June-Oct, scented at night. For full sun on sandy slopes and flats.	SPGF, CFDS	
Gomphostigma virgatum	R16.95 (4L) | 2	R8.90 | 2		Shrub to 2.6m with scented white flowers. For damp soils in wetlands or along freshwater streams.	CLFW	
Gymnosporia buxifolia	R21.80 (4L) | 10			Spikethorn. Large shrub/ small tree, 3-7m, excellent spiny security hedge. Showy flowers attract insect pollinators, which in turn attract birds.	CFSF, SPGF, ASF	
Helichrysum crispum		R8.90 | 80		Small rounded shrub to 50cm, woolly grey leaves, creamy white flowers. For dry, sandy, windy conditions.	CFDS, HSF, LAF	
Helichrysum cymosum	R16.95 (4L) | 2	R8.90 | 40	R4.15 | 24	Gold carpet. Low shrub with grey foliage and yellow flowerheads. For sun or semi-shade in seasonally wet sand. Water well to establish.	CFDS, CFSF, SPGF	
Helichrysum dasyanthum	R17.60 (4L) | 20	R8.90 | 0		1mx1m shrub with yellow flowers. For dry, sandy and windy conditions.	CFDS, CFSF, SPGF, SSR	
Helichrysum niveum	R16.95 (4L) | 1			Dwarf twiggy, ericoid shrublet to 20cm. Adapted to dry, sandy and windy conditions.	HSF, CFDS	
Helichrysum patulum	R15.75 (4L) | 10	R8.90 | 40	R4.05 | 24	1mx1.5m sprawling shrub for dry, sandy and windy conditions.	CFDS, PSR, SSR	
Helichrysum petiolare	R16.95 (4L) | 15	R8.90 | 0		1mx1m shrub with soft grey foliage. For semi-shade to full sun in a sheltered position.	SPGF	
Helichrysum teretifolium	R18.20 (4L) | 10	R9.00 | 20		Compact groundcover to 30cm with dark green foliage and cream flowers. For semi-shade to full sun on sandy flats and slopes.	CFDS, HSF	

Prepared by Caitlin von Witt 2018/08/13

VELD TYPE KEY (note this list is not exhaustive and only includes the veld types currently represented by our Cape Flats Fynbos Nursery):	
CFDS	**CAPE FLATS DUNE STRANDVELD** Endangered (coastal, neutral-alkaline sands; mostly water-wise, wind-resistant plants)
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LAF	**LOURENSFORD ALLUVIUM FYNBOS** Critically Endangered (seasonally wet flats near Strand)
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SPECIES LISTED ALPHABETICALLY:

Species name (A-Z)	SIZE: 4L/21cm and 2L/15cm	SIZE: Multipot plugs (311ml)	SIZE: 6-pack plugs (90ml)	Description	Veld Type	Image
	PRICE | QUANTITY AVAILABLE					
Agathosma capensis	R23.40 (15cm) | 50			Steenbokbuchu. Evergreen, rounded shrub to 1m. Aromatic leaves and mauve flowers. Good bee forage. Flowering time mainly July-Nov. Suitable for lower clay slopes and sandy coastal flats as a border plant.	SPGF	
Agathosma glabrata **(Endangered)**	R23.40 (15cm) | 1			Lemon-scented buchu. Compact shrub to 50cm with bright purple flowers from July-Dec. Attracts bee and butterfly pollinators. For damp sandy flats and dune slacks.	CFDS, CFSF	
Anthospermum aethiopicum	R18.90 (4L) | 5			Dioecious shrub to 2m; attractive filler shrub for moist areas. Flowering trime: Aug-Jan. Suitable for clay or seasonally wet sandy soils.	ASF, PSR, CFSF, SSR, SPGF, LAF	
Arctotheca populifolia	R16.95 (4L) | 5			Creeping, mat-forming perennial groundcover to 20cm. Grey heart-shaped leaves and yellow daisy flowers. Good bee forage. Excellent dune stabiliser for dry, sandy conditons.	HSF, CFDS	
Arctotis incisa	R15.75 (4L) | 25	R8.90 | 0	R4.10 | 24	Sprawling grey-leaved perennial daisy to 40cm. Suitable for dry, sandy conditions.	CFDS, CFSF	
Arctotis stoechadifolia	R15.75 (4L) | 0	R8.90 | 0	R4.00 | 72	Fast-growing groundcover, for dry sandy conditions.	CFDS	
Athanasia crithmifolia	R18.65 (4L) | 40	R8.90 | 0		1.5mx1.5m seasonal wetland shrub. Fast-growing, large yellow flowerheads attract many insect pollinators.	CFSF, PSR, SPGF, SSR, CLFW	

Prepared by Caitlin von Witt 2018/08/13

Athanasia dentata	R18.15 (4L) | 20	R9.00 | 0		1mx1m shrub for dry, sandy and windy conditions. Large yellow daisy flowers and fresh-green toothed leaves.	CFDS CFSF	
Athanasia trifurcata	R16.95 (4L) | 30	R8.90 | 0		1mx1m shrub for dry, sand or clay. Extremely wind- and water-wise. Bee forage.	CFDS PSR CFSF SSR SPGF LAF	
Carex clavata	R15.25 (2L) | 10	R9.00 | 20		50cm tall seasonal wetland sedge with attractive chestnut brown flower spikes	CLFW CFSF SSR	
Carpobrotus edulis		R7.40 | 60	R3.80 | 48	Sour fig, popular edible plant. Fast-growing succulent groundcover to 50cm for coastal conditions. A useful sand stabiliser. Pale yellow flowers.	CFDS HSF CFSF	
Carpobrotus acinaciformis		R7.40 | 20	R3.80 | 24	Sour fig - popular edible plant. Fast-growing succulent groundcover to 50cm for coastal conditions. A useful sand stabiliser. Bright pink flowers.	CFDS	
Chasmanthe aethiopica	R17.60 (4L) | 5			Winter-flowering bulb to 0.5m. Orange tubular flowers pollinated by sunbirds. Sun or semi-shade. Hardy. Sold as clump of approx. 3 shooting bulbs in 4L bag during growing season (May/June/July).	CFDS HSF CFSF PSR SPGF SSR	
Chasmanthe floribunda	R17.60 (4L) | 10			Winter-flowering bulb to 1m. Orange tubular flowers pollinated by sunbirds. Sun or semi-shade. Hardy. Sold as clump of approx. 3 shooting bulbs in 4L bag during growing season (May/June). More robust and floriferous than *C. aethiopica*.	CFSF SPGF	
Chironia baccifera	R19.80 (4L) | 1			Ornamental shrub with starry pink flowers, 40cm-1m. Withstands dry, sandy, windy conditions once established.	CFDS SPGF PSR	
Chrysocoma coma-aurea	R16.95 (4L) | 15	R8.90 | 20		0.6mx0.6m shrub with a mass of yellow button-shaped flowers in spring. For sand or clay in dry, windy conditions. Attracts bees.	CFDS CFSF PSR	
Cliffortia ericifolia **(Endangered)**	R18.15 (4L) | 0	R9.40 | 20		50cm tall shrub with small ericoid glossy green leaves. Suitable as a filler for seasonally wet sands over clays, or acid sands.	CFSF ASF CLFW CFDS	
Cliffortia ferruginea	R16.95 (4L) | 0	R8.90 | 0	R4.15 | 6	Groundcover to 40cm with glossy green leaves for seasonally wet sands. Full sun or semi-shade.	CFSF CLFW ASF	
Cliffortia juniperina var. *juniperina*		R9.50 | 5		Warty caperose. Fine-leaved filler species to 1m for full sun.	CFSF SPGF	

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Cliffortia obcordata	R15.75 (4L) | 20	R8.90 | 0		1.2mx1.5m shrub for dry, sandy and windy conditions.	CFSF SPGF	
Cliffortia strobilifera	R15.75 (4L) | 80	R8.90 | 20	R4.00 | 0	3mx3m fast-growing wetland shrub with lush green foliage	CFSF CLFW	
Coleonema album	R19.95 (4L) | 2			White confetti bush. 2m tall buchu with small honey-scented flowers. Withstands coastal (dry, sandy, windy) conditions.	CFDS HSF	
Commelina africana	R15.75 (12cm) | 5			Common yellow commelina. Spreading groundcover to 50cm for sandy soil in semi-shade to full sun. Yellow flowers from Oct-Mar.	PSF	
Cotyledon orbiculata	R23.40 (4L) | 10	R9.20 | 0		Pig's ear. 1m tall succulent with silvery grey leaves with a red margin. Orange tubular flowers attract bees and birds. For well-drained soils in semi-shade to full sun. Ideal for rockeries.	CFDS HSF	
Cynodon dactylon			R1.45 (200-plug tray) | 100	Couch grass/kweek. Perennial, water-wise mat forming grass. Full sun to semi-shade.	LAF HSF CFSF PSR SPGF SSR	
Cyperus textilis	R16.95 (4L) | 60	R8.90 | 20	R4.15 | 528	1-3m tall wetland sedge. Provides nesting material for birds. May be used to clean polluted water.	CLFW	
Dasispermum suffruticosum		R9.20 | 0		Dune celery. Sprawling coastal perennial with slightly fleshy stems and leaves. Small white/cream flowers.	CFDS	
Delosperma litorale	R16.95 (4L) | 10		R4.15 | 24	Trailing vygie groundcover with white flowers. Hardy, suited to coastal conditions.	CFDS	
Ehrharta calycina		R8.90 | 0		Perennial grass to 0.7m with rose pink flowerheads. For acidic sandy soils.	ASF CFDS	
Ehrharta villosa var. villosa	R17.60 (4L) | 5			Tall (1-1.5m) perennial grass for alkaline sands. Florets softly silvery hairy.	CFDS HSF ASF	
Elegia nuda	R19.40 (4L) | 0			1m tall upright wetland restio, compact growth. For seasonally wet acid sands.	HSF CFSF ASF	
Elegia tectorum (Fish Hoek)	R19.40 (4L) | 50	R9.30 | 40	R4.35 | 0	1.5m tall seasonal wetland restio. Dwarf form of Elegia tectorum. For seasonally wet neutral sands.	CFDS HSF	

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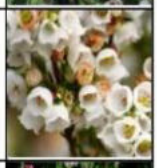
Eragrostis curvula		R9.00 | 140		Weeping love grass. Perennial tufted grass to 1 (to 1.5)m. Good forage, erosion control and an attractive ornamental grass that provides food for seed-eating birds. For full sun/semi-shade on sandy or clay slopes. Not suitable for seasonally wet flats or near nature reserves as can be invasive.	SPGF	
Erica annectens **(Vulnerable, Cape Peninsula Endemic)**	R21.80 (15cm) | 5			Approx. 60cm-1m tall, erect to spreading dwarf shrub. Orange to red 2cm-long corolla tube attracts nectar-feeding birds. Flowering time: Dec-Feb. Grows on acidic moist rock ledges from Noordhoek to Simonstown.	PSF	
Erica cerinthoides	R21.80 (15cm) | 5			Fire erica. Shrub to 1m for full sun in well-drained acidic sand. Red tubular flowers attract sunbirds.	CFSF PSF SPGF	
Erica curviflora	R21.80 (15cm) | 5			Water heath. Streamside/seepage shrub to 1.6m with showy, curved, tubular orange-red flowers which attract sunbirds. For full sun.	CLFW	
Erica ericoides	R40.00 (15cm) | 2			Compact shrub to 80cm. Small pale pink honey-scented flowers from Jan-Apr. Suitable for acid sand or clay on slopes and flats.	SPGF PSF	
Erica mammosa (white-flowered 'gilva' form)	R40.00 (15cm) | 2			Nine-pin heath. Tall, branching shrub to 2m. 2cm-long tubular white flowers attract bird pollinators. Flowering time: Dec-Apr. For full sun in well-drained acid sands, thrives in sandy seepage areas.	PSF SPGF	
Erica margaritacea **(Critically Endangered Cape Flats Endemic)**	R38.50 (15cm) | 5			Pearl heath. Compact shrub to 50cm. Pearly white-pink flowers in summer attract insect pollinators. Suitable for seasonally wet acid sands in full sun.	CFSF	
Erica subdivaricata	R38.50 (15cm) | 4			Shrub to 1m with small bell-shaped, white flowers that attract insect pollinators. Suitable for damp, partially shady spots.	CFSF	
Erica verticillata **(Extinct in the Wild)**	R40.00 (15cm) | 4			Whorled heath. Tall shrub to 1.5m with mauve-pink flowers from late summer to autumn. Suitable for seasonally wet acid sands in full sun. Attracts nectar-feeding birds.	CFSF	
Eriocephalus africanus	R16.40 (4L) | 60	R8.90 | 0		Wild rosemary, edible herb. 1.2mx1.2m shrub for dry, sandy and windy conditions.	CFDS SSR CFSF HSF PSR	

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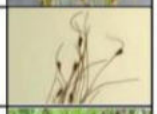
Eriocephalus racemosus	R17.40 (4L) | 25			Wild rosemary, edible herb. 1.2m hardy erect shrub for dry, sandy conditions. Less robust than *E. africanus*.	HSF ASF	
Euclea racemosa	R65.00 (10L) | 0			Sea guarrie. Small to medium-sized tree, ideal for hedges. Edible fruit, attracts birds. Dry, sandy and windy conditions.	CFDS ASF SSR HSF	
Euryops pectinatus	R17.40 (4L) | 20	R8.90 | 20		Golden daisy bush. Shrub to 1.5m with divided grey-green leaves and large yellow daisy flowers, free flowering. For sull sun on sandy or clay slopes.	PSF	
Falkia repens	R14.60 (2L) | 10	R8.90 | 40	R4.15 | 48	Fast-growing groundcover for moist areas in sun or shade. Pink trumpet-shaped flowers.	CFDS CFSF	
Felicia filifolia	R16.40 (4L) | 20	R8.90 | 0		1mx1m shrub for dry, sandy and windy conditions. Showy purple daisy flowers in spring.	CFDS PSR SSR	
Ficinia bulbosa	R18.80 (4L) | 80			Sedge with delicate, fresh green culms to 50cm. For irrigated areas.	CFDS ASF CFSF	
Ficinia capitella	R18.80 (4L) | 5			Sedge with fine, pendulous lime-green culms to 30cm. For irrigated areas.	CFDS CFSF	
Ficinia indica	R18.80 (4L) | 0			0.4m tall sedge for seepage areas. Rich chestnut-coloured spikes.	LAF PSF CFSF SPGF	
Ficinia lateralis	R18.80 (4L) | 50			0.6m tall tufted sedge for seasonally wet coastal sands. Wind tolerant.	CFDS	
Ficinia nodosa (Scirpus nodosus)	R16.95 (4L) | 20	R8.90 | 300		1m tall sedge with fresh green stems. For seasonally wet areas. Withstands summer drying. Excellent wetland filtration and soil stabilisation.	CFDS CFSF CLFW	
Freylinia lanceolata	R19.40 (4L) | 50			Small tree to 4m with cream-coloured, honey-scented tubular flowers. Attracts pollinators. For irrigated applications.	CLFW	
Fuirena coerulescens		R9.50 | 0		Delicate sedge to 50cm for damp areas.	CFDS	
Geranium incanum	R14.60 (2L) | 20	R8.90 | 20	R4.10 | 24	Groundcover for damp sandy soils. Delicate pale pink/white flowers.	CFDS CLFW CFSF SSR HSF	

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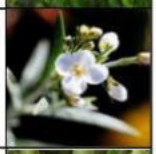
Gladiolus angustus	R18.20 (15cm) | 0		R4.25 | 72	Marsh painted lady. Bulbous plant, spring flowering. Sold as clump of approx. 3 shooting bulbs in 15cm pot during growing season.	CFDS CLFW	
Gnidia pinifolia	R16.95 (15cm) | 5			Pine-leaf saffron bush. Shrub to 1m with long tubular flowers which are fragrant at night, attracting moth pollinators. Flowers all year round. For full sun on lower slopes and sheltered sandy flats.	SPGF ASF	
Gnidia squarrosa	R16.40 (15cm) | 5			Aandbossie. Lax shrub, 1-2m. Cream flowers from June-Oct, scented at night. For full sun on sandy slopes and flats.	SPGF CFDS	
Gomphostigma virgatum	R16.95 (4L) | 2	R8.90 | 2		Shrub to 2.6m with scented white flowers. For damp soils in wetlands or along freshwater streams.	CLFW	
Gymnosporia buxifolia	R21.80 (4L) | 10			Spikethorn. Large shrub/ small tree, 3-7m, excellent spiny security hedge. Showy flowers attract insect pollinators, which in turn attract birds.	CFSF SPGF ASF	
Helichrysum crispum		R8.90 | 80		Small rounded shrub to 50cm, woolly grey leaves, creamy white flowers. For dry, sandy, windy conditions.	CFDS HSF LAF	
Helichrysum cymosum	R16.95 (4L) | 2	R8.90 | 40	R4.15 | 24	Gold carpet. Low shrub with grey foliage and yellow flowerheads. For sun or semi-shade in seasonally wet sand. Water well to establish.	CFDS CFSF SPGF	
Helichrysum dasyanthum	R17.60 (4L) | 20	R8.90 | 0		1mx1m shrub with yellow flowers. For dry, sandy and windy conditions.	CFDS CFSF SPGF SSR	
Helichrysum niveum	R16.95 (4L) | 1			Dwarf twiggy, ericoid shrublet to 20cm. Adapted to dry, sandy and windy conditions.	HSF CFDS	
Helichrysum patulum	R15.75 (4L) | 10	R8.90 | 40	R4.05 | 24	1mx1.5m sprawling shrub for dry, sandy and windy conditions.	CFDS PSR SSR	
Helichrysum petiolare	R16.95 (4L) | 15	R8.90 | 0		1mx1m shrub with soft grey foliage. For semi-shade to full sun in a sheltered position.	SPGF	
Helichrysum teretifolium	R18.20 (4L) | 10	R9.00 | 20		Compact groundcover to 30cm with dark green foliage and cream flowers. For semi-shade to full sun on sandy flats and slopes.	CFDS HSF	

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Hellmuthia membranacea	R18.20 (4L) | 5			50cm-1m tall sedge with large attractive flowerheads. Drought tolerant. Excellent soil stabiliser.	CFDS	
Hermannia pinnata	R18.20 (4L) | 0			Fast growing, mat-forming shrublet to 0.15m with creeping stems. Pale orange, nodding bell-shaped flowers. Suitable for sandy, well-drained soil.	HSF	
Imperata cylindrica		R9.20 | 40		Sword grass. Perennial rhizomatous grass to 50cm for seasonally wet areas. Host plant for the Critically Endangered Barber's ranger butterfly (*Kedestes barberae bunta*) in False Bay Nature Reserve.	CFDS HSF CFSF CLFW	
Isolepis prolifera	R14.75 (2L) | 10	R8.90 | 100		Low trailing sedge, rooting at the nodes. Grows in marshy conditions or 5-10cm deep water.	CLFW	
Jordaaniella dubia	R16.95 (4L) | 35		R4.15 | 600	Hardy creeping vygie with large yellow flowers. For dry, sandy, windy conditions.	CFDS HSF	
Juncus capensis	R18.20 (4L) | 20	R9.10 | 0		50cm tall seasonal wetland rush. Excellent wetland filtration and soil stabilisation.	CLFW SPGF	
Juncus effusus	R18.20 (4L) | 0	R9.10 | 10		Soft rush - 50cm-1m tall seasonal wetland rush.	SPGF CLFW	
Juncus kraussii	R16.95 (4L) | 50	R8.90 | 100	R4.15 | 0	1m tall wetland rush. Host plant for damselflies.	CFDS CLFW	
Juncus lomatophyllus	R18.80 (4L) | 10	R9.20 | 10		40cm tall wetland rush. Filtration for ecopools and grey water wetlands.	CLFW	
Kiggelaria africana	R105.00 (20L, 1.5m) | 0			Wild peach. Fast-growing tree to 20m for sheltered slopes or ravines in clay or loamy soil. Symbiotic relationship with *Acraea horta* butterfly, with the caterpillars attracting birds.	SPGF CLFW	
Lampranthus emarginatus		R9.40 | 0		Clusterleaf brightfig. Vygie to 30cm with narrow grey leaves and a show of purple flowers in spring/summer. For sandy flats and slopes in full sun.	SPGF PSR	
Lampranthus filicaulis **(Vulnerable)**		R9.40 | 0		Threadleaf brightfig. Prostrate perennial vygie with pink flowers in spring. For sandy irrigated areas.	CFSF SPGF	

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Lampranthus reptans **(Near Threatened)**		R9.00 | 20	R4.20 | 24	Creeping perennial vygie with showy yellow flowers for irrigated areas (grows naturally in seasonal wetlands).	CFSF	
Lampranthus stenus **(Critically Endangered)**		R9.40 | 20		Narrowleaf brightfig. Vygie to 30cm with narrow grey leaves and pink flowers in late spring/summer. For sandy flats and slopes in full sun.	CFSF	
Leonotis leonurus	R15.80 (4L) | 50	R8.90 | 120		2mx2m shrub for dry, sandy and windy conditions. Rewarding orange tubular flowers. Prune hard after flowering.	CFDS CFSF SPGF CLFW ASF	
Lessertia frutescens	R17.20 (4L) | 50			Cancer bush. Shrub to 1,5m tall with silvery grey compound leaves and nectar-rich orange-red flowers in spring, attracting sunbirds. For coastal sands and stony slopes. Water well to establish, water-wise thereafter. Short-lived but readily seeds itself.	CFDS ASF	
Leucadendron argenteum **(Rare and Endangered)**	R24.00 (2L) | 4			Silver tree. 7-10m tall tree with silvery-hairy leaves and separate male and female plants. Flowers attract beetle pollinators. Females produce cones. For full sun in sandy granite-derived soils only. No compost or fertiliser.	SPGF	
Leucadendron coniferum **(Vulnerable)**	R20.60 (4L) | 0	R9.60 | 20		Dune conebush. Coastal shrub or small tree, 2-4m. Attractive silvery green foilage. Withstands dry, sandy, windy conditions. No compost or fertiliser.	CFDS HSF	
Leucadendron floridum **(Critically Endangered Cape Peninsula Endemic)**	R24.00 (15cm) | 0			Flats conebush. Dioecious shrub to 2m. Attractive silvery green foliage. Wind- and beetle-pollinated. For permanently moist sands adjacent rivers/wetlands. No compost or fertiliser.	CFSF SPGF HSF CLFW PSF	
Leucadendron lanigerum var. lanigerum **(Endangered)**	R20.60 (4L) | 0	R9.60 | 0		Common shale conebush. Shrub to 1.5m. Flowering time: July-Sep. No compost or fertiliser.	ASF SSR LAF	
Leucadendron laureolum	R28.50 (4L) | 40			Laurel-leaf conebush. Large protea to 2.5m. Flowering time: June-Aug. For acid sands, wind tolerant. No compost or fertiliser.	HSF CFSF PSF	
Leucadendron levisanus **(Critically Endangered Cape Flats Endemic)**	R20.60 (4L) | 50	R9.60 | 0		Cape Flats conebush. 1-2m tall protea for seasonally wet acid sands. Tolerant of windy conditions. No compost or fertiliser.	CFSF	
Leucadendron salignum	R28.50 (4L) | 0			Common sunshine conebush. Large shrub to 2m. Flowering time: May-Dec. Full sun. For acid sands, wind tolerant. No compost or fertiliser.	HSF ASF LAF	

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Leucadendron strobilinum **(Cape Peninsula Endemic)**	R24.00 (2L) | 10			Peninsula conebush. Large shrub to 2.6m. Flowering time: Sep-Oct. For damp, rocky slopes in neutral-acid sand. Full sun. No compost or fertiliser.	PSF	
Leysera gnaphalodes	R16.40 (2L) | 4		R4.20 | 24	Shrublet to 0.4m with pale grey foliage. Suitable for windswept clay slopes. Flowering time: Sep-Nov.	ASF SSR	
Linum africanum	R16.40 (15cm) | 5			Wild flax. Compact shrub to 30cm with copious yellow flowers in summer. For semi-shade. Variable habitat from clay slopes to coastal sands.	SPGF	
Lobelia anceps (Lobelia alata)	R14.75 (2L) | 0	R8.90 | 0	R4.15 | 24	Groundcover with pretty blue flowers for irrigated areas.	CFSF SPGF CUW	
Maurocenia frangula	R82.50 (10L) | 4			Bittersweet cherry. Small rounded tree to 3m with large leathery dark green leaves. Small white flowers from May to June followed by showy, edible cerise fruit. Occurs in coastal forest and rocky slopes. Plant in full sun in sandy soil.	CFDS	
Melianthus major	R18.80 (4L) | 2			Kruidjie-roer-my-nie. Large streamside shrub to 3m. Rusty-red, nectar-rich flower spikes attract birds. Prefers rich, moist, well-drained soils in full sun to semi-shade. Prune heavily in summer.	SPGF CUW	
Mentha longifolia subsp. capensis	R15.75 (4L) | 40	R8.90 | 20		Edible wild mint. For seasonal wetlands.	SPGF CUW	
Metalasia densa	R20.60 (4L) | 0			Erect shrub to 2m with green to white-woolly foliage. For sandy, windy conditions. Flowering time: June-Oct.	HSF PSR ASF PSF CFSF	
Metalasia muricata	R16.95 (4L) | 80	R8.90 | 40		2mx2m silvery-grey shrub with cream honey-scented flowerheads. For dry, sandy and windy conditions along the coast.	CFDS HSF ASF	
Mimetes fimbrifolius **(Rare Cape Peninsula Endemic)**	R24.00 (2L) | 10			Tree pagoda. 4x5m tree with flowerheads clasped by reddish-yellow leaves at branch tips. Flowering time: Jul-Dec. Attracts bird pollinators. For full sun on moist rocky slopes and sandy flats. May live for up to 100 years!	PSF	
Monopsis lutea	R16.35 (4L) | 30	R8.90 | 60	R4.10 | 24	Marsh groundcover with pretty yellow flowers and bright green trailing stems. Damp sands.	CUW SSR	

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Morella cordifolia	R18.80 (4L) | 80	R9.30 | 0		Waxberry. 2-3m tall spreading shrub for dry, sandy and windy conditions.	CFDS CFSF HSF	
Muraltia mitior **(Endangered)**	R19.60 (4L) | 70	R9.40 | 0		Beautiful purple-flowered shrub with finger-like branches to 1m. For sandy, seasonally wet areas.	CFDS	
Muraltia (Nylandtia) spinosa	R20.00 (4L) | 0			Tortoise berry; 1.5x1m shrub with masses of purple flowers in winter and edible fruit. For dry, sandy and windy conditions.	CFDS CFSF HSF	
Olea europaea subsp. africana	R105.00 (20L) | 10			Wild olive. 9mx12m tree with glossy green foliage. Drought-, frost- and wind-resistant. Fruit attracts birds.	CFDS CFSF SPGF PSR SSR	
Orphium frutescens (pink)	R16.95 (4L) | 120	R8.90 | 0		80cm tall upright wetland shrub with showy pink flowers. Buzz-pollinated by carpenter bees.	CFDS CFSF CLFW	
Orphium frutescens (white)	R16.95 (4L) | 120	R8.90 | 0		80cm tall upright wetland shrub with showy white flowers. Buzz-pollinated by carpenter bees.	CFDS SPGF CLFW	
Osteospermum fruticosum	R16.40 (4L) | 0	R8.90 | 0	R4.10 | 24	Trailing African daisy. Semi-succulent groundcover to 40cm with white flowers, ray florets mauve on underside. Attracts butterflies. Full sun. Wind- and drought-resistant.	CFDS	
Osteospermum incanum	R16.95 (4L) | 0			Spreading, fast-growing shrub to 1.5m. Leaves softly hairy, grey. For dry, sandy and windy conditions.	CFDS CFSF	
Osteospermum monilifernm	R16.40 (4L) | 20	R8.90 | 40		Large, spreading, fast-growing shrub to 3m. Edible berries attract birds. For dry, sandy and windy conditions.	CFDS HSF CFSF SSR SPGF PSF	
Otholobium bracteolatum	R16.40 (4L) | 120	R8.90 | 0	R4.10 | 24	1mx1.5m shrub with purple and white pea flowers. Adapted to dry, sandy, windy conditions.	CFDS	
Otholobium decumbens		R8.90 | 20		Prostrate mat-forming forb with mauve flowers. For full sun in sandy soil.	CFSF SPGF	
Otholobium fruticans **(Rare Peninsula Endemic)**	R16.40 (2L) | 30			40cmx1m trailing semi-shrub with purple flowers. For sandy acidic soil on the slopes of Table Mountain.	SPGF PSF	

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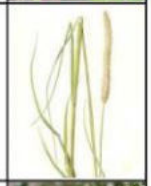
Passerina paleacea	R19.60 (4L) | 20	R9.50 | 20		Rare gonnabos. Shrub to 1m with ericoid leaves. For neutral to alkaline sands in full sun.	CFDS	
Pelargonium betulinum	R16.95 (4L) | 0	R8.90 | 10		Camphor-scented pelargonium. 1mx1m shrub for dry, sandy and windy conditions. Showy pink flowers.	CFDS CFSF HSF	
Pelargonium capitatum	R15.80 (4L) | 40	R8.90 | 20		Rose-scented pelargonium. Fast-growing groundcover with pink flowers on long stalks. Water- and wind-wise.	CFDS CFSF SPGF HSF	
Pelargonium cucullatum subsp. *tabulare*	R16.90 (12cm) | 4			Tree pelargonium. Shrub to over 2m with showy pink flowers in late spring/summer. Full sun, drought tolerant.	CFSF SPGF PSR HSF	
Pennisetum macrourum	R18,80 (4L) | 0			African feather grass. Beautifully backlit tall wetland grass to 2,5m. Suitable for full sun to semi-shade in marginal or well-irrigated applications.	CFSF CLFW	
Phylica ericoides	R18.80 (4L) | 80	R9.20 | 20		1m tall spreading shrub with white button-like flowers. For dry, sandy and windy conditions.	CFDS HSF CFSF SPGF	
Plecostachys serpyllifolia	R15.80 (4L) | 5	R8.90 | 40	R4.00 | 24	1mx1m seasonal wetland shrub with cobwebby grey foliage.	SPGF CLFW HSF	
Podalyria calyptrata	R38.50 (15cm) | 2			Sweetpea bush. Large shrub to 3m with glossy silvery-green foliage. Showy pink flowers in spring attract carpenter bees, honeybees, hoverflies, butterflies and birds. For damp acid sand or clay in full sun.	SPGF PSF	
Podalyria sericea **(Vulnerable)**	R38.50 (15cm) | 0			Small rounded shrub 1mx1m. Silvery-shiny leaves and pink flowers in spring/summer. Attracts carpenter bees, honeybees, butterflies and other insects, which in turn attract birds. For full sun on acid-neutral sand or clay slopes.	SPGF PSF	
Polygala myrtifolia	R19.40 (4L) | 0			September bush. Evergreen, water-wise shrub/small tree of 1-4m, for use as a windbreak or hedge. Striking purple flowers mainly in autumn and spring. Provides forage for bees.	CFDS CFSF SPGF	

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Prionium serratum	R20.00 (4L) | 2			Palmiet. Large wetland graminoid to 2m or more. Excellent water purifier. Flowerheads eaten as a vegetable when in bud.	CLFW	
Pseudoselago spuria **(rare Cape Flats form)**	R18.20 (4L) | 5	R9.00 | 20		Powderpuff plant. Upright perennial shrub to 60cm, white flowerheads. Prefers moist, sandy soils. Full sun.	CFSF	
Psoralea aphylla	R18.80 (4L) | 20			Seasonal wetland shrub to 2m, leaves reduced, shoots silvery hairy, stems weeping, masses of mauve/white flowers in summer. Now rare on the Cape Flats. Plant in full sun under irrigation.	CFSF CLFW	
Psoralea glaucina **(Critically Endangered Cape Flats Endemic)**	R18.20 (4L) | 0	R9.00 | 40		Groundcover for seasonally damp neutral-alkaline sands. Purple pea flowers.	CFDS	
Psoralea pinnata	R18.20 (4L) | 200	R9.00 | 20		3-4mx2m fast-growing seasonal wetland plant/small tree with masses of mauve and white flowers in late spring/summer.	CFSF SPGF CLFW HSF	
Psoralea repens	R15.80 (4L) | 2	R8.90 | 80	R4.00 | 24	Groundcover for alkaline sands. Drought- and wind- resistant. Purple pea flowers.	CFDS	
Ruschia macowanii	R15.80 (4L) | 60	R8.90 | 40		1mx1m sprawling vygie for dry, sandy and windy conditions	CFDS	
Salvia africana-caerulea		R9.60 | 5		Blue sage. 1.5mx1.5m aromatic shrub for clay slopes and flats.	SPGF SSR PSR ASF	
Salvia africana-lutea	R16.95 (4L) | 100	R8.90 | 20		1.5mx1.5m shrub for dry, sandy and windy conditions. Orange, tubular, bird-pollinated flowers.	CFDS HSF PSR SSR	
Salvia chamelaeagnea	R16.95 (4L) | 10	R8.90 | 20		Rough blue sage. Dense shrub to 2m for irrigated areas/seasonal wetlands in clay soils. Lime green foliage and large blue and white flowers in summer.	SPGF CLFW	
Salvia lanceolata	R17.60 (4L) | 0			1.5mx1.5m shrub for dry, sandy and windy conditions. Peach-orange, tubular, bird-pollinated flowers.	CFDS ASF	
Scabiosa incisa	R17.60 (4L) | 2			Fast-growing perennial groundcover with beautiful mauve, long-stemmed flowerheads from spring to summer. For coastal sands in full sun. Attracts butterflies.	CFDS	

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Schoenoplectus scirpoides	R18.20 (4L) | 30	R9.00 | 0	Ex open R6.00 | 0	2m tall attractive wetland reed. Requires permanent water, 50cm deep.	CLFW	
Scirpoides thunbergii	R18.20 (4L) | 2	R9.00 | 0		0.7m tall rhizomatous sedge. Suitable for sandy damp areas.	ASF CFSF	
Searsia crenata	R19.80 (4L) | 10	R9.50 | 0		Shrub/small tree to 4m. Ideal coastal or inland hedging plant. Drought and wind tolerant. Host plant for butterflies; berries attract birds. Full sun.	CFDS CFSF SPGF	
Searsia lucida	R19.80 (4L) | 0	R9.60 | 0		Shrub/small tree (3-5mx4m) with attractive glossy green leaves. Excellent hedging plant. Drought and wind tolerant. Berries attract birds. Full sun.	CFDS HSF CFSF SPGF	
Selago canescens	R16.40 (2L) | 0			Bitterbush. Evergreen shrub to 1.5m with attractive mauve flowers. Flowering time: July-Sep. Host plant for butterflies. For loamy soil in full sun.	SPGF	
Selago corymbosa	R16.40 (2L) | 0			Perennnial densely leafy shrublet to 0.6m. Creamy white flowerheads. Host plant for butterflies. Suitable for sun or semi-shade.	SPGF	
Senecio halimifolius	R15.80 (4L) | 50	R8.90 | 360		2mx1.5m seasonal wetland shrub with yellow daisy flowers which attract insect pollinators. Tolerates summer drying.	CFDS CFSF SPGF CLFW SSR	
Seriphium plumosum (Stoebe cinerea)	R18.90 (2L) | 40			Many branched grey-woolly, shrub to 1.5m for clay slopes in semi-shade to full sun.	SPGF	
Seriphium plumosum (Stoebe plumosa)	R21.40 (4L) | 0	R9.50 | 0		1mx1m shrub with woolly grey foliage for dry, sandy and windy conditions. Water-wise contrast filler.	CFDS CFSF LAF	
Serruria aemula **(Endangered Cape Flats Endemic)**	R24.00 (2L) | 0	R9.60 | 20		Shrublet to 0.5m with finely divided leaves. Silvery-pink flowers appear from July-October. For irrigated or seasonally wet sands in full sun. No compost or fertiliser.	CFSF	

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Serruria foeniculacea **(Critically Endangered Cape Flats Endemic)**	R21.40 (4L) | 10	R9.50 | 10		1mx1m protea with silvery pink flowers. For seasonally wet acid sands. No compost or fertiliser.	CFSF	
Serruria glomerata **(Vulnerable Cape Peninsula Endemic)**	R24.00 (2L) | 0			Compact shrublet to 0.5mx0.5m. Flowering time: Aug-Oct. Suitable for seasonally wet acid sands. No compost or fertiliser.	HSF CFSF	
Sideroxylon inerme **(Protected tree)**	R180.00 (20L, 3m) | 2			Milkwood. 10-15m tall tree with glossy green leaves, small white flowers and purple/black fruit which attracts birds. Suitable for coastal conditions.	CFDS	
Solanum africanum	R16.95 (4L)| 2	R8.90 | 40		Dronkbessie. Creeping succulent shrub with stems to 3m. Groups of pendulous mauve flowers with yellow stamens followed by black berries.	CFDS	
Stachys aethiopica	R16.40 (15cm) | 5		R4.10 | 24	Kattekruie. Hardy spreading groundcover with delicate white-pink flowers. For semi-shade.	CFDS SSR SPGF PSR	
Struthiola dodecandra	R19.40 (4L) | 2	R9.30 | 0		1-1.5m tall shrub with sweet-smelling white flowers. For seasonally wet flats and slopes.	CFSF SPGF CUFW	
Struthiola striata	R19.80 (4L) | 30			Shrub to 1m with small tubular flowers, scented at night, moth-pollinated. For damp sandy flats.	ASF CFSF	
Tarchonanthus littoralis	R33.00 (4L) | 10; R105.00 (20L, 1.5m) | 40			Camphor tree. 2-9m semi-deciduous, hardy, water-wise tree with grey leaves for coastal conditions. Excellent windbreak/tall hedge.	CFDS	
Tetragonia decumbens	R15.80 (4L) | 40	R8.90 | 60	R4.00 | 144	Dune spinach - popular edible plant. Fast-growing groundcover to 50cm for coastal conditions. A useful sand stabiliser.	CFDS HSF	
Tetragonia fruticosa	R15.80 (4L) | 2	R8.90 | 0		Slaaibos - popular edible plant. Fast-growing groundcover to 50cm for coastal conditions. A useful sand stabiliser.	CFDS HSF	
Thamnochortus punctatus	R21.80 (4L) | 0			Steenbok reed. Dwarf perennial restio to 1m, spreading to 0.5m at the base. For full sun in well-drained soil. Water well to establish.	ASF CFSF	
Thamnochortus spicigerus	R21.80 (4L) | 40	R9.50 | 200		Tall thatching reed. Large tussock-forming reed to 2.5m, spreading to 1.5m at the base. For well-drained, neutral-alkaline sand in full sun.	CFDS HSF	

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Trachyandra ciliata	R16.40 (4L) | 5			Veldkool. Perennial to 50cm for coastal sands. Edible flower buds can be steamed or boiled in the same way as asparagus, or cooked in a stew.	CFDS	
Trachyandra divaricata	R16.40 (4L) | 20	R8.90 | 20		Sandkool. Perennial to 50cm for coastal sands. The branched edible flower buds can be steamed or boiled.	CFDS HSF	
Tribolium uniolae	R18.90 (2L) | 0			Tufted perennial grass to 0.6m with compact golden flowerheads. For sandy or clay slopes and flats.	ASF PSF LAF SPGF CFSF	
Wachendorfia thyrsiflora	R19.40 (4L) | 10			Marsh butterfly lily. Tall evergreen geophyte with spikes of yellow flowers reaching 2.5m (Sep-Dec). For permanently marshy areas in full sun.	SPGF CFSF CLFW PSF HSF	
Watsonia meriana	R17.60 (4L) | 0			Cormous plant, leaves to 0.6m, flowers to 2m. Tubular red flowers attract sunbirds. For seasonally inundated areas. Sold as clump of approx. 3 shooting bulbs in 4L bag during growing season (winter/spring).	CFDS CFSF SPGF CLFW	
Watsonia tabularis **(Cape Peninsula Endemic)**	R18.20 (4L) | 0			Cormous plant, sword-shaped leaves to 1m, orange flowers from Nov-Jan, bird-pollinated. Water-wise, suited to sunny rockeries. Prefers neutral to acid soils (occurs naturally on sandstone from sea level to Table Mt summit). Sold as clump of approx. 3 shooting bulbs in 4L bag during growing season.	CFSF SPGF PSF	
Zantedeschia aethiopica				Arum lily. Geophytic species to 1m with fresh green foliage and elegant large white spathes; these support a microcosm of wildlife from beetles to bees to frogs and spiders. For full sun or semi-shade in marshy conditions. Evergreen with permanent moisture availability, deciduous with seasonal moisture. Rhizomes attract porcupines.	CLFW SPGF CFSF	

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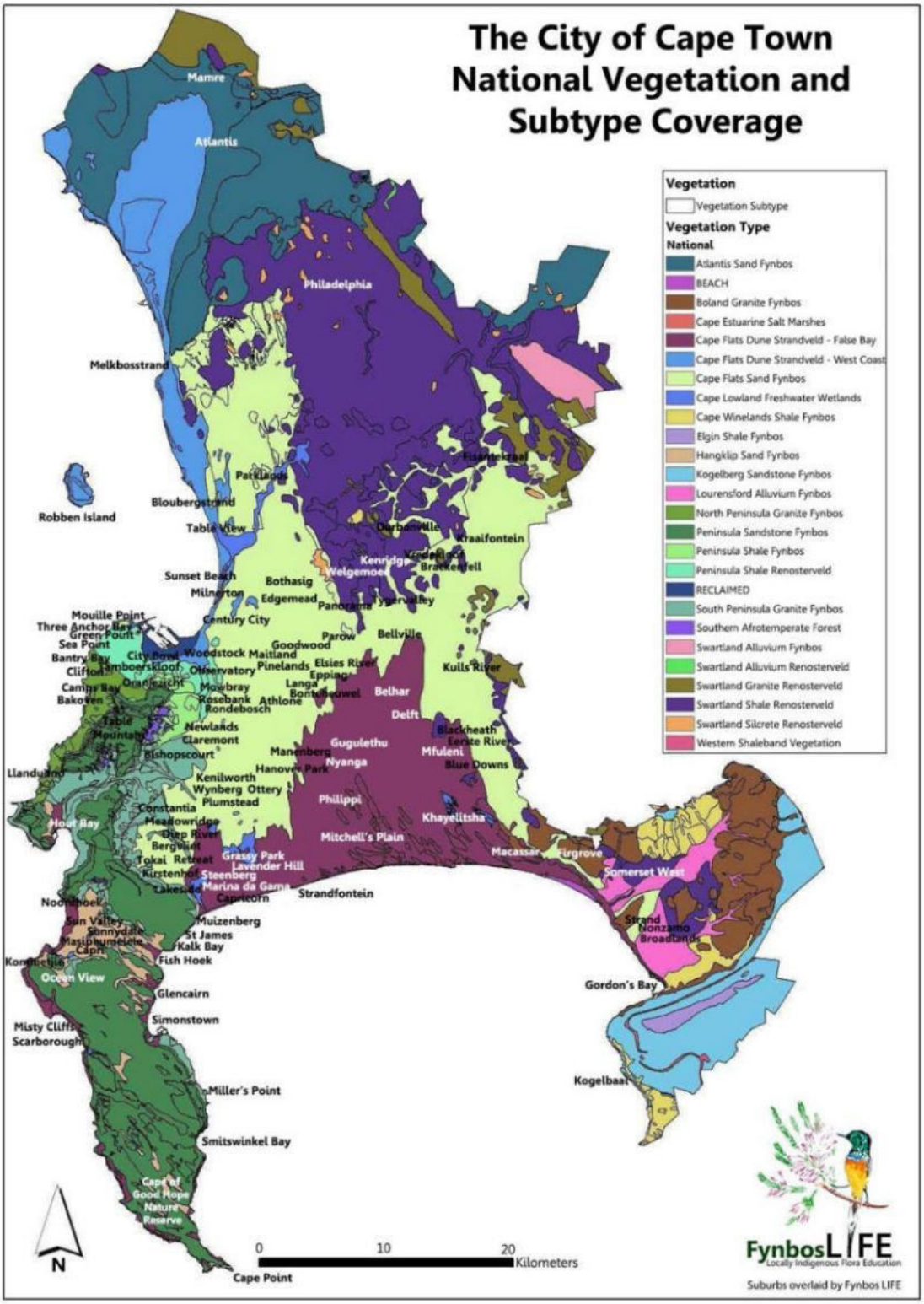
APPENDIX A. CITY OF CAPE TOWN VEGETATION MAP WITH SUBURBS OVERLAID



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APPENDIX J – Stakeholder Engagement Correspondence

Appendix J1 – Meeting Minutes with Cape Nature, COCT and DEA&DP

MARK BOTHA

CONSERVATION STRATEGY, TACTICS AND INSIGHT

Biodiversity Offset for the Cape Winelands Airport

Meeting Record: DEA&DP, CapeNature & City of Cape Town – Biodiversity Management Branch

7 June 2024 09h00 – 11h00: Google meet Platform online .

Present online: Frances Balayer, (FB); Ayesha Hamdulay (AH) – **DEA&DP**
Alana Duffel-Canham (ADC); Ismat Adams (IA), Marius Wheeler (MW) - **CapeNature**
Jacques vd Merwe (JvdM) – **CCT**
Paul Slabbert (PS) **PHS Consulting – EAP**
Bianca Bleuler (BB) **FEN Consulting: Freshwater & Wetland Offset**
Mark Botha (MB) **Biodiversity Offset.** Also compiled this meeting record.

Declined /Apologised: Cliff Dorse, Charmaine Oxtoby (CCT). Marlene Laros, Eldon van Boom, Natasha Bieding **(DEA&DP)**

Meeting Objective: Initial Consultation and Offset overview. Authorities to query offset development up to this point, confirm existence of key concerns, fatal flaws, and required specific information needs in Assessment and Offset Reports.

1. Listed Activity & Development Overview: see attached PPT

PS provided a short PPT overview of the CWA develop, the aeronautical and CAA ad biophysical constraints. This set the scene for the Wetland and Biodiversity Offset inputs to follow.

Questions:

FB queried adherence to the Mitigation hierarchy and other possible mitigation prior to offsets?
IA asked what opportunities existed to avoid the very high significance patches?

PS confirmed that the constraints on runway length, alignment and the location of the quarry precluded any other avoidance or minimisation. Rehabilitation is not sufficient in these ecosystems – thus the EAP and client knew offsets would likely be triggered.

FB queried whether CWA would be able to handle the traffic volumes as an alternative to CTIA.

PS confirmed that CWA was being designed to do so.

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2. Wetland impact and offset proposals – see attached PPT

BB gave an overview of the Wetland impacts, present and desired ecological states and calculated offset requirements (13,7ha FE + 6,7 ha ecosystem target) . She presented the range of rejected candidate sites, explaining the lack of seep wetlands available for offsets, and confirmed the best option would be on-site rehabilitation of a channelled valley bottom (CVB) wetland of the Klapmuts river.

Questions:

FB checked whether the proposed wetland rehabilitation would require further authorisations, and if so, whether this would be included in the CWA application?

PS confirmed that if there were no objections from the authorities to the current proposals, then the wetland rehab measures would be included in the current application.

IA was concerned that a seep wetland impact was being exchanged for a CVB offset outcome. He stipulated that the reports would need a full motivation for the seep wetland loss and the trading for a CVB wetland.

BB responded that seeps are scarce and unavailable to provide the full offset required, and that the condition of the impacted seep is poor, and possibly even worse than when assessed (in 2022). Further, the remaining small seep south of the current impacted one would be included in the rehabilitation proposals, and that the functional benefits of the offset would materialise in the same system as the impacted seep – which is the objective of wetland offsets.

PS added that the east of the site would play a role in stormwater management as required by CCT, and that this could be built into the current wetland rehabilitation measures.

MW requested confirmation that the offset site was within the ownership and control of the applicant – PS responded in the affirmative.

MB queried whether there is an opportunity to secure the rehabilitation of a larger upland area between the impacted seeps, runway safety zone and the CVB wetland – to provide greater ecological functioning, provide ore area for receiving search and rescue species, and to take advantage of the fine scale gradients in soil type, texture, depth and moisture for renosterveld rehabilitation. JvdM acknowledged the benefits of this/

PS noted that although there might be a small opportunity for this, the client was also concerned about retaining agricultural production in the region, and there would be constraints on the rehabilitation option. BB reiterated that a buffer of at least 32m around each wetland would need to be retained and rehabilitated to a functional renosterveld type.

3. Terrestrial Impact and offset proposals – See attached PPT

MB gave a quick background to the project, focusing on the biodiversity impacts and the initial calculation of offset requirements by Nick Helme. He confirmed that ecosystem distribution is complex in the area, but most of the impact is on Swartland Renosterveld on granite and shales. MB confirmed that a terrestrial offset of 77 ha of the impacted vegetation types is needed, focusing on the priorities in the BioNet that are not adequately protected. The top candidate site is large enough and hosts the impacted CR species of concern, among many other red-listed species.

Questions:

IA questioned if the top candidate site was awarded NR eligibility from site review due to previous reactive offsets – JvdM & MB confirmed that it was assessed proactive by CCT in 2012.

ADC confirmed that land use pressure is increasing in the region, and that CN would require any site protection agreements to be in perpetuity. IA added that he was expecting the site to be secured appropriately in some way prior to any EA being awarded.

MB confirmed that and site protection arrangement would be in perpetuity, and that a survey and subdivision and subsequent transfer to the CCT or a PBO was optimal means to achieve this. The management agreement would be for a minimum of 30 years and if possible capitalise an endowment to cover costs for the foreseeable future.

MW supported that if the CCT wishes to take on management, that that would be ideal.

Meeting ended at 10h15 - 7 June 2024

Appendix J2 – Meeting minutes of the offset discussion held with the DWS

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Project name: Cape Winelands Airport Development Wetland Offset Discussion					
Venue	**Teams**	**Date**	**16/09/2024**	**Time**	**14:00**
Chairperson	**Bianca Bleuler**		**Minutes prepared by**	**Freshwater Ecologist Network Consulting (Pty) Ltd**	

Attendance			Apologies
Stephen van Staden	(SvS)	stephen@sasenvgroup.co.za	Mark Botha
Bianca Bleuler	(BB)	bianca@sasenvgroup.co.za	
Amanda Fritz-White	(AF)	amanda@phsconsulting.co.za	
Paul Slabbert	(PS)	paul@phsconsulting.co.za	
Olivia Brunings	(OB)	olivia@phsconsulting.co.za	
Shaddai Daniel	(SD)	DanielS@dws.gov.za	
Warren Dreyer	(WD)	DreyerW@dws.gov.za	

Item	Description
1.	**Welcome** Bianca Bleuler (BB) of FEN Consulting welcomed everybody to the meeting and reminded everyone that the draft offset report was distributed for comment.
2.	**Attendance and Apologies** Refer to the table above and the attendance register for attendees and apologies.
3.	**Background** BB gave a background of the project. She described the locality of the project indicating that the study area has been subject to historical mining and agriculture and activities associated with the Cape Winelands Airport (CWA). BB further explained that a specialist freshwater impact assessment was done by FEN Consulting indicating the potential impacts of the development of the DWS on the wetlands associated with the study area and described the ecological condition of the freshwater ecosystems associated with the study area. The seep wetlands are considered largely modified whereas the channelled valley bottom (CVB) wetlands 2 and 3 are considered seriously modified. All

Item	Description
	freshwater ecosystems have very low ecoservice provision and low/ marginal ecological importance and sensitivity. BB explained the offset consideration criteria and noted a lack of seep wetlands in the greater catchment to achieve like for like offset from a hydrogeomorphic point of view. Initial investigation identified numerous potential areas as suitable areas for offsetting, including the three wetlands identified by Khula Environmental Consultants in 2018, and an onsite offset. It was determined that, in terms of physical hectares, 6.74 ha of wetland area would be lost and an additional 0.7 ha of indirect wetland impact is anticipated. The wetland offset investigation was thus based on an estimated loss of 7.44 ha. In terms of the quantum of offset, it was determined that the 6.74 ha of seep wetland could be offset with a 3.3 functional hectare equivalence (HaE) and conservation HaE of 13.0 ha.
4.	**Target offset wetlands explained**
	BB described the ecological condition of the onsite wetlands to be offset indicating the largely and seriously modified conditions of the remainder of the seep and CVB 1 wetlands, respectively and explained which wetland areas are targeted for offset. It was noted that in addition to the remainder of the seep wetland and CVB wetland 1, the agricultural drain connecting the two systems would also be rehabilitated.
5.	**Future access road considerations**
	BB discussed the potential for future development of access roads through the CVB wetland which has been incorporated into future development planning by the Western Cape Government. Environmental Impact Assessment (EIA) and Water Use Authorisation (WUA) are still to be conducted for these roads prior to them potentially being developed in the future. Based on the Access Management Plan, some access road alternatives are considered of which two may traverse the potential offset area, and it was recommended that existing access roads be upgraded rather than constructing new roads. The access roads that may traverse the CVB wetland offset area were incorporated into the offset calculations to account for their future potential development. BB explained that from a freshwater perspective, only one of the two proposed access roads be developed and the other rehabilitated. One of the access roads is also located adjacent to a CVB wetland which is to be rehabilitated should that road alternative be selected as the preferred road.
6.	**Offset initiative summary**
	BB explained that with the offsetting of the remainder of the seep wetland and CVB wetland 1, the offset target will be exceeded with a 0.1 HaE gain in functional HaE and a 17.5 HaE gain in ecosystem conservation HaE. An additional gain is anticipated for the rehabilitation of the agricultural drain hydrologically connecting the seep wetland to the CVB wetland 1, which was not calculated as part of the offset investigation.
7.	**KRCA Rehabilitation Plan**
	BB explained the rehabilitation plan, with particular focus on the following aspects: • Improving hydraulic regime of the wetlands; • Remediation of gully and headcut erosion and incision; • Alien invasive species control (although to a limited extent); • Revegetation; • Alien grass (particularly kikuyu) management; and • Ongoing maintenance and management.
8.	**Comments and questions**
	Warren Dreyer (WD) indicated that in principle he was pleased with the approach but that formal feedback will be provided. Shaddai Daniel (SD) asked if CWA will be falling under ACSA. Paul Slabbert (PS) indicated that CWA is a private project and not an ACSA project.

Item	Description
	SD asked whether the overall operations and the maintenance management, including stormwater management, as well as maintenance and management of the watercourses, will be undertaken by the private entity and not in partnership with ACSA, which PS confirmed. SD then queried whether the stormwater management and hydropedological impacts to the wetland offset will be included into the offset report particularly considering the current problems observed at the Cape Town International Airport as a result of the high water table. BB responded that the offset report for CWA will be updated to include stormwater management and hydropedological considerations. BB also indicated that the study area slopes away from the airstrip, implying that any stormwater directed to the wetlands will have no implications on the operations of the CWA. From a hydropedological point of view the proposed CWA also does not pose a significant risk to the wetlands. SD reiterated that the offset report would need to incorporate a hydropedologist opinion on the offset to which BB responded that it will be included in the report. SD asked how the stormwater on site will be managed and how it will impact the wetlands. BB responded by indicating that the impacts of stormwater management is included in the freshwater report but reference to the report and its recommendations will be made in the offset report. SD wanted clarity on whether the off site offsets are still to be investigated to achieve the 13 ha ecological conservation HaE. BB indicated that the 13 HaE will be achieved by the onsite offset reiterating the rehabilitation of ~ 40 ha of wetland area to achieve the offset target. SD asked if having the offset site in such close proximity to the CWA would have an operational impact on the CWA. BB indicated that this would have to be confirmed by the relevant specialists. Amanda Fritz-Whyte (AF) indicated that faunal and avifaunal studies have been conducted along with a bird strike report. AF indicated that all stormwater ponds except for the quarry will be dry ponds. The quarry will however be designed to have additional protection measures to deter birds. The bird strike specialist have been providing input and guidance on the design and stormwater area landscaping. A wildlife management plan will also be developed but will only be finalised after the Environmental Authorisation has been obtained. SD indicated that the impacts with regards to bird strikes and wildlife may need to be provided to the Department of Water and Sanitation earlier as input cannot be provided without it. PS reiterated that the offset interventions will not result in large standing bodies of water due to the non-perennial nature of the system. As such the bird strike risk is considered low as large birds will not be drawn to the wetlands. PS also reiterated the difference between the CWA and Cape Town International Airport site in that CWA is not a low-lying site and the airstrip is in a high lying area. In response to the future road development, SD reiterated that any areas that are going to be allocated and designated as offset areas are not going to be allowed to have development within them. BB indicated that both road alternatives' footprints were explicitly excluded from the offset investigations. Existing roads will also be used rather than creating new roads and additional mitigation measures were added to the report which must be implemented to ensure that the functionality of the system will be maintained. PS indicated that the roads form part of the Province's Road Access Strategy, so the access roads were included from an access point of view rather than a future urban expansion point of view. DS asked whether designs for the road are available in order to understand if there will be specification for subsurface flow allowance. BB indicated that the idea would be to ensure hydraulic connectivity of the system through inclusion of culverts etc. in the design of the roads. SD indicated her concern that the roads will have additional impacts on the offset area which would require other mitigation measures but will have to review the offset report in more detail. SD asked whether the offset report contains detail on habitat creation and ecoservice provision to which BB responded that it does.
9.	**Way Forward**
	BB ended off the meeting noting that the meeting minutes will be shared and thanked the participants for their time in attending the meeting. BB and AF indicated that if the Department have any questions, the project team can be contacted.
	The meeting closed at 14h45

Appendix J3 – Draft Memorandum of Understanding

Draft Memorandum of Understanding

Of

CAPEWINELANDS AERO (PTY) LTD
HEREIN REPRESENTED BY
MR DEON CLOETE
IN HIS CAPACITY AS DIRECTOR FOR *CAPEWINELANDS AERO (PTY) LTD*
HE BEING DULY AUTHORISED THERETO

TO ENSURE INTEGRITY OF THE TARGET OFFSET AREA

This Memorandum of Understanding (MoU) sets for the terms and understanding of the CAPEWINELANDS AERO *(PTY) LTD* to *OFFSET THE REQUIRED 6.74 HA OF WEST COAST SHALE RENOSTERVELD WETLAND BY REHABILITATING THE ON SITE TARGET OFFSET AREA.*

PERMEABLE

PRE-EMPTING the conditions of the environmental authorisation in terms of the National Environmental Management Act, 2004 (Act No 8 of 2004) as well as the Water Use Authorisation for offsetting an ~ 40 ha area of wetland (remaining portion of a seep wetland and a channelled valley bottom wetland) on Portion 7 of Farm 942, Kliprug and the Remaining Extent of Farm 474, Joostenbergs Kloof as a result of the development and resultant loss of 6.74 ha of wetland on the same property, for which the environmental authorisation and Water Use Authorisation is yet to be issued.

ACKNOWLEDGING CapeWinelands Aero (Pty) Ltd's commitment to protect the target offset area;

MINDFUL of the need for Sustainable Development to support development and implementation of scientifically sound procedures for integrated approaches to land use planning;

DESIROUS of the sustainable development of the target offset area whilst optimising benefits to local communities;

RECOGNISING the outstanding universal value of natural freshwater ecosystems and the fact that it may provide habitat to species of conservation concern, not only of the Republic of South Africa, but of humankind as a whole deserving protection and transmission to future generations;

FURTHER RECOGNISING the significance that the target offset area is to be protected in perpetuity (at least for thirty years);

CONCERNED that the target offset area is under increased pressure from an ecological functionality and conservation point of view;

COMMITTED to maintaining the integrity of the target offset area and to ensuring that negative impacts of development are avoided, minimised or remedied in pursuit of sustainable development; and

ACKNOWLEDGING that the participation of all stakeholders is crucial to the conservation and sustainable development of the target offset area and that this will be enhanced through long-term cooperative efforts guided by the relevant biodiversity offsets programmes and implementation plans.

HEREBY AGREE AS FOLLOWS:

ARTICLE I - DEFINITIONS

In this Agreement the following expressions shall bear the following meanings and related expressions shall bear corresponding meanings:

"Cape Nature" means Cape Nature, provincial biodiversity authority;

"CapeWinelands Aero" means the CapeWinelands Aero (Pty Ltd (the developers);

"COCT" means City of Cape Town;

"Community" means community as defined in the National Environmental Management Act, 1998 (Act No. 107 of 1998);

"DEA&DP" means the Department of Environmental Affairs and Development Planning;

"DWS" means the Department of Water and Sanitation;

"MoU" means this Memorandum of Understanding and its annexures;

"NEMA" means the National Environmental Management Act, 1998 (Act No. 107 of 1998) and related amendments and regulations;

"NWA" means the National Water Act, 1998 (Act No. 36 of 1998) and related regulations;

"Parties" means the CapeWinelands Aero and any other party that may be involved in the offset programme, which may include Cape Nature, COCT, DEA&DP and DWS;

"Stakeholders" means individuals or groups of individuals or representative institutions with a stake, direct interest or a right recognisable under law in the development and management of the Conservation Area, such as local or provincial authorities;

"Sustainable development" means sustainable development as defined in the National Environmental Management Act, 1998 (Act No. 107 of 1998);

"Target offset area" means the remaining seep wetland and portion of the channelled valley bottom (CVB) wetland to be rehabilitated which is located on potion 7 of Farm 942 and the remaining extent of Farm 474. The offset area associated with the remainder of the seep wetland is 3.68 ha in extent, whereas the portion of the CVB wetland to be rehabilitated is 36.2 ha in extent. Future development planning by the Western Cape Government in the form of constructing access roads through the CVB wetland from the R304 may be necessary. The two access roads that may traverse the CVB wetland offset area have been purposefully excluded from the target offset area.

ARTICLE II - OBJECTIVES

The goal of this Draft MoU is to comply, as far as possible with the relevant provisions of the Environmental and Water Use authorisation still to be issued. Should minor adjustments to the offset be required this Draft MoU may need to be amended accordingly.

The purpose of this Draft MoU is to ensure the integrity of target offset area through comprehensive biodiversity offsets programmes thereby optimising benefits to local communities. This Draft MOU assumes that the remainder of the seep wetland and CVB wetland HGM unit will be rehabilitated to a Category D and E ecological condition, respectively as part of this offset investigation. Should additional offset investigation be required, the Draft MOU may need to be amended accordingly.

To attain the goal of this Draft MoU, the Parties agree to:

i) CapeWinelands Aero aims to provide funding and rehabilitate the target offset area in the manner as defined in the Approved Offset Plan on Portion 7 of Farm 942, Kliprug and the Remaining Extent of Farm 474, Joostenbergs Kloof;
ii) promote alliances in the management of natural resources in support of wetland areas;
iii) ensure compliance with the provisions of this MoU as well as with the requirements of other applicable legislation through monitoring and evaluation;
iv) encourage social, economic and other partnerships among Stakeholders;
v) promote integrated planning, research, education, awareness and capacity building;
vi) collaborate in formulating detailed wetland offsets programmes and implementation plans; and
vii) provide adequate financial, human and other resources for the effective implementation of the MoU.

ARTICLE III - DEVELOPMENT OF BIODIVERSITY OFFSET PROGRAMMES

The Parties agree to develop detailed wetland offset programmes which will form part of this MoU as annexures. The offset framework will be underpinned by, among others, the following components:

a) Obtaining the relevant statutory authorization for the relevant rehabilitation activities;
b) Identified earthworks that will be required after more detailed analyses;
c) Alien vegetation clearing; and
d) Improvement of wetland habitat and functionality.

The above components for offsets will be translated into more comprehensive programmes and implementation plans.

ARTICLE IV - INSTITUTIONAL ARRANGEMENTS

INSTITUTIONAL ARRANGEMENT

CapeWinelands Aero agrees to:

i) ensure coordination of the implementation of this MoU through the established Environmental Advisory Committee (EAC) or relevant subcommittees constituted by the Parties and any other person or organisations identified and agreed to by the Parties;
ii) capacitate the EAC to be able to champion and monitor the development and implementation of the biodiversity offsets programmes and implementation plans;
iii) ensure periodic review and updating of the biodiversity offsets programmes and implementation plans;

iv) appoint an implementing agent to oversee the management of the offset area, should CapeWinelands Aero require to or not be capable of implementing the wetland offset plan;
v) ensure effective participation of other key stakeholders, including government and nongovernmental organisations, communities, landowners, the academic community and the private sector at the international, national and local levels, in the implementation of the MoU;
vi) develop means whereby local communities sustainably benefit from the use of natural and cultural resources provided by the target offset area.

PRINCIPLES OF COOPERATION

The Parties shall observe the following principles in their cooperation in terms of this MoU:

a) Respect the role of the lead institution on an agreed joint program;
b) Acknowledge each Party's support;
c) Honour commitments; and
d) Ensure that information of mutual interest is forwarded to each Party within reasonable timeframes.

ARTICLE VI - CONFIDENTIALITY

Any Party shall treat information furnished by another Party or another person for purposes of the execution of this MoU as confidential.

A Party so furnished with information shall not disclose such information to any other person without the prior written consent of any other Party and shall take reasonable steps to ensure that such information is not disclosed to another person.

The Parties shall continue to observe the principle of confidentiality even after the MoU is no longer valid or is suspended for any reason whatsoever by CapeWinelands Aero.

ARTICLE VII - CORRUPTION

CapeWinelands Aero acknowledge and commit themselves to a policy of zero tolerance towards corrupt activities.

The Parties shall assist each other in developing fraud and corruption prevention strategies.

ARTICLE VIII - REVIEW AND AMENDMENTS

CapeWinelands Aero shall review, where necessary, the contents of the final MoU annually or when deemed necessary.

No alteration, variation, addition or agreed cancellation of the final MoU shall be of any force or effect unless reduced to writing in an addendum to the final MoU and signed by any additional Parties involved or their duly authorized signatories.

CapeWinelands Aero shall review the progress achieved in the implementation of the final MoU one (1) year after it has entered into force.

ARTICLE IX - DISPUTE RESOLUTION

Any disagreement or dispute arising within CapeWinelands Aero or between any involved Parties with regard to interpretation or implementation of this MoU shall be settled amicably, or if not possible, through the procedures and processes as laid down in Chapter 4 of NEMA.

ARTICLE X - ENTRY INTO FORCE, DURATION AND TERMINATION

The rights, responsibilities and obligations of CapeWinelands Aero to this Draft MoU shall commence on the signature date of the final MoU.

The Final MoU may be terminated by any Party giving one (1) year's written notice in advance to other Parties.

ARTICLE XII - GENERAL

1. Entire contract

This Draft MoU and its annexures constitutes the entire Draft agreement of CapeWinelands Aero with regard to the matters dealt within this Draft MoU and no representations, terms, conditions or warranties not contained in the Final MoU shall be binding.

2. Variation, cancellation and waiver

No contract varying, adding to, deleting from or cancelling the final MoU, and no waiver of any right under the Final MoU, shall be effective unless reduced to writing and signed by or on behalf of CapeWinelands Aero.

3. Cession

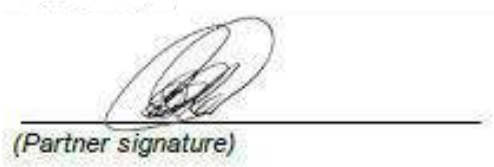
No Party may cede that Party's rights or delegate that Party's obligations without the prior written consent of the other Parties.

4. Applicable law

This Draft MoU shall be interpreted and implemented in accordance with the laws of South Africa.

ARTICLE XIII – DOMICILIUM AND SIGNATURE

CapeWinelands Aero choose as its *domicilia citandi et executandi* an address set out in this clause for all purposes arising out of or in connection with this Draft MoU at which addresses all processes and notices arising out of or in connection with this Draft MoU, its breach or termination may validly be served upon or delivered. For purposes of this MoU CapeWinelands Aero's address is as defined below the signatory below.



(Partner signature)

Date: 11 November 2024

Deon Cloete

Partner name

Capewinelands Aero (Pty) Ltd

organization, position

PO Box 13449,
Mill Street,
Gardens
8010

APPENDIX K – Details, Expertise and Curriculum Vitae of Specialists

Bianca Hagen MPhil Environmental Management (Stellenbosch University)
Stephen van Staden MSc Environmental Management (University of Johannesburg)

1. (a). (ii) The expertise of that specialist to compile a specialist report including a curriculum vitae

Company of Specialist:	FEN Consulting (Pty) Ltd		
Name / Contact person:	Stephen van Staden		
Postal address:	221 Riverside Lofts, Tygerfalls Boulevard, Bellville,		
Postal code:	7539	Cell:	083 415 2356
Telephone:	011 616 7893	Fax:	086 724 3132
E-mail:	stephen@sasenvgroup.co.za		
Qualifications	Environmental Management (University of Johannesburg)		
Registration / Associations	Registered Professional Scientist at South African Council for Natural Scientific Professions (SACNASP)		

1. (b) a declaration that the specialist is independent in a form as may be specified by the competent authority

I, Stephen van Staden, declare that -

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the relevant legislation and any guidelines that have relevance to the proposed activity;
- I will comply with the applicable legislation;
- I have not, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct

---

Signature of the Specialist

SAS ENVIRONMENTAL GROUP OF COMPANIES – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF BIANCA BLEULER

PERSONAL DETAILS

Position in Company	Junior Field Specialist
Joined SAS Environmental Group of Companies	2023

MEMBERSHIP IN PROFESSIONAL SOCIETIES

None

EDUCATION

Qualifications

MPhil Environmental Management (Stellenbosch University)	2022
PGD Environmental Management (Stellenbosch University)	2018
BSc Hons Biodiversity and Ecology (Stellenbosch University)	2017
BSc Biodiversity and Ecology (Stellenbosch University)	2016

Short Courses

Tools for Wetland Assessment presented by Prof. F. Ellery and Rhodes University	2020

AREAS OF WORK EXPERIENCE

South Africa –Western Cape

KEY SPECIALIST DISCIPLINES

Legislative Requirements, Processes and Assessments

- Water Use Applications (Water Use Licence Applications / General Authorisations)
- Environmental and Water Use Audits
- Environmental Control Officer (ECO) work
- Environmental Management Programme (EMPr) compilation

Freshwater Assessments

- Desktop Freshwater Delineation
- Freshwater (wetland / riparian) Delineation and Assessment
- Freshwater Eco Service and Status Determination
- Rehabilitation Assessment / Planning
- Plant Species and Landscape Plans

SAS ENVIRONMENTAL GROUP OF COMPANIES
SPECIALIST CONSULTANT INFORMATION –

CURRICULUM VITAE OF STEPHEN VAN STADEN

PERSONAL DETAILS

Position in Company	Managing Member, Group CEO, Water Resource Discipline Lead, Ecologist, Aquatic Ecologist
Date of Birth	13 July 1979
Nationality	South African
Languages	English, Afrikaans
Joined SEGC	2003 (year of establishment)
Other Business	Trustee of the Serenity Property Trust

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Registered Professional Scientist at South African Council for Natural Scientific Professions (SACNASP);
Accredited River Health Practitioner by the South African River Health Program (RHP);
Member of the South African Soil Surveyors Association (SASSO) Member of the Gauteng Wetland Forum;
Member of the Gauteng Wetland Forum;
Member of International Association of Impact Assessors (IAIA) South Africa;
Member of the Land Rehabilitation Society of South Africa (LaRSSA)

EDUCATION

Qualifications

MSc Environmental Management (University of Johannesburg)	2003
BSc (Hons) Zoology (Aquatic Ecology) (University of Johannesburg)	2001
BSc (Zoology, Geography and Environmental Management) (University of Johannesburg)	2000

Short Courses

Integrated Water Resource Management, the National Water Act, and Water Use Authorisations, focusing on WULAs and IWWMPs	2017
Tools for Wetland Assessment (Rhodes University)	2017
Legal liability training course (Legricon Pty Ltd)	2018
Hazard identification and risk assessment training course (Legricon Pty Ltd)	2018
Wetland Management: Introduction and Delineation (WLID1502S) (University of the Free State)	2018
Hydropedology and Wetland Functioning (TerraSoil Science and Water Business Academy)	2018

CORE FIELDS OF EXPERTISE

Legislative Requirements, Processes and Assessments

- Water Use Applications (Water Use Licence Applications / General Authorisations)
- Environmental and Water Use Audits
- Freshwater Resource Management and Monitoring as part of EMPR and WUL conditions

Freshwater Assessments

- Freshwater (wetland / riparian) Delineation and Assessment
- Freshwater Eco Service and Status Determination
- Rehabilitation Assessment / Planning
- Maintenance and Management Plans
- Plant Species and Landscape Plans
- Freshwater Offset Plans
- Hydropedological Assessment
- Pit Closure Analysis

Aquatic Ecological Assessment and Water Quality Studies

- Habitat Assessment Indices (IHAS, HRC, IHIA & RHAM)
- Aquatic Macro-Invertebrates (SASS5 & MIRAI)
- Fish Assemblage Integrity Index (FRAI)
- Fish Health Assessments
- Riparian Vegetation Integrity (VEGRAI)
- Toxicological Analysis
- Water quality Monitoring
- Screening Test
- Riverine Rehabilitation Plans

Biodiversity Assessments

- Floral Assessments
- Biodiversity Actions Plan (BAP)
- Biodiversity Management Plan (BMP)
- Alien and Invasive Control Plan (AICP)
- Ecological Scan
- Terrestrial Monitoring
- Biodiversity Offset Plan

Soil and Land Capability Assessment

- Soil and Land Capability Assessment
- Hydropedological Assessment

Visual Impact Assessment

- Visual Baseline and Impact Assessments
- Visual Impact Peer Review Assessments

ANNEXURE 8: WASTE MANAGEMENT PLAN

WASTE MANAGEMENT PLAN FOR THE EXPANSION OF THE CAPE WINELANDS AIRPORT

(P10 OF FARM 724, RE OF FARM 724, P23 OF FARM 724, P7 OF FARM 942, RE OF FARM 474, P3 OF FARM 474 AND P4 OF FARM 474)

JULY 2025

COVER IMAGE NOT REPRESENTATIVE OF THE PROJECT SITE
© ADOBE STOCK

PREPARED FOR
CAPEWINELANDS AERO (PTY) LTD

PREPARED BY
PHS CONSULTING

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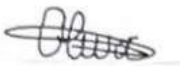
EDITOR & REVIEW	Olivia Brunings	2023/6743 (Candidate)		24 June 2025

PLEASE NOTE THAT ALL CHANGES TO THE DRAFT REPORT FOR COMMENT (VERSION 1) ARE UNDERLINED.

PLEASE NOTE THAT ALL CHANGES TO THE DRAFT REPORT FOR COMMENT (VERSION 2) ARE UNDERLINED & IN BLUE.

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KEY TERMS AND ABBREVIATIONS

Applicant – Capewinelands Aero (Pty) Ltd

Auditing - A systematic and objective assessment of an organization's activities and services conducted and documented on a periodic basis to a predetermined standard.

Baling – the manual or mechanical tying, bundling or wrapping of compressed waste material.

Chipping – the manual or mechanical chopping or cutting of garden waste into smaller pieces in preparation for further processing.

Competent Authority – the organ of state charged by the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008)(as amended), as the licensing authority.

Composting – means a controlled biological process in which organic materials are broken down by micro-organisms by means of aerobic and anaerobic processes.

CWA – Cape Winelands Airport

Department of Environmental Affairs and Development Planning: Waste Management (DEA&DP: WM)– the provincial authority for sustainable environmental management and integrated development planning.

DWS - Department of Water & Sanitation

EA – Environmental Authorisation

EAP – Environmental Assessment Practitioner

EM – Environmental Manager

EMD - Environmental Management Division

Environmental Management Programme (EMPr) an environmental management tool used to ensure that undue or reasonably avoidable adverse impacts of the construction, operation, and decommissioning of a project are managed, and that positive benefit of the projects are enhanced.

Environmental Control Officer (ECO) – a suitably qualified environmental consultant to be appointed by the Applicant to oversee the implementation of the suite of Environmental Management Plans complied for the site, inclusive of this Veld Fire Management Plan.

Handling – means functions associated with the movement of waste, including storage, treatment and ultimate disposal, by means of manual systems or automated systems;

National Environmental Management Act (Act 107 of 1998, as amended) (NEMA)– national legislation that provides principles for decision-making on matters that affect the environment.

N&S - Norms & Standards

Separation at Source (S@S) - Involves sorting post-consumer waste at the point of generation—whether at homes, businesses, or industrial sites—using a system that divides waste into categories, such as a two-bag system for recyclables and non-recyclables (e.g., wet and dry waste). At the Airport, S@S means providing separate bins at each waste collection point, ensuring that waste is properly sorted before being transported to the Waste Management Facility for further processing

Shredding – the breaking down of waste material, through manual or mechanical cutting or tearing into smaller parts.

Sorting – the manual or automated separation of waste materials according to type, class, state of contamination or usability for a particular purpose.

Site - Area where the proposed development will take place.

Waste Facility – a commercial place, infrastructure or containment of any kind including associated structures or infrastructure where there is sorting, shredding, grinding, crushing, screening, chipping or baling of general waste.

WCO – Waste Control Officer

WMP – Waste Management Plan

WMF - Waste Management Facility

WULA – Water Use License Application

WWTW – Waste Water Treatment Works

SECTION 1: CONTEXTUAL INFORMATION

1.1. Background

This report is an Environmental Management Programme (EMPr) for the Waste Management Facilities proposed at the Cape Winelands Airport (CWA). PHS Consulting was appointed by *Capewinelands Aero (Pty) Ltd* to compile this document in order to satisfy the requirements of NEM: WA. The CWA development, historically known as Fisantekraal Airfield (FAFK), is located approximately 10.5 km northeast of Durbanville and 25 km northeast of Cape Town International Airport (CTIA) (see Figure 1).

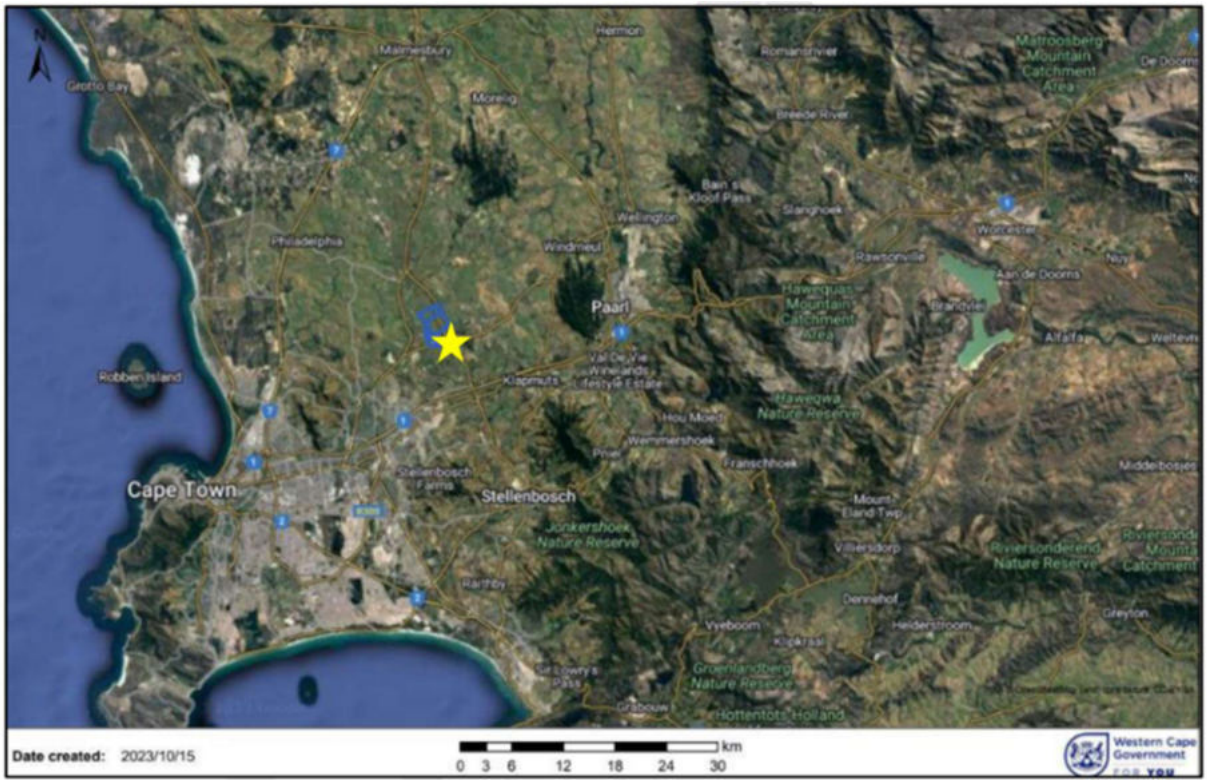


Figure 1: Regional location of CWA (indicated by yellow star and with cadastrals outlined in blue).

Initially constructed around 1943 as a South African Air Force aerodrome during World War II, CWA has since transitioned into a general aviation (GA) airfield. The current 150-hectare site includes four concrete runways, each 90 meters wide and varying in length between 700 meters and 1,500 meters. The facility supports various unscheduled operations such as recreational flying, flight training, aircraft maintenance, charter operations, crop spraying, and aerial banner towing. The development spans across the following cadastral portions (see Figure 2):

- Portion 23 of Farm 724,
- RE of Farm 724,
- Portion 10 of Farm 724,

- Portion 4 of Farm 474,
- RE of Farm 474,
- Portion 7 of Farm 942,
- Portion 3 of Farm 474.

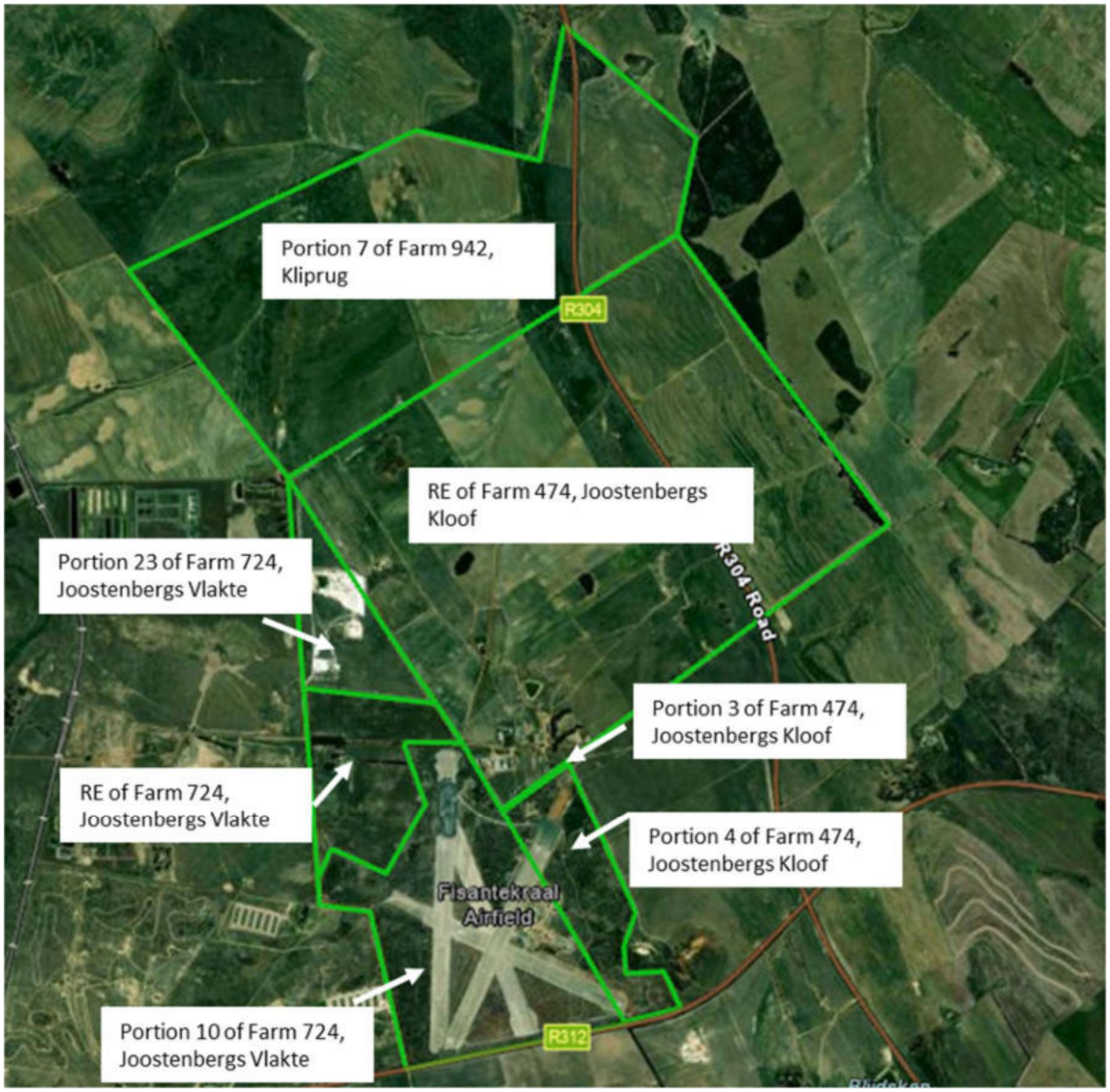


Figure 2: Cadastrals forming part of application area

The proposed development will expand the existing airport facilities, encompassing five additional cadastral portions, creating a combined area of 885 hectares. Of this area, 470 hectares will be allocated for airport development, including an airside precinct, terminal precinct, services precinct, general aviation precinct and associated landscaping (**Appendix A**). The remaining land will remain as agricultural zones, designated as an agricultural precinct. This agricultural precinct will feature a combination of dryland agriculture, conservation of botanically sensitive areas, and wetland offsets.

The project envisions a phased development approach, including the realignment of a primary runway to an orientation of 01-19 with a length of 3.5 km. The upgraded CWA is planned to transition from a general aviation airfield into a commercial airport capable of facilitating long-haul, wide-body flights by airlines and unscheduled operators from across the world. The airport's expansion will serve multiple roles within the aviation sector and will support a variety of industries, including fixed-based operations, private charter services, flight training, helicopter services, aircraft maintenance, hotel and conferencing facilities, retail and food services, warehousing, logistics, and freight operations.

No Waste License application is required for the proposed project, in terms of the National Environmental Management: Waste Act (NEM: WA), 2008 (Act 59 of 2008). However, CWA will have to adhere and register in terms of several "Norms & Standards" as per NEM: WA. One of the requirements is the compilation of an EMPr to be adopted by Department of Environmental Affairs and Development Planning: Waste Management (DEA&DP: WM). However, considering the project will have an overarching EMPr, of which this document will form an Annexure, we will refer to this document as a Waste Management Plan (WMP) instead.

Waste management is the process of collecting, treating, recycling, and disposing of different waste materials to reduce the environmental impact of waste. A WMP plays a key role in achieving sustainable waste management. The purpose of this plan is to ensure that effective procedures are implemented for the handling, storage, transportation and disposal of waste that is generated from the proposed development activities. The plan prescribes measures for the collection, temporary storage and safe disposal of the waste streams associated with the project and includes provisions for the recovery, re-use and recycling of waste. Airports, by their very nature, generate a significant amount of waste. This waste comes from a variety of sources and requires careful management to reduce environmental impacts. *Capewinelands Aero (Pty) Ltd* can effectively manage construction and operational waste by requiring in-house teams, contractors and operators to follow a Waste Management Plan that identifies:

- The types of waste materials that will likely be generated on a site;
- The procedures that will be used to collect, sort and store the waste materials;
- How the materials will be reused or recycled
- Who will haul away the waste material;
- The location to which the materials will be hauled; and
- Final disposal requirements

The compilation of the WMP was based on waste stream information available at the time of compilation. Construction practices and operations must be measured and analyzed to determine the efficiency of the plan and whether further revision of the plan is required. This WMP describes the facility management in detail, and is prescriptive, identifying specific individuals or organizations responsible for undertaking specific tasks to ensure that environmental impacts resulting from the

operation of the CWA is minimized. This WMP is an open-ended document and information gained during on-going monitoring of procedures on site could lead to changes in the recommendations and specifications of this document. This plan should be updated should further detail regarding waste quantities and categorization become available, during the construction and/or operational stages.

1.2. Purpose and Principles of the WMP

The purpose of this Waste Management Plan is to describe the principles, procedures and management of the waste generated by Cape Winelands Airport and to ensure waste is reduced, reused and recycled wherever possible. The Waste Management Plan outlines measures to manage and mitigate waste generation and resource consumption during the construction and operation of the development. The Waste Management Plan is therefore designed to support an ecological based management approach underpinned by adaptive management principles through the entirety of the project life cycle.

In general, the following phases can apply: planning & design; pre-construction activities; construction activities; operational activities and rehabilitation &/or decommissioning. However, the need to include all the above phases depends on the scale and scope of each individual project. Decommissioning of the facility is not currently foreseen and therefore it is not further addressed in this document. The WMP focuses primarily on the construction and operational phase of the facility and is intended to guide construction and operational aspects in line with relevant legislative requirements and the recommendations made by the specialist and/or consultant(s) as applicable.

As indicated, the WMP forms part of the overarching EMPr for the CWA and will therefore be included and circulated as stipulated in the EMPr. The WMP must form part of all contractual documents for this project. The approval of the WMP by DEA&DP: WM will require that the landowner and all appointed contractors must comply with the requirements therein. Any amendments/ changes/ upgrades to the WMP will require submission to and approval by DEA&DP: WM.

Capewinelands Aero (Pty) Ltd are committed to implementing the WMP so that it is effective, accurate, economical and ensures that the procedures put into place are working and are maintained. The aim is to minimise waste and the reduction of waste pollution. An integrated approach to waste management will be implemented on site with the aim of:

- Considering the Life Cycle Analysis of waste on site allows one to better understand the true impacts of any given goods or services over the course of the entire life cycle.
- Product Stewardship accountability needs to be placed on those who design, manufacture, use, or dispose of products. Collaboration in this regard between CWA and its suppliers/ service providers can result in innovative and continued improving of achieving waste management targets.
- Prioritizing the reduction of waste volumes is therefore paramount. Continued education and training of all CWA staff, sub-contractors and passengers is required.

- If avoidance or reduction is not feasible, the maximum amount of waste is to be recycled or re-used through separation and sorting of waste on site.
- Waste that cannot be recycled is to be disposed of in the most environmentally responsible manner possible.
- As a last resort, non-recoverable waste will be sent to the appropriate Landfill (hazardous or non-hazardous).
- Monitoring, recording and auditing of all waste management taking place on site.

Such an approach is illustrated in Figure 3 below.

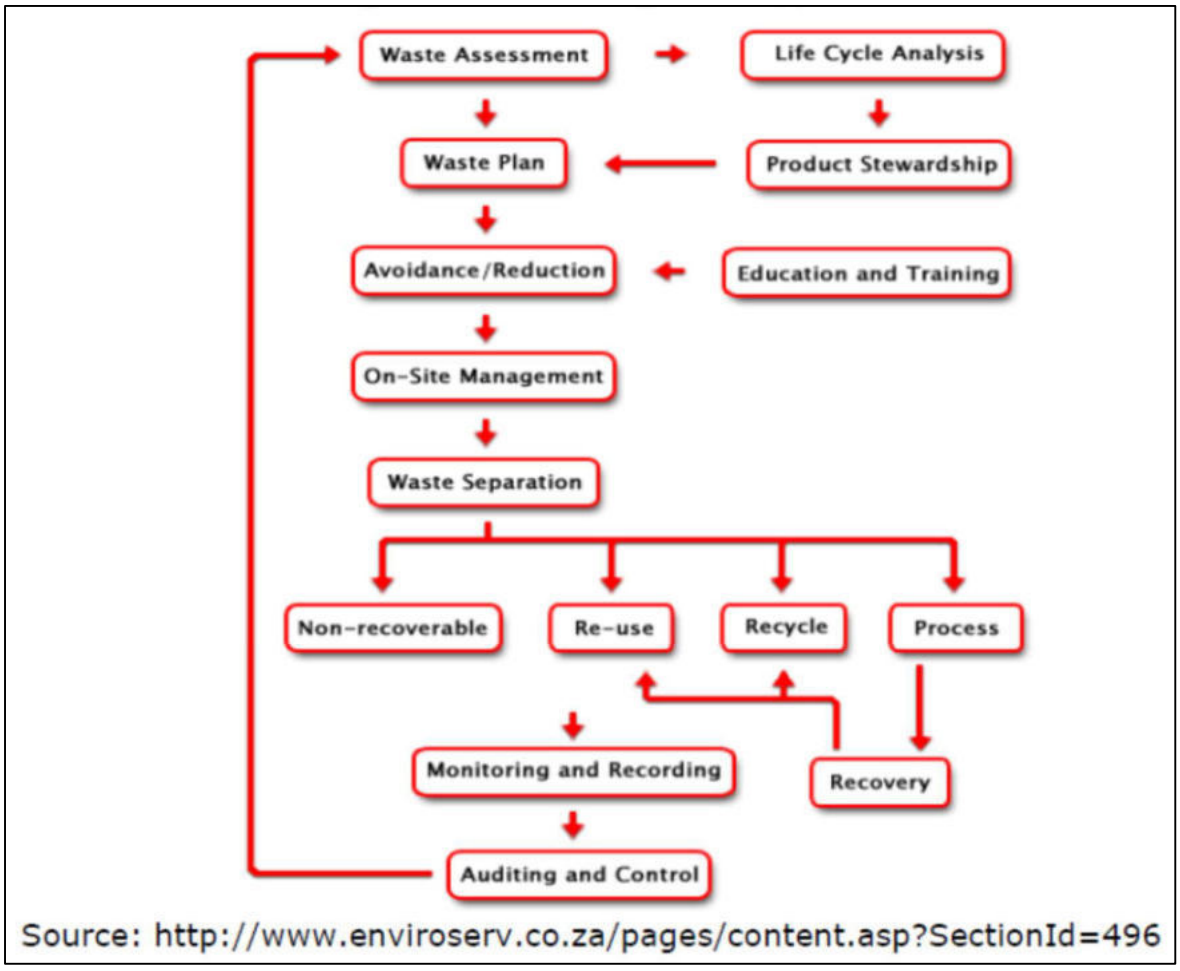


Figure 3: The integrated waste management approach to waste.

1.3. Status of the WMP

The WMP must form part of all contractual documents for this project. The WMP includes all relevant documentation within this report and/or referred to within it. The approval of the WMP by DEA&DP: WM will require that the landowner and all appointed contractors must comply with the requirements

therein. Any amendments/ changes/ upgrades to the WMP will require submission to and approval by DEA&DP: WM.

1.4. Comment to the WMP

The WMP forms part of the contract identifying and specifying the procedures to be followed by all contractors, and employees of the facility to eliminate or reduce adverse impacts of the works on the environment. The appointed EAP will hand over the WMP to the landowner/operator for implementation. Should the landowner/operator, contractor or employee persistently fail to observe the provisions of the WMP, the auditing EAP can recommend remediation actions including notification of the relevant authority for a compliance audit.

Copies of the WMP will be made available to all senior personnel on site, who will be required to familiarize themselves with the contents of the document and to follow procedures accordingly. Each contractor involved in the development and/or operation of the facility will be expected to sign for, and thus acknowledge receipt of the final WMP, and thereby will be expected to abide by the specifications of the document, as well as annexures and any amendments thereto.

The WMP will include goals and objectives set to achieve the required environmental standards. The Landowner will be responsible for the overall implementation of the WMP

1.5. Relevant legislation and policies

Waste in South Africa is currently governed by means of a number of pieces of legislation, including:

- National Environmental Management: Waste Act (NEM: WA), 2008 (Act 59 of 2008) (as amended).
- The South African Constitution (Act 108 of 1996).
- Hazardous Substances Act (Act 5 of 1973).
- Health Act (Act 63 of 1977).
- Environment Conservation Act (Act 73 of 1989).
- Occupational Health and Safety Act (Act 85 of 1993).
- National Water Act (Act 36 of 1998).
- The National Environmental Management Act (Act 107 of 1998).
- Municipal Structures Act (Act 117 of 1998).
- Municipal Systems Act (Act 32 of 2000).

- Mineral and Petroleum Resources Development Act (Act 28 of 2002).
- National Environmental Management: Air Quality Act, 2004 (Act 39 of 2004) (NEM: AQA)
    - The provisions of the National Dust Control Regulations published in terms of section 53 (o), read with section 32 of the NEM: AQA.
    - The provisions of the National Greenhouse Gas Emission Reporting Regulations published in terms of section 53 (aA), (o) and (p), read with section 12 of the NEM: AQA.
    - The National Ambient Air Quality Standards published in terms of section 9 (1) of the NEM: AQA.
- City of Cape Town: Integrated Waste Management By-law, 2009.

It was clarified with DEA&DP: WM that no Waste License application is required for the proposed project, in terms of the National Environmental Management: Waste Act (NEM: WA), 2008 (Act 59 of 2008) based on the following:

- The airport will have a WMF of approx. 1250 m^2, where all waste streams will go for temporary storage and where waste separation will take place.
- General waste will be sorted and temporarily stored in various categories.
- Shredding and baling of general waste will take place.
- All sorted, shredded or baled recyclable waste will be collected by recycling companies for off-site processing.
- Organic, food, garden, decomposable waste will go to a composting facility and bio-digester that will generate electricity. Alternatively organic waste will be collected by an accredit service provide for off-site composting.
- A sewerage package plant is proposed as an alternative to a conventional Waste Water Treatment Works.
- The sewerage effluent water generated by the package plant is normally used for irrigation or toilet flushing.
- The biodigester requires water to operate, but the water demand can be reduced or replaced by the sewerage effluent water from the sewage package plant (SPP).
- Considering the airports location the biodigester intents to use biomass sourced from the surrounding agricultural area, supplemented by general food waste from the airport or other organic /decomposable waste.
- Hazardous waste will be removed to a licensed facility.
- The intent is not to feed raw sewage sludge into the bio-digester, this will go into the SPP and then the outflow effluent water will be used in the biodigester. Bio-solids after treatment will be removed to a licenced facility alternatively if tested as non-hazardous it can be used in the biodigester.

- The combined tons of waste and water/ sewerage effluent water per day will probably exceed 100 Tons per day with the ability to produce 1 MW of continues power.
- The by-product from the bio-digester plant comprises "liquid fertilizer" which is planned to be used as organic agricultural fertiliser."

Based on the above, CWA will have to register and adhere in terms of the following Norms & Standards (N&S) due to the waste activities described above and the exceedance of the thresholds below:

- "National Norms and Standards for the Storage of Waste" (GN926 of 29 November 2013) should the facility have the capacity to store more than 80m^3 for hazardous waste and/or 100m^3 for general waste at any one time and for a period exceeding 90 days. (CWA 1250 m2 waste facility)
- "National Norms and Standards for Sorting, Shredding, Grinding, Crushing, Screening, Chipping or Baling of General Waste" (GN1093 of 11 October 2017) if general waste is sorted, shredded, grinded, crushed, screened, chipped or baled in an operational area at the facility exceeding 1000m^2. If the operational area does not exceed 1000m^2, the facility needs to register in terms of GN1093 only and adhere to section 28 of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended, and sections 16(1) and 16(3) of the NEM: WA. (CWA 1250 m2 waste facility).
- National Norms and Standards for Organic Waste Composting (GN 561 in GG 44762 of 25 June 2021) read with GN 1757 in GG 45907 of 11 February 2022. The composting facility will process less than 10 tonnes per day of organic waste, therefore it will be registered ito the N&S and aligned with the requirements of applicable integrated waste management by-laws and comply with the principle of duty of care as per S28 of NEMA.
- The activity of anaerobic digestion (biodigester) resort under the NEM: WA "*National Norms and Standards for Organic Waste Treatment*", published as GN. No. 1984 of 1 April 2022, and no longer requires an application for a waste management licence. Facilities that have the capacity to process in excess of 10 tonnes of organic waste per day need to register in terms of and adhere to GN No. 1984. (BIOMASS exceeds 10 tonnes per day plus the additional organic waste streams).
- GN No. 1984 above does not apply to any infectious animal waste, raw sewage or sewage sludge that does not meet the minimum quality standards for sludge as determined by the Department of Waste and Sanitation in their "*National Norms and Standards for Domestic Waste and Sanitation Services*", published as GN No. 982 of 8 September 2017. (The intent is to regard treated solids from the on-site WWTW as hazardous, to be removed from site, however if the minimum standards can be achieved it could be used in the bio-digester. Please note it needs to adhere to the requirement for the submission of Standard Operating Procedures (SOP) in accordance with section 6.2 of GN No. 1984.

- DEA&DP: Waste Management noted the intent to use the digestate from the anaerobic digester as a liquid fertiliser. The Department requested that once available, the digestate be analysed to determine its suitability as a liquid fertiliser, and that these results be made available to the Department, the DWS and the Western Cape Department of Agriculture.
- DEA&DP: Waste Management requires more information on the future biosolids resulting from the sewage package plant before a classification of the waste can be awarded. If the biosolids are regarded as hazardous it will be transported and disposed of at a hazardous waste facility. If not deemed hazardous it will be fed into the biodigester. Waste classification of the biosolids will also depend on an analysis provided on the chemical constituency of the biosolids, and depending on end use, the Department might require total concentration and leachable concentration tests to be conducted on the biosolids.

This Waste Management Plan (WMP) is in part fulfilment of the aforementioned NEM: WA Norms and Standards. Please note the WMP is an evolving document that will be shaped by the EIA process and final detailed operational procedure will become clear during the design phases for the WMF. As a norm a new waste facility must be registered with the competent authority in accordance with the N&S within 90 days prior to any construction of the WMF taking place. Considering the amount of time before the WMF will be constructed in relation to the current junction in the EIA process, it is therefore highly likely that this WMP will only be finally adopted by DEA&DP: WM after the Environmental Authorisation for the projects has been issued. Some design details of the WMF will therefore not form part of the WMP at this point in time until it's required to finally submit the WMP for adoption. Therefore 90 days prior to the construction of the WMF a NEM: WA Registration form will be submitted adhering to all the requirements of the N&S as attached under Annexure B.

1.6. The competent authority

DEA&DP: WM will review the WMP and on approval they may have the following role to play:

- Review and monitor implementation of the WMP;
- Review whether there is compliance by the landowner;
- Perform random control checks;
- Review ECO, incident and audit reports; and
- Enforce legal mechanisms for contraventions of the WMP.

SECTION 2: PROJECT DETAIL

2.1. Planning Phase

The SDP is divided into four (4) Precincts namely Airside, Airport Landside, General Aviation and Services Precincts. Please refer to Figure 4 & Figure 5 and Appendix A for more detail. The site has dedicated areas earmarked for waste management inside the services precinct (Figure 6). The rational for the location of infrastructure on site was primarily dictated by the 3.5 km runway orientation, this resulted in the airside precinct to be on the east of the site and the landside precincts to be located on the western side of the site. This also allowed for effective integration with the future urban area, services and access roads. Therefore, the services precinct was also positioned on the west to support the landside development. The WMF is opposite the City of Cape Town's WWTW, an area not suitable for residential development, and therefore suitable for the proposed activities.

The EIA process identified all bio-physical environments and constraints regarded as sensitive. Noteworthy sensitive areas that will remain on site after development is intact indigenous vegetation on the south eastern side of the runway and a partly remaining seep wetland on the eastern side of the runway all within the airside precinct. None of these areas will be exposed to any waste risks considering the services precinct where the WMF is located on the western side completely separated from these environments. Waste generated in these natural areas is organic waste generated by the natural landscape or windblown waste in the form of plastic or paper originating on or off-site. The main waste streams on site will be on the western side of the site, within the built environment. Any waste escaping the management system will end up in the stormwater system that will have sufficient retention and trap capacity to eliminate waste risks. The location of the waste facilities is on stable level ground, it will be inside a contained demarcated area designed in accordance with the N&S, therefore the on-site waste risk is limited and only relevant if managed poorly. The risk of waste smell to airport and surrounding land users is mitigated by the fact that the WMF is inside the services precinct, separate from the airport airside and landside precincts. This separation is regarded as sufficient to avoid waste smell impacts. The implementation of the WMP and N&S will also mitigate the possible impact of flies, rodents or pests etc. considering the design and management requirements as per N&S.

The agricultural area to the east of the airport contains wetland areas, however it's far from the waste management facility on the west, it also falls within two separate water sheds eliminating the risk of contamination via stormwater surface flows. The main waste streams originate on the west of the site, directly connected via a contained service network to the WMF. Therefore, neighboring areas to the west of the airport are most vulnerable to the waste streams. The risk of unmanaged waste stream reaching an off-site area is considered low. If waste is spilled or mismanaged, it could either flow via stormwater to neighboring sites, blow by wind or disperse foul odors onto neighboring properties. But if managed well, all waste streams

should move efficiently to the WMF, that is contained within a defined service precinct where it will be managed, delivered, handled and collected. All waste skips should be covered at all time and waste storage facilities should all be under roof and closed off.

2.2. Construction Phase

The airside precinct will be developed first (Figure 4). This relates to the demolition of existing unwanted infrastructure, usable material will be crushed for compaction re-use on site, unwanted waste will be removed to recycling or landfill, followed by earthmoving, cut and fill, then the construction of the new 3.5 km airstrip with associated airside infrastructure.

During the initial demolition and construction phase, the waste facilities will relate to a mobile waste yard managed by the contractors and the position will be away from sensitive features and informed by site logistics i.e. where works are taking place. Thereafter landside development will commence. As soon as the services precinct is established the WMF will be established and formally developed and used for the remainder of the construction an operational phase (Figure 6)

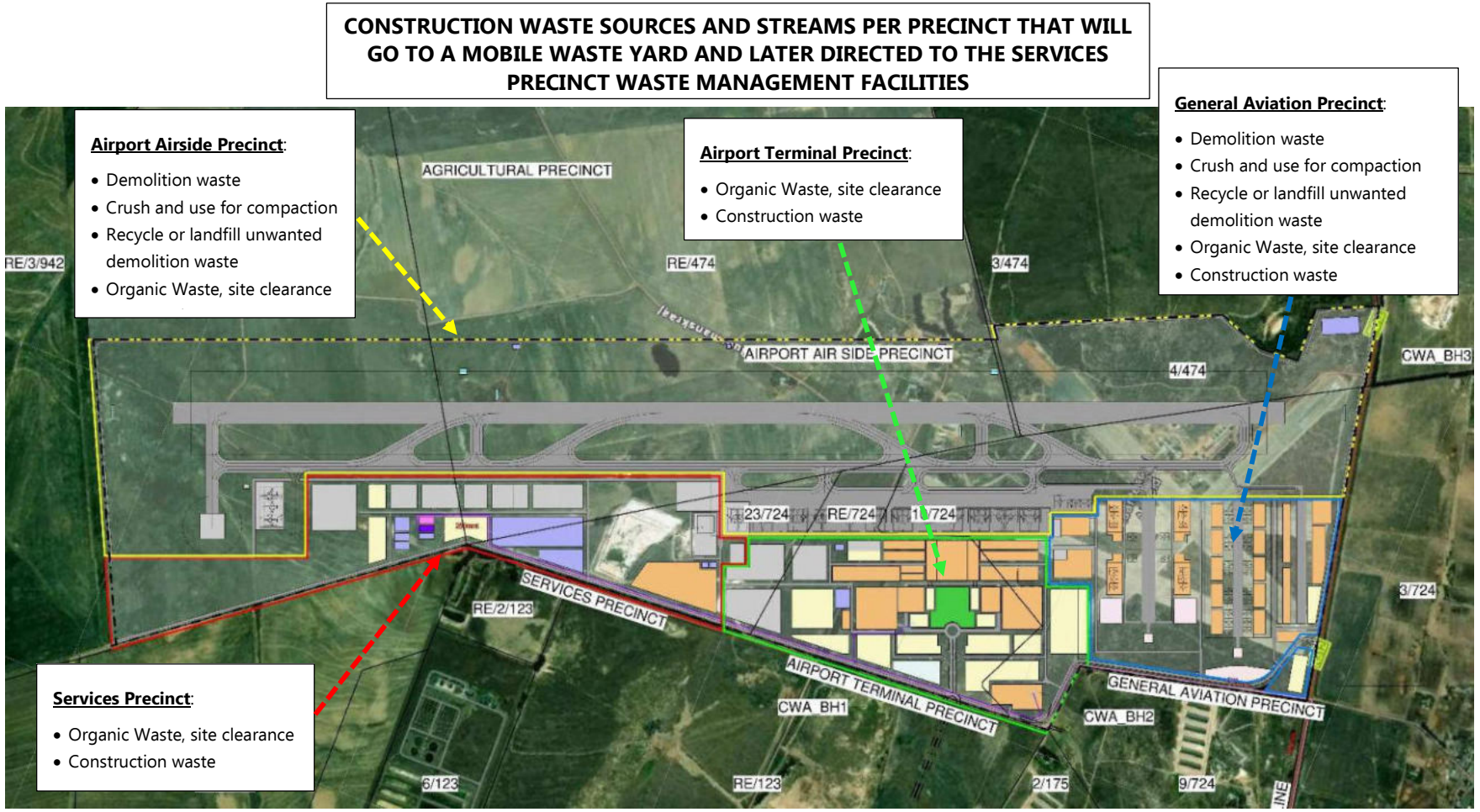


Figure 4: The Phase 2 SDP for the Cape Winelands Airport expansion. All waste streams during construction will be separated at source from where it will go to a mobile waste yard, location determined by logistics. When the services precinct (red outlined area also refer to Figure 6 below) is complete all waste streams will go to the waste management facility from where it will be collected and removed from site.

2.3. Operational Phase

Figure 5 indicates the various waste streams during operations in each precinct. While every waste source, before feeding into the waste stream, will be expected to implement a certain level of sorting and temporary storage at the source, ultimately all waste will end up in the Services Precinct (Figure 6), where it will be managed and from where it will be collected by external service providers. The Services Precinct will include a dedicated Waste Management Facility (WMF) for General Solid Waste management as well as a dedicated area for the Sewage Package Plant WWTW and Biodigester with a composting area. During the initial demolition and construction works a mobile waste yard will be used by the contractor, located in a low sensitivity but logistical functional area. Soon after the services precinct is established the dedicated WMF will be used for construction and operational waste management.

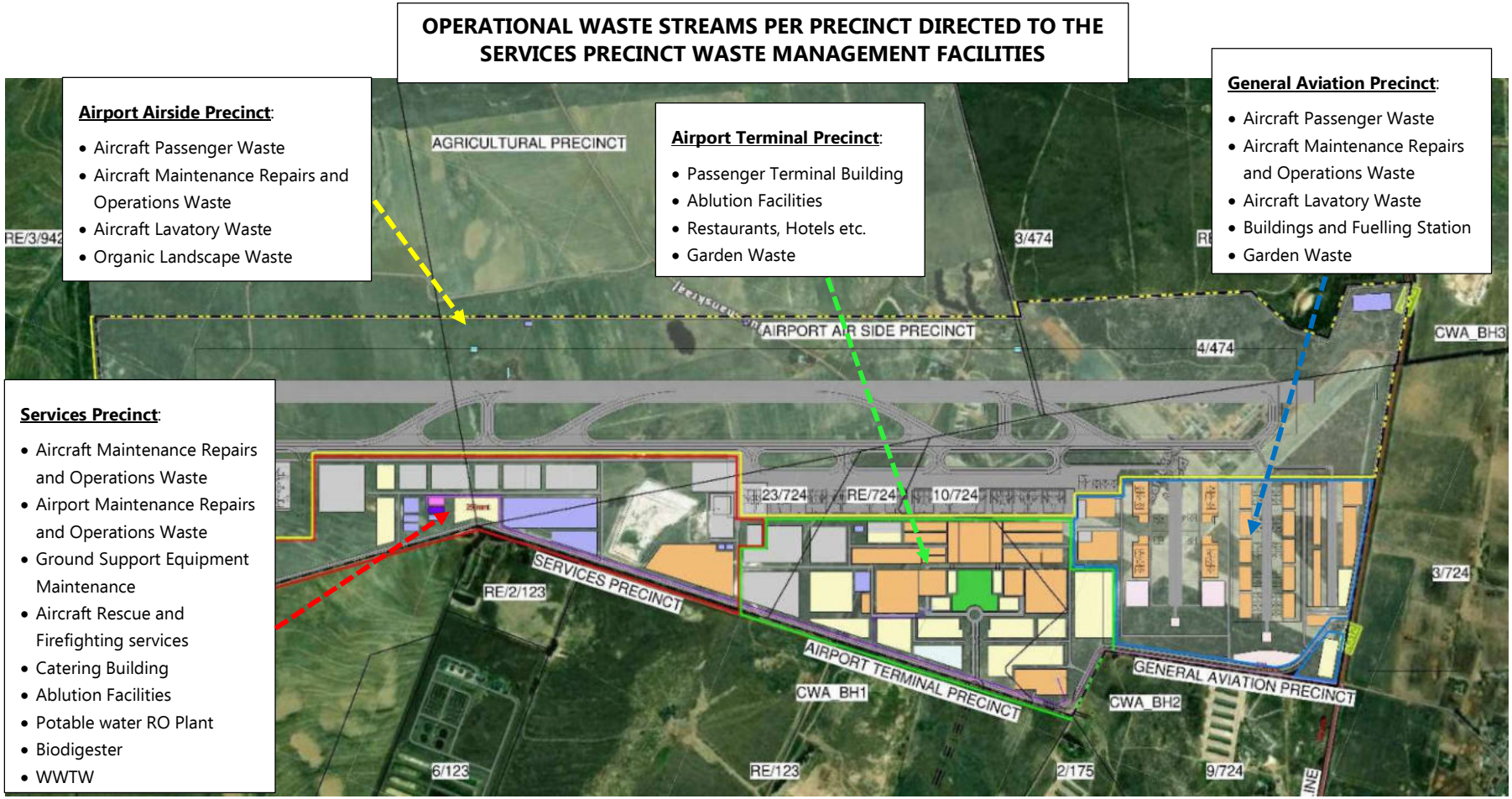
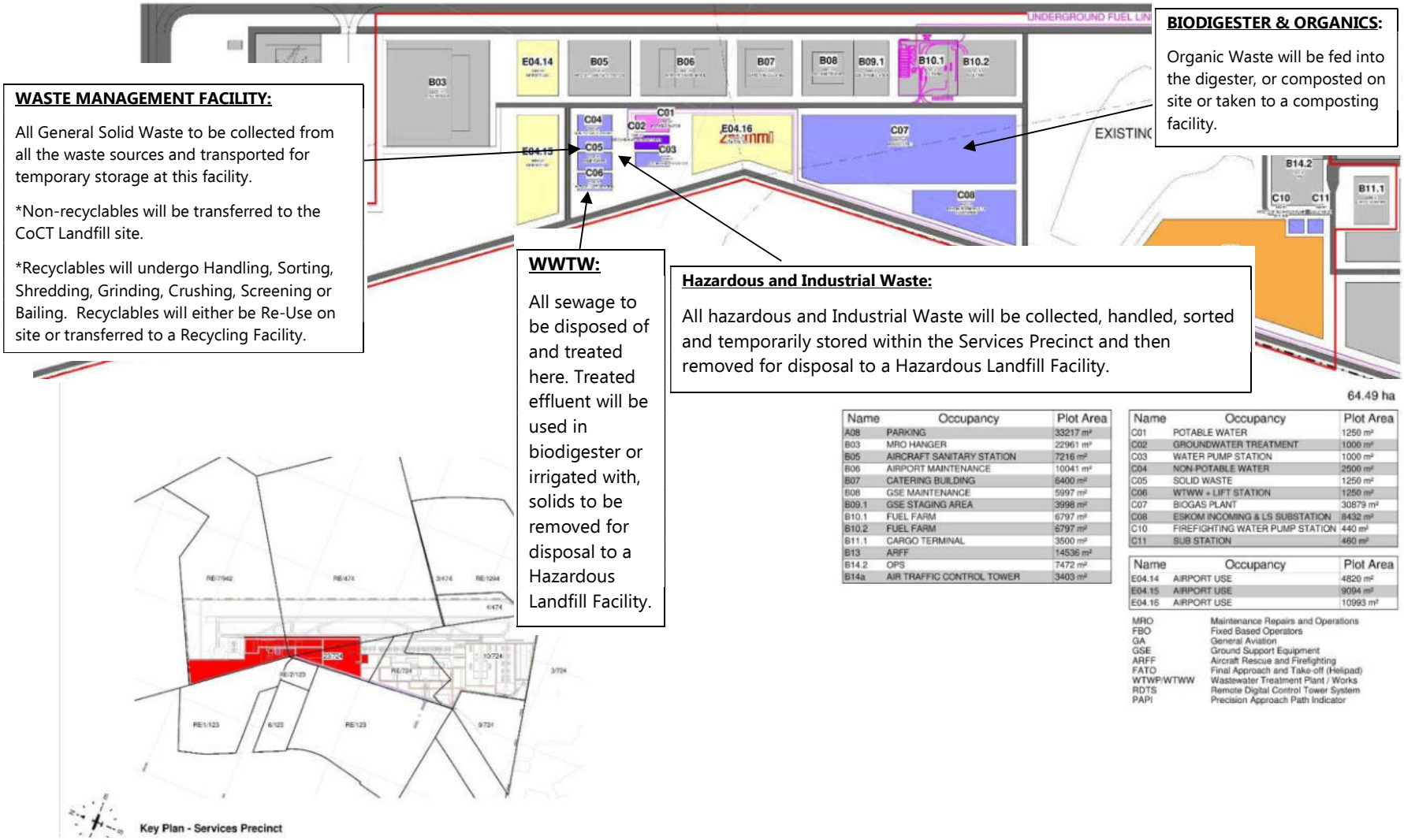


Figure 5: The Phase 2 SDP for the Cape Winelands Airport expansion. All waste streams on the airport will be separated at source from where it will go to the services precinct (red outlined area) for the management of waste on site and where it will be collected for further off-site management.



Name	Occupancy	Plot Area
A08	PARKING	33217 m²
B03	MRO HANGER	22961 m²
B05	AIRCRAFT SANITARY STATION	7216 m²
B06	AIRPORT MAINTENANCE	10041 m²
B07	CATERING BUILDING	6400 m²
B08	GSE MAINTENANCE	5997 m²
B09.1	GSE STAGING AREA	3998 m²
B10.1	FUEL FARM	6797 m²
B10.2	FUEL FARM	6797 m²
B11.1	CARGO TERMINAL	3500 m²
B13	ARFF	14536 m²
B14.2	OPS	7472 m²
B14a	AIR TRAFFIC CONTROL TOWER	3403 m²

Name	Occupancy	Plot Area
C01	POTABLE WATER	1250 m²
C02	GROUNDWATER TREATMENT	1000 m²
C03	WATER PUMP STATION	1000 m²
C04	NON-POTABLE WATER	2500 m²
C05	SOLID WASTE	1250 m²
C06	WTWW + LIFT STATION	1250 m²
C07	BIOGAS PLANT	30879 m²
C08	ESKOM INCOMING & LS SUBSTATION	8432 m²
C10	FIREFIGHTING WATER PUMP STATION	440 m²
C11	SUB STATION	460 m²

Name	Occupancy	Plot Area
E04.14	AIRPORT USE	4820 m²
E04.15	AIRPORT USE	9094 m²
E04.16	AIRPORT USE	10993 m²

Figure 6: The 'Services Precinct' within the Cape Winelands Airport development where waste will be managed and collected.

SECTION 3: RESPONSIBILITIES AND ENFORCEMENT OF THE WMP

3.1. The Applicant: Capewinelands Aero (Pty) Ltd

The Applicant who is the landowner, developer and operator of the airport will be responsible for the overall implementation of the WMP.

The Applicant is accountable for the potential impacts of the activities that are undertaken and is responsible for managing these impacts. The Applicant has the overall environmental responsibility to ensure that the implementation of the operational requirements complies with the relevant legislation. The Applicant must ensure that he/she is fully familiar with the requirements of this WMP, any relevant Environmental Authorization or any other legally binding documentation.

3.2 The CWA Environmental Management Division (EMD) & Environmental Manager (EM)

The **CWA Environmental Management Division (EMD)** will be established at the start of construction to ensure environmental compliance throughout the project. The CWA EMD will appoint an **Environmental Manager (EM)** to oversee all aspects of Environmental Management on site. The Environment Manager is responsible for ensuring that the organisation meets its environmental policy commitments and improves its environmental performance. Not only do they monitor performance and ensure compliance with relevant laws and regulatory requirements, but they are also proactive in identifying and promoting opportunities to reduce the environmental impact of the organisation's activities, products and services.

Led by an Environmental Manager, the CWA EMD will consist of several teams e.g. landscaping, waste management, alien species control, fire management etc. During the initial phases it could be one multitask team to be split as the tasks increase. Each team will have a Team Leader reporting directly to the in-house ECO during operations, and EM during construction. In the case of waste management this would be the Waste Control Officer (WCO). The Environmental Manager will oversee the implementation of Environmental Management Plans (EMPr), compliance with regulations, day-to-day environmental management of the site, managing the necessary applications, and overseeing external service providers such as the appointed Environmental Control Officer (ECO) during

construction. Responsibilities also include internal audits and developing strategies for waste minimization and emissions reduction.

3.3. The Environmental Control Officer (ECO)

The Environmental Control Officer (ECO) is responsible for overseeing and verifying the proper execution of the EMPr during the construction and operational phase. This includes ensuring that various contractors working on-site comply with the waste management plan within their designated areas. During the construction phase, an independent Environmental Assessment Practitioner (EAP) firm must be appointed to serve as the ECO who will work alongside the EM. Once the project transitions fully into the operational phase, this function can be managed by an in-house ECO within the CWA Environmental Management Division who will report to the EM. During the construction phase, monthly ECO reports must be prepared and submitted to the Department of Environmental Affairs and Development Planning (DEADP) during construction and to the EM during operations.

3.4. Waste Control Officer

A designated Waste Control Officer (WCO) must be appointed within the EMD to lead the waste team to manage the day-to-day operation of the Waste Management Facility and oversee the implementation of the WMP. The waste control officer will assume overall responsibility for managing the WMF, employees and contractors and ensure and oversee the implementation of the WMP onsite in its entirety. All decisions regarding environmental procedures and protocol must be approved by the WCO, who also has the authority to stop any activity in contravention of the WMP. The role of is interactive and must include daily site visits with the following:

- Conduct environmental awareness training on the operation of the facility and implementation of the WMP;
- Monitor the site and operation of the facility for potential environmental issues on a daily basis,
- Consult with the Applicant, and all staff/contractors to resolve emerging environmental issues;
- Review method statements and determine the most environmentally sensitive options of *modus operandi* for the development tasks,
- Oversee the implementation of environmental procedures set out in this document,
- Report on environmental issues,
- Receive minutes of all site meetings,
- Maintain open and direct communication with the Applicant, contractors, and authorities,

- Monitor contractors, the WMP and the implementation thereof; followed by reporting to the relevant authorities,
- Take immediate action on site where clearly defined no-go areas/actions are violated, or in danger of being violated, and to inform the Applicant immediately,
- Keep an up-to-date record of works on site, as they relate to environmental issues in the Site Control Register including records of non-compliance incidents,
- Be contactable by the public regarding matters of environmental concern as they relate to the development,
- Issue any instructions to the management team via an appropriate management tool,
- Keep photographic records of site visits and records of communication to and from relevant authorities,
- Keep a Site Control Register consisting of the following sections:
    - The **Site Control Sheet** will be used to set out weekly reports in which the findings from daily site monitoring activities are consolidated.
    - The **Environmental Site Instruction Section** will be used to record all general site instructions relating to the protection of the environment and instructions issued by the site manager for the purpose of facilitating the issuing of the site instruction by the landowner.
    - The **Incidents Reporting Section** will be used to record all incidents pertaining to environmental issues onsite as well as remedial actions steps that were or need to be taken.
    - The **Complaints Register** will be used to record all complaints received and responses thereto.

Please note the above list is not exhaustive, the responsibilities of the site manager are adaptive and extent beyond environmental aspects. Many of these tasks would also be performed by the ECO on a larger scale.

3.5. Engineers and Contractors

The engineers and contractors, where applicable, are responsible for physically carrying certain development and maintenance activities. The responsibilities indicated here are also relevant to sub-contractors.

The responsibilities of the engineers and contractors include but are not limited to the following:

- Be conversant with the WMP, EMPr, any relevant Environmental Authorisation or any other legally binding documentation;
- Have a responsibility to adhere to any conditions and recommendations laid out in above mentioned documentation;
- Prevent actions that may cause harm to the environment;

- Be responsible for any remedial activities in response to an environmental incident;
- Review and amend any construction activities to align with the WMP, EMPr and Best Practice Principles;
- Ensure compliance of all site personnel and / or visitors to the WMP, EMPr and any other authorisations.

SECTION 4: WASTE HIERARCHY & REDUCING WASTE TO LANDFILL

Waste materials fall into four categories for management (after pre-treatment), which include: Re-use; Recycle; Residual wastes; and Landfill. From a very early stage the EM, ECO and WCO needs to look at how to manage the waste generated, thereby reducing the amount of waste to be removed from the project site.

The waste hierarchy is a simple ranking system used for the different waste management options according to which is the best for the environment. The most preferred option is to prevent waste, and the least preferred choice is disposal in landfill sites (Figure 7). The waste hierarchy outlines a preferred order for waste management: prevention, reuse, recycling, and energy recovery, with disposal as a last resort. This strategic approach promotes environmentally friendly practices, ensuring efficient resource use and reducing environmental impact.

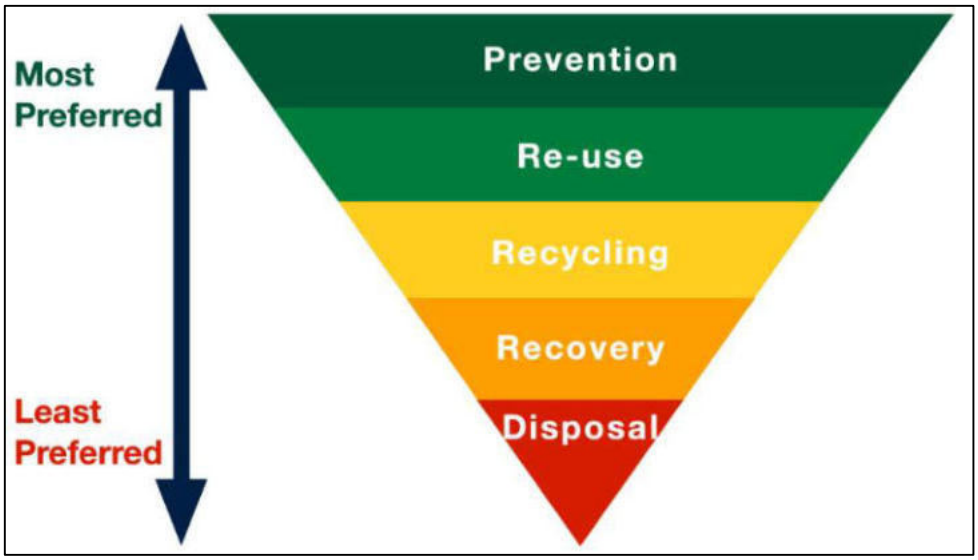


Figure 7: The Waste Hierarchy.

4.1 Prevention

The idea of avoiding things becoming waste in the first place is essential and the preferred option in the waste hierarchy. When we take action to prevent waste from arising in the first place, there is simply less waste. Less waste means less need to reuse products, less disposal, less expenses and most importantly, less waste at landfill sites.

We can prevent waste by using fewer and avoiding unnecessary materials during design, manufacturing and packaging products. It also means using less hazardous waste materials where you can.

This can be achieved through various strategies, such as:

- Promoting refillable water bottles and promoting reusable shopping bags. Airports can partner with concessionaires to offer discounts or incentives for passengers who bring their own reusable water bottles and shopping bags. Additionally, installing convenient water refill stations throughout the terminal can discourage the purchase of bottled water.
- Encouraging concessionaires to use sustainable packaging. Airports can incentivize businesses to use biodegradable or compostable packaging materials for food and beverages. Collaborating with concessionaires to explore alternative packaging options, such as paper or plant-based materials, can significantly reduce reliance on traditional plastic packaging.
- Implementing digital solutions. Replacing paper boarding passes and printed schedules with digital alternatives can significantly reduce paper waste. Airports can invest in mobile applications that allow passengers to access boarding passes, flight information, and terminal maps electronically. This not only reduces paper consumption but also enhances the passenger experience with a more streamlined and convenient travel process.
- Partnering with airlines to reduce single-use items. Collaboration between airports and airlines can lead to initiatives like eliminating unnecessary in-flight plastic service ware or offering pre-packaged meals with minimal plastic wrapping. Airports can leverage their partnerships with airlines to implement sustainable practices throughout the entire travel journey, reducing waste generation at both the airport and onboard flights.

4.2 Re-use

If surplus materials can be used in the future site works, they are classified as re-use materials. If they are surplus to requirements and need to be removed from site and they can be removed and used in their present form, they can be removed from site for re-use. The surplus products will be labelled, and a storage area recorded for future reference.

When waste is created, the waste hierarchy prioritizes reuse. Where possible, reusing products and materials before it becomes waste is the next best option. By cleaning, repairing and refurbishing items, we can significantly increase the number of things we reuse. As more single-use products are being phased out for reusable alternatives, re-using things is more accessible than ever.

4.3 Recycling

If surplus materials cannot be reused in their present form but could be used in a different form, they will be sent to recycling or labelled as future recycling. Recycling plays a vital role in diverting waste from landfills and conserving resources. Recycling is the most environmentally friendly solution when it comes to disposing of waste.

Today, most items we use can now be recycled. Everyday products that we can recycle include paper, cardboard, glass, wood, metal and most plastics. Ways of encouraging recycling during the operational phase include:

1. Setting up clearly labelled bins:

   Bins for different recyclable materials like paper, plastic, and metal should be easily identifiable and conveniently located throughout the terminal buildings, concourses, and even in public areas outside the terminal. Using standardised colour-coding systems and clear signage with pictograms can ensure intuitive waste segregation by passengers and staff, regardless of language barriers.

2. Educating passengers and staff:

   Clear signage, informational kiosks, and awareness campaigns can encourage proper sorting of recyclable items, reducing contamination and improving recycling efficiency. Engaging educational programs can target both passengers and airport personnel to ensure everyone understands the importance of waste segregation and contributes effectively. Making use of digital displays and interactive kiosks can provide informative and engaging content to educate travellers about the airport's recycling practices and encourage their participation.

3. Partnering with recycling facilities:

   Establishing strong relationships with local recycling facilities ensures proper processing and responsible management of collected recyclables. Partnering with local facilities not only supports the regional recycling infrastructure but also reduces transportation distances associated with waste hauling, reducing the environmental impact of the recycling process itself.

4.4 Recovery

Recovery is the next best option when we can't apply the first 2 Rs of waste management in the waste hierarchy. For waste that we can't recycle, it may be possible to recover energy in the form of "waste to energy". Waste to energy is the process of incinerating non-recyclable waste to produce electricity. This helps reduce our reliance on fossil fuels and decreases carbon emissions.

Composting is also a method we use when we can't recycle materials. Composting turns organic wastes into nutrient-rich food for plants.

4.5 Landfill

Residual waste can come in several forms including:

- Waste that cannot be disposed of due to its category, class or material (e.g. old tyres, metals and contaminated waste). Ways of reusing or disposing of the waste from the site needs to found; and
- Unused machinery, spare parts or discarded parts. All items of this nature will be identified and dated. These items will be assessed quarterly to gauge their importance for potential future use. Once an item is deemed to have little or no future potential to be utilised, it will be either assessed for reuse in another form or disposed of from the site.

Residual waste can be an eyesore, fire hazard and has potential to impact on the environment through leachates. All residual wastes will be identified, and new residual wastes will be added to the residual waste catalogue for auditing. Residual wastes that are deemed essential or have the potential for future use will be stored in a neat and tidy manner and where possible under cover to avoid or reduce the potential for further corrosion or damage to the product.

Furthermore, if the above options cannot be satisfied, then the only alternative left is to send the surplus materials to landfill. The least sustainable option in the waste hierarchy and our last resort is landfill and incineration when energy recovery isn't possible.

SECTION 5: WASTE TYPES, SOURCES AND STREAMS

5.1. Construction Phase

Construction Waste (Figure 8) can be divided into four categories (General Solid Waste, Organic Waste, Hazardous & Industrial Waste, and Sewage) which entails waste generated during the construction phase of the proposed development, namely: Site clearance & excavation activities; construction of airside infrastructure first followed by landside infrastructure and buildings; demolition of existing infrastructure and buildings; and maintenance work required. The types of waste, materials and sources of waste have been summarized as follows:

A. General Solid Waste

Waste Materials: Soil / Sand, Concrete, Rock, Metals, Asphalt, Plastic, Wood, Bricks & masonry materials, Glass, Nails, Cement Bags etc.

Waste Sources: Demolition, land clearing & excavation; construction of new buildings & material; and maintenance work.

General Solid Waste will undergo: Collection, Identification, Handling, Sorting, Storage, Crushing as pre-treatment of the waste type prior to Transfer, Disposal, Re-Use or Recycling. Recyclables will be re-used/ recycled on site or taken to a Recycling Facility. Non-recyclables will be transferred to a Landfill.

B. Organic Waste

Waste Materials: Topsoil, Alien clearing and indigenous or general vegetation removal etc.

Waste Source: Land clearing & excavation.

Organic Waste will undergo: Collection, Identification, Handling, Sorting and Storage as pre-treatment of the waste type prior to Transfer to the Biodigester or Composting Facility.

C. Hazardous & Industrial Waste

Waste Materials: Asbestos; old fuel storage infrastructure/ equipment, hydrocarbon waste etc.

Waste Sources: Demolition, land clearing & excavation; maintenance work; accidental hydrocarbon spills and hydrocarbon waste from vehicle, equipment and machinery parts and servicing (oil cans, filters, rags etc).

Industrial Waste will be collected and temporarily be sorted on site for storage if parts could be reuse or recycled (collected for recycling). All hazardous waste will be transferred and disposed of at the Hazardous Landfill Facility.

D. Sewage (Hazardous)

Waste Materials: Sewage; Lavatory Waste etc.

Waste Sources: Existing infrastructure and portable toilets.

Sewerage Waste will undergo: Storage, Collection and Transfer initially to the Municipal WWTW until the Package Plant WWTW on site is completed.

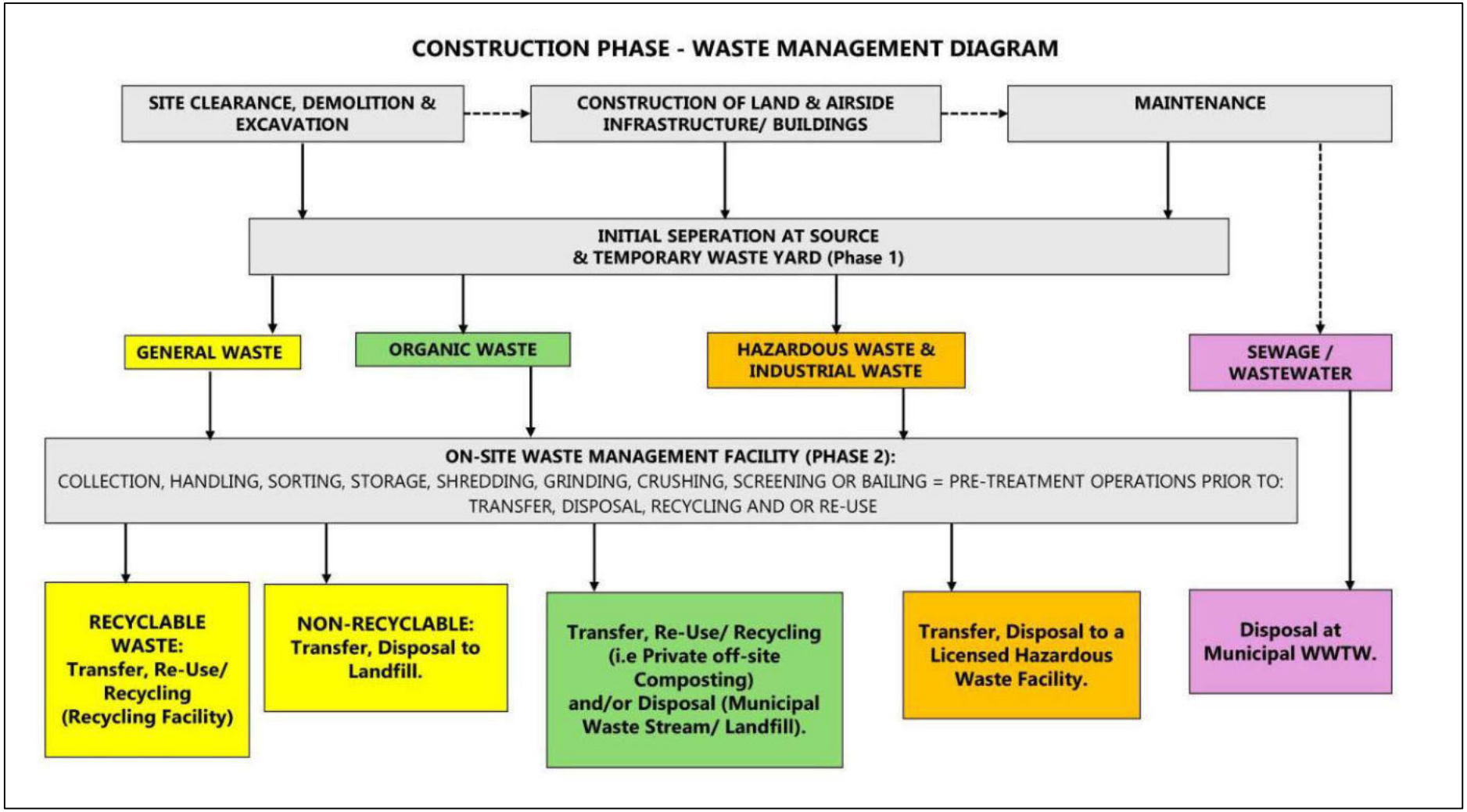


Figure 8: The lifecycle of the construction waste from the Cape Winelands Airport.

5.2. Operational Phase

The site and its associated activities will generate waste at various stages of operation. Waste generated during the operational phase can be divided into several main categories (General Solid Waste, Organic Waste, Hazardous & Industrial Waste and Sewage). The expected volume of each waste type is not available at this time and specific service providers will be contracted in to assist, remove and dispose of waste types present onsite, where necessary. The types of waste generated during the Operational Phase can be summarised into the following waste types which include waste material and source:

A. General Solid Waste (Figure 9)

Domestic waste from the airside precinct in the form of airplane users and the landside precinct in the form of restaurants, hotels and offices on site will be separated at source into general (non-hazardous), recyclable (non-hazardous), organic waste and hazardous. These waste steams will be moved to the waste management facility in the services precinct. The general waste will be collected by the service provider and disposed of at a licensed landfill. The recyclable materials will be collected from site by recycling companies for further processing. The organic waste will be used in the on-site bio-digester or composting facility.

Airplane waste from the airside precinct can be split into 2 waste streams:

- "Normal" Waste - such as magazines, plastic bottles etc. This is discarded to the designated waste storage area onsite from where it is disposed into the various waste streams e.g. recycling etc.
- Galley waste – This is and remains the airline/catering contractor's property and thus responsibility. The airport does not take responsibility for it. Although certain Airports classify this waste as Hazardous.

Waste Materials: Plastic, Paper, Cardboard, Metal, Glass etc. (Some recyclable & some non – recyclable)

Waste Sources: Terminal Waste, Tenant Waste, Airline Waste (Deplaned waste is mostly mixed), Cargo Waste, General Aviation Sector, Restaurants, Hotel, Offices, Warehousing etc.

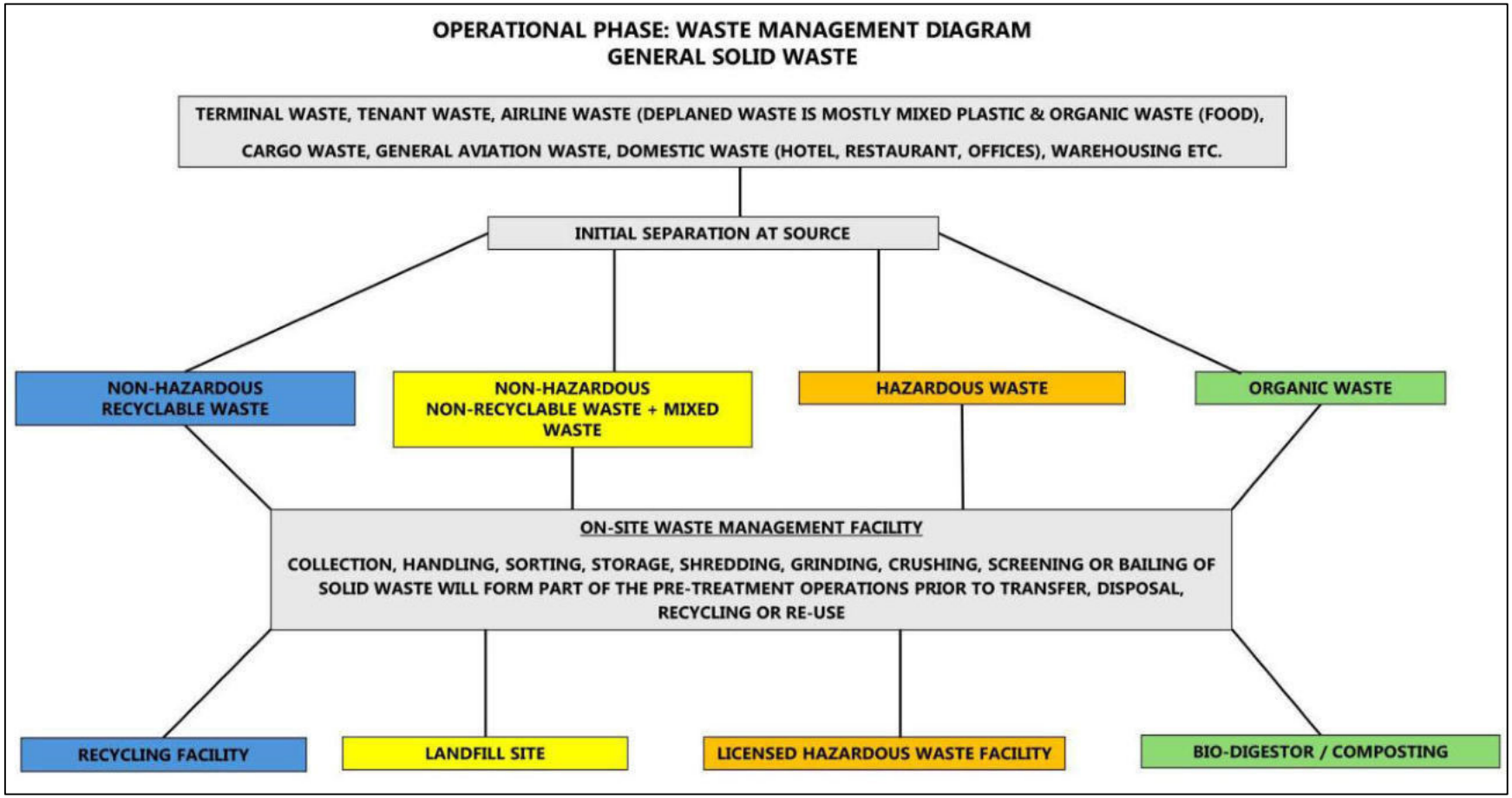


Figure 9: The lifecycle of operational general solid waste from the Cape Winelands Airport.

B. Organic Waste (Figure 10)

Garden waste from landscaping (non-hazardous) will be sent to composting site or the biodigester. Domestic waste from the restaurants, hotel and offices on site will be separated at source into general/non-recyclables (non-hazardous), recyclable (non-hazardous) and organic. The organic waste will be sent to the biodigester, on site composting facility and/or an off-site licensed composting facility.

Waste Materials: Food waste, Garden waste from landscaping etc.

Waste Sources: Terminal Waste, Tenant Waste, Arline Waste (Deplaned waste is mostly mixed), General Aviation Sector, Hotel, Residential etc.

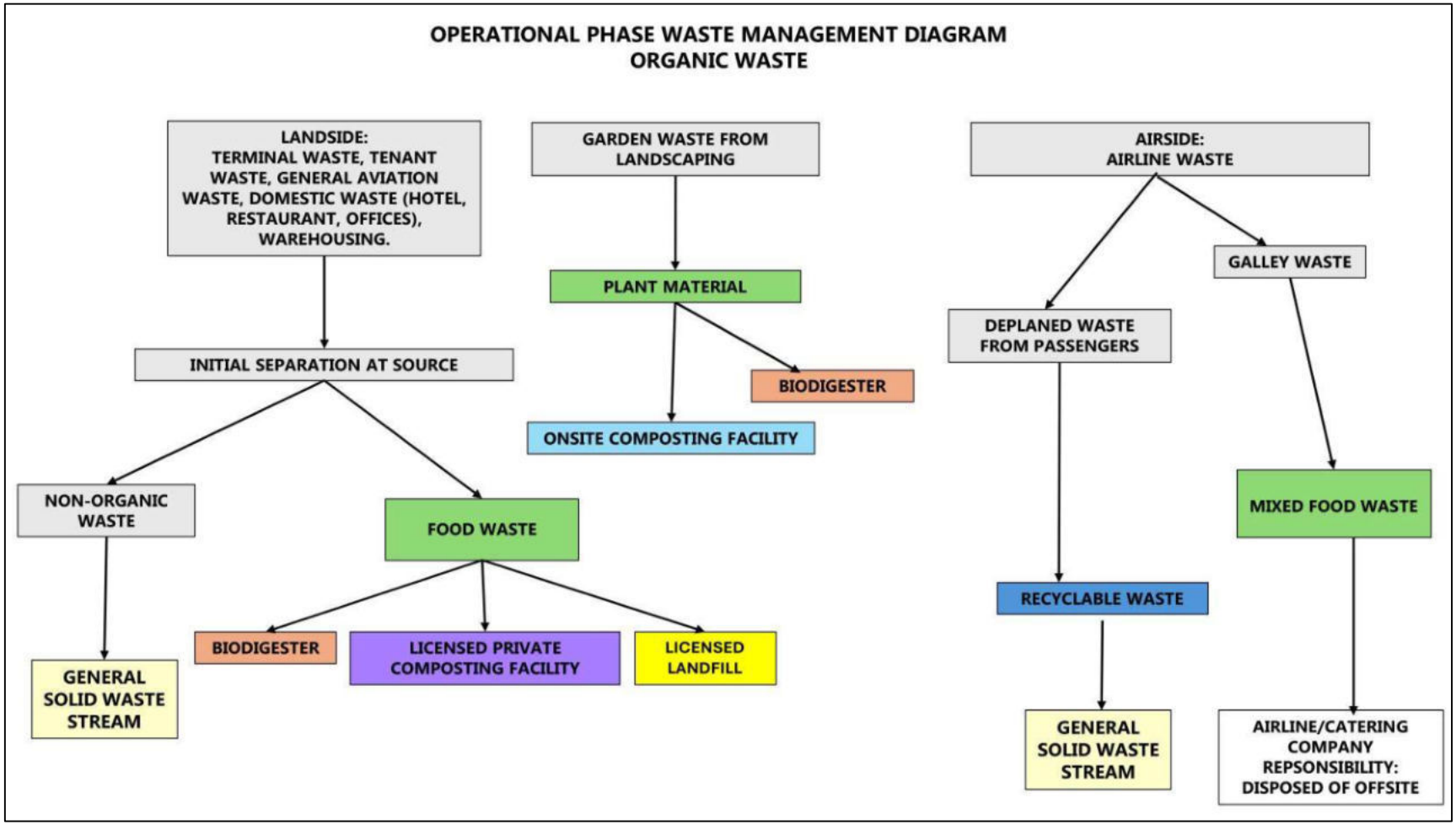


Figure 10: The lifecycle of operational organic waste from the Cape Winelands Airport.

C. Hazardous and Industrial Waste (Figure 11)

Used oils and fuels (hazardous) will be collected for re-use by recycling companies. Oil containing rags and materials (hazardous) will be disposed of to a Hazardous Landfill Facility. Any waste metals (non-hazardous) will be sent to recycling.

Waste Materials: Used oils and fuels; Oil containing rags and materials; Paint, metal work debris, chemicals/ chemical residue; Solar panels, batteries; non-recyclable glass; tyres etc.

Waste Sources: Refueling activities; Materials originating from aviation and vehicle maintenance, waste generated during various airport & industrial operations etc.

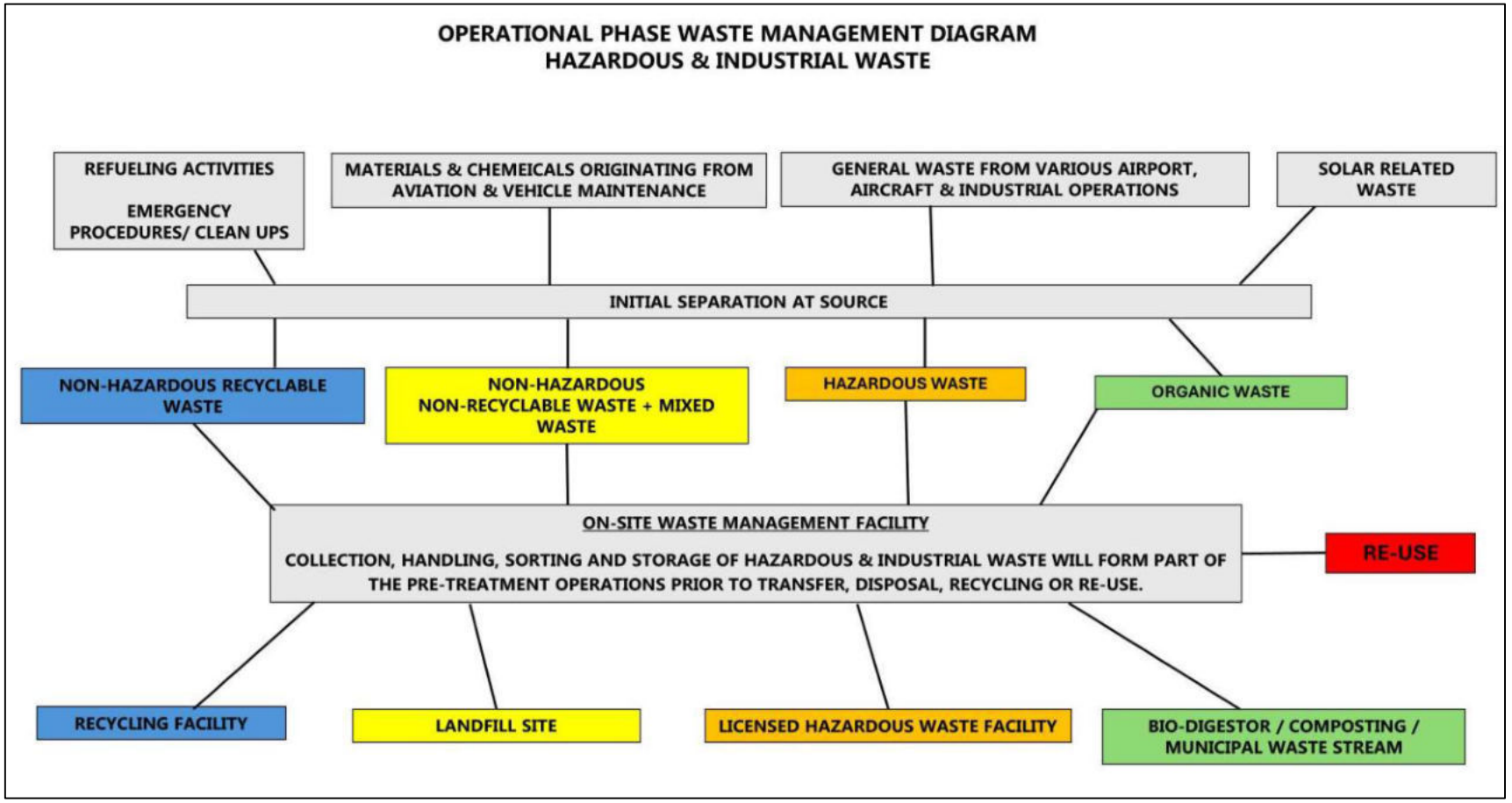


Figure 11: The lifecycle of operational hazardous and industrial waste from the Cape Winelands Airport.

D. Sewage (Hazardous) (Figure 12)

Sewage is the part of wastewater that is contaminated with feces or urine but is often used to mean any wastewater. The site will have its own wastewater treatment works (WWTW) as an alternative to the conventional City of Cape Town WWTW directly NW of the site (However, the site will have a connection to the CoCT WWTW, which would be used in emergencies or during maintenance of the on-site WWTW). The plant will generate treated sludge/ biosolids and treated effluent water. The treated effluent water will be used as a supplementary input liquid in the biodigester on site to generate electricity. The treated sludge will be disposed to landfill. The raw sewage goes through a pre-screening process where certain solids are removed. As this takes place prior to treatment, any material that is removed remains classified as hazardous. This material will need to be temporarily stored and removed by honey suckers from time to time before being disposed at a licensed hazardous waste facility. There will also be a solid component after the treatment has been undertaken. Seeing as this has been through the treatment process it is no longer regarded as hazardous and could potentially be used to feed into the biodigester. However, it will be tested and only used if proven to be non-hazardous.

Waste Materials: Sewage; lavatory waste, wastewater etc.

Waste Sources: All onsite buildings and Aircrafts etc.

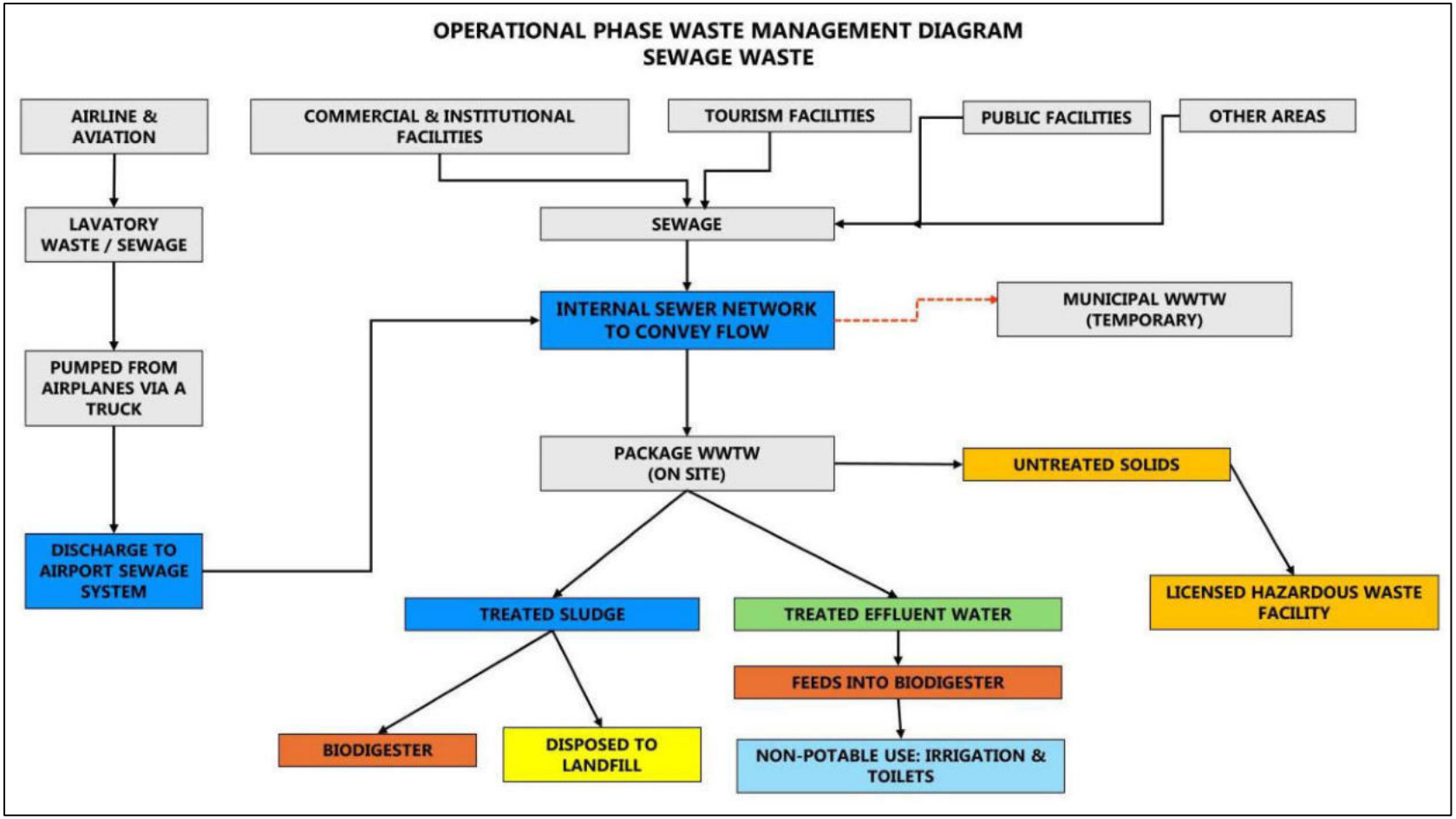


Figure 12: The lifecycle of operational sewage waste from the Cape Winelands Airport.

E. Other Waste:

- Waste input and output related to the biodigester

  The biodigester will output digestate as liquid and solid fraction. The liquid fraction can be used for irrigation on site and the solid fraction for fertilizer application to land, dependent on development of a suitable offset market. Considering the liquid and solid fraction can be reused this does not constitute waste.

- Brine from potable water treatment plant

  Brine will either go straight into the pipeline heading to the Municipal WWTW or, if the onsite Package Plant WWTW is in operation, disposing of brine into the WWTW would need to be investigated further. If neither of these options will be utilized, brine will be disposed of at a Landfill Facility.

- Spills and emergency procedures

  This relates to contaminated peat and materials used during emergency procedures to clean up for example hydrocarbon spills etc. In addition, waste as a result of training procedures e.g. firefighting residue is also as a result of emergency procedures. This will further be addressed as part of the **Emergency Response Plan (to be developed after Environmental Authorisation)**.

SECTION 6: IMPACTS AND MITIGATION MANAGEMENT

The applicant is committed to the implementation of the waste hierarchy to achieve a reduction to landfill and to contribute to a productive the waste economy. Table 1 below summarizes the Waste Types, Sources, Stream handling and Impacts if the waste hierarchy is applied of the Construction and Operational Phases at CWA.

Table 1: Waste Types, Sources, Stream handling & Impact at the CWA.

Waste Type	Materials	Source	Recommended Stream Handling	Impact
Construction Phase				
General Waste	Soil / Sand, Concrete, Rock, Metals, Asphalt, Plastic, Wood, Bricks & masonry materials, Glass, Nails, Cement Bags etc.	Land clearing, Demolition & excavation; construction of runway new buildings & material; maintenance work.	**Re-use:** Keep topsoil; Cut and Fill with on-site material; Crushing and re-use for compaction **Recycle:** Sorting Metals and wood **Disposal Landfill:** Transfer disposal of unwanted	**Off-site:** Reduce landfill to 20%; large reduction of impact on landfill space, transport reduce traffic on roads and emissions **On-Site:** Initial mobile managed waste yard, later fixed managed WMF as per recommendations and N&S – Low impact
Organic Waste	Alien clearing and indigenous vegetation removal etc.	Land clearing & excavation.	**Re-use:** Shredding (chipper) biomass, mulch use to stabilise exposed sandy areas **Composting on-site:** Organics **Composting off-site:** Transfer excess	**Off-site:** Reduce landfill to 0% total reduction of impact on landfill space, transport reduce traffic on roads and emissions **On-Site:** Managed stabilisation reduces dust impact and composting for future landscaping as per recommendations and N&S – Very Low impact

Hazardous & Industrial Waste	Asbestos; old fuel storage infrastructure/ equipment, hydrocarbon waste etc.	Demolition, land clearing & excavation; maintenance work; accidental hydrocarbon spills and hydrocarbon waste from vehicle, equipment and machinery parts and servicing (oil cans, filters, rags etc).	**Specialized:** Safe handling, storage **Recycle:** Limited **Disposal Landfill:** Licensed Hazardous Waste Facility.	**Off-Site:** No reduction in landfill unavoidable **On – site:** Low if specialized handling applies
Sewage	Sewage; Lavatory Waste etc.	Existing infrastructure and portable toilets.	Initial phases **Disposal**: CoCT WWTW Later Phases **Re-use:** On-site treatment, use treated effluent **Disposal:** Hazardous bio-solids	**Off-site:** initial phase to CoCt WWTW, capacity exists **On-site:** Manage WWTW, reduce pressure on off-site infrastructure, positive use of waste water as part of energy generation; Low impact if handled as per recommendations and N&S
Waste Type	**Materials**	**Source**	**Recommended Stream Handling Stream**	**Impact**
Operational Phase				
General Solid Waste	Plastic, Paper, Cardboard, Metal, Glass etc. (Some	Terminal Waste, Tenant Waste, Airline Waste (Deplaned	**Prevent:** Industry changes	**Off-site:** Reduce landfill to 50% large reduction of impact on landfill space,

	recyclable & some non – recyclable)	waste is mostly mixed), Cargo Waste, General Aviation Sector, Restaurants, Hotel, Offices, Warehousing etc.	**Recycle:** Handling, Sorting, Storage, Shredding, Grinding, Crushing, Screening or Bailing prior to collection **Non-Recycling:** Handling, Storage Transfer or Landfill Disposal	transport reduce traffic on roads and emissions. **On-site:** Fixed managed WMF as per recommendations and N&S – Low impact
Organic Waste	Garden waste from landscaping etc. Food waste	Terminal Waste, Tenant Waste, Arline Waste (Deplaned waste is mostly mixed), General Aviation Sector, Hotel, Residential etc.	**Re-use:** Shredding (chipper) biomass, mulch use to stabilize reduce moisture evaporation **Composting on-site:** Organics **Composting off-site:** Transfer excess **Treatment:** Biodigester	**Off-site:** Reduce landfill to 0% total reduction of impact on landfill space, transport reduce traffic on roads and emissions **On-Site:** Managed stabilization; composting for future landscaping; treatment to Biogas energy as per recommendations and N&S – Very Low impact
Hazardous and Industrial Waste	Used oils and fuels; Oil containing rags and materials; Paint, metal work debris, chemicals/ chemical residue; Solar	Refueling activities; Materials originating from aviation and vehicle maintenance; spills from training and	**Specialized:** Safe handling, storage **Recycle:** Limited	**Off-Site:** No reduction in landfill unavoidable **On – site:** Low if specialized handling applies

	panels, batteries; hydrocarbon waste etc.	emergency situations/ procedures etc.	**Disposal Landfill:** Licensed Hazardous Waste Facility.	
Sewage	Sewage; Lavatory Waste etc.	All onsite buildings; Aircrafts etc.	**Treatment:** on-site WWTW **Re-use:** use treated effluent in Biogas or irrigation or flushing of toilets **Disposal:** Hazardous bio-solids	**Off-site:** CoCT WWTW, reduction by 90% **On-site:** Managed WWTW, reduce pressure on off-site infrastructure, positive use of waste water as part of energy generation; Low impact if handled as per recommendations and N&S
Brine from Reverse Osmosis (RO) Plant	Brine	RO Plant for Potable Water.	**Disposal:** WWTW/ Landfill	**Off-site:** Low quantities **On-site:** Low quantities

The following additional impacts is possible if large quantities of waste are self-managed on-site. The N&S provide clear guidance the designs and actions to apply but additional mitigation measures have been identified to reduce the impacts on and off site:

Table 2: Impacts associated with an on-site WMF

	Impact	Activity	Proposed mitigation
1	Natural resource contamination	Natural areas located on the east of the airside precinct are separated from waste activities however, stormwater originating from the site	• Minimize the use of wash water onsite as far as possible by applying high pressure hoses. • The facility must be managed such that all runoff originating from the site is diverted into a stormwater control channel that contain detention and trapping facilities before it leaves the WMF. • All stormwater control channels in close proximity to WMF must be suitably lined to prevent seepage into groundwater.

		could contain waste and can result in pollution or waste can be dispersed by wind into the natural areas	• The overflow of stormwater channels needs to be trapped and allowed to settle in a detention pond. • The nutrient rich stormwater originating from the composting and biodigester site must be trapped and used as a moisture additive within the composting facility to enhance the composting process. • No nutrient enriched water may be released offsite. • All stormwater infrastructure must be regularly inspected and serviced to ensure design capacity and integrity is maintained. • To ensure suitable stormwater control capacity is maintained onsite, stormwater channels must be kept free from silt. The stormwater control channels must be cleared of any sedimentation (if required) during the dry season. • All water that has entered the composting and biogas areas must be treated as leachate. • To prevent nutrient rich leachate from percolating into the ground, the land areas where composting are established should be compacted to ensure that the soil drainage is poor or virtually impervious. • All wind dispersed waste must be collected on a daily basis and taken to the WMF • The WMF must have closed containers to avoid wind dispersing waste
2	Generation of atmospheric emissions and odors	Waste trucks entering and exiting the WMF transport potentially foul-smelling material. In addition, active composting, organic piles emit volatile compounds.	• All trucks or vehicles transporting waste material will be required to secure and cover all loads with shade cloth to avoid debris or plastic etc. that can blow or fall on public roads or areas. • Composting operations should process organic material on the same day to avoid stagnant heaps. • Optimizing certain variables can minimize composting emissions. The carbon-nitrogen ratio, temperature, moisture content (at least 25%), aeration, and pH must be monitored by the facility manager on a weekly basis to ensure optimal organic matter breakdown without production of excessive atmospheric emissions or odors. • All storage and operating areas need to be contained in bunkers, lined and covered where required.

			• The WMF in the services precinct is located directly opposite the City of Cape Town Fisantekraal WWTW therefore part of a node already exposed to odors where residential development is not likely.
3	Soil Erosion	The increased bare, hardened and compacted surfaces associated with the facility results in reduced surface roughness, increased run-off and increased erosion potential. Areas where stormwater runoff is concentrated are most likely to experience erosion.	• Wherever possible, ensure that the WMF surface is covered by tar, concrete or paving and areas around the stormwater system vegetated as per landscape and SWMP. • Establish and maintain suitable vegetation cover at all stormwater concentration points. These areas include road verges, the banks of stormwater channels, berms and other infrastructure that may increase surface runoff. • Should any erosion be detected, the ECO must identify the cause of such erosion and ensure that the most appropriate method of mitigation or stabilization is employed as soon as possible.
4	Generation of dust and noise	The movement of transport trucks to and from the facility will result in the generation of dust and noise.	• The level of dust and noise generated by WMF activities will be insignificant in the broader landscape, especially after the roads a surfaced. Nevertheless, it is recommended that working hours are restricted to 06:00 to 18:00 daily. • All transport vehicles and machinery/equipment used onsite must be regularly maintained and kept in good working order to prevent excessive noise. • It is recommended that a dustcart is available onsite to water down dusty roads not tarred, particularly during the dry summer months. • A suitable speed limit (40 – 60 km/h) must be enforced on all access roads. • Ensure compliance with the provisions as set out in the National Environmental Management: Air Quality Act (NEM: AQA), National Dust Control Regulations (Notice 827 of 2013) and Western Cape Noise Control Regulations (P.N. 200/2013).

5	Visual impacts	Given the location of the facility visual impacts are expected to be negligible.	• Scrape and sweep all areas where material is processed weekly to ensure that minimal waste material is present outside the contained areas
6	Consumption of resources (water)	Inefficient use of valuable freshwater for cleaning of waste bins and areas.	• Maintain all water infrastructure in a good working condition. • Use high pressure power hoses for cleaning. • Ensure that all taps remain closed when not in use. • Educate all employees on the importance of natural resources and wise water use practices. • Should any leaks occur, these must be reported immediately and repaired as soon as possible. • When emptying transport bins, ensure all material is removed manually as far as practicably possible to minimize the need for wash water.
7	Attraction Birds and Vermin.	Waste activities have the potential to attract flies.	With suitable management, this impact can be kept to a minimum. The flowing management measures should however continue to be followed: • All organic waste delivered to the site must be covered or worked immediately. • Apply roofs over waste areas to avoid attraction. • Apply containment of waste to avoid attraction. • Apply bait stations for organic pest control. • Correct management of pH and temperature within the composting rows will control the spread of pests and diseases as larva/eggs/worms/bacteria can't live at optimal composting temperatures. • Ensure that WMF does not have pooling or standing water. • Best practice pest control measures will be implemented, and a Certified Pest Control Company will be appointed at the onset of the Construction and Operational Phases to ensure that preventative measures are put in place and monitored to ensure the effectiveness of the Pest Control Schedule.

8	Leakage of potentially hazardous substances	Operation of trucks and machinery can result in leaking or spilling of fuel or oil which is hazardous for the environment.	• All transport vehicles and machinery must be confined to access roads and approved development footprints. • All transport vehicles and machinery/equipment used onsite must be regularly maintained and kept in good working order to prevent potential leaks.
9	Employment opportunities	The operation of the facility generates the opportunity to create additional direct and indirect employment opportunities.	• This is a positive impact. No mitigation required.

SECTION 7: DEVELOPMENT PHASE REQUIREMENTS

7.1. Planning and Design Requirements

Based on the above, CWA will have to register and adhere to the following Norms & Standards (N&S) due to the waste activities described above. Each of these N&S list specific criteria that need to be planned and designed for. The position of the WMF is inside the services precinct of the CWA and this precinct is located away from public operations and residential areas. The site is opposite the CoCT WWTW, a zone suitable for waste management.

Find attached under Appendix B the following specification documents that will be adhered to and included in the WMP when the N&S Application is submitted to DEA&DP: WM:

a. National Norms and Standards for the Storage of Waste (GN926 of 29 November 2013)
b. National Norms and Standards for Sorting, Shredding, Grinding, Crushing, Screening, Chipping or Baling of General Waste (GN1093 of 11 October 2017).
c. National Norms and Standards for Organic Waste Composting (GN 561 in GG 44762 of 25 June 2021) read with GN 1757 in GG 45907 of 11 February 2022.
d. National Norms and Standards for Organic Waste Treatment (GN. No. 1984 of 1 April 2022
e. National Norms and Standards for Domestic Waste and Sanitation Services", published as GN No. 982 of 8 September 2017.

7.2. Construction Phase Requirements

The N&S listed below provide specific criteria how the WMF need to be constructed. Find attached under Appendix B the following specification documents that will be adhered to and included in the WMP when the N&S Application is submitted to DEA&DP: WM:

a. National Norms and Standards for the Storage of Waste (GN926 of 29 November 2013)
b. National Norms and Standards for Sorting, Shredding, Grinding, Crushing, Screening, Chipping or Baling of General Waste (GN1093 of 11 October 2017).
c. National Norms and Standards for Organic Waste Composting (GN 561 in GG 44762 of 25 June 2021) read with GN 1757 in GG 45907 of 11 February 2022.
d. National Norms and Standards for Organic Waste Treatment (GN. No. 1984 of 1 April 2022
e. National Norms and Standards for Domestic Waste and Sanitation Services", published as GN No. 982 of 8 September 2017.

7.3. Reduce transportation of waste

- City of Cape Town (and neighbouring municipalities) registered service providers will be contracted to remove and recycle waste from the site.
- The following Landfill sites will be used to deposit waste that cannot be recycled or re-used:
  - General Waste can be transported to the Vredenburg landfill site.
  - All hazardous waste will be transported to the Vissershok site. Vissershok site is off the N7 into Frankdale Road, adjacent to Morningstar.
- Specialist Waste removal companies such as *EnviroServe* and *Wasteman* can be used for dangerous or contaminated waste.

SECTION 8: OPERATIONAL & CONSTRUCTION PHASE REQUIREMENTS AND MANAGEMENT OBJECTIVES

Section 6 of this report identified several impacts related to the operation of the WMF. Many of the impacts can be mitigated by management procedures and regarded as goals to be implementation. Management activities were described to achieve the objectives together with monitoring and target criteria.

8.1 Components of Waste Management

- Goals: The key environmental goals are set for the operation of the property.
- Objectives: These are set to meet the goals.
- Risk & Impacts: If the goal is not achieved.
- Actions: Measures put in place to achieve objectives.
- Monitoring: To check if the objectives are achieved.
- Targets: Indicators of the effectiveness of the programme.
- Remedial Action: If targets are not met.

8.2. Waste Management

The CWA will have an on-site waste management facility for waste generated during the Construction & Operational Phase of the proposed development however during the initial demolition and construction phases a mobile waste yard will be created and managed by the contractor with the location depending on logistics. As soon as the services precinct is completed and accessible then a more permanent WMF will be developed. A plan for the management of waste during construction and operational phase is detailed below.

8.2.1 Construction Phase:

As previously stated, construction practices must be measured and analyzed in order to determine the efficiency of the plan and whether further revision of the plan is required. A Method Statement, in line with this WMP, detailing specific waste management practices during construction should be prepared by the Contractor prior to the commencement of construction.

8.2.1.1 Waste Assessment / Inventory

- The EM in consultation with the WCO must develop and presented to the independent ECO, implement and maintain a waste inventory reflecting all waste generated during construction for all waste streams.
- Construction method and materials should be carefully considered in view of waste reduction, re-use, and recycling opportunities.
- Once a waste inventory has been established, targets for minimization, re-use, recycling of waste should be set.

8.2.1.2 Waste collection, handling and storage

- Each subcontractor must implement their own waste recycling system (separation @ source), i.e. separate bins or skips for food waste, plastics, paper, wood, glass cardboard, metals, concrete, brick etc.
- Portable toilets must be monitored and maintained daily.
- Waste collection bins or skips and hazardous waste containers must be provided by the principal contractor and placed at various areas around site for the storage of all waste streams.
- Initially a dedicated mobile waste yard area must be established on site for the storage of all waste streams, with final disposal to landfill the last option. The location will be determined prior to the commencement of construction, to fit into the logistics of the construction operations.
- Signage/ colour coding must be used to differentiate disposal areas for the various waste streams (i.e. paper, cardboard, metals, food waste, glass, concrete, brick etc.).
- Hazardous waste must be stored within a bunded area or contained skip constructed according to SABS requirements. The volume of waste stored in the bunds must not exceed 110% of the bund capacity.
- The location of all temporary waste storage areas must aim to minimize the potential for impact on the surrounding environment, including prevention of contaminated runoff, seepage, and avifauna and vermin control. All temporary waste storage areas must be at least 100m away from sensitive areas as identified within the site plans and pointed out by the ECO.
- Waste storage shall be in accordance with all Regulations and best-practice guidelines and under no circumstances may waste be burnt on site.
- Waste must be removed from site on a weekly basis.
- Vegetation removed from the site must be chipped, used on site to stabilize soils alternatively removed from the site and disposed of at an appropriate waste disposal facility.

- A dedicated waste management team must be appointed by the principal contractors, whom will be responsible for ensuring the continuous sorting of waste and maintenance of the area. The waste management team must be trained in all areas of waste management and monitored by the ECO during construction.
- All waste removed from site must be done so by a registered/ licensed subcontractor, who must supply information regarding how waste recycling/ disposal will be achieved. The registered subcontractor must provide waste manifests for all removals at least once a month.

8.2.1.3. Management of waste storage areas

- A central waste yard area would be established, at which waste (incl. recyclables) would be stored. Some materials would be stored in stockpiles while others would be stored in bins or skips. Stockpiles and bins would be appropriately labelled, managed and monitored.
- The position of all waste storage areas inside the yard must be located 100 meters away from sensitive areas as specified in the site plans and pointed out by the ECO.
- The waste storage area must have a suitable storm water system separating clean and dirty storm water.
- Waste storage areas attracting birds must be under roof, or the waste storage containers must be covered with tarpaulins (or similar material) to prevent the ingress of water.
- Collection bins or skips placed around site and at subcontractors' camps must be maintained and emptied on a regular basis by the principal contractor.
- Waste must be stored in designated containers and not on the ground.
- Inspections and maintenance of bunds must be undertaken daily. Bunds must be inspected for leaks or cracks in the foundation and walls.
- It is assumed that any rainwater collected inside the bund is contaminated and must be removed and stored as hazardous waste, and not released into the environment. If any leaks occur in the bund, these must be removed immediately.

8.2.1.4. Disposal

- Waste generated on site must be removed on a regular basis, as determined by the WCO and ECO. This frequency may change during construction depending on waste volumes generated at different stages of the construction process.
- Waste must be removed by a suitably qualified contractor and disposed at an appropriately licensed landfill site. Proof of appropriate disposal must be provided by the contractor.

8.2.1.5. Record keeping

- The success of the waste management plan is determined by measuring criteria such as waste volumes, cost recovery from recycling, cost of disposal. Recorded data can indicate the effect of training and education, or the need for education.

- This will provide trends and benchmarks for setting goals and standards, providing clear evidence of the success or otherwise of the plan.
- Documentation (waste manifest, certificate of issue or safe disposal) must be kept by the WCO detailing the quantity, nature, and outcome of any regulated waste for audit purposes.
- Waste management must form part of the monthly reporting requirements in terms of volumes generated, types, storage and final disposal.

8.2.2. Operational Phase:

It is expected that the operational phase will result in the production of general, organic and hazardous waste in accordance with Table 1 above. All waste generated will be required to be temporarily separated and stored at the source (S@S), in appropriate sealed containers/ areas, prior to transfer to the Waste Management Facility (WMF) on site.

The following waste management principles apply during the operational phase:

- The EM in consultation with the in-house ECO and WCO must develop, implement and maintain a waste inventory reflecting all waste generated during operation for all waste streams.
- The intent is to encourage and develop a separation system at source, that will assist in handling the waste streams.
- The waste storage area would allow for the further separation of waste streams based on their management requirements and would therefore include:
    - Wheeled bins;
    - Front lift bins;
    - Bulk bins and skips;
    - Bulk material storage bays;
    - Hazardous waste storage areas;
    - Bunded bulk storage for fuels and oils etc.;
    - Balers for cardboard/ plastic;
    - Battery storage containers;
    - The biodigester for recovery of energy from organic waste; and
    - A composting facility for processing garden and food waste.
- Quarantined Waste would be managed in accordance with the requirements of the relevant quarantine authority.
- The position of all waste storage areas is in the Services Precinct away from sensitive areas. The main waste storage area must have a suitable storm water system separating clean and dirty storm water.
- Waste storage areas must be under roof, or the waste storage containers must be covered with tarpaulins (or similar material) to prevent the ingress of water and attraction of birds and vermin.

- S@S is crucial for effective waste management. All waste must be stored in appropriate temporary storage containers (separated between different operational wastes, and contaminated or wet waste) at each operational area prior to being taken to the waste storage area for final sorting (if required).
- Recyclable waste should be further separated into appropriate bins or skips under categories as per Figure 13 (S@S).

Figure 13: Colour coded storage bins and skips for the separation of solid waste.

- Adequate waste collection bins placed in correct locations in the development and in the WMF must be supplied. Separate bins and skips should be provided for various waste streams (S@S).
- Temporary waste storage containers must be inspected for any sign of deterioration on a biannual basis.
- Recyclable waste must be removed from the waste stream and stored separately (S@S).
- Waste storage shall be in accordance with all best-practice guidelines and under no circumstance may waste be burnt on site.
- The Airport Workshop uses oils etc. Oil separators will be installed at this location and will need to be emptied/cleaned regularly.
- Hazardous waste will be removed to a licensed facility.
- General waste will be sorted and temporarily stored in various categories. Some shredding and baling of general waste will take place on site. All sorted, shredded or baled recyclable waste will be collected by recycling companies for offsite processing.
- Organic, food, garden, decomposable waste will go to composting and or a biodigester.
- A sewage package plant is proposed as an alternative to a conventional Municipal Wastewater Treatment Works. The treated sewage effluent water generated by the package plant is normally used for irrigation or toilet flushing but could also be used to supplement the biodigester.

- A biodigester and PV is proposed to reduce the need for Eskom supply. Considering the airport's location, the biodigester intends to use Biomass, supplemented by general food waste from the airport and/or other organic /decomposable waste from the area.
- The "waste" from the biodigester plant comprises "liquid fertilizer" which is planned to be used as organic agricultural fertilizer (refer to Section below).
- Vegetation removed from the site must be stored, chipped and removed to the composting facility for reuse or if appropriate to the Biodigester.
- Waste generated on site must be removed on a regular basis throughout the operational phase.
- Waste that cannot be reused or recycled must be removed by a suitably qualified contractor and disposed of at an appropriately licensed landfill site. Proof of appropriate disposal must be provided to the Waste Control Officer by the contractor.

8.3. Reduce transportation of waste

- City of Cape Town (and neighbouring municipalities) registered service providers will be contracted to remove and recycle waste from the site.
- The following Landfill sites will be used to deposit waste that cannot be recycled or re-used:
    - General Waste can be transported to the Vredenburg landfill site.
    - All hazardous waste will be transported to the Vissershok site. Vissershok site is off the N7 into Frankdale Road, adjacent to Morningstar.
- Specialist Waste removal companies such as *EnviroServe* and *Wasteman* can be used for dangerous or contaminated waste.

SECTION 9: MONITORING AND COMPLIANCE

9.1. Environmental Reporting

To ensure that the necessary environmental waste issues are adequately addressed and recorded, the following environmental reporting shall be undertaken:

- During construction the independent ECO will compile monthly reports as per the EMPr requirements, a dedicated section on waste will be included. These reports will be sent to DEA&DP monthly.
- During operations the inhouse ECO will compile monthly reports as per the EMPr requirements, a dedicated section on waste will be included. These reports will be sent to the EM monthly.
- An internal audit detailing the environmental performance of the facility must be conducted every 12 months by the owner of the waste management facility and an official report thereof must be prepared. These audit reports must be safely stored and made available to the external auditor as well as the environmental authority (upon request).
- External audits of the waste facility must be conducted every 12 months by an independent auditor (EAP) and official audit reports must be prepared documenting the findings. The external audit report must be submitted to the provincial authority upon request and must include (but is not limited to) the following
    - An indication of the compliance of the facility with the National Norms and Standards for this WMP as approved by the provincial authority:
        - National Norms and Standards for the Storage of Waste (GN926 of 29 November 2013)
        - National Norms and Standards for Sorting, Shredding, Grinding, Crushing, Screening, Chipping or Baling of General Waste (GN1093 of 11 October 2017).
        - National Norms and Standards for Organic Waste Composting (GN 561 in GG 44762 of 25 June 2021) read with GN 1757 in GG 45907 of 11 February 2022.
        - National Norms and Standards for Organic Waste Treatment (GN. No. 1984 of 1 April 2022
        - National Norms and Standards for Domestic Waste and Sanitation Services", published as GN No. 982 of 8 September 2017.
    - An indication of compliance with requirements issued by the relevant authority either at national, provincial or local level.
    - An indication of any major environmental incidents or non-compliance that occurred and details of how the incidents or non-compliance were addressed.

  - An indication of the presence of records of safe disposal certificates for all hazardous or general waste removed from the facility.
  - An indication if hazardous waste is separated from general waste and that such waste is removed by a registered waste handling company for either recycling or disposal at a registered facility.

- Incident reporting
  - All incidents must be recorded, and the appointed environmental manager/waste control officer must be notified. See Appendix C for a template of an Incident Report to serve as a guideline for the recording and addressing of emergency incidents as and when they occur.

9.2 Record Keeping

The applicants EM should keep records of the following:

- Internal and external audit reports.
- A site control register:
  - The control register must outline daily monitoring undertaken by the site manager.
  - It is recommended that the register is in a digital format as this will ensure that all records are easily accessible for internal and external auditing requirements.
  - An incident and complaints register must form part of the overall site control register.
- Reviews of the WMP,
- Amendments to the WMP
- Quantities of incoming waste types.

Records should be kept and must be made available for review on request, based on adequate motivation. Minutes of meetings on site must reflect environmental queries, complaints, actions agreed upon, dates of eventual compliance and must form part of the official environmental site record.

In addition to the summary report, the environmental manager / waste control officer shall keep photographic records of site visits and an ad hoc record of incidents or events on site, especially in the case of transgressions from WMP specifications. Such photographs are to be taken with an in-camera dating facility.

9.3 Method Statements

For identified activities the Contractor is requested to submit a method statement (MS) for comment by the EM ECO or WCO. The method statement must provide a step-by-step plan (which may include a schematic diagram etc.) to

inform the responsible person(s) on the process and actions to take in a sequential and logical manner, which aims to reduce the impact of undertaking the activity within a reasonable timeframe and cost.

The format should clearly indicate the following:

What - a brief description of the work to be undertaken;

How - a detailed description of the process of work, methods and materials;

Where - a description/sketch map of the locality of work; and

When - the sequencing of actions with due commencement dates and completion date estimates.

The Contractor must submit the method statement to the EM, ECO or WCO prior to the start of any construction activity. Work may not commence until the comments of the site manager/waste control officer have been received and taken into consideration, and the EM, ECO or WCO has approved the method statement for implementation on site.

9.4. Monitoring

The monitoring of works on site is necessary to demonstrate compliance with the specifications of the WMP and to allow for problems or issues of non-conformance to be identified and appropriate corrective measures to minimize environmental damage to be implemented.

The WMF and all waste storage containers will be inspected weekly to ensure that they are maintained in a condition appropriate for their use and containment of the specific waste.

Skips and/or bins will need to be monitored regularly to ensure that cross contamination doesn't occur. All waste removed from site including products for reuse will also be monitored to ensure no cross contamination.

Monitoring should include daily visual checks by the EM, ECO or WCO, as well as a review of site documentation. Monitoring should include photographic records as outlined in this document. An internal audit detailing the environmental performance of the facility must be conducted every 12 months by the owner of the waste management facility and an official report thereof must be prepared. These audit reports must be safely stored and made available to the external auditor as well as the environmental authority (upon request). The internal auditor shall complete the performance record at the end of each table in section 9.2 of this document, as a record of transgressions or problems experienced on site, and how they were dealt with. External audits of the waste management facility must be conducted every 24 months by an independent auditor (EAP) and official audit reports must be prepared documenting the findings.

9.5. Waste Control Sheets

The sheets below must be used by the EM, ECO or WCO as basis for the development of a Site Control Register.

a. Communication Construction and Operation

TASK	**MITIGATION AND ENVIRONMENTAL CONTROLS**	ACTION
Site Control Register	• To be updated on a regular basis	EM, ECO or WCO
Public complaints	• To be recorded in complaints register, along with records of responses to them in the Site Control Register	EM, ECO or WCO
Environmental Awareness education	• Each contractor team, tenants and operators involved with the waste management activity at CWA are to attend an introduction or annual training session.	EM, ECO or WCO
Method Statements	• All waste source point owners or tenants need to be contractually tied to waste separation at source and the procedure of collection and removal to the WMF. • Record of members attending training sessions to be kept, and updated regularly • Method statements to indicate What, How, Where and When activities are to take place. • Method statements for each relevant activity identified by ESM and ECO to be submitted prior to the start of that activity on site. • Work or waste activity is not to commence until method statement approved by ESM or ECO and Site Manager if necessary.	Contractor or Operators
COMMENTS/ UPDATE		
RECORD OF PERFORMANCE		

Acceptable		**Details of Transgression**	**Responsible Party**	**Action Taken**	**Date**
Yes	**No**				

b. Site Actions Construction

TASK	**MITIGATION AND ENVIRONMENTAL CONTROLS**	**ACTION**
Waste Stream handling	• Implement waste stream handling procedures for construction as per Table 1 above	Contractor, EM ECO, WCO

COMMENTS/ UPDATE

RECORD OF PERFORMANCE					
Acceptable		**Details of Transgression**	**Responsible Party**	**Action Taken**	**Date**
Yes	**No**				

c. Site Action Operations

TASK	MITIGATION AND ENVIRONMENTAL CONTROLS	ACTION
Waste Stream handling	• Implement waste stream handling procedures for operations as per Table 1 above	Contractor, EM ECO & WCO
COMMENTS/ UPDATE		
RECORD OF PERFORMANCE		

Acceptable		Details of Transgression	Responsible Party	Action Taken	Date
Yes	**No**				

d. General Site Procedures

TASK	MITIGATION AND ENVIRONMENTAL CONTROLS	ACTION
Avoid natural resource contamination	• Minimize the use of wash water onsite as far as possible by applying high pressure hoses. • The facility must be managed such that all runoff originating from the site is diverted into a stormwater control channel that contain detention and trapping facilities before it leaves the WMF. • All stormwater control channels in close proximity to WMF must be suitably lined to prevent seepage into groundwater. • The overflow of stormwater channels needs to be trapped and allowed to settle in a detention pond. • The nutrient rich stormwater originating from the composting and biodigester site must be trapped and used as a moisture additive within the composting facility to enhance the composting process. • No nutrient enriched water may be released offsite. • All stormwater infrastructure must be regularly inspected and serviced to ensure design capacity and integrity is maintained. • To ensure suitable stormwater control capacity is maintained onsite, stormwater channels must be kept free from silt. The stormwater control channels must be cleared of any sedimentation (if required) during the dry season. • All water that has entered the composting and biogas areas must be treated as leachate. • To prevent nutrient rich leachate from percolating into the ground, the land areas where composting are established should be compacted to ensure that the soil drainage is poor or virtually impervious. • All wind dispersed waste must be collected on a daily basis and taken to the WMF • The WMF must have closed containers to avoid wind dispersing waste	EM, ECO & WCO
Avoid the generation of	• All trucks or vehicles transporting waste material will be required to secure and cover all loads with shade cloth to	EM, ECO & WCO

atmospheric emissions and odors	avoid debris or plastic etc. that can blow or fall on public roads or areas. • Composting operations should process organic material on the same day to avoid stagnant heaps. • Optimizing certain variables can minimize composting emissions. The carbon-nitrogen ratio, temperature, moisture content (at least 25%), aeration, and pH must be monitored by the facility manager on a weekly basis to ensure optimal organic matter breakdown without production of excessive atmospheric emissions or odors. • All storage and operating areas need to be contained in bunkers, lined and covered where required. • The WMF in the services precinct is located directly opposite the City of Cape Town Fisantekraal WWTW therefore part of a node already exposed to odors where residential development is not likely.	
Avoid Soil Erosion	• Wherever possible, ensure that the WMF surface is covered by tar, concrete or paving and areas around the stormwater system vegetated as per landscape and SWMP. • Establish and maintain suitable vegetation cover at all stormwater concentration points. These areas include road verges, the banks of stormwater channels, berms and other infrastructure that may increase surface runoff. Should any erosion be detected, the ECO must identify the cause of such erosion and ensure that the most appropriate method of mitigation or stabilization is employed as soon as possible.	EM, ECO & WCO
Avoid the generation of dust and noise	• The level of dust and noise generated by WMF activities will be insignificant in the broader landscape, especially after the roads a surfaced. Nevertheless, it is recommended that working hours are restricted to 06:00 to 18:00 daily. • All transport vehicles and machinery/equipment used onsite must be regularly maintained and kept in good working order to prevent excessive noise. • It is recommended that a dustcart is available onsite to water down dusty roads not tarred, particularly during the dry summer months.	EM, ECO & WCO

	• A suitable speed limit (40 – 60 km/h) must be enforced on all access roads. Ensure compliance with the provisions as set out in the National Environmental Management: Air Quality Act (NEM: AQA), National Dust Control Regulations (Notice 827 of 2013) and Western Cape Noise Control Regulations (P.N. 200/2013).	
Avoid Visual impacts	Scrape and sweep all areas where material is processed weekly to ensure that minimal waste material is present outside the contained areas	EM, ECO & WCO
Limit Consumption of resources (water)	• Maintain all water infrastructure in a good working condition. • Use high pressure power hoses for cleaning. • Ensure that all taps remain closed when not in use. • Educate all employees on the importance of natural resources and wise water use practices. • Should any leaks occur, these must be reported immediately and repaired as soon as possible. When emptying transport bins, ensure all material is removed manually as far as practicably possible to minimize the need for wash water.	EM, ECO & WCO
Limit Attraction Birds and Vermin	With suitable management, this impact can be kept to a minimum. The flowing management measures should however continue to be followed: • All organic waste delivered to the site must be covered or worked immediately. • Apply roofs over waste areas to avoid attraction. • Apply containment of waste to avoid attraction. • Apply bait stations for organic pest control. • Correct management of pH and temperature within the composting rows will control the spread of pests and diseases as larva/eggs/worms/bacteria can't live at optimal composting temperatures. • Ensure that WMF does not have pooling or standing water • Best practice pest control measures will be implemented, and a Certified Pest Control Company will be appointed on the onset of the Construction and Operational Phases to ensure that	EM, ECO & WCO

	preventative measures are put in place and monitored to ensure the effectiveness of the Pest Control Schedule.	
Avoid Leakage of potentially hazardous substances	• All transport vehicles and machinery must be confined to access roads and approved development footprints. • All transport vehicles and machinery/equipment used onsite must be regularly maintained and kept in good working order to prevent potential leaks.	EM, ECO & WCO
COMMENTS/ UPDATE		
RECORD OF PERFORMANCE		

Acceptable		**Details of Transgression**	**Responsible Party**	**Action Taken**	**Date**
Yes	**No**				

9.6. Review of the WMP

The WMP will be reviewed by the EM and ECO on an ongoing basis. Based on observations during site inspections and issues raised at site meetings, the EM will determine whether any procedures require modification to improve the efficiency and applicability of the WMP on site. The WMP must be updated and submitted to the competent authority should any significant changes occur to the operations regarding the waste facility.

Any such changes or updates will be registered in the weekly record, as well as being included as an annexure to this document. Annexures of this nature must be distributed to all relevant parties on site.

9.7. Environmental Audits

Internal auditing will take place annually during the operational phase. A suitably qualified EAP Environmental Auditor is to be appointed, at the expense of the Applicant, to undertake external audits of compliance with the WMP. External audits of the waste facility must be conducted annually by an independent auditor and official audit reports must be prepared documenting the findings.

Objectives should be to audit compliances with the key components of the WMP, to identify main areas requiring attention and recommend priority actions. The audit should cover a cross section of issues, including implementation of environmental controls, environmental management, and environmental monitoring.

Results of the audits should inform changes required to the specifications of the WMP or additional specifications to deal with any environmental issues which arise on site and have not been dealt with the in the current document.

The national, provincial and local authorities must be given access to audit or inspect the facility if requested.

9.8. Incident reporting

Environmental incident reporting is a vital part of communication. Employees are required to report all environmental related problems, incidents, and pollution, so that the appropriate mitigation actions can be implemented timeously. See Appendix B for a template that can be used for incident reporting

The EM shall investigate the incident and record the following information:

- How the incident happened;
- The reasons the incident happened;
- How rehabilitation or clean up needs to take place;
- The nature of the impact that occurred;
- The type of work, process or equipment involved; and
- Recommendations to avoid future such incidents and/or occurrences.
- Shall inform the ECO & WCO of all incidents that were reported.
- Shall consult with the ECO & WCO for recommendations on actions to be taken or implemented where appropriate (e.g., clean-ups).

9.9. External Records and Monitoring

Records must be kept of the volumes/ mass of the different waste streams that are collected from the site throughout the life of the project. The appointed waste contractor is to provide monthly reports to the operator containing the following information:

- Monthly volumes/ mass of the different waste streams collected;
- Monthly volumes/ mass of the waste that is disposed of at a landfill site;
- Monthly volumes/ mass of the waste that is recycled; and
- Data illustrating progress compared to previous months.

This report will aid in monitoring the progress and relevance of the waste management procedures that are in place.

Monitoring the quantity and types of wastes being generated by the CWA operations will be recorded in the wastes logbook and always kept on site so that regular reviews can be undertaken.

All products that are of concern in relation to the waste being generated will be replaced were possible for products that are less wasteful and/or considered to be environmentally friendly.

The Applicant will continue to review the type of surplus materials produced and were possible, change the site design and operation to minimize products that go to landfill. Recycling or reuse of waste is a priority.

The WMP and its importance will be communicated to the whole team regularly. Business wide updates including improved recycling amounts will be communicated and discussed at management and 'toolbox' meetings.

The WMP will be analyzed to produce key performance indicators, and it will be the EM and ECO's responsibility to develop best practice solutions throughout the CWA operations and monitor them.

A **Groundwater Monitoring Plan** will be implemented to monitor potential impacts of waste sources and assist with the development of environmentally sustainable practices as part of the CWA EMPr.

The waste facility should be free from odour or emissions that are likely to cause a nuisance. An **Odour Monitoring Plan** can be developed during operations by the EM and ECO and implemented to monitor potential odour impacts associated with the various waste streams on site and assist with the development of environmentally sustainable solutions, where applicable, should this become a concern.

The **Emergency Preparedness and Response Plan** to be compiled post authorization, as a condition of approval and as stipulated in the CWA EMPr, includes the:

- Emergency response plan,
- Hazard Identification,
- Remedial Actions, and
- Preventative measures.

9.10. Operational Waste Survey

Carrying out a waste survey is an important first step in refining a waste management plan. In particular, such information is crucial to developing a recycling program. A waste survey can reveal a lot about the patterns of people in the facility as well as their use and distribution of everyday items throughout the facilities and grounds. This would however require specific knowledge of airport operations and applicable regulations, as the situations that each airport faces are unique and highly dependent on its geographical and social condition.

A waste survey by the EM should include:

- Identifying materials that can and cannot be recycled in the region.
- Locations within the airport that generate waste.
- The types of waste generated in each area (paper, scrap metal, plastic, etc.).
- Identifying materials that can be reduced, reused, and recycled.
- The quantity of waste generated by each area of the airport (airlines, administrative offices, enplaned and deplaned passengers, concessions, etc.).
- Commodity rates for recyclable materials.

- Costs associated with processing recyclables.
- Hauling, disposal, and labour costs for landfill-bound waste.

9.11. Laboratory Tests:

Once available, the digestate from the anaerobic biodigester will be analysed by the EM to determine its suitability as a liquid fertiliser, and that these results be made available to DEA&DP, the DWS and the Western Cape Department of Agriculture.

After the onsite WWTW are functional testing on the biosolids resulting from the sewage package plant will be considered before a classification of the waste can be given. The waste classification of the biosolids will also depend on an analysis provided on the chemical constituency of the biosolids, and depending on end use, the total concentration and leachable concentration tests will be conducted on the biosolids. This will determine how this waste source is handled.

SECTION 10: TRANSGRESSIONS IN TERMS OF WMP

The Applicant must comply with the requirements of this WMP on an on-going basis and any failure on his part to do so will entitle the relevant competent authorities to **take corrective action against the transgressor**.

In the event that any activities are undertaken outside the scope of the adopted WMP requirements, in terms of the action outlined within the given method statement, the person(s) responsible will potentially be subject to Section 24(F) of NEMA and that appropriate enforcement and compliance requirements will follow by the competent authority.

Transgressions relate to actions by the Applicant, contractor or contractor team members whereby damage or harm is inflicted upon the environment or any feature thereof and where any of the conditions or specifications of the WMP/ EMPr/ EA/ WULA are infringed upon.

In instances of environmental damage, the damage is, where possible, to be repaired and rehabilitated using appropriate measures, as specified and undertaken by appropriate specialists, for the account of the responsible party.

Issues of non-compliance noted by the EM/ ECO are to be communicated to relevant parties and appropriate action must be taken to rectify the situation. Issues of non-compliance must be reported in the required site visit report. The EM/ECO will advise on appropriate corrective actions when necessary.

SECTION 11: CONCLUSION

The waste management plan is prepared for the construction and operational (including maintenance) phases of the CWA, which would collate measures to manage waste and thus avoid and mitigate impacts to human health and the environment. A combination of on-site and off-site management measures would provide a range of options to reuse, recycle, recover and treat waste generated at the proposed airport. However, there are other considerations to waste management such as waste reduction, segregation of waste, disposal of waste, financial impacts of waste disposal and recording, monitoring, education and reviewing.

Construction practices and operations must be measured and analyzed to determine the efficacy of the plan and whether further revision of the plan is required. This plan should be updated should further detail regarding waste quantities and categorization become available, during the construction and/or operational stages.

APPENDIX A: SITE DEVELOPMENT PLAN AND ASSOCIATE PLANS

APPENDIX B: NORMS AND STANDARDS

APPENDIX C: INCIDENT REPORT TEMPLATE

Environmental Incident Report

Date:	**File reference number:**
Name:	
Exact location of incident:	

Section 1: Description of incident

Section 2: Remedial action required

Section 3: Relevant Documentation

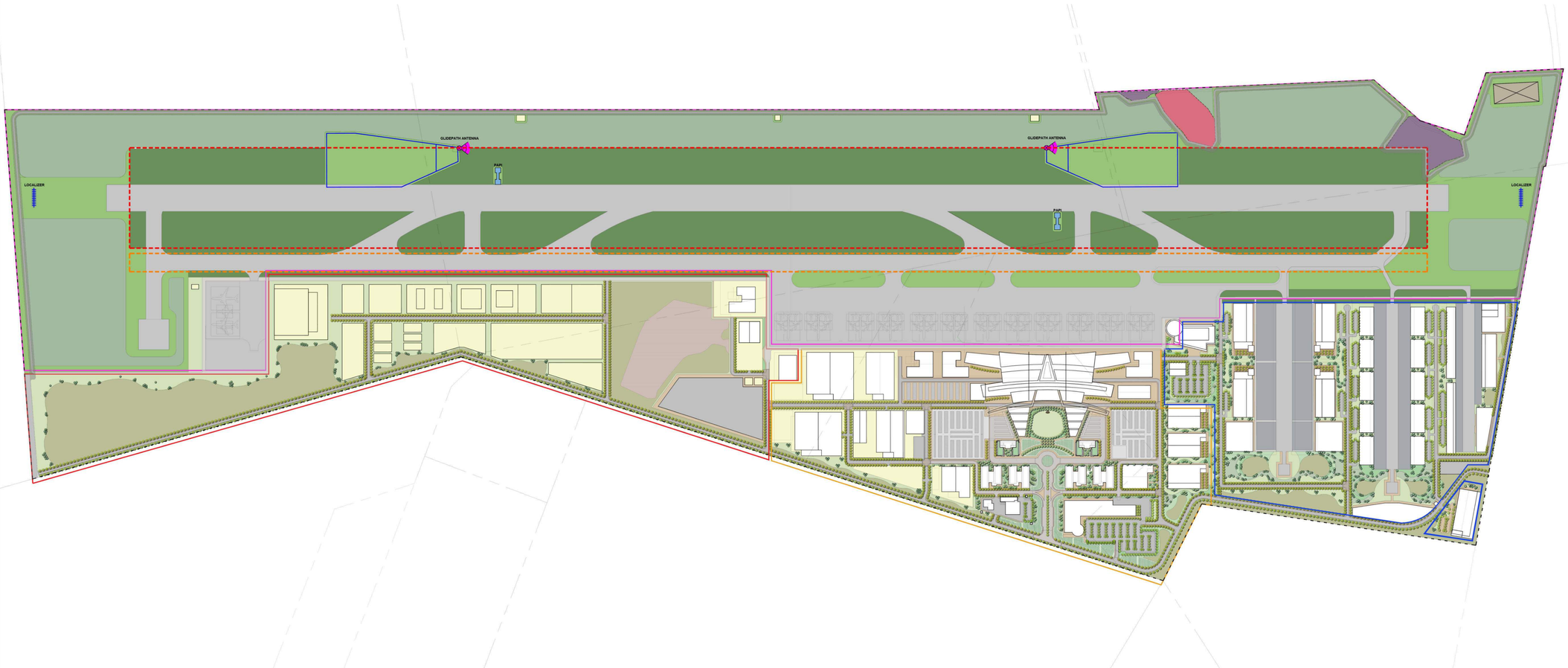
Section 4: Steps to prevent recurrence

Section 5: Signatures

Environmental manager:	Date: .....
ECO:	Date: .....
Landowner:	Date: .....

APPENDIX D: CV OF EAP

ANNEXURE 9: LANDSCAPING PLAN (s)



north

LANDSCAPE PLAN

Scale 1:4500

0 40 100 200 400 1000

LEGEND (cont...)

PHASING LINE

- AIRPORT AIR SIDE PRECINCT
- SERVICE PRECINCT
- AIRPORT TERMINAL PRECINCT
- GENERAL AVIATION PRECINCT
- BOUNDARY/FENCE LINE

ORIGINAL INDIGENOUS REMNANTS

- 1.6 ha VERY HIGH; TO REMAIN UNTOUCHED AT THE AIRPORT AIRSIDE PRECINCT.
- 0.2 ha MEDIUM: AREA TO REMAIN UNTOUCHED AT THE AIRPORT AIRSIDE PRECINCT.
- 1.6 ha MEDIUM; SOME OF AREA TO BE DESTRUCTED DUE TO THE RUNWAY STRIP AREA AT THE AIRPORT AIRSIDE PRECINCT.

EXTREMITIES

- RUNWAY STRIP AREA AT THE AIRPORT AIRSIDE PRECINCT.
- TAXIWAY STRIP AREA AT THE AIRPORT AIRSIDE PRECINCT.
- ILS GP BEAM FORMING AREA AT THE AIRPORT AIRSIDE PRECINCT.
- FUTURE INSTRUMENT LANDSCAPING SYSTEM FACILITIES AT THE AIRPORT AIRSIDE PRECINCT (i.e LOCALISER, MARKER BEACONS, SIGNAGES etc) & SUB-STATIONS AROUND AIRPORT AIRSIDE ARE SUBJECT TO LATER POSITIONS & DETAIL DESIGN; LANDSCAPING AROUND THESE WILL BE KEPT TO A MINIMUM BUFFER OF 5m OFFSET OF 200mm VYGIE & ANNUALS / PERENNIALS FYNBOS GROUND COVER SPECIES.
- BRUSH-CUT FIREBREAK: 15m WIDE ALIGNING WITH THE PERIMETER ACCESS ROAD; OFFSET FROM BOUNDARY; NOT ENCROACHING INTO INDIGENOUS REMNANTS AREAS.

NOTES

NO.	DATE	REVISION	DRAWN
B	2025.03.06	ADDED 5m WIDE FIREBREAK AROUND ACCESS ROAD	MM
C	2025.03.07	GENERAL UPDATE TO LEGEND DESCRIPTION	MM

LEGEND

SOFT LANDSCAPE

- TREES IN PARKING AREA AT THE AIRPORT TERMINAL PRECINCT
- BOUNDARY/VERGE TREES AT THE SERVICE PRECINCT, AIRPORT TERMINAL PRECINCT & GENERAL AVIATION PRECINCT.
- TREE CLUSTERS AT THE SERVICE PRECINCT, TERMINAL PRECINCT & GENERAL AVIATION PRECINCT.
- TREES IN PAVED CUT-OUT AREAS AT THE AIRPORT TERMINAL PRECINCT.
- INDIGENOUS SHRUBS & GROUND COVER PLANTING AT THE AIRPORT TERMINAL PRECINCT & GENERAL AVIATION PRECINCT
- INDIGENOUS SHRUBS & GROUND COVERS WITH BERMS/MOUNDS AT THE AIRPORT TERMINAL PRECINCT.
- PLANTED BERMS AT THE AIRPORT TERMINAL PRECINCT.
- HYDROSEEDED AREAS: SAND FYNBOS & RENOSTERVELD AT THE AIRPORT AIRSIDE PRECINCT; SPECIES LIMITED TO 700mm IN MAXIMUM HEIGHT.
- VYGIE & ANNUALS/PERENNIALS FYNBOS GROUND COVER SPECIES AT THE AIRPORT AIRSIDE PRECINCT: VARIOUS SPECIES LIMITED TO 200mm IN MAXIMUM HEIGHT TO COMPLY WITH THE FRANGIBILITY REQUIREMENTS OF ICAO.
- VYGIE & ANNUALS/PERENNIALS FYNBOS GROUND COVER SPECIES AT THE AIRPORT AIRSIDE PRECINCT: VARIOUS SPECIES LIMITED TO 300mm IN MAXIMUM HEIGHT TO COMPLY WITH THE FRANGIBILITY REQUIREMENTS OF ICAO.
- SAND FYNBOS AND RENOSTERVELD REHABILITATION PLANTING AT THE SERVICE PRECINCT.
- LAWN AT THE SERVICE PRECINCT, TERMINAL PRECINCT & GENERAL AVIATION PRECINCT
- LAWNED BERMS AT THE AIRPORT TERMINAL PRECINCT.
- ORNAMENTAL VINEYARDS AT THE AIRPORT TERMINAL PRECINCT.
- GREEN ROOFS AT THE AIRPORT TERMINAL PRECINCT.

HARD LANDSCAPE

- INTERNAL PAVED PEDESTRIAN WALKWAYS AT THE AIRPORT TERMINAL PRECINCT.
- INTERNAL PAVED PLAZA AREAS AT THE AIRPORT TERMINAL PRECINCT.
- PAVED VEHICULAR ROAD AT THE SERVICE PRECINCT, TERMINAL PRECINCT & GENERAL AVIATION PRECINCT.
- 1.8m PAVED WIDE NMT WALKWAYS AT THE SERVICE PRECINCT, TERMINAL PRECINCT & GENERAL AVIATION PRECINCT.
- 3.0m PAVED WIDE NMT WALKWAYS AT THE SERVICE PRECINCT, TERMINAL PRECINCT & GENERAL AVIATION PRECINCT.
- PAVED INTERSECTION AREAS AT THE SERVICE PRECINCT & TERMINAL PRECINCT.
- RUNWAY, TAXI & APRON ASPHALT FINISHED SURFACES AT THE AIRPORT AIRSIDE PRECINCT AND GENERAL AVIATION PRECINCT
- AIRPORT MAINTENANCE ROAD ASPHALT FINISHED SURFACES AT THE AIRSIDE PRECINCT & SERVICE PRECINCT.
- SPACE FOR OCCASIONAL USE AND SLOPED PLANTING AT AIRPORT TERMINAL PRECINCT
- SOLAR PHOTOVOLTAIC SOLAR PANELS OVER PARKING BAYS AT THE AIRPORT TERMINAL PRECINCT.
- INDICATIVE BUILDING ROOFSCAPE EXTENTS AT THE SERVICE PRECINCT, TERMINAL PRECINCT & GENERAL AVIATION PRECINCT.
- FUTURE DEVELOPMENT AREAS WITH INDICATIVE BUILDINGS AT THE SERVICE PRECINCT & TERMINAL PRECINCT.
- EXISTING QUARRY AT THE SERVICE PRECINCT.
- ESKOM INCOMING SUB-STATION AT THE AIRPORT AIRSIDE PRECINCT.

DRAFT

PROJECT

CAPE WINELANDS AIRPORT - PAL 4, FISANTEKRAAL

DRAWING TITLE

OVERALL LANDSCAPE CONCEPT PLAN

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DRAWN MM
CHECKED JJ/JED
APPROVED JJ

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APPENDIX 39C

ANNEXURES TO THE ENVIRONMENTAL MANAGEMENT PROGRAMME FOR THE EXPANSION OF THE CAPE WINELANDS AIRPORT.

ANNEXURE

ANNEXURE 10 - STORMWATER MANAGEMENT PLAN
ANNEXURE 11 - BIRD AND WILDLIFE HAZARD MANAGEMENT PLAN
ANNEXURE 12 - EMERGENCY PREPAREDNESS AND RESPONSE PLAN
ANNEXURE 13 - ARCHITECTURAL DESIGN GUIDELINES
ANNEXURE 14 - CWA OUTDOOR ADVERTISING GUIDELINES
ANNEXURE 15 - ENVIRONMENTAL AWARENESS PLAN
ANNEXURE 16 - MAINTENANCE MANAGEMENT PLAN
ANNEXURE 17 - GROUNDWATER MANAGEMENT PLAN (TBC)
ANNEXURE 18 - BIODIVERSITY OFFSET REPORT
ANNEXURE 19 - NOISE MITIGATION AND MANAGEMENT PLAN (TBC)
ANNEXURE 20 - PERMITS AND LICENSE

ANNEXURE 10: STORMWATER MANAGEMENT PLAN

Concept Stormwater Management Plan

Cape Winelands Airport

Reference: A89083-CWA-CSWMP

Submission Date: 2024/08/12

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Author signature		Approver signature	
Name	A. vd Nest	Name	C. Talip
Title	Technologist (Civil)	Title	Technical Director

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1 Introduction

Zutari has been tasked with the development of a Concept Stormwater Management Plan advising the Cape Winelands Airport company (CWA) on the management of stormwater for the proposed development and to engage the City of Cape Town's Catchment, Stormwater & River Management (CSRM) officials regarding the various submission requirements associated with stormwater management on the site.

This Concept Stormwater Management Plan discusses the proposed stormwater management systems for the Cape Winelands Airport development and details the stormwater infrastructure and interventions proposed to achieve the requirements stipulated in the applicable policies and guidelines.

Accordingly, this development is subject to the City of Cape Town's Stormwater Policy (Management of Urban Stormwater Impacts Policy – C58/05/09) which states criteria for compliance when considering the quality and quantity of stormwater run-off from the post-developed site.

Considerations for the implementation of stormwater management measures for the proposed development will occur in the following manner:

1. Assess status quo and existing stormwater infrastructure.
2. Assess policy requirements and engage in high-level discussion with City of Cape Town officials.
3. Prepare a Concept Stormwater Management Plan for recommending high-level interventions to be implemented to ensure compliance to the Policy.
4. Prepare at a later stage a detailed Stormwater Management Plan to recommend measures to mitigate the hydrology-, hydraulic-, and pollution-related effects of surface water released into the municipal stormwater network, and to illustrate how the proposed Cape Winelands Airport development will comply with the relevant policies.

The submission of this Concept Stormwater Management Plan for the proposed Cape Winelands Airport development will address points 1) to 3) listed above with any comments received from CoCT being incorporated into the submission of the detailed Stormwater Management Plan to follow.

Zutari will also develop and submit a detailed Stormwater Management Plan for the development (which will address point 4) at a later stage as described later in this report.

1.1 Location and Nature of the Development

The proposed Cape Winelands Airport development is located within the jurisdictional area of the City of Cape Town, Northern Region, Kraaifontein District and is located at the following coordinates: 33°46'13.84"S, 18°44'24.20"E. The proposed Cape Winelands Airport site is to be located on portions of Erven: PA724-0, PA724-10, PA474-4, PA474-23,PA474-4, PA474-0 and MA942-7, while the general location in relation to the surrounding areas can be seen below in Figure 1.

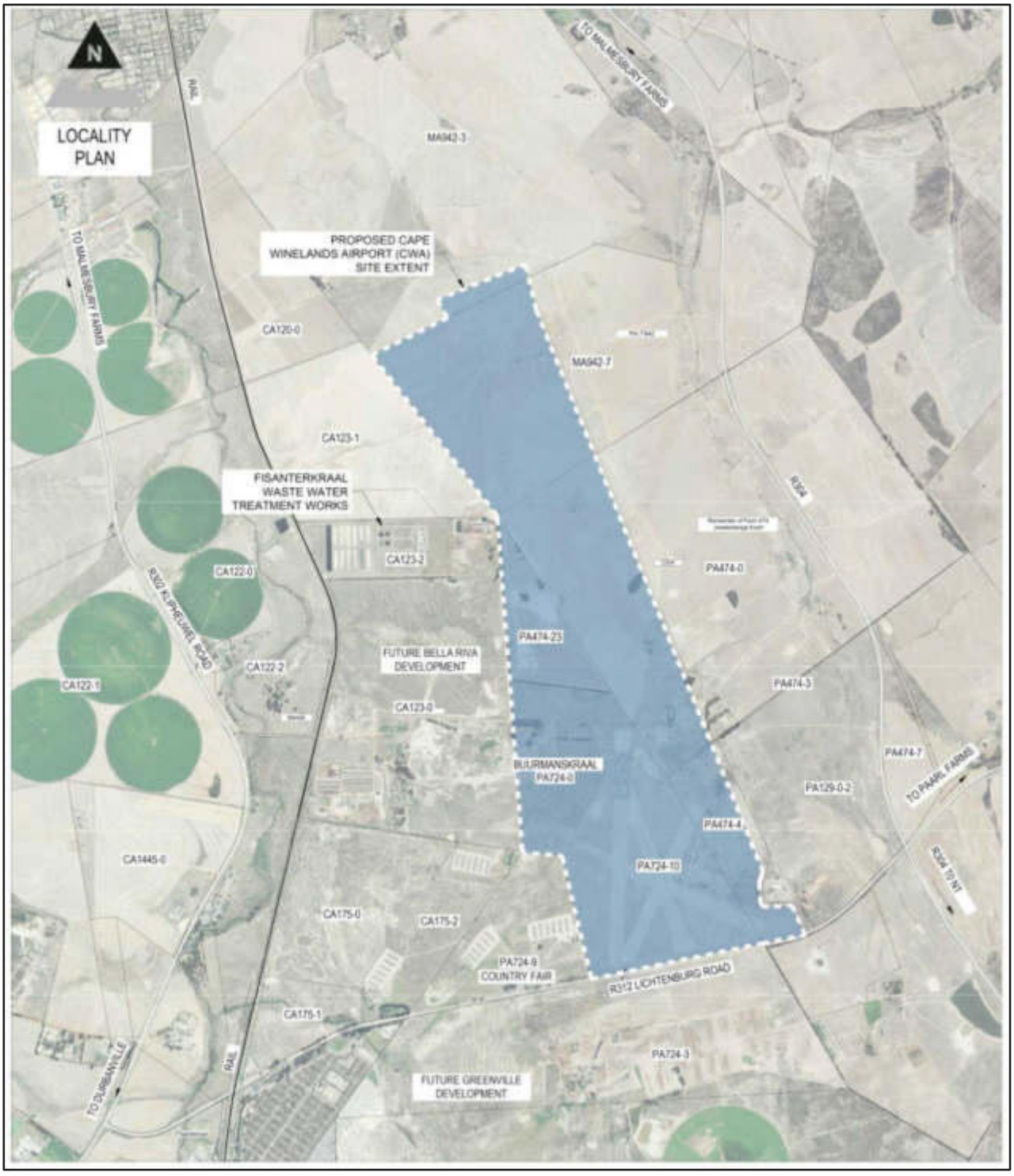

Figure 1: Site Locality Map

The current Site Development Plan and stormwater drawings used to compile this Concept Stormwater Management Plan may be referenced in Appendix A – Drawings.

1.2 Objectives of the report

This Concept Stormwater Management Plan for the Cape Winelands Airport has the following objectives:

- To identify measures to comply with the Council's Management of Urban Stormwater Impacts Policy (C58/05/09) (City of Cape Town (CCT), 2009).
- To identify measures to comply with Council's Floodplain and River Corridor Management Policy (C58/05/09) (City of Cape Town (CCT), 2009).
- To propose methods (structural controls) for removing, reducing, or retarding runoff flows, and preventing targeted stormwater runoff constituents, pollutants, and contaminants from reaching receiving water bodies.

The purpose of this Concept Stormwater Management Plan is to stipulate a framework consisting of minimum Best Management Practices (BMP's) required for implementation. The current proposal is that Cape Winelands Airport is constructed in two (2) phases and the intention of this report is to specify minimum requirements which need to be adhered to for the ultimate scheme to satisfy various statutory requirements. When detailed design commences, the developer will be required to submit a detailed Stormwater Management Plan for each phase which satisfies the requirements stated in this overarching Concept Stormwater Management Plan. If there is any deviation from this Concept Stormwater Management Plan, the developer must first submit an amended Concept Stormwater Management Plan for approval.

2 Status Quo and Existing Infrastructure

2.1 Existing Site Conditions and Topography

The existing property is currently mainly used for agricultural purposes with approximately 90% of the surface areas being green permeable spaces and the remainder consisting of the existing Cape Winelands Airport (previously known as the Fisantekraal Aerodrome), basic farm roads and small holdings. The existing site topography can be summarised as follows:

- The proposed Cape Winelands Airport site is approximately 430 hectares in size.
- Site slopes:
    - A ridge is formed along the centre of the site splitting the flows in easterly and westerly directions. The stormwater then drains towards the Klapmuts River and the Mosselbank River respectively.
    - In addition, there are low points situated along the site boundary resulting in numerous outfalls discharging from the Cape Winelands Airport development site boundary.
- The vegetation is generally defined by agricultural farmlands.
- The existing site topography consists of varying slopes that range between 0.25% and 6%
- The stormwater from the existing site quarry daylights into the adjacent property, the proposed Bella Riva development, and flows overland towards the Mosselbank River.
- Clearly defined watercourses are noted along the eastern and western boundaries of the site.

The pre-development scenario has been modelled in PCSWMM and the actual Topographical LIDAR Survey (DTM at 5m Grid Interval), received from Geospatial Project Services in January 2021, was used to create the topographic height illustration seen below in Figure 2: General Topography and Natural Overland Flow Direction.

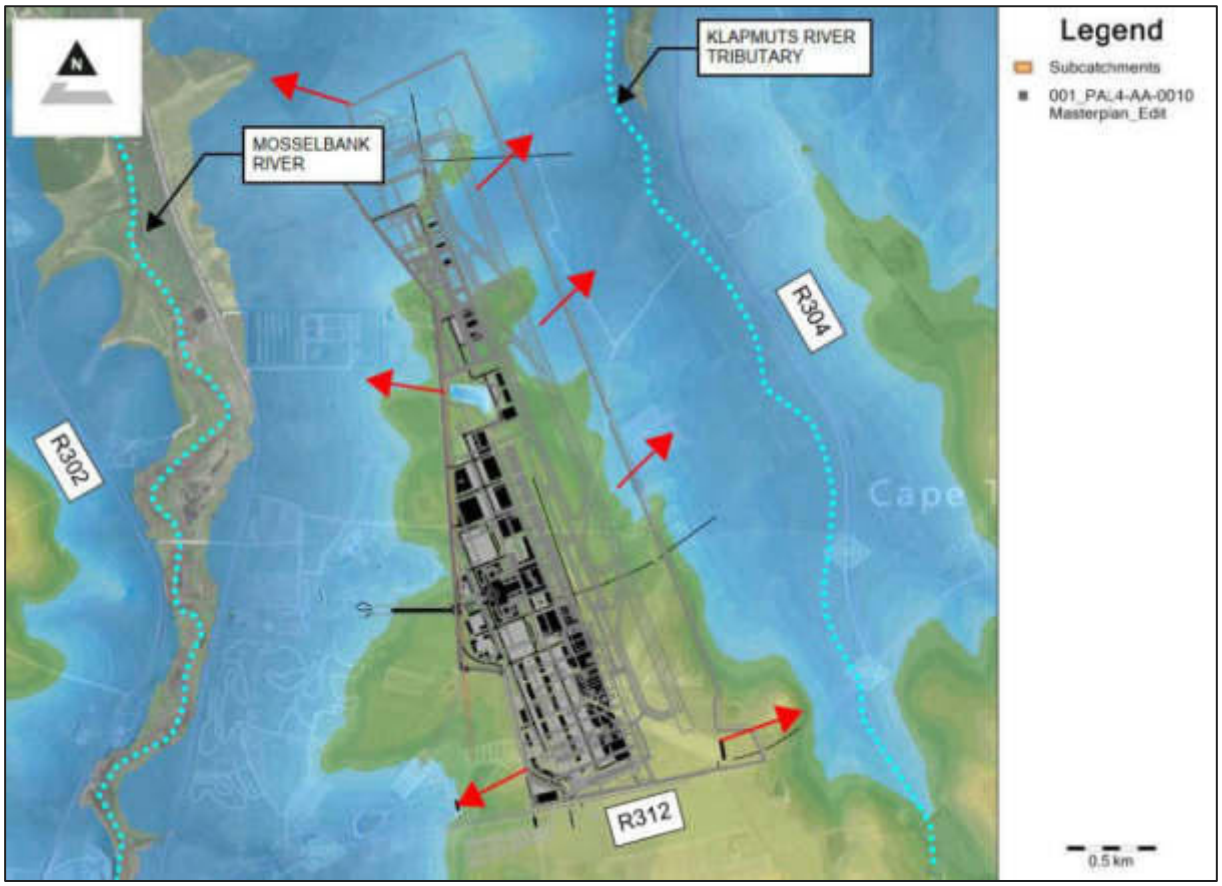

Figure 2: General Topography and Natural Overland Flow Direction

The general topography and overland flow direction of the site can be clearly seen. The spine of the development is the highest point positioned along the centre of the site in a south to north direction, with a portion of the overland runoff flowing towards the western boundary and into the Mosselbank River and the remaining portion of the runoff towards the eastern boundary and into the Klapmuts River.

2.2 Geotechnical Investigation

A detailed geotechnical investigation was carried out by GEOSS South Africa (Pty) Ltd. This investigation found that the materials on site are generally classified as “soft” to “intermediate” excavation in accordance with SANS 1200D. The soil type used for characterising soil infiltration in the hydrological model is that of Sand.

The proposed Cape Winelands Airport site is approximately 430 hectares and therefore the site was divided into five (5) main geotechnical zones which exhibit similar soil profile characteristics based on the descriptions of the material encountered in the trail pits, considering the several methods of investigation carried out. The general ground profiles are defined in five (5) geotechnical zones on site and can be seen in Figure 3 below:

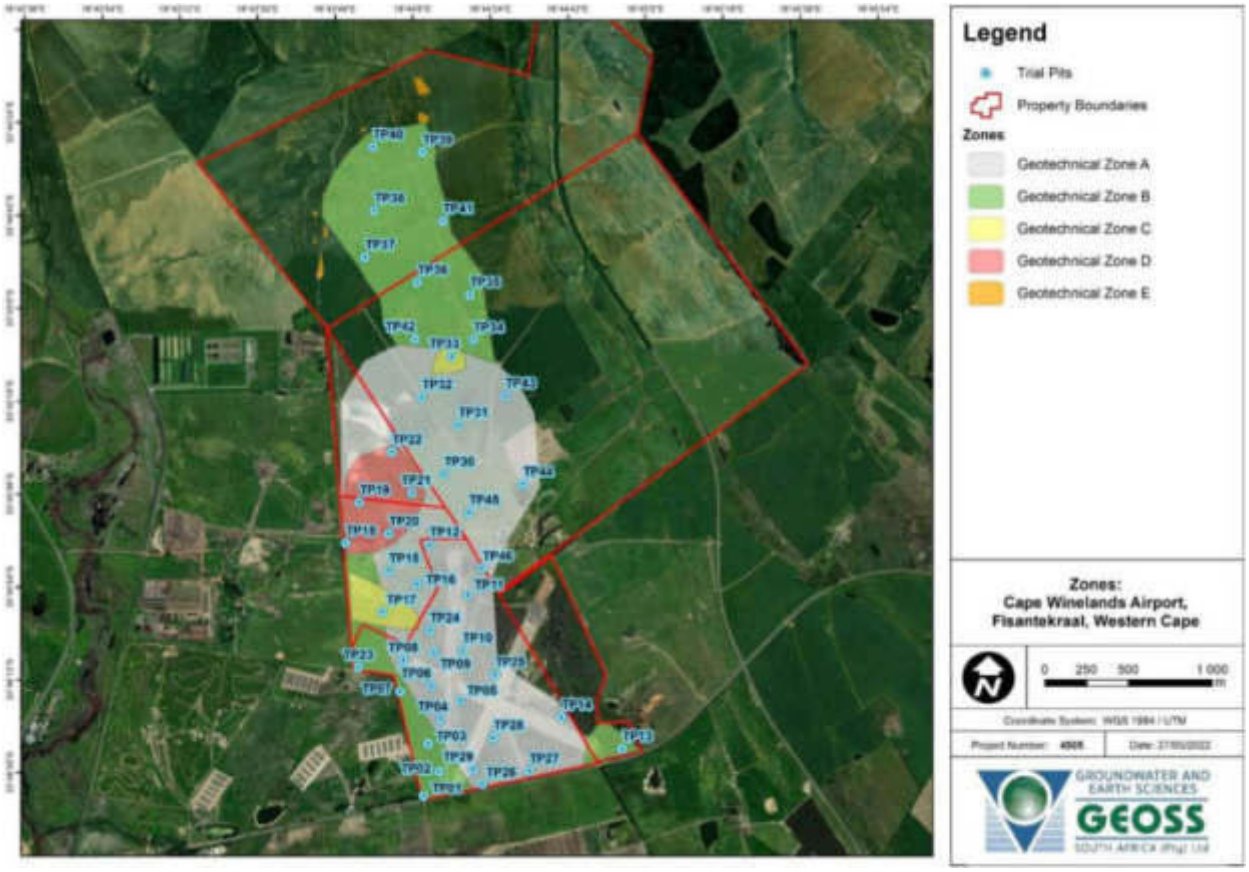

Figure 3: Geotechnical Investigation Zones

The predominant ground profiles present on site are summarized as:

- The upper layer of soils generally consists of a between 500mm and 900mm of slightly voided very loose to medium dense sand to gravelly sand (Transported/hillwash).
- The pedogenic materials encountered are described as medium dense to very dense partially cemented nodular to hardpan ferricrete in a sandy matrix.
- The sandy fine gravel materials encountered are described as a very loose to medium dense sandy fine gravel.
- The residual material encountered is generally described as a silty clay, medium dense to very dense silty sand or gravelly silty sand.
- A relatively shallow water table is expected, and it is likely that water seepage may be encountered during the wet season.

The Geotechnical Investigation can be found attached hereto as Appendix B – Geotechnical Investigation Report (GEOSS). The detailed stormwater management plan for each phase of the development should consider the specific geotechnical properties of each of the identified zones.

2.3 Existing Stormwater Infrastructure

There are no formal existing municipal stormwater infrastructure connections along the immediate boundaries of the site. The Cape Winelands Airport development is situated on a high point and a ridge is formed along the centre of the site splitting the flows in easterly and westerly directions resulting in various low points situated along the site boundary. Due to the natural low points situated across the site, it was necessary to maintain the eight natural outfall locations which discharge stormwater from the Cape Winelands Airport site.

The clearly defined watercourses noted along the eastern and western boundaries of the site were assessed as part of the Flood Risk Assessment which is attached hereto as Appendix C – Flood Risk Assessment Report.

The proposed future Bella Riva development is situated to the west of the proposed Cape Winelands Airport. After assessing the SWMP prepared for the Bella Riva development we can confirm that the Bella Riva development will account for a portion of the Cape Winelands pre-development flows – for further detail pertaining to the Bella Riva Stormwater Management Plan reference can be made to Appendix D. It is proposed that the Cape Winelands Airport development discharges stormwater from the detention pond (Pond 2 / Outfall 2) into the future proposed Bella Riva stormwater infrastructure as can be seen on Figure 4 below. Furthermore, reference can be made to Figure 7 below for an overview of the Pond / Outfall numbers.

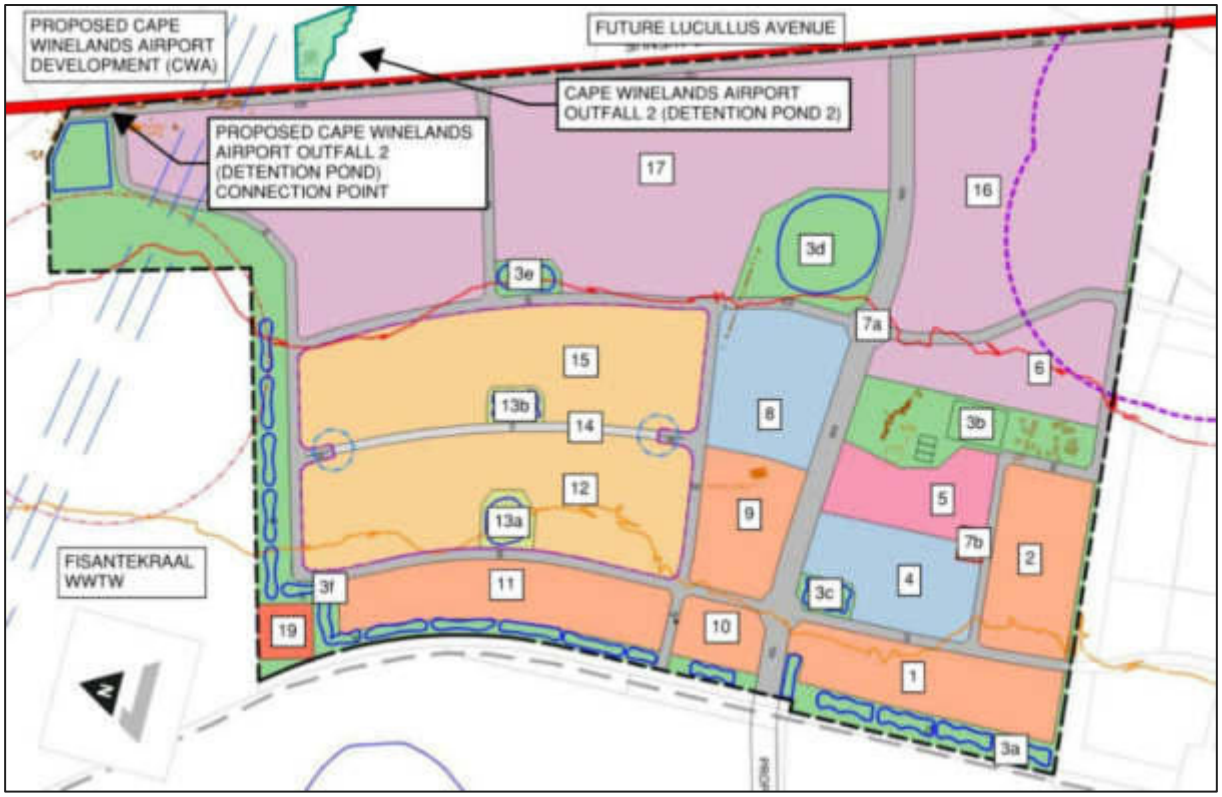

Figure 4: Bella Riva Future Development Layout

The detailed Cape Winelands Airport Stormwater Management Plan will include further detail pertaining to the measures and mitigations required to ensure the protection of the existing environment and avoid erosion.

2.4 Environmental Authorisations

The Cape Winelands Airport company has appointed independent environmental consultants to undertake an environmental process and the associated public participation requirements, as stipulated in the Environmental Conservation Act, 1989 (Act No. 73 of 1989) (ECA) and the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) for the authorisation of the Cape Winelands Airport (CWA) development.

The Environmental Impact Assessment (EIA) for the proposed Cape Winelands Airport development is currently in the Pre-application Scoping Phase and the initial 30 day public participation period has closed. The required public meeting was concluded. Upon completion of the Concept Stormwater Management Plan, a formal application will be lodged, and the statutory in-process Scoping Phase will commence.

A Water Use Licence Application (WULA) is also required in terms of the Water Act of 1998, for the storage of water, construction of infrastructure within wetlands and rivers, storage of stormwater and discharge of stormwater from the Cape Winelands Airport development.

2.5 Interaction with Freshwater Ecologist

A Freshwater Ecology Impact Assessment Report was compiled by FEN Consulting (Pty) Ltd as part of the Environmental Impact Assessment (EIA) and Water Use Authorisation (WUA) processes for the proposed Cape Winelands Airport development.

This assessment identified numerous freshwater ecosystems within the proposed Cape Winelands Airport's development extent as well as the investigation area (defined as a 500m radius around the proposed Cape Winelands Airport development). These freshwater ecosystems include a combination of seep wetlands; and channelled valley bottom (CVB) wetlands as can be seen below on Figure 5.

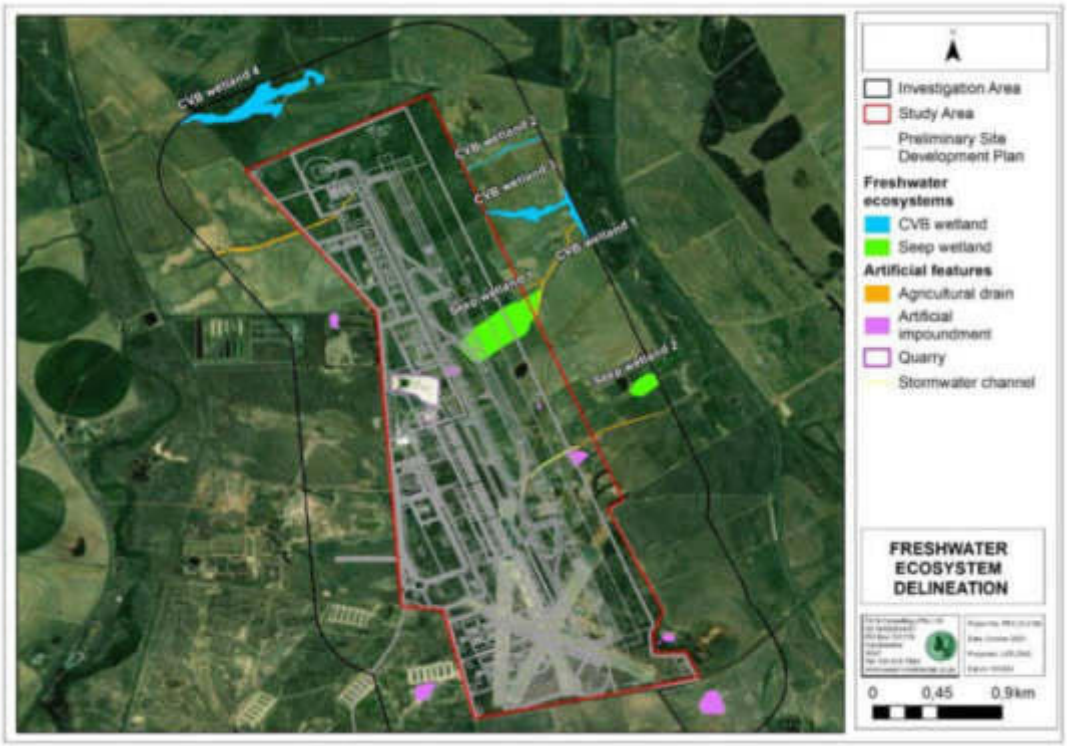

Figure 5: Aquatic Ecosystem Layout

Further to the above, the Freshwater Ecologist's Impact Assessment Report details the potential design, construction and operational impacts of the development and corresponding recommended monitoring and mitigation measures required to limit the impact of the development on the aquatic ecosystem.

The recommendations and rehabilitation measures summarised below are contained in the Freshwater Ecologists Impact Assessment report in order to reduce the risks of the development to a low negative significance:

- Construction work, particularly within the 15 m construction conservation buffer of the wetlands, must as far as possible be restricted to the dry, summer season. Channelled valley bottom Wetlands 2 and 3 and the remainder of Seep Wetland 1 where development will not occur, as well as the wetlands' 15 m construction phase conservation buffers must be marked as a no-go areas during the construction phase of the proposed development.
- Sediment trapping devices must be utilised downstream of where works are to be undertaken within seep wetland 1.
- Under no circumstances must linear infrastructure be trenched within the channelled valley bottom Wetlands 2 and 3 or their conservation buffers. Design plans must reconsider the layout of the water pipelines and fences to avoid these wetlands.
- Any fences which are to traverse the channelled valley bottom Wetlands 2 and 3 must be installed in such a way that hydro pedological processes are not impeded within these systems. It is recommended that the erection of fence posts within the channelled valley bottom Wetlands 2 and 3 are avoided.
- Stormwater attenuation ponds must be designed and landscaped in accordance with a Stormwater Management Plan with input from a Landscape and Open Space Planning consultant as well as a Freshwater Ecologist. All stormwater infrastructure must be incorporated into the Stormwater Management Plan.
- For the construction of the maintenance road along the eastern boundary of the study area, it is recommended that culverts be installed to allow the passage of water from the upstream portions of the channelled valley bottom Wetlands 2 and 3 to the downgradient portions. Any disturbed areas within these wetlands must be rehabilitated on completion of construction of the road. Cobbles are to be placed downstream of the maintenance road to trap sediment and reduce flow velocity of surface water entering the wetlands. The maintenance road should ideally avoid seep wetland 1 and circumvent it to avoid further fragmentation of the wetland. Should this not be possible, the road must be designed in such a manner as to allow hydraulic and hydro pedological process connectivity in the landscape while also allowing fauna to traverse the roadway.
- Disturbed areas related to the maintenance road and fences which will traverse the channelled valley bottom Wetlands 2 and 3 must be rehabilitated once construction activities have ceased.
- Control measures related to trenching and stockpiling activities must be strictly implemented.
- A monitoring programme must be implemented to detect and prevent the pollution of soils, surface water and groundwater.
- Wetlands that will be impacted by the proposed Cape Winelands Airport development must be monitored and where possible improved. An offset plan is being compiled by FEN Consulting which will outline an appropriate monitoring approach.
- A Service Infrastructure Management Plan is to be compiled which details the frequency in which service infrastructure, particularly the sewer and water treatment plants and sewer conveyance infrastructure must be serviced. This will assist in the prevention of leakages and bursting of the sewer infrastructure.
- An emergency plan must be compiled to ensure a quick response and attendance to the matter in case of a leakage or bursting of a pipeline or overtopping of sewage at the treatment plant.

This Concept Stormwater Management Plan therefore incorporates the recommendations pertaining to stormwater from both the freshwater ecologist and the environmental representatives and were used as such to shape the design of the stormwater system and control measures. For further context and detail to the above listed measures the Freshwater Ecologists Impact Assessment Report should be read in conjunction with this Concept Stormwater Management Plan. Due to the length of the Freshwater EIA Report, a draft version can be made available upon request.

2.6 Site Development Plan

The Cape Winelands Airport development is a commercial airport which entails the redevelopment of the existing Fisantekraal Aerodrome. The proposed Site Development Plan that informs this Concept Stormwater Management Plan is shown below in Figure 6. The proposed development consists of combination of interconnecting roads leading to the runways, taxiways, terminal building, hangers, workshops, hotels, administration buildings and commercial buildings.

The latest Site Development Plan is attached hereto as part of Appendix A – Drawings.

Figure 6: Site Development Plan (PAL 4 Ultimate Scheme)

2.7 Proposed Phasing

The proposed Cape Winelands Airport development is envisaged to be constructed in two phases based on conceptual information available at this stage. When the detailed design commences, the developer will be required to submit a detailed Stormwater Management Plan for each phase demonstrating compliance with the Concept Stormwater Masterplan and the CoCT policy requirements are achieved and satisfied.

The detailed Cape Winelands Airport Stormwater Management Plan will include further detail pertaining to the development phasing plan once layouts are made available.

3 Policy Requirements and City of Cape Town Engagement

3.1 Background

This concept Stormwater Management Plan describes the approach used for the design of the stormwater infrastructure for the Cape Winelands Airport development. The purpose is to describe how the proposed stormwater management infrastructure will achieve the requirements stipulated in the applicable policies. Urbanisation typically impacts on natural waterway health in two key areas:

- The quantity of stormwater runoff is increased as the proportion of impervious area within a catchment is increased, leading to larger peak flows and more frequent runoff which may have detrimental effects on river health and can cause flooding in downstream areas.
- The quality of runoff is also negatively impacted with additional pollutant loads in the form of gross pollutants, suspended sediments, and various other pollutants such as nitrogen, phosphorus, and heavy metals.

The Management of Urban Stormwater Impacts Policy has been prepared by the CCT CSRM Branch to address these stormwater impacts and ensures that new developments incorporate Water Sensitive Urban Design elements.

3.2 Policy Requirements

The Cape Winelands Airport site is categorised as a Brownfields Development. To achieve the stormwater management objectives mentioned above, the CCT recommends the following criteria for a Brownfields Development Site (> 50 000m^2) by means of on-site facilities:

A. Improve quality of runoff
    - Design storm event: 0.5-year Recurrence Interval (RI), 24-hour storm.
    - Pollutants removal target: SS – 80%, TP – 45%.

B. Control quantity and rate of runoff
    - 24 hour extended detention of 1-year Recurrence Interval (RI), 24-hour storm.
    - Up to 10-year RI storm peak flow reduced to pre-development level.
    - Up to 50-year RI storm peak flow reduced to existing development level.
    - Evaluate the effects of the 100-year RI storm event.

C. Encourage natural groundwater recharge
    - As and where possible and appropriate on the development site.

3.3 Interaction with City of Cape Town officials and departures from Policy

A number of interactions have taken place between Zutari and the CCT officials since commencement of the development of this Concept Stormwater Management Plan. These include:

- 9th April 2024 – An introductory meeting between Zutari's Carshif Talip, Ashley van der Nest, Marno Pretorius and the CCT's Johann Terblanche, Willem Burger, Motlatsi Nkhoesa, Kloey Bam, Willie Liebenberg, and Stefan De Villiers.
    - This meeting was arranged to provide an introductory overview of the project, objectives, concept, and proposed timelines of the project to Mr Johann Terblanche. This platform was also used to discuss various pertinent items regarding stormwater management within the catchment as well as other project related matters.

4 Proposed Stormwater Management Measures

4.1 Design Overview

The proposed stormwater drainage network is based on a dual stormwater system, consisting of a major and a minor network, conveying stormwater generated on site via pipes and overland flow routes into seven (7) dry attenuation ponds with engineered layerworks and one (1) wet detention pond, positioned at strategic locations along the proposed Cape Winelands Airport development site boundary.

The basic stormwater design principles used to inform the concept design of stormwater infrastructure for the Cape Winelands Airport site can be best described as follows:

- The natural drainage direction of stormwater of the site will remain unchanged as the site generally falls in a south to north direction with outfalls positioned strategically along the eastern and western boundaries.
- The minor system will comprise of open drains, an underground piped network complete with channels, inlet catchpits, oil separators, manholes and outlet structures sized to accommodate stormwater runoff from the roads, buildings, and other hard surfaced area for at least minor storm events up to the 1:5-year RI storm.
- The major system will comprise of roads and on-site overland flow paths which will operate in conjunction with the minor system to accommodate stormwater runoff from roofs and other hard surfaced areas for major storm events up to and including the 1:50-year RI storm.
    - The design levels allow for on-site overland flow routes in the event of a blockage or failure of the minor system.
- Where no on-site overland flow paths exist to accommodate run-off from major storm events, the underground piped network will be sized to accommodate run-off for major storm events (up to the 1:50 year).
- The overland flow routes on the Cape Winelands Airport site are designed to safely convey the 1:100-year storm event towards the ponds situated along the boundary of the site. From there formal overland escape routes, in the form of pond overflows, will be designed to convey peak runoff from the 1:100-year storm which cannot be handled by the above proposed stormwater system before discharging into the adjacent infrastructure.

4.2 Required Site Area

The adopted rainfall depths used were extrapolated from the CCT rainfall grids. The 24-hour 0.5-year RI storm rainfall is 20.1mm with the area of the Cape Winelands Airport site equating to ±430 ha for the calculation. The calculated Water Quality Volume (WQv) is calculated to be approximately 37.82ML. See 4.5.2 below for the detailed calculations.

To accommodate the required treatment of this volume, the following Low Impact Developments (LID's) will be implemented as detailed in Table 1 below:

BMP's	BMP	Approximate Surface Area (m^2)	Depth (m)	Recurrence Interval (Years)	Attenuation Volume (m^3)
Pond 1	Dry Attenuation Pond	7,000	2.0	1:50 Year RI	10,800
Pond 2	Wet Detention Pond	28,000	5.0	1:50 Year RI	95,000
Pond 3	Dry Attenuation Pond	5,700	2.0	1:50 Year RI	9,600
Pond 4	Dry Attenuation Pond	1,800	1.5	1:50 Year RI	2,100

Pond 5	Dry Attenuation Pond	6,300	2.0	1:50 Year RI	10,800
Pond 6	Dry Attenuation Pond	500	1.0	1:50 Year RI	350
Pond 7	Dry Attenuation Pond	1,150	1.5	1:50 Year RI	1,550
Pond 8	Dry Attenuation Pond	2,700	2.0	1:50 Year RI	4,200
Swale 9	Dry Swales	15,000	1.0	1:50 Year RI	9,000

Table 1: Proposed Low Impact Developments (LID)

The proposed areas identified for the low impact developments (LID's) can be seen in Figure 7 below.

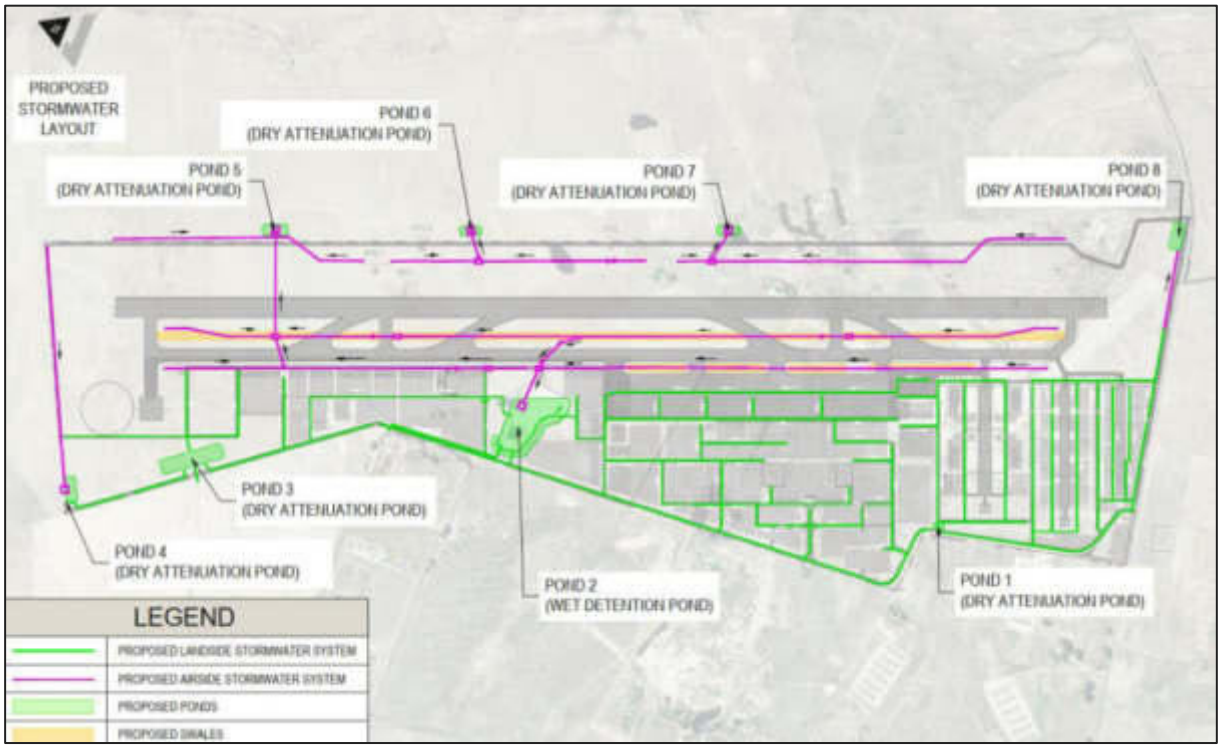

Figure 7: Proposed Areas Identified for LIDs

4.3 Best Management Practices (BMP's)

4.3.1 Dry Attenuation Pond with Engineered Layerworks

As previously mentioned, it is proposed that all stormwater generated on the Cape Winelands Airport site be conveyed into seven (7) dry attenuation ponds and one (1) wet detention pond strategically positioned around the development. These ponds will be designed to attenuate up to the 1:50-year post development flows. Treatment of stormwater run-off conveyed to the ponds will mainly be achieved through the dry pond infiltration layerworks relying on filtration to reduce waterborne pollutant concentration through sedimentation, filtration, and plant uptake of nutrients.

According to Armitage *et.al.* (2013), the potential pollutant removal rate for a dry attenuation pond with engineered layerworks is:

- Nutrient Removal Rate (TP): 40% - 50%
- Sediment Removal Rate (TSS): 50% - 80%

The proposed dry attenuation pond with engineered layerworks consists of the following:

- **Filter Media:** A mix of sand and loam which removes the runoff pollutants and supports the vegetation on the surface. This layer will be 100mm deep.
- **Transition Layer:** Located under the filter media, contains coarse sand which prevents the movement of finer particles from the top layer to pass through to the drainage layer. This layer also aids in preventing clogging of the drainage layer. This may be replaced with a Geotextile wrapping as approved by the Engineer. This layer will have a depth of 300mm.
- **Drainage Layer:** This layer is in fact a system which consists of a 19mm stone layer and a 110mm perforated sub-soil pipe that collects and conveys water into the proposed stormwater variable outlet structure. This layer will have a depth of 200mm.

Typical details of the dry attenuation pond engineered layerworks can be seen below in Figure 8: Typical Dry Attenuation Pond Engineered Layerworks.

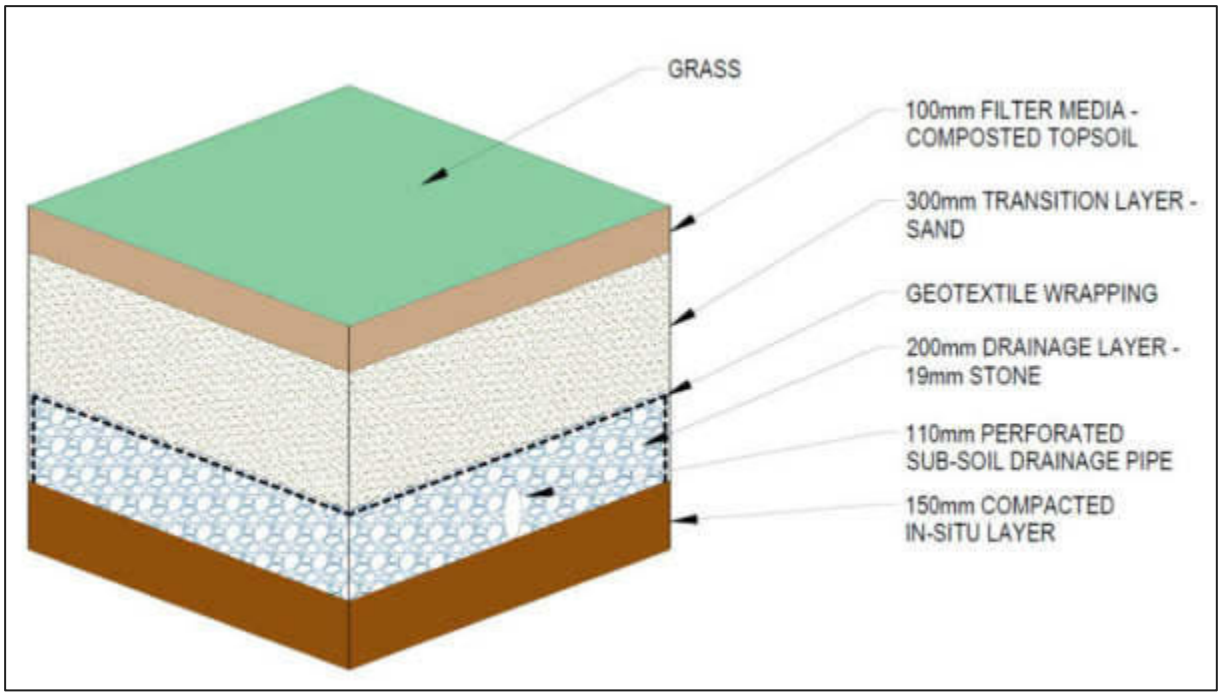

Figure 8: Typical Dry Attenuation Pond Engineered Layerworks

4.3.2 Dry Swale with Engineered Layerworks

Runoff from the Cape Winelands Airport runway and taxiways will be directed overland to landscaped areas. As can be seen on Figure 7 above, selected landscaped areas will consist of landscaped swales which then drain towards localised detention ponds and wetland areas.

The swales provide both stormwater treatment and conveyance functions, combining a bioretention system installed in the base of the swale which is designed to convey stormwater. The swale component provides pre-treatment of stormwater to remove coarse to medium sediments while the bioretention system removes finer particulates and associated contaminants.

The swales also provide a form of flow retardation for frequent storm events and are particularly efficient at removing nutrients. The swale treatment process operates by filtering stormwater runoff through surface of the swale and then percolating the runoff through a prescribed filter media, forming the bioretention component which provides treatment through fine filtration, extended detention treatment and some biological uptake.

Typically, the swale is underlain by a formalised piped drainage network which usually conveys stormwater from within the development to a swale outfall, as shown in Figure 9 below.

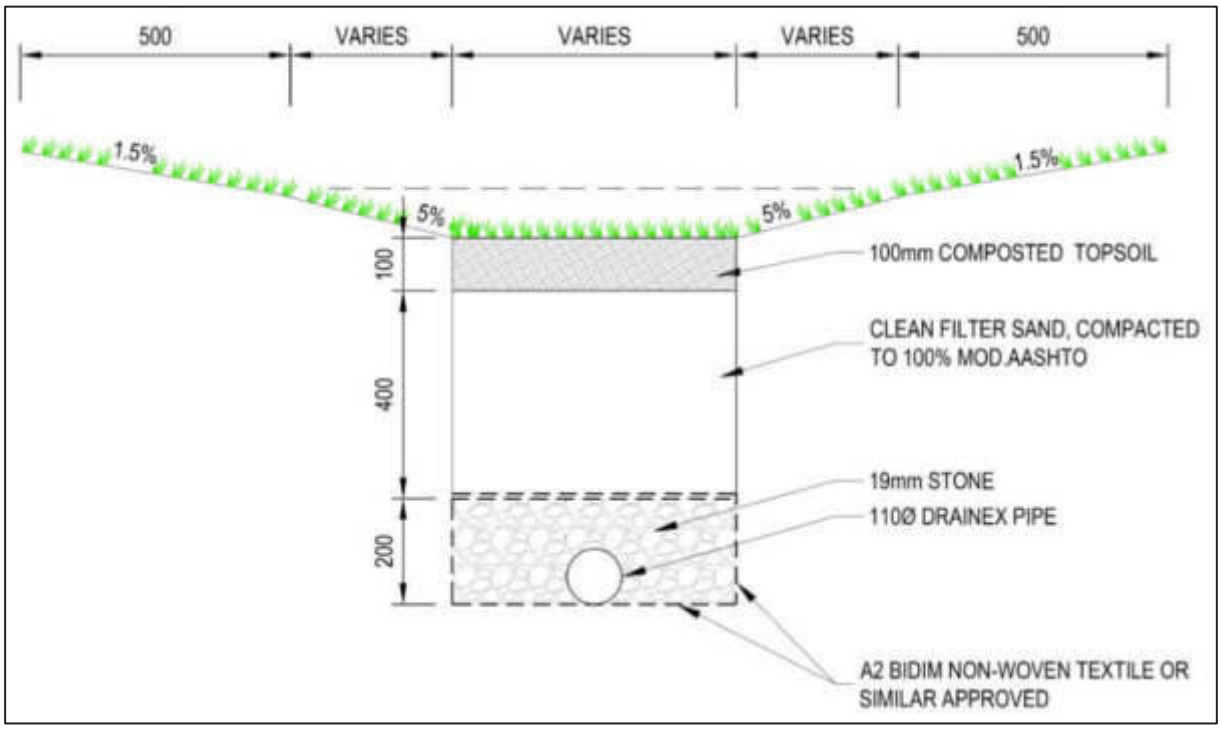

Figure 9: Typical Cross-Section of Dry Swale

4.3.3 Wet Detention Pond

Stormwater runoff generated by the catchment areas situated to the West of the site, which is not infiltrated into the dry swales, will be conveyed to the wet detention pond (Pond 2 / Outfall 2). The wet detention pond will operate in a similar manner to the dry swales when it comes to treatment of runoff, however besides treatment, the wet detention pond will serve a key function for attenuation on the site. Pond 2 / Outfall 2 has been designed with a formalised variable outlet structure which will release peak flows from the various Recurrence Interval storms.

The design of the wet detention pond is based on the following:

- The bottom of the existing Quarry is to be filled up to an invert level of 105.00masl
- The permanent water level is assumed to be at 107.5masl (Which equates to an initial depth of 2.5m from the new invert of the pond)
- Inlet headwall is at 108.25masl
- Variable outlet structure
    - Orifice 1 = 108.00masl
    - Orifice 2 = 108.25masl
    - Orifice 3 = 108.75masl
    - Orifice 4 = 109.50masl
- Overflow level into the proposed Lucullus Road extension is at 110.30masl

The conceptual design of the proposed wet detention pond at Outfall 2 can be seen shown in Figure 10 below:

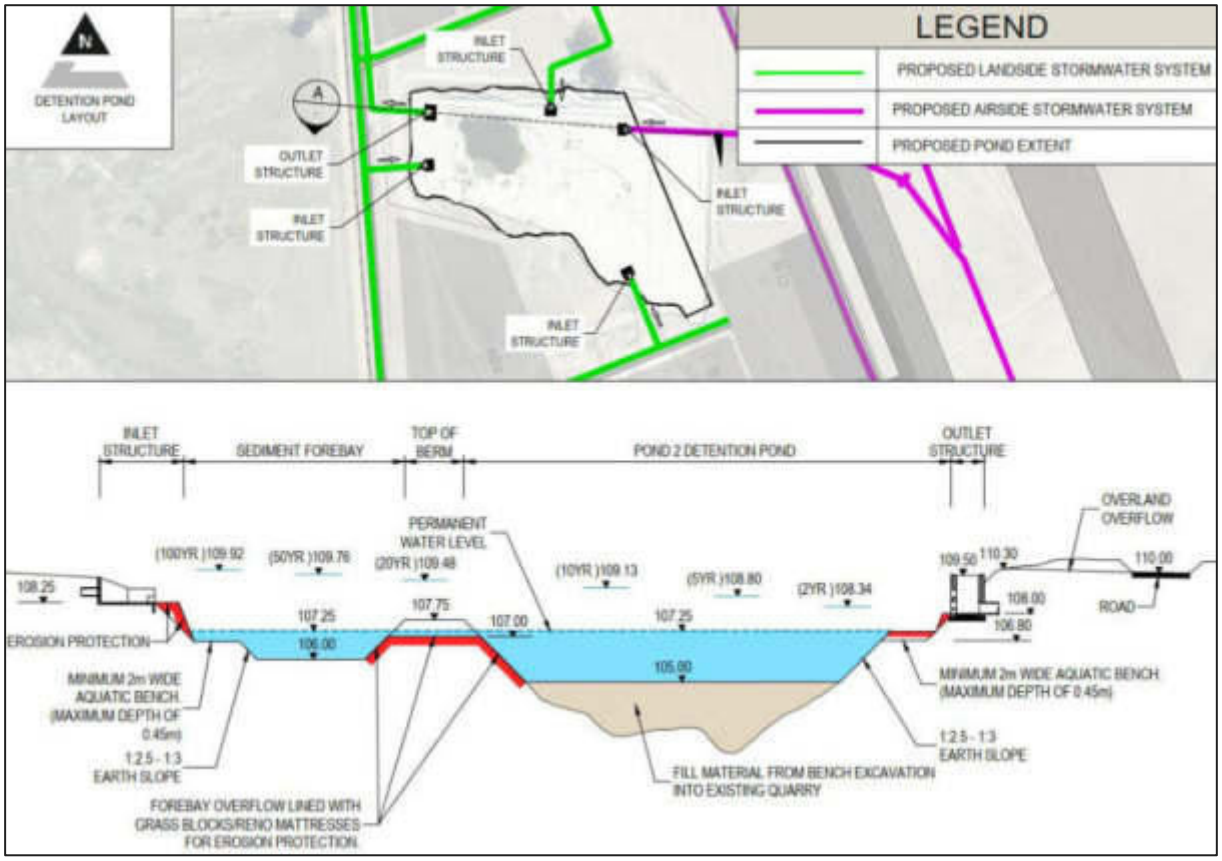

Figure 10: Typical Cross section of the Wet Detention Pond

Figure 11 below depicts a typical inlet structure for the Cape Winelands Airport and Figure 12 shows a typical variable outlet structure discharging flow from the pond.

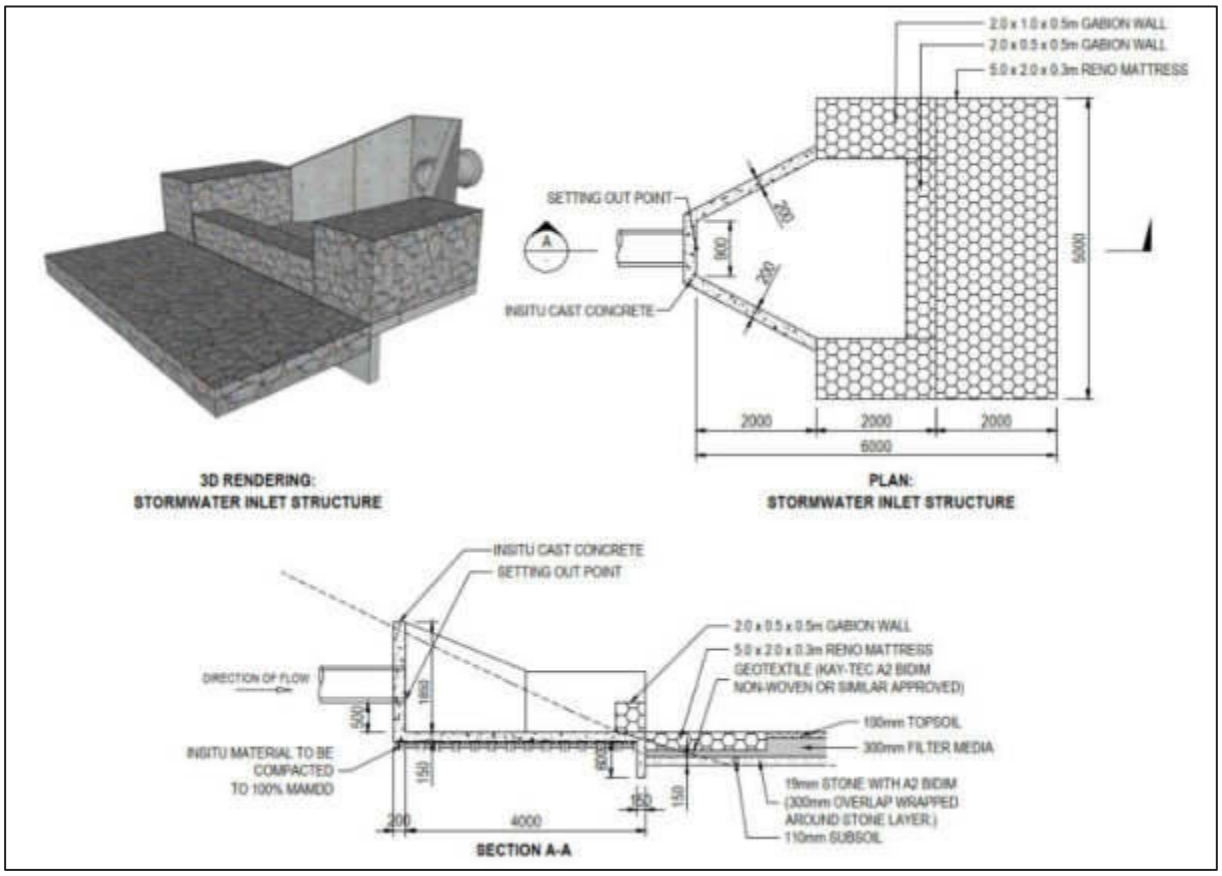

Figure 11: Wet Detention Pond – Typical Pond Inlet Structure

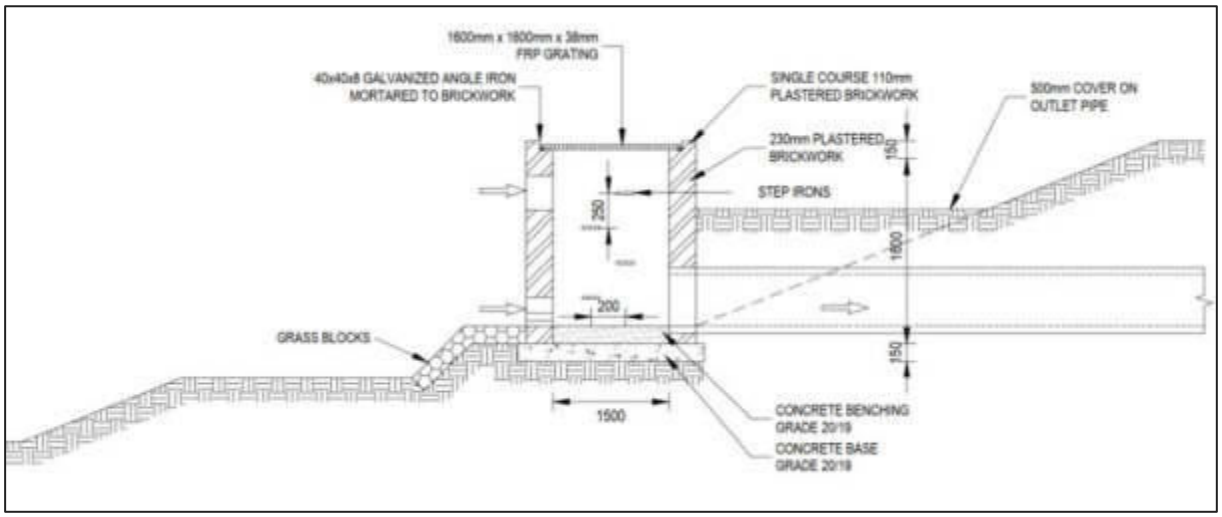

Figure 12: Wet Detention Pond – Typical Variable Outlet Structure

4.4 Calculation of Stormwater Runoff

The stormwater management concepts were investigated using the Personal Computer Stormwater Management Model (PCSWMM) software. The modelling was used to develop pre-development and post-development models to compare the status quo with the proposed Cape Winelands Airport site's ultimate state, and to interpret and analyse the stormwater management interventions considered.

The overall site is categorized as a Brownfields Development. Although the generation of additional hard surfaces is expected due to the development, a combination of stormwater management control systems will ensure that the peak runoff volumes discharged from the Cape Winelands Airport is below pre-development levels to mitigate any negative impacts on adjacent properties.

Three scenarios were modelled:

- 0.5-year storm event – to address treatment requirements.
- 1-year extended detention – to address attenuation requirements.
- Larger storm events – to address attenuation requirements.

Stormwater runoff was calculated using the "PCSWMM 2017 2D Professional" software package.

An extract of the relevant PCSWMM model simulation output data is attached hereto as Appendix E – PCSWMM Model Simulation Output Results. Additional data is available on request.

4.4.1 Rainfall Data and Simulation of Storm Events

Various design storms (South Africa, 24h SCS Type 2) were created and simulated based on the rainfall data and storm distributions as shown in Table 2: City of Cape Town Rainfall Depths from CCT Climate Grid below. Rainfall data from the City of Cape Town's Rainfall Grid RP2 200 Climate Change is used to create storm events for return intervals from 2 year to 100 year storms, while rainfall data for the 0.5 year and 1-year storms were extrapolated from the Rainfall Grid.

Source of Rainfall Information	**Recurrence Interval (years) / Storm Rainfall (mm)**							
	0.5yr	**1yr**	**2yr**	**5yr**	**10yr**	**20yr**	**50yr**	**100yr**
CCT Rainfall Grid RP2 200 (15% Added for Climate Change)	20.1	32.9	44.9	60.3	71.4	83.0	99.4	112.7

Table 2: City of Cape Town Rainfall Depths from CCT Climate Grid

4.4.2 Pre-Development Runoff

To simulate the stormwater runoff for the various storm-events, sub-catchment parameters were determined for pre-development simulations as can be seen below in Figure 13. The sub-catchment parameters are summarised below in Table 3:

Sub-Catchment Parameters	Cape Winelands Airport (Pre-Development)
Area (ha)	430
Width (m)	Varies
Length (m)	Varies
% Impervious Area	Varies per catchment
"n" Impervious Area	0.02
"n" Pervious Area	0.05
Depression Storage Impervious Area (mm)	2
Depression Storage Pervious Area (mm)	5
Modified Green and Ampt Soil Parameters for Texture Class Sand (Rawls *et al.*, 1983)	
Suction Head (mm)	49.02
Conductivity (mm/hr)	120.34
Initial Deficit (frac.)	0.413

Table 3: Typical PCSWMM Pre-development Model Sub-Catchment Parameters

The pre-development peak runoff volumes are summarised in Table 4 below:

Pre-Development (Brownfields) Peak Volumes (m^3/s) - Recurrence Interval (Years)					
Outfall	**2yr**	**5yr**	**10yr**	**20yr**	**50yr**
Pond 1	0.350	0.492	0.596	0.706	0.873
Pond 2	1.085	1.520	1.838	2.174	2.654
Pond 3	0.243	0.334	0.400	0.469	0.567
Pond 4	0.238	0.330	0.396	0.466	0.565
Pond 5	0.470	0.642	0.767	0.897	1.082
Pond 6	0.289	0.396	0.473	0.553	0.668
Pond 7	1.691	2.392	2.909	3.457	4.245
Pond 8	0.189	0.256	0.304	0.356	0.428
Cape Winelands Airport Site Overall Total	**4.555**	**6.362**	**7.683**	**9.078**	**11.082**

Table 4: Pre-development Peak Runoff Volumes

The Pre-Development Scenario and subdivision of the various sub-catchments can be seen in Figure 13 below:

Figure 13: Pre-Development Scenario

The Pre-Development scenario and sub-catchments parameters can be seen in Table 5 below.

Pre-Development Scenario (Existing Development)											
Name	Description	Area (ha)	Width (m)	Flow Length (m)	Slope (%)	Imperv. (%)	N Imperv	N Perv	Dstore Imperv (mm)	Dstore Perv (mm)	Zero Imperv (%)
S1	Pre-Dev	66.8069	445.608	1499.2	2.8	10	0.02	0.05	2	5	25
S1_1	Pre-Dev	32.001	206.458	1550.0	0.5	10	0.02	0.05	2	5	25
S10_1	Pre-Dev	98.8727	429.881	2300.0	3.5	10	0.02	0.05	2	5	25
S11_1	Pre-Dev	36.311	290.488	1250.0	2.8	5	0.02	0.05	2	5	25
S12_1	Pre-Dev	58.7382	533.983	1100.0	2.3	5	0.02	0.05	2	5	25
S16_1	Pre-Dev	1.9185	38.37	500.0	1	5	0.02	0.05	2	5	25
S2	Pre-Dev	31.6982	176.124	1799.8	2.5	5	0.02	0.05	2	5	25
S5_1	Pre-Dev	12.584	96.8	1300.0	2.8	10	0.02	0.05	2	5	25
S6_1	Pre-Dev	31.1301	222.358	1400.0	2.5	5	0.02	0.05	2	5	25
S8_1	Pre-Dev	20.9606	220.638	950.0	3.5	5	0.02	0.05	2	5	25
S9_1	Pre-Dev	32.3893	185.082	1750.0	3.5	10	0.02	0.05	2	5	25

Table 5: PCSWMM Pre-Development Model Catchment Parameter Summary

4.4.3 Post-Development Runoff

To accurately model run-off from various areas on site for the Post-Development Scenario, the site was subdivided into various sub-catchments. This sub-division was based on surface type and various other geometric constraints. The post development sub-catchment parameters are summarised below in Table 6:

Sub-Catchment Parameters	**Cape Winelands Airport (Post-Development)**
Area (ha)	430
Width (m)	Varies
Length (m)	Varies
"n" Impervious Area	0.014 (roof) 0.014 (asphalt) 0.014 (Other – Paved / Concrete Hardstand)
"n" Pervious Area	0.05
Slope (%)	Varies
Depression Storage Impervious Area (mm)	2
Depression Storage Pervious Area (mm)	5
Modified Green and Ampt Soil Parameters for Texture Sand (Rawls *et al.*, 1983)	
Suction Head (mm)	49.02
Conductivity (mm/hr)	120.34
Initial Deficit (frac.)	0.413

Table 6: Typical PCSWMM Post-development Model Sub-Catchment Parameters

The post-development peak un-attenuated runoff volumes for the development are summarised in Table 7 below.

Post-Development Peak Un-Attenuated Volumes (m^3/s) - Recurrence Interval (Years)					
Outfall	**2yr**	**5yr**	**10yr**	**20yr**	**50yr**
Pond 1	2.419	3.379	4.059	4.748	5.570
Pond 2	8.289	11.713	14.334	17.135	21.416
Pond 3	2.116	2.959	3.582	4.235	5.212
Pond 4	0.106	0.148	0.179	0.212	0.259
Pond 5	1.763	2.553	3.099	3.563	3.850
Pond 6	0.099	0.144	0.177	0.213	0.265
Pond 7	0.322	0.465	0.571	0.683	0.844
Pond 8	0.639	0.933	1.155	1.395	1.738
Cape Winelands Airport Site Overall Total	**15.753**	**22.294**	**27.156**	**32.184**	**39.154**

Table 7: Post-development Peak Un-Attenuated Runoff Volumes

The Post-Development Scenario and subdivision of the various sub-catchments can be seen in Figure 14 below:

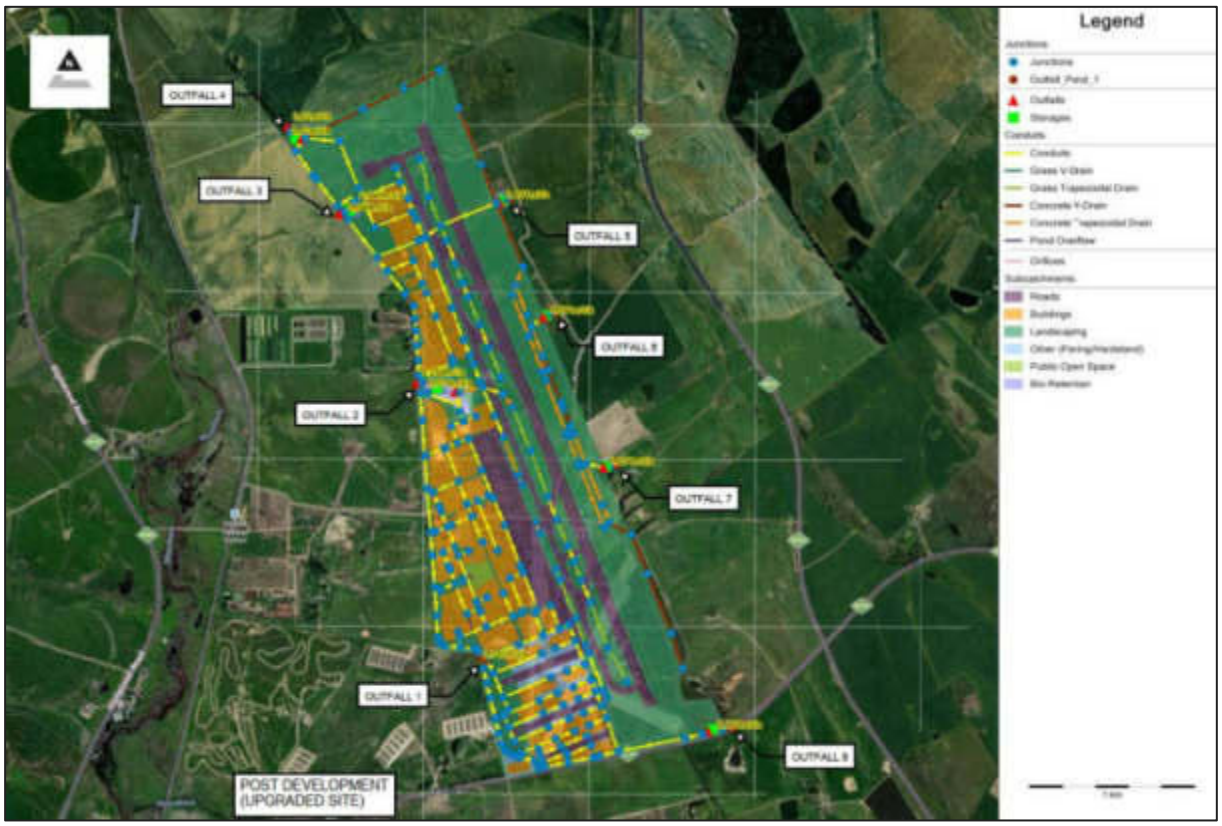

Figure 14: Post-Development Scenario

The Post-Development scenario and sub-catchments parameters can be seen in Table 8 below:

Name	Description	Area (ha)	Width (m)	Flow Length (m)	Slope (%)	Imperv. (%)	N Imperv	N Perv	Dstore Imperv (mm)	Dstore Perv (mm)	Zero Imperv (%)
S136_1	Building	0.8716	87.16	100.0	0.5	100	0.014	0.05	2	5	50
S136_3	Building	0.5861	58.61	100.0	0.5	100	0.014	0.05	2	5	50
S136_4	Building	1.1421	114.21	100.0	0.5	100	0.014	0.05	2	5	50
S136_5	Building	1.7665	176.65	100.0	0.5	100	0.014	0.05	2	5	50
S824_1	Building	0.5428	54.28	100.0	0.5	100	0.014	0.05	2	5	50
S824_2	Building	1.3202	132.02	100.0	0.5	100	0.014	0.05	2	5	50
S825	Building	1.2328	123.28	100.0	0.5	100	0.014	0.05	2	5	50
S826	Building	1.959	122.438	160.0	0.5	100	0.014	0.05	2	5	50
S827	Building	0.044	4.4	100.0	0.5	100	0.014	0.05	2	5	50
S828	Building	1.8348	131.057	140.0	0.5	100	0.014	0.05	2	5	50
S829	Building	0.1827	30.45	60.0	0.5	100	0.014	0.05	2	5	50
S830	Building	0.325	46.429	70.0	0.5	100	0.014	0.05	2	5	50
S831_1	Building	0.967	96.7	100.0	0.5	100	0.014	0.05	2	5	50
S831_2	Building	0.9844	98.44	100.0	0.5	100	0.014	0.05	2	5	50
S832_1	Building	0.7294	72.94	100.0	0.5	100	0.014	0.05	2	5	50
S832_2	Building	1.525	152.5	100.0	0.5	100	0.014	0.05	2	5	50
S833	Building	3.3216	332.16	100.0	0.5	100	0.014	0.05	2	5	50
S834	Building	0.046	4.6	100.0	0.5	100	0.014	0.05	2	5	50
S835_1	Building	0.2346	23.46	100.0	0.5	100	0.014	0.05	2	5	50
S835_2	Building	0.5313	53.13	100.0	0.5	100	0.014	0.05	2	5	50
S836_1	Building	0.5395	53.95	100.0	0.5	100	0.014	0.05	2	5	50
S836_2	Building	0.5775	57.75	100.0	0.5	100	0.014	0.05	2	5	50
S837_1	Building	0.4918	49.18	100.0	0.5	100	0.014	0.05	2	5	50
S837_2	Building	0.4226	42.26	100.0	0.5	100	0.014	0.05	2	5	50
S838_1	Building	0.4154	41.54	100.0	0.5	100	0.014	0.05	2	5	50
S838_2	Building	0.4921	49.21	100.0	0.5	100	0.014	0.05	2	5	50
S839	Building	1.7435	174.35	100.0	0.5	100	0.014	0.05	2	5	50
S840	Building	1.4043	140.43	100.0	0.5	100	0.014	0.05	2	5	50

Name	Description	Area (ha)	Width (m)	Flow Length (m)	Slope (%)	Imperv. (%)	N Imperv	N Perv	Dstore Imperv (mm)	Dstore Perv (mm)	Zero Imperv (%)
S841	Building	0.35	35	100.0	0.5	100	0.014	0.05	2	5	50
S842	Building	0.2623	43.717	60.0	0.5	100	0.014	0.05	2	5	50
S843	Building	0.7544	94.3	80.0	0.5	100	0.014	0.05	2	5	50
S844	Building	1.6538	165.38	100.0	0.5	100	0.014	0.05	2	5	50
S845	Building	0.1999	24.988	80.0	0.5	100	0.014	0.05	2	5	50
S846	Building	1.1666	58.33	200.0	0.5	100	0.014	0.05	2	5	50
S847	Building	0.1725	34.5	50.0	0.5	100	0.014	0.05	2	5	50
S848	Building	0.1843	36.86	50.0	0.5	100	0.014	0.05	2	5	50
S849	Building	0.4468	44.68	100.0	0.5	100	0.014	0.05	2	5	50
S850	Building	0.7638	63.65	120.0	0.5	100	0.014	0.05	2	5	50
S851	Building	0.4126	41.26	100.0	0.5	100	0.014	0.05	2	5	50
S852_1	Building	1.2712	63.56	200.0	0.5	100	0.014	0.05	2	5	50
S852_2	Building	1.1488	57.44	200.0	0.5	100	0.014	0.05	2	5	50
S853	Building	0.06	30	20.0	0.5	100	0.014	0.05	2	5	50
S854	Building	0.941	94.1	100.0	0.5	100	0.014	0.05	2	5	50
S855	Building	0.2623	43.717	60.0	0.5	100	0.014	0.05	2	5	50
S856	Building	0.1999	24.988	80.0	0.5	100	0.014	0.05	2	5	50
S857_1	Building	0.5944	59.44	100.0	0.5	100	0.014	0.05	2	5	50
S857_2	Building	0.4931	49.31	100.0	0.5	100	0.014	0.05	2	5	50
S858_1	Building	0.7458	74.58	100.0	0.5	100	0.014	0.05	2	5	50
S858_2	Building	0.7087	70.87	100.0	0.5	100	0.014	0.05	2	5	50
S859	Building	0.8432	84.32	100.0	0.5	100	0.014	0.05	2	5	50
S860_1	Building	2.1968	219.68	100.0	0.5	100	0.014	0.05	2	5	50
S860_2	Building	0.8911	89.11	100.0	0.5	100	0.014	0.05	2	5	50
S861	Building	1.0992	109.92	100.0	0.5	100	0.014	0.05	2	5	50
S862	Building	0.1	10	100.0	0.5	100	0.014	0.05	2	5	50
S863	Building	0.1	10	100.0	0.5	100	0.014	0.05	2	5	50
S864	Building	0.125	12.5	100.0	0.5	100	0.014	0.05	2	5	50
S865	Building	0.125	12.5	100.0	0.5	100	0.014	0.05	2	5	50
S866	Building	0.125	12.5	100.0	0.5	100	0.014	0.05	2	5	50
S867	Building	0.25	25	100.0	0.5	100	0.014	0.05	2	5	50
S868_1	Building	0.481	48.1	100.0	0.5	100	0.014	0.05	2	5	50
S868_2	Building	0.4284	42.84	100.0	0.5	100	0.014	0.05	2	5	50
S869_1	Building	0.2381	23.81	100.0	0.5	100	0.014	0.05	2	5	50
S869_2	Building	0.2438	24.38	100.0	0.5	100	0.014	0.05	2	5	50
S870_1	Building	0.5659	56.59	100.0	0.5	100	0.014	0.05	2	5	50
S870_3	Building	0.5213	52.13	100.0	0.5	100	0.014	0.05	2	5	50
S870_4	Building	0.5905	59.05	100.0	0.5	100	0.014	0.05	2	5	50
S870_5	Building	0.6183	61.83	100.0	0.5	100	0.014	0.05	2	5	50
S871_1	Building	0.2174	21.74	100.0	0.5	100	0.014	0.05	2	5	50
S871_2	Building	0.5041	50.41	100.0	0.5	100	0.014	0.05	2	5	50
S872	Building	1.0041	100.41	100.0	0.5	100	0.014	0.05	2	5	50
S873	Building	0.64	64	100.0	0.5	100	0.014	0.05	2	5	50
S874	Building	0.9996	99.96	100.0	0.5	100	0.014	0.05	2	5	50
S875	Building	1.3594	135.94	100.0	0.5	100	0.014	0.05	2	5	50
S876_1	Building	0.8486	84.86	100.0	0.5	100	0.014	0.05	2	5	50
S876_2	Building	0.619	61.9	100.0	0.5	100	0.014	0.05	2	5	50
S876_3	Building	0.4886	48.86	100.0	0.5	100	0.014	0.05	2	5	50
S877_1	Building	0.4882	48.82	100.0	0.5	100	0.014	0.05	2	5	50
S877_2	Building	0.8587	85.87	100.0	0.5	100	0.014	0.05	2	5	50
S878	Building	0.5928	59.28	100.0	0.5	100	0.014	0.05	2	5	50
S879	Building	0.5569	69.612	80.0	0.5	100	0.014	0.05	2	5	50
S880	Building	0.9289	46.445	200.0	0.5	100	0.014	0.05	2	5	50
S881	Building	0.6308	31.54	200.0	0.5	100	0.014	0.05	2	5	50
S882	Building	0.591	29.55	200.0	0.5	100	0.014	0.05	2	5	50
S883_1	Building	1.3383	133.83	100.0	0.5	100	0.014	0.05	2	5	50
S883_2	Building	1.3698	136.98	100.0	0.5	100	0.014	0.05	2	5	50
S884	Building	0.7919	79.19	100.0	0.5	100	0.014	0.05	2	5	50

Name	Description	Area (ha)	Width (m)	Flow Length (m)	Slope (%)	Imperv. (%)	N Imperv	N Perv	Dstore Imperv (mm)	Dstore Perv (mm)	Zero Imperv (%)
S885	Building	0.622	62.2	100.0	0.5	100	0.014	0.05	2	5	50
S886	Building	0.7017	70.17	100.0	0.5	100	0.014	0.05	2	5	50
S887	Building	0.7017	70.17	100.0	0.5	100	0.014	0.05	2	5	50
S888	Building	0.622	62.2	100.0	0.5	100	0.014	0.05	2	5	50
S889	Building	0.7017	70.17	100.0	0.5	100	0.014	0.05	2	5	50
S890	Building	0.7017	70.17	100.0	0.5	100	0.014	0.05	2	5	50
S891_1	Building	1.1307	113.07	100.0	0.5	100	0.014	0.05	2	5	50
S891_3	Building	0.705	70.5	100.0	0.5	100	0.014	0.05	2	5	50
S891_4	Building	0.9408	94.08	100.0	0.5	100	0.014	0.05	2	5	50
S892_1	Building	1.1103	111.03	100.0	0.5	100	0.014	0.05	2	5	50
S892_3	Building	0.7257	72.57	100.0	0.5	100	0.014	0.05	2	5	50
S892_4	Building	0.9389	93.89	100.0	0.5	100	0.014	0.05	2	5	50
S893	Building	0.6315	50.52	125.0	0.5	100	0.014	0.05	2	5	50
S894_1	Building	0.7528	75.28	100.0	0.5	100	0.014	0.05	2	5	50
S894_2	Building	1.1102	111.02	100.0	0.5	100	0.014	0.05	2	5	50
S895	Building	0.4636	46.36	100.0	0.5	100	0.014	0.05	2	5	50
S896	Building	0.8512	85.12	100.0	0.5	100	0.014	0.05	2	5	50
S897	Building	0.5204	52.04	100.0	0.5	100	0.014	0.05	2	5	50
S898	Building	0.2987	24.892	120.0	0.5	100	0.014	0.05	2	5	50
S1_4	Grass	0.3307	66.14	50.0	0.5	0	0.02	0.05	2	5	0
S12_1	Grass	0.4631	30.873	150.0	0.5	0	0.02	0.05	2	5	0
S12_2	Grass	0.3307	33.07	100.0	0.5	0	0.02	0.05	2	5	0
S12_3	Grass	0.8082	36.736	220.0	0.5	0	0.02	0.05	2	5	0
S12_5	Grass	0.4882	32.547	150.0	0.5	0	0.02	0.05	2	5	0
S12_6	Grass	0.4429	31.636	140.0	0.5	0	0.02	0.05	2	5	0
S12_7	Grass	0.64	32	200.0	0.5	0	0.02	0.05	2	5	0
S12_8	Grass	0.3765	34.227	110.0	0.5	0	0.02	0.05	2	5	0
S13	Grass	4.4598	222.99	200.0	0.5	0	0.02	0.05	2	5	0
S15_3	Grass	0.6131	30.655	200.0	0.5	0	0.02	0.05	2	5	0
S15_4	Grass	0.6073	30.365	200.0	0.5	0	0.02	0.05	2	5	0
S18	Grass	2.1429	107.145	200.0	0.5	0	0.02	0.05	2	5	0
S18_6	Grass	3.2386	323.86	100.0	0.5	0	0.02	0.05	2	5	0
S183	Grass	0.5514	55.14	100.0	0.5	0	0.02	0.05	2	5	0
S184_1	Grass	0.0808	8.08	100.0	0.5	0	0.02	0.05	2	5	0
S184_3	Grass	0.0804	8.04	100.0	0.5	0	0.02	0.05	2	5	0
S184_4	Grass	0.6383	63.83	100.0	0.5	0	0.02	0.05	2	5	0
S185	Grass	0.1687	16.87	100.0	0.5	0	0.02	0.05	2	5	0
S186	Grass	0.2872	28.72	100.0	0.5	0	0.02	0.05	2	5	0
S187	Grass	0.3972	39.72	100.0	0.5	0	0.02	0.05	2	5	0
S189	Grass	0.0903	9.03	100.0	0.5	0	0.02	0.05	2	5	0
S19	Grass	0.0543	5.43	100.0	0.5	0	0.02	0.05	2	5	0
S190	Grass	0.7908	79.08	100.0	0.5	0	0.02	0.05	2	5	0
S191	Grass	0.3845	38.45	100.0	0.5	0	0.02	0.05	2	5	0
S193_2	Grass	0.423	70.5	60.0	0.5	0	0.02	0.05	2	5	0
S193_3	Grass	0.7555	75.55	100.0	0.5	0	0.02	0.05	2	5	0
S193_4	Grass	0.6987	87.338	80.0	0.5	0	0.02	0.05	2	5	0
S193_5	Grass	0.2076	34.6	60.0	0.5	0	0.02	0.05	2	5	0
S193_6	Grass	0.5185	74.071	70.0	0.5	0	0.02	0.05	2	5	0
S193_7	Grass	0.7365	92.062	80.0	0.5	0	0.02	0.05	2	5	0
S195_1	Grass	0.5457	54.57	100.0	0.75	0	0.02	0.05	2	5	0
S195_2	Grass	0.9104	91.04	100.0	0.75	0	0.02	0.05	2	5	0
S197_1	Grass	0.5532	55.32	100.0	0.5	0	0.02	0.05	2	5	0
S197_3	Grass	0.3629	36.29	100.0	0.5	0	0.02	0.05	2	5	0
S197_4	Grass	0.2028	20.28	100.0	0.5	0	0.02	0.05	2	5	0
S197_5	Grass	0.116	11.6	100.0	0.5	0	0.02	0.05	2	5	0
S197_6	Grass	0.3071	30.71	100.0	0.5	0	0.02	0.05	2	5	0
S198_1	Grass	0.338	33.8	100.0	0.5	0	0.02	0.05	2	5	0
S198_10	Grass	0.0743	7.43	100.0	0.5	0	0.02	0.05	2	5	0
S198_2	Grass	0.3601	36.01	100.0	0.5	0	0.02	0.05	2	5	0
S198_3	Grass	0.3197	31.97	100.0	0.5	0	0.02	0.05	2	5	0

Name	Description	Area (ha)	Width (m)	Flow Length (m)	Slope (%)	Imperv. (%)	N Imperv	N Perv	Dstore Imperv (mm)	Dstore Perv (mm)	Zero Imperv (%)
S198_4	Grass	0.1222	12.22	100.0	0.5	0	0.02	0.05	2	5	0
S198_5	Grass	0.1467	14.67	100.0	0.5	0	0.02	0.05	2	5	0
S198_6	Grass	0.3309	33.09	100.0	0.5	0	0.02	0.05	2	5	0
S198_7	Grass	0.1941	19.41	100.0	0.5	0	0.02	0.05	2	5	0
S198_8	Grass	0.1324	13.24	100.0	0.5	0	0.02	0.05	2	5	0
S199	Grass	0.309	30.9	100.0	0.5	0	0.02	0.05	2	5	0
S200_1	Grass	0.3474	34.74	100.0	0.5	0	0.02	0.05	2	5	0
S200_2	Grass	0.4685	46.85	100.0	0.5	0	0.02	0.05	2	5	0
S201	Grass	0.27	24.545	110.0	0.5	0	0.02	0.05	2	5	0
S202	Grass	0.5447	54.47	100.0	0.5	0	0.02	0.05	2	5	0
S203	Grass	0.1518	15.18	100.0	0.5	0	0.02	0.05	2	5	0
S204	Grass	0.1672	15.2	110.0	0.5	0	0.02	0.05	2	5	0
S205	Grass	0.162	16.2	100.0	0.5	0	0.02	0.05	2	5	0
S206_1	Grass	0.2851	23.758	120.0	0.5	0	0.02	0.05	2	5	0
S206_2	Grass	0.414	34.5	120.0	0.5	0	0.02	0.05	2	5	0
S206_3	Grass	0.2117	21.17	100.0	0.5	0	0.02	0.05	2	5	0
S207	Grass	0.453	45.3	100.0	0.5	0	0.02	0.05	2	5	0
S208_1	Grass	0.5643	70.538	80.0	0.5	0	0.02	0.05	2	5	0
S208_2	Grass	0.1272	12.72	100.0	0.5	0	0.02	0.05	2	5	0
S208_3	Grass	0.312	31.2	100.0	0.5	0	0.02	0.05	2	5	0
S208_4	Grass	0.2359	23.59	100.0	0.5	0	0.02	0.05	2	5	0
S209	Grass	0.6781	67.81	100.0	0.5	0	0.02	0.05	2	5	0
S21	Grass	3.4882	348.82	100.0	0.5	0	0.02	0.05	2	5	0
S210_1	Grass	0.2153	21.53	100.0	0.5	0	0.02	0.05	2	5	0
S210_3	Grass	0.2828	28.28	100.0	0.5	0	0.02	0.05	2	5	0
S210_4	Grass	0.1065	10.65	100.0	0.5	0	0.02	0.05	2	5	0
S210_5	Grass	0.2299	22.99	100.0	0.5	0	0.02	0.05	2	5	0
S211_1	Grass	0.9571	95.71	100.0	0.5	0	0.02	0.05	2	5	0
S211_2	Grass	2.1091	210.91	100.0	0.5	0	0.02	0.05	2	5	0
S212_1	Grass	0.2361	23.61	100.0	0.5	0	0.02	0.05	2	5	0
S212_2	Grass	1.5663	156.63	100.0	0.5	0	0.02	0.05	2	5	0
S213_1	Grass	0.4712	47.12	100.0	0.5	0	0.02	0.05	2	5	0
S213_2	Grass	0.1444	14.44	100.0	0.5	0	0.02	0.05	2	5	0
S213_3	Grass	1.4522	90.762	160.0	0.5	0	0.02	0.05	2	5	0
S214	Grass	0.1355	13.55	100.0	0.5	0	0.02	0.05	2	5	0
S215	Grass	0.3375	33.75	100.0	0.5	0	0.02	0.05	2	5	0
S216	Grass	1.1982	66.567	180.0	0.5	0	0.02	0.05	2	5	0
S217_1	Grass	0.39	39	100.0	0.5	0	0.02	0.05	2	5	0
S217_2	Grass	0.5325	44.375	120.0	0.5	0	0.02	0.05	2	5	0
S217_3	Grass	0.885	88.5	100.0	0.5	0	0.02	0.05	2	5	0
S218	Grass	0.2	20	100.0	0.5	0	0.02	0.05	2	5	0
S219	Grass	0.1902	19.02	100.0	0.5	0	0.02	0.05	2	5	0
S22	Grass	4.487	448.7	100.0	0.5	0	0.02	0.05	2	5	0
S220	Grass	0.0274	2.74	100.0	0.5	0	0.02	0.05	2	5	0
S221	Grass	0.3031	30.31	100.0	0.5	0	0.02	0.05	2	5	0
S222	Grass	0.1232	12.32	100.0	0.5	0	0.02	0.05	2	5	0
S223_1	Grass	0.1515	18.938	80.0	0.5	0	0.02	0.05	2	5	0
S223_2	Grass	1.2694	79.338	160.0	0.5	0	0.02	0.05	2	5	0
S224	Grass	0.0499	4.99	100.0	0.5	0	0.02	0.05	2	5	0
S225	Grass	0.0297	2.97	100.0	0.5	0	0.02	0.05	2	5	0
S226	Grass	0.3987	39.87	100.0	0.5	0	0.02	0.05	2	5	0
S227	Grass	0.4756	47.56	100.0	0.5	0	0.02	0.05	2	5	0
S228	Grass	0.0537	5.37	100.0	0.5	0	0.02	0.05	2	5	0
S229_1	Grass	0.1344	13.44	100.0	0.5	0	0.02	0.05	2	5	0
S229_2	Grass	0.1093	10.93	100.0	0.5	0	0.02	0.05	2	5	0
S229_3	Grass	0.2684	26.84	100.0	0.5	0	0.02	0.05	2	5	0
S229_4	Grass	0.069	6.9	100.0	0.5	0	0.02	0.05	2	5	0
S230_1	Grass	0.336	33.6	100.0	0.5	0	0.02	0.05	2	5	0
S230_2	Grass	0.2926	29.26	100.0	0.5	0	0.02	0.05	2	5	0

Name	Description	Area (ha)	Width (m)	Flow Length (m)	Slope (%)	Imperv. (%)	N Imperv	N Perv	Dstore Imperv (mm)	Dstore Perv (mm)	Zero Imperv (%)
S231	Grass	0.1566	15.66	100.0	0.5	0	0.02	0.05	2	5	0
S232	Grass	0.0252	2.52	100.0	0.5	0	0.02	0.05	2	5	0
S233	Grass	0.0476	4.76	100.0	0.5	0	0.02	0.05	2	5	0
S234	Grass	0.0572	5.72	100.0	0.5	0	0.02	0.05	2	5	0
S235	Grass	0.302	30.2	100.0	0.5	0	0.02	0.05	2	5	0
S236	Grass	0.0157	1.57	100.0	0.5	0	0.02	0.05	2	5	0
S237	Grass	0.1674	16.74	100.0	0.5	0	0.02	0.05	2	5	0
S238	Grass	0.0874	8.74	100.0	0.5	0	0.02	0.05	2	5	0
S239	Grass	0.4724	47.24	100.0	0.5	0	0.02	0.05	2	5	0
S240_1	Grass	0.2282	25.356	90.0	0.5	0	0.02	0.05	2	5	0
S240_2	Grass	0.3818	42.422	90.0	0.5	0	0.02	0.05	2	5	0
S241	Grass	0.2344	29.3	80.0	0.5	0	0.02	0.05	2	5	0
S242	Grass	0.8934	52.553	170.0	0.5	0	0.02	0.05	2	5	0
S28	Grass	0.6137	61.37	100.0	0.5	0	0.02	0.05	2	5	0
S29	Grass	2.3307	116.535	200.0	0.5	0	0.02	0.05	2	5	0
S3	Grass	4.463	446.3	100.0	0.5	0	0.02	0.05	2	5	0
S3_119	Grass	1.5332	85.178	180.0	0.5	0	0.02	0.05	2	5	0
S3_122	Grass	1.921	80.042	240.0	0.5	0	0.02	0.05	2	5	0
S3_124	Grass	3.594	94.579	380.0	0.5	0	0.02	0.05	2	5	0
S3_126	Grass	2.9847	149.235	200.0	0.5	0	0.02	0.05	2	5	0
S3_127	Grass	3.0986	154.93	200.0	0.5	0	0.02	0.05	2	5	0
S3_17	Grass	2.9314	101.083	290.0	0.5	0	0.02	0.05	2	5	0
S3_18	Grass	1.1744	65.244	180.0	0.5	0	0.02	0.05	2	5	0
S3_19	Grass	0.9188	45.94	200.0	0.5	0	0.02	0.05	2	5	0
S3_20	Grass	2.9278	146.39	200.0	0.5	0	0.02	0.05	2	5	0
S3_21	Grass	1.662	83.1	200.0	0.5	0	0.02	0.05	2	5	0
S3_23	Grass	1.6534	91.856	180.0	0.5	0	0.02	0.05	2	5	0
S3_24	Grass	1.2164	121.64	100.0	0.5	0	0.02	0.05	2	5	0
S3_27	Grass	2.9873	90.524	330.0	0.5	0	0.02	0.05	2	5	0
S3_32	Grass	1.3324	74.022	180.0	0.5	0	0.02	0.05	2	5	0
S3_42	Grass	0.4377	43.77	100.0	0.5	0	0.02	0.05	2	5	0
S3_89	Grass	1.38	138	100.0	0.5	0	0.02	0.05	2	5	0
S3_7	Grass	0.2614	26.14	100.0	0.5	0	0.02	0.05	2	5	0
S3_8	Grass	1.6619	83.095	200.0	0.5	0	0.02	0.05	2	5	0
S32	Grass	0.1018	10.18	100.0	0.5	0	0.02	0.05	2	5	0
S32_1	Grass	0.2138	21.38	100.0	0.5	0	0.02	0.05	2	5	0
S32_10	Grass	1.0169	40.676	250.0	0.5	0	0.02	0.05	2	5	0
S32_11	Grass	0.6588	32.94	200.0	0.5	0	0.02	0.05	2	5	0
S32_12	Grass	0.548	39.143	140.0	0.5	0	0.02	0.05	2	5	0
S32_13	Grass	0.0756	7.56	100.0	0.5	0	0.02	0.05	2	5	0
S32_3	Grass	0.5271	29.283	180.0	0.5	0	0.02	0.05	2	5	0
S32_6	Grass	0.5857	32.539	180.0	0.5	0	0.02	0.05	2	5	0
S32_8	Grass	0.6524	32.62	200.0	0.5	0	0.02	0.05	2	5	0
S36	Grass	3.2245	161.225	200.0	0.5	0	0.02	0.05	2	5	0
S37	Grass	0.7418	30.908	240.0	0.5	0	0.02	0.05	2	5	0
S38	Grass	6.0018	300.09	200.0	0.5	0	0.02	0.05	2	5	0
S4	Grass	1.1763	65.35	180.0	0.5	0	0.02	0.05	2	5	0
S45_11	Grass	0.166	16.6	100.0	1.5	0	0.02	0.05	2	5	0
S45_12	Grass	0.1515	15.15	100.0	1.5	0	0.02	0.05	2	5	0
S45_14	Grass	0.1155	9.625	120.0	1.5	0	0.02	0.05	2	5	0
S45_16	Grass	0.1027	5.706	180.0	1.5	0	0.02	0.05	2	5	0
S45_17	Grass	0.1004	5.578	180.0	1.5	0	0.02	0.05	2	5	0
S45_19	Grass	0.0996	9.96	100.0	1.5	0	0.02	0.05	2	5	0
S45_2	Grass	0.0706	8.825	80.0	1.5	0	0.02	0.05	2	5	0
S45_20	Grass	0.0968	9.68	100.0	1.5	0	0.02	0.05	2	5	0
S45_22	Grass	0.1331	7.829	170.0	1.5	0	0.02	0.05	2	5	0
S45_23	Grass	0.056	11.2	50.0	1.5	0	0.02	0.05	2	5	0
S45_25	Grass	0.1246	7.788	160.0	1.5	0	0.02	0.05	2	5	0
S45_26	Grass	0.1226	7.662	160.0	1.5	0	0.02	0.05	2	5	0

Name	Description	Area (ha)	Width (m)	Flow Length (m)	Slope (%)	Imperv. (%)	N Imperv	N Perv	Dstore Imperv (mm)	Dstore Perv (mm)	Zero Imperv (%)
S45_28	Grass	0.1202	8.013	150.0	1.5	0	0.02	0.05	2	5	0
S45_29	Grass	0.1104	7.36	150.0	1.5	0	0.02	0.05	2	5	0
S45_3	Grass	0.0707	10.1	70.0	1.5	0	0.02	0.05	2	5	0
S45_31	Grass	0.1584	9.9	160.0	1.5	0	0.02	0.05	2	5	0
S45_32	Grass	0.0259	6.475	40.0	1.5	0	0.02	0.05	2	5	0
S45_34	Grass	0.1121	8.623	130.0	1.5	0	0.02	0.05	2	5	0
S45_37	Grass	0.0951	10.567	90.0	1.5	0	0.02	0.05	2	5	0
S45_38	Grass	0.0742	8.244	90.0	1.5	0	0.02	0.05	2	5	0
S45_40	Grass	0.0654	8.175	80.0	1.5	0	0.02	0.05	2	5	0
S45_42	Grass	0.2917	16.206	180.0	1.5	0	0.02	0.05	2	5	0
S45_43	Grass	0.0268	6.7	40.0	1.5	0	0.02	0.05	2	5	0
S45_45	Grass	0.077	9.625	80.0	1.5	0	0.02	0.05	2	5	0
S45_46	Grass	0.0261	6.525	40.0	1.5	0	0.02	0.05	2	5	0
S45_47	Grass	0.0863	9.589	90.0	1.5	0	0.02	0.05	2	5	0
S45_48	Grass	0.0478	9.56	50.0	1.5	0	0.02	0.05	2	5	0
S45_49	Grass	0.092	4.6	200.0	1.5	0	0.02	0.05	2	5	0
S45_5	Grass	0.1644	10.96	150.0	1.5	0	0.02	0.05	2	5	0
S45_6	Grass	0.1202	8.586	140.0	1.5	0	0.02	0.05	2	5	0
S45_7	Grass	0.0692	8.65	80.0	1.5	0	0.02	0.05	2	5	0
S45_8	Grass	0.1316	10.967	120.0	1.5	0	0.02	0.05	2	5	0
S5	Grass	1.679	167.9	100.0	0.5	0	0.02	0.05	2	5	0
S51_1	Grass	0.3084	20.56	150.0	0.868	0	0.02	0.05	2	5	0
S51_2	Grass	0.2899	19.327	150.0	0.868	0	0.02	0.05	2	5	0
S54	Grass	7.3951	369.755	200.0	0.5	0	0.02	0.05	2	5	0
S6	Grass	3.8232	212.4	180.0	0.5	0	0.02	0.05	2	5	0
S66_3	Grass	7.9683	796.83	100.0	0.5	0	0.02	0.05	2	5	0
S66_4	Grass	5.6638	566.38	100.0	0.5	0	0.02	0.05	2	5	0
S66_5	Grass	2.4406	244.06	100.0	0.5	0	0.02	0.05	2	5	0
S67	Grass	6.2018	310.09	200.0	0.5	0	0.02	0.05	2	5	0
S7_1	Grass	0.5354	66.925	80.0	0.5	0	0.02	0.05	2	5	0
S7_11	Grass	1.6543	82.715	200.0	0.5	0	0.02	0.05	2	5	0
S7_12	Grass	0.4761	23.805	200.0	0.5	0	0.02	0.05	2	5	0
S7_3	Grass	3.8494	192.47	200.0	0.5	0	0.02	0.05	2	5	0
S7_39	Grass	0.4525	22.625	200.0	0.5	0	0.02	0.05	2	5	0
S7_4	Grass	1.2187	121.87	100.0	0.5	0	0.02	0.05	2	5	0
S7_41	Grass	4.353	217.65	200.0	0.5	0	0.02	0.05	2	5	0
S7_44	Grass	3.2677	163.385	200.0	0.5	0	0.02	0.05	2	5	0
S7_45	Grass	8.0963	404.815	200.0	0.5	0	0.02	0.05	2	5	0
S7_46	Grass	6.3093	315.465	200.0	0.5	0	0.02	0.05	2	5	0
S7_48	Grass	5.241	262.05	200.0	0.5	0	0.02	0.05	2	5	0
S7_5	Grass	1.3015	130.15	100.0	0.5	0	0.02	0.05	2	5	0
S7_50	Grass	6.9122	345.61	200.0	0.5	0	0.02	0.05	2	5	0
S7_51	Grass	2.0226	101.13	200.0	0.5	0	0.02	0.05	2	5	0
S7_53	Grass	7.9924	399.62	200.0	0.5	0	0.02	0.05	2	5	0
S7_6	Grass	0.3656	45.7	80.0	0.5	0	0.02	0.05	2	5	0
S7_7	Grass	0.5805	72.562	80.0	0.5	0	0.02	0.05	2	5	0
S7_8	Grass	8.4494	422.47	200.0	0.5	0	0.02	0.05	2	5	0
S70_1	Grass	0.0629	6.29	100.0	0.5	0	0.02	0.05	2	5	0
S70_4	Grass	2.1595	179.958	120.0	0.5	0	0.02	0.05	2	5	0
S71_1	Grass	0.1697	16.97	100.0	0.5	0	0.02	0.05	2	5	0
S71_10	Grass	0.2056	20.56	100.0	0.5	0	0.02	0.05	2	5	0
S71_11	Grass	0.5037	50.37	100.0	0.5	0	0.02	0.05	2	5	0
S71_3	Grass	0.2287	22.87	100.0	0.5	0	0.02	0.05	2	5	0
S71_5	Grass	0.5007	50.07	100.0	0.5	0	0.02	0.05	2	5	0
S71_6	Grass	0.9087	90.87	100.0	0.5	0	0.02	0.05	2	5	0
S71_7	Grass	0.4584	45.84	100.0	0.5	0	0.02	0.05	2	5	0
S71_8	Grass	2.0617	206.17	100.0	0.5	0	0.02	0.05	2	5	0
S71_9	Grass	1.2004	120.04	100.0	0.5	0	0.02	0.05	2	5	0
S8	Grass	2.4899	177.85	140.0	0.5	0	0.02	0.05	2	5	0

Name	Description	Area (ha)	Width (m)	Flow Length (m)	Slope (%)	Imperv. (%)	N Imperv	N Perv	Dstore Imperv (mm)	Dstore Perv (mm)	Zero Imperv (%)
S8_1	Grass	0.3446	34.46	100.0	0.5	0	0.02	0.05	2	5	0
S8_2	Grass	0.0385	3.85	100.0	0.5	0	0.02	0.05	2	5	0
S8_4	Grass	0.4417	44.17	100.0	0.5	0	0.02	0.05	2	5	0
S9	Grass	0.115	57.5	20.0	0.5	0	0.02	0.05	2	5	0
S10	Grass	0.0274	13.7	20.0	0.5	0	0.02	0.05	2	5	0
S39_1	Grass	0.1002	5.894	170.0	0.5	0	0.02	0.05	2	5	0
S39_2	Grass	3.1992	188.188	170.0	0.5	0	0.02	0.05	2	5	0
S39_4	Grass	0.0905	5.324	170.0	0.5	0	0.02	0.05	2	5	0
S39	Grass	0.1296	43.2	30.0	0.5	0	0.02	0.05	2	5	0
S40	Grass	0.0372	18.6	20.0	0.5	0	0.02	0.05	2	5	0
S173_1	Hardstand	0.1263	12.63	100.0	0.5	75	0.014	0.05	2	5	25
S173_2	Hardstand	0.2799	27.99	100.0	0.5	75	0.014	0.05	2	5	25
S173_3	Hardstand	0.2705	27.05	100.0	0.5	75	0.014	0.05	2	5	25
S173_5	Hardstand	0.3134	31.34	100.0	0.5	75	0.014	0.05	2	5	25
S173_6	Hardstand	0.3854	38.54	100.0	0.5	75	0.014	0.05	2	5	25
S173_7	Hardstand	0.6522	65.22	100.0	0.5	75	0.014	0.05	2	5	25
S174_1	Hardstand	0.3036	30.36	100.0	0.5	75	0.014	0.05	2	5	25
S174_2	Hardstand	0.1225	12.25	100.0	0.5	75	0.014	0.05	2	5	25
S175_1	Hardstand	0.6458	64.58	100.0	0.5	75	0.014	0.05	2	5	25
S175_3	Hardstand	0.4175	41.75	100.0	0.5	75	0.014	0.05	2	5	25
S175_4	Hardstand	0.546	54.6	100.0	0.5	75	0.014	0.05	2	5	25
S176_1	Hardstand	0.6518	65.18	100.0	0.5	75	0.014	0.05	2	5	25
S176_3	Hardstand	0.4128	41.28	100.0	0.5	75	0.014	0.05	2	5	25
S176_4	Hardstand	0.5468	54.68	100.0	0.5	75	0.014	0.05	2	5	25
S177_1	Hardstand	0.9674	96.74	100.0	0.5	75	0.014	0.05	2	5	25
S177_2	Hardstand	1.3616	136.16	100.0	0.5	75	0.014	0.05	2	5	25
S178_1	Hardstand	0.9746	97.46	100.0	0.5	75	0.014	0.05	2	5	25
S178_2	Hardstand	1.358	135.8	100.0	0.5	75	0.014	0.05	2	5	25
S179_1	Hardstand	0.773	77.3	100.0	0.5	75	0.014	0.05	2	5	25
S179_2	Hardstand	0.3155	31.55	100.0	0.5	75	0.014	0.05	2	5	25
S179_3	Hardstand	0.2267	22.67	100.0	0.5	75	0.014	0.05	2	5	25
S180	Hardstand	0.1434	14.34	100.0	0.5	75	0.014	0.05	2	5	25
S181	Hardstand	0.3693	36.93	100.0	0.5	75	0.014	0.05	2	5	25
S182_2	Hardstand	0.273	27.3	100.0	0.5	75	0.014	0.05	2	5	25
S182_3	Hardstand	0.8996	89.96	100.0	0.5	75	0.014	0.05	2	5	25
S182_4	Hardstand	0.6964	69.64	100.0	0.5	75	0.014	0.05	2	5	25
S188_1	Hardstand	0.1164	11.64	100.0	0.5	75	0.014	0.05	2	5	25
S188_2	Hardstand	0.1918	19.18	100.0	0.5	75	0.014	0.05	2	5	25
S194_1	Hardstand	0.1845	18.45	100.0	0.5	75	0.014	0.05	2	5	25
S194_3	Hardstand	0.1137	11.37	100.0	0.5	75	0.014	0.05	2	5	25
S194_4	Hardstand	0.1485	14.85	100.0	0.5	75	0.014	0.05	2	5	25
S32_4	Hardstand	0.8011	106.813	75.0	1.5	75	0.014	0.05	2	5	25
S_Pond1	Pond	0.2098	41.96	50.0	0.5	0	0.02	0.035	2	5	0
S_Pond2	Pond	3.2903	411.288	80.0	0.5	0	0.02	0.035	2	5	0
S_Pond3	Pond	0.6095	76.188	80.0	0.5	0	0.02	0.035	2	5	0
S_Pond4	Pond	0.1253	31.325	40.0	0.5	0	0.02	0.035	2	5	0
S_Pond5	Pond	0.4485	64.071	70.0	0.5	0	0.02	0.035	2	5	0
S_Pond6	Pond	0.0918	45.9	20.0	0.5	0	0.02	0.035	2	5	0
S_Pond7	Pond	0.2703	90.1	30.0	0.5	0	0.02	0.035	2	5	0
S_Pond8	Pond	0.2045	102.25	20.0	0.5	0	0.02	0.035	2	5	0
S1	Road	0.2934	29.34	100.0	1.5	100	0.014	0.05	2	5	25
S1_8	Road	1.2397	35.42	350.0	1.5	100	0.014	0.05	2	5	25
S11	Road	0.0144	7.2	20.0	1	100	0.014	0.05	2	5	25
S11_1	Road	0.1071	10.71	100.0	0.5	100	0.014	0.05	2	5	25
S11_10	Road	0.0881	8.81	100.0	0.5	100	0.014	0.05	2	5	25
S11_11	Road	0.0748	7.48	100.0	0.5	100	0.014	0.05	2	5	25
S11_12	Road	0.1193	11.93	100.0	0.5	100	0.014	0.05	2	5	25
S11_2	Road	0.0842	8.42	100.0	0.5	100	0.014	0.05	2	5	25
S11_4	Road	0.1661	16.61	100.0	0.5	100	0.014	0.05	2	5	25
S11_5	Road	0.1133	11.33	100.0	0.5	100	0.014	0.05	2	5	25
S11_6	Road	0.135	13.5	100.0	0.5	100	0.014	0.05	2	5	25
S11_7	Road	0.1212	12.12	100.0	0.5	100	0.014	0.05	2	5	25
S11_8	Road	0.1291	12.91	100.0	0.5	100	0.014	0.05	2	5	25
S11_9	Road	0.0993	9.93	100.0	0.5	100	0.014	0.05	2	5	25
S13_11	Road	3.2981	194.006	170.0	1.5	100	0.014	0.05	2	5	25

Name	Description	Area (ha)	Width (m)	Flow Length (m)	Slope (%)	Imperv. (%)	N Imperv	N Perv	Dstore Imperv (mm)	Dstore Perv (mm)	Zero Imperv (%)
S13_12	Road	2.8633	143.165	200.0	1.5	100	0.014	0.05	2	5	25
S13_14	Road	2.183	128.412	170.0	1.5	100	0.014	0.05	2	5	25
S13_2	Road	3.7056	217.976	170.0	1.5	100	0.014	0.05	2	5	25
S13_8	Road	2.2906	134.741	170.0	1.5	100	0.014	0.05	2	5	25
S139_1	Road	0.19	19	100.0	0.5	100	0.014	0.05	2	5	25
S139_2	Road	0.2501	17.864	140.0	0.5	100	0.014	0.05	2	5	25
S14	Road	0.4324	43.24	100.0	1.5	100	0.014	0.05	2	5	25
S140_1	Road	0.2455	20.458	120.0	0.5	100	0.014	0.05	2	5	25
S140_2	Road	0.1968	15.138	130.0	0.5	100	0.014	0.05	2	5	25
S141_1	Road	0.1978	19.78	100.0	0.5	100	0.014	0.05	2	5	25
S141_2	Road	0.1638	16.38	100.0	0.5	100	0.014	0.05	2	5	25
S141_4	Road	0.2705	27.05	100.0	0.5	100	0.014	0.05	2	5	25
S141_5	Road	0.1037	10.37	100.0	0.5	100	0.014	0.05	2	5	25
S143_1	Road	0.1235	12.35	100.0	0.5	100	0.014	0.05	2	5	25
S143_2	Road	0.1954	15.031	130.0	0.5	100	0.014	0.05	2	5	25
S143_3	Road	0.1526	15.26	100.0	0.5	100	0.014	0.05	2	5	25
S144_1	Road	0.1849	23.112	80.0	0.5	100	0.014	0.05	2	5	25
S144_3	Road	0.3115	14.159	220.0	0.5	100	0.014	0.05	2	5	25
S144_4	Road	0.1335	13.35	100.0	0.5	100	0.014	0.05	2	5	25
S144_5	Road	0.152	10.133	150.0	0.5	100	0.014	0.05	2	5	25
S145_2	Road	0.1074	10.74	100.0	0.5	100	0.014	0.05	2	5	25
S147	Road	0.4239	28.26	150.0	0.5	100	0.014	0.05	2	5	25
S148_1	Road	0.1977	10.983	180.0	0.5	100	0.014	0.05	2	5	25
S15	Road	0.2072	10.36	200.0	0.521	100	0.014	0.05	2	5	25
S150	Road	0.357	12.75	280.0	0.5	100	0.014	0.05	2	5	25
S152	Road	0.0198	9.9	20.0	0.5	100	0.014	0.05	2	5	25
S153	Road	1.2938	129.38	100.0	0.5	100	0.014	0.05	2	5	25
S155	Road	0.1133	11.33	100.0	0.5	100	0.014	0.05	2	5	25
S156_1	Road	0.1718	17.18	100.0	0.5	100	0.014	0.05	2	5	25
S157	Road	0.0807	8.07	100.0	0.5	100	0.014	0.05	2	5	25
S158_1	Road	0.0881	8.81	100.0	0.5	100	0.014	0.05	2	5	25
S158_2	Road	0.1513	10.087	150.0	0.5	100	0.014	0.05	2	5	25
S16	Road	0.228	27.874	81.8	0.519	100	0.014	0.05	2	5	25
S160_2	Road	0.1475	10.536	140.0	0.5	100	0.014	0.05	2	5	25
S161_1	Road	0.0418	4.18	100.0	0.5	100	0.014	0.05	2	5	25
S161_2	Road	0.1013	10.13	100.0	0.5	100	0.014	0.05	2	5	25
S161_3	Road	0.141	9.4	150.0	0.5	100	0.014	0.05	2	5	25
S161_5	Road	0.094	9.4	100.0	0.5	100	0.014	0.05	2	5	25
S161_6	Road	0.1572	10.48	150.0	0.5	100	0.014	0.05	2	5	25
S163	Road	0.172	13.231	130.0	0.5	100	0.014	0.05	2	5	25
S164_1	Road	0.1539	9.619	160.0	0.5	100	0.014	0.05	2	5	25
S164_3	Road	0.1075	8.958	120.0	0.5	100	0.014	0.05	2	5	25
S164_4	Road	0.1032	9.382	110.0	0.5	100	0.014	0.05	2	5	25
S164_5	Road	0.0476	7.933	60.0	0.5	100	0.014	0.05	2	5	25
S165	Road	0.1017	10.17	100.0	0.5	100	0.014	0.05	2	5	25
S166_1	Road	0.109	9.909	110.0	0.5	100	0.014	0.05	2	5	25
S166_3	Road	0.1154	9.617	120.0	0.5	100	0.014	0.05	2	5	25
S166_4	Road	0.1912	9.56	200.0	0.5	100	0.014	0.05	2	5	25
S167_1	Road	0.1259	9.685	130.0	0.5	100	0.014	0.05	2	5	25
S167_2	Road	0.2613	10.887	240.0	0.5	100	0.014	0.05	2	5	25
S168_1	Road	0.0794	8.822	90.0	0.5	100	0.014	0.05	2	5	25
S168_2	Road	0.116	9.667	120.0	0.5	100	0.014	0.05	2	5	25
S168_3	Road	0.0784	8.711	90.0	0.5	100	0.014	0.05	2	5	25
S168_4	Road	0.1217	9.362	130.0	0.5	100	0.014	0.05	2	5	25
S17	Road	0.1038	9.962	104.2	0.542	100	0.014	0.05	2	5	25
S170_1	Road	0.2726	27.26	100.0	0.5	100	0.014	0.05	2	5	25
S170_2	Road	0.092	9.2	100.0	0.5	100	0.014	0.05	2	5	25
S170_3	Road	0.2656	13.28	200.0	0.5	100	0.014	0.05	2	5	25

Name	Description	Area (ha)	Width (m)	Flow Length (m)	Slope (%)	Imperv. (%)	N Imperv	N Perv	Dstore Imperv (mm)	Dstore Perv (mm)	Zero Imperv (%)
S170_4	Road	0.5958	29.79	200.0	0.5	100	0.014	0.05	2	5	25
S170_5	Road	0.0917	9.17	100.0	0.5	100	0.014	0.05	2	5	25
S170_7	Road	0.173	9.105	190.0	0.5	100	0.014	0.05	2	5	25
S170_8	Road	0.2387	23.87	100.0	0.5	100	0.014	0.05	2	5	25
S171_1	Road	0.1244	12.44	100.0	0.5	100	0.014	0.05	2	5	25
S171_10	Road	0.1248	12.48	100.0	0.5	100	0.014	0.05	2	5	25
S171_13	Road	0.1741	17.41	100.0	0.5	100	0.014	0.05	2	5	25
S171_14	Road	0.137	13.7	100.0	0.5	100	0.014	0.05	2	5	25
S171_16	Road	0.1952	19.52	100.0	0.5	100	0.014	0.05	2	5	25
S171_17	Road	0.1292	12.92	100.0	0.5	100	0.014	0.05	2	5	25
S171_18	Road	0.1467	14.67	100.0	0.5	100	0.014	0.05	2	5	25
S171_19	Road	0.129	12.9	100.0	0.5	100	0.014	0.05	2	5	25
S171_2	Road	0.2101	21.01	100.0	0.5	100	0.014	0.05	2	5	25
S171_3	Road	0.1036	10.36	100.0	0.5	100	0.014	0.05	2	5	25
S171_4	Road	0.1119	11.19	100.0	0.5	100	0.014	0.05	2	5	25
S171_5	Road	0.1779	17.79	100.0	0.5	100	0.014	0.05	2	5	25
S171_7	Road	0.0981	9.81	100.0	0.5	100	0.014	0.05	2	5	25
S171_8	Road	0.1416	14.16	100.0	0.5	100	0.014	0.05	2	5	25
S18_3	Road	0.1855	6.182	300.1	1	100	0.014	0.05	2	5	25
S192	Road	0.0078	0.78	100.0	0.5	100	0.014	0.05	2	5	25
S196_1	Road	0.1117	9.308	120.0	0.5	100	0.014	0.05	2	5	25
S196_2	Road	0.0731	8.6	85.0	0.5	100	0.014	0.05	2	5	25
S196_3	Road	0.0649	8.113	80.0	0.5	100	0.014	0.05	2	5	25
S2	Road	1.2727	36.363	350.0	1.5	100	0.014	0.05	2	5	25
S2_1	Road	1.0831	28.503	380.0	1.5	100	0.014	0.05	2	5	25
S2_11	Road	2.2623	59.534	380.0	1.5	100	0.014	0.05	2	5	25
S2_12	Road	0.5442	14.321	380.0	1.5	100	0.014	0.05	2	5	25
S2_2	Road	0.3157	8.308	380.0	1.5	100	0.014	0.05	2	5	25
S2_21	Road	0.8985	23.645	380.0	1.5	100	0.014	0.05	2	5	25
S2_22	Road	1.0928	28.758	380.0	1.5	100	0.014	0.05	2	5	25
S2_23	Road	0.3759	9.892	380.0	1.5	100	0.014	0.05	2	5	25
S2_24	Road	0.9336	24.568	380.0	1.5	100	0.014	0.05	2	5	25
S2_25	Road	0.5713	15.034	380.0	1.5	100	0.014	0.05	2	5	25
S2_26	Road	1.4833	39.034	380.0	1.5	100	0.014	0.05	2	5	25
S2_27	Road	0.8646	22.753	380.0	1.5	100	0.014	0.05	2	5	25
S2_28	Road	0.2321	6.108	380.0	1.5	100	0.014	0.05	2	5	25
S2_3	Road	2.6638	70.1	380.0	1.5	100	0.014	0.05	2	5	25
S2_4	Road	0.5751	15.134	380.0	1.5	100	0.014	0.05	2	5	25
S2_5	Road	1.477	38.868	380.0	1.5	100	0.014	0.05	2	5	25
S2_6	Road	2.6067	68.597	380.0	1.5	100	0.014	0.05	2	5	25
S2_7	Road	0.7242	19.058	380.0	1.5	100	0.014	0.05	2	5	25
S2_8	Road	0.7619	20.05	380.0	1.5	100	0.014	0.05	2	5	25
S23_2	Road	1.8856	58.3	320.0	1.5	100	0.014	0.05	2	5	25
S23_3	Road	0.3537	11.053	320.0	1.5	100	0.014	0.05	2	5	25
S23_4	Road	0.089	2.781	320.0	1.5	100	0.014	0.05	2	5	25
S24_2	Road	0.391	32.583	120.0	0.5	100	0.014	0.05	2	5	25
S24_3	Road	0.5227	34.847	150.0	0.5	100	0.014	0.05	2	5	25
S24_4	Road	0.4546	34.969	130.0	0.5	100	0.014	0.05	2	5	25
S3_1	Road	0.6254	41.693	150.0	0.5	100	0.014	0.05	2	5	25
S3_11	Road	0.1077	10.77	100.0	1.5	100	0.014	0.05	2	5	25
S3_3	Road	0.1839	18.39	100.0	1.5	100	0.014	0.05	2	5	25
S3_4	Road	0.3978	39.78	100.0	0.5	100	0.014	0.05	2	5	25
S3_5	Road	0.6568	43.787	150.0	0.5	100	0.014	0.05	2	5	25
S43	Road	0.2585	25.85	100.0	0.5	100	0.014	0.05	2	5	25
S45_1	Road	0.2575	8.583	300.0	1.5	100	0.014	0.05	2	5	25
S45_10	Road	0.2034	9.245	220.0	1.5	100	0.014	0.05	2	5	25
S45_13	Road	0.2098	11.656	180.0	1.5	100	0.014	0.05	2	5	25
S45_15	Road	0.1595	8.861	180.0	1.5	100	0.014	0.05	2	5	25
S45_18	Road	0.1365	7.583	180.0	1.5	100	0.014	0.05	2	5	25
S45_21	Road	0.1326	7.367	180.0	1.5	100	0.014	0.05	2	5	25
S45_24	Road	0.1626	8.558	190.0	1.5	100	0.014	0.05	2	5	25
S45_27	Road	0.1501	7.9	190.0	1.5	100	0.014	0.05	2	5	25

Name	Description	Area (ha)	Width (m)	Flow Length (m)	Slope (%)	Imperv. (%)	N Imperv	N Perv	Dstore Imperv (mm)	Dstore Perv (mm)	Zero Imperv (%)
S45_30	Road	0.1548	8.6	180.0	1.5	100	0.014	0.05	2	5	25
S45_33	Road	0.2073	9.423	220.0	1.5	100	0.014	0.05	2	5	25
S45_36	Road	0.1489	9.927	150.0	1.5	100	0.014	0.05	2	5	25
S45_39	Road	0.1213	10.108	120.0	1.5	100	0.014	0.05	2	5	25
S45_4	Road	0.0926	9.26	100.0	1.5	100	0.014	0.05	2	5	25
S45_41	Road	0.0877	9.744	90.0	1.5	100	0.014	0.05	2	5	25
S45_44	Road	0.3679	18.395	200.0	1.5	100	0.014	0.05	2	5	25
S48_1	Road	0.7316	40.644	180.0	0.5	100	0.014	0.05	2	5	25
S48_2	Road	1.2654	48.669	260.0	0.5	100	0.014	0.05	2	5	25
S49	Road	0.3742	11.694	320.0	1.5	100	0.014	0.05	2	5	25
S50	Road	0.895	89.5	100.0	0.5	100	0.014	0.05	2	5	25
S52	Road	0.2688	26.88	100.0	1.5	100	0.014	0.05	2	5	25
S52_1	Road	0.9801	39.204	250.0	1.5	100	0.014	0.05	2	5	25
S52_11	Road	1.3274	41.481	320.0	1.5	100	0.014	0.05	2	5	25
S52_12	Road	0.3773	11.791	320.0	1.5	100	0.014	0.05	2	5	25
S52_13	Road	1.5427	48.209	320.0	1.5	100	0.014	0.05	2	5	25
S52_14	Road	0.8432	26.35	320.0	1.5	100	0.014	0.05	2	5	25
S52_15	Road	1.3374	41.794	320.0	1.5	100	0.014	0.05	2	5	25
S52_17	Road	1.4635	45.734	320.0	1.5	100	0.014	0.05	2	5	25
S52_18	Road	0.8291	25.909	320.0	1.5	100	0.014	0.05	2	5	25
S52_19	Road	1.714	53.562	320.0	1.5	100	0.014	0.05	2	5	25
S52_2	Road	1.7186	53.706	320.0	1.5	100	0.014	0.05	2	5	25
S52_20	Road	0.6075	18.984	320.0	1.5	100	0.014	0.05	2	5	25
S52_21	Road	1.5213	47.541	320.0	1.5	100	0.014	0.05	2	5	25
S52_22	Road	1.0859	33.934	320.0	1.5	100	0.014	0.05	2	5	25
S52_23	Road	1.1041	34.503	320.0	1.5	100	0.014	0.05	2	5	25
S52_3	Road	0.6074	18.981	320.0	1.5	100	0.014	0.05	2	5	25
S52_4	Road	1.5055	47.047	320.0	1.5	100	0.014	0.05	2	5	25
S52_5	Road	1.2382	38.694	320.0	1.5	100	0.014	0.05	2	5	25
S52_8	Road	0.9968	39.872	250.0	1.5	100	0.014	0.05	2	5	25
S52_9	Road	1.2407	38.772	320.0	1.5	100	0.014	0.05	2	5	25
S55	Road	0.7012	18.453	380.0	1.5	100	0.014	0.05	2	5	25
S56	Road	1.0483	27.587	380.0	1.5	100	0.014	0.05	2	5	25
S7	Road	1.3726	42.894	320.0	1.5	100	0.014	0.05	2	5	25
S7_2	Road	0.2068	6.893	300.0	1	100	0.014	0.05	2	5	25
S70	Road	1.2429	69.05	180.0	1	100	0.014	0.05	2	5	25
S70_3	Road	0.0998	24.95	40.0	1.5	100	0.014	0.05	2	5	25
S72	Road	0.1622	32.44	50.0	0.5	100	0.014	0.05	2	5	25
S8_6	Road	0.0628	15.7	40.0	1.5	100	0.014	0.05	2	5	25
S12	Road	0.0815	8.15	100.0	0.5	100	0.014	0.05	2	5	8
S20	Road	5.3601	536.01	100.0	0.5	100	0.014	0.05	2	5	25
S23	Road	0.1872	18.72	100.0	0.5	100	0.014	0.05	2	5	25
S24	Road	0.1688	16.88	100.0	0.5	100	0.014	0.05	2	5	25
S25	Road	0.0688	6.88	100.0	0.5	100	0.014	0.05	2	5	25
S26	Road	0.3161	31.61	100.0	0.5	100	0.014	0.05	2	5	25
S27	Road	0.0832	8.32	100.0	0.5	100	0.014	0.05	2	5	25
S30	Road	0.3277	32.77	100.0	0.5	100	0.014	0.05	2	5	25
S31	Road	0.0934	9.34	100.0	0.5	100	0.014	0.05	2	5	25
S33	Road	0.162	16.2	100.0	0.5	100	0.014	0.05	2	5	25
S34	Road	0.2228	22.28	100.0	0.5	100	0.014	0.05	2	5	25
S35	Road	0.0936	9.36	100.0	0.5	100	0.014	0.05	2	5	25

Table 8: PCSWMM Post-Development Model Catchment Parameter Summary

4.4.4 Extended Detention of the 1-year 24hr Event

When considering the 1-year 24-hour storm event to establish the extent of extended detention achieved by the proposed stormwater control measures, it is important to take note of the following:

- The run-off generated during the 1-year storm event is relatively low and can easily be discharged via the proposed underground stormwater pipe system
- It is not practical for outlet pipes to be sized smaller than 110mm Ø as the probability of blockage is high

It is proposed that variable outlet structures are designed specifically for each of the ponds based on the peak volume inflows. A typical variable outlet structure detail can be seen in Figure 15 below.

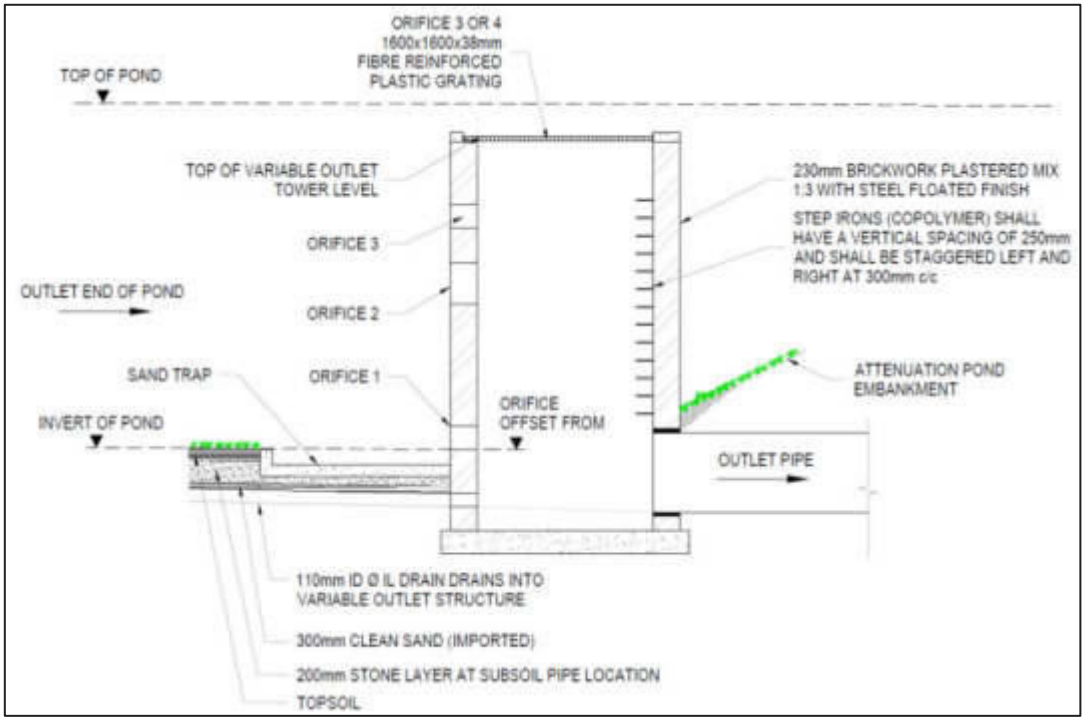

Figure 15: Typical Variable Outlet Structure

The typical variable outlet structure detail depicted above should be read with Table 9 below, where the pond structure and various orifice sizes and numbers indicated with their desired offset from the respective pond invert levels.

Pond No.	Orifice 1		Orifice 2		Orifice 3		Orifice 4	
	Outlet (mm)	Offset (m)	Outlet (mm)	Offset (m)	Outlet (mm)	Offset (m)	Outlet (m)	Offset (m)
1	200	0	250	0.5	300	1	Grid 1600x1600	1.85
2	200	3	300	3.25	300	3.75	Grid 1600x1600	4.5
3	160	0	200	0.25	200	0.6	Grid 1600x1600	1.35
4	160	0	200	0.3	Grid 1600x1600	0.85		
5	200	0	300	0.5	Grid 1600x1600	1.95		
6	110	0	Grid 1600x1600	0.5				
7	160	0	200	0.3	Grid 1600x1600	1		
8	160	0	200	0.4	Grid 1600x1600	1.65		

Table 9: Variable Outlet Structure Offsets for each Pond

Extended detention achieved by the overall stormwater systems for the post development scenario is in accordance with the CoCT policy requirements for the 1-year 24-hour storm event. The figures below indicate the various pond inflows over 48 hours at the outfall manhole in the pre-development unattenuated scenario (Grey) and the post-development attenuated scenario (Blue).

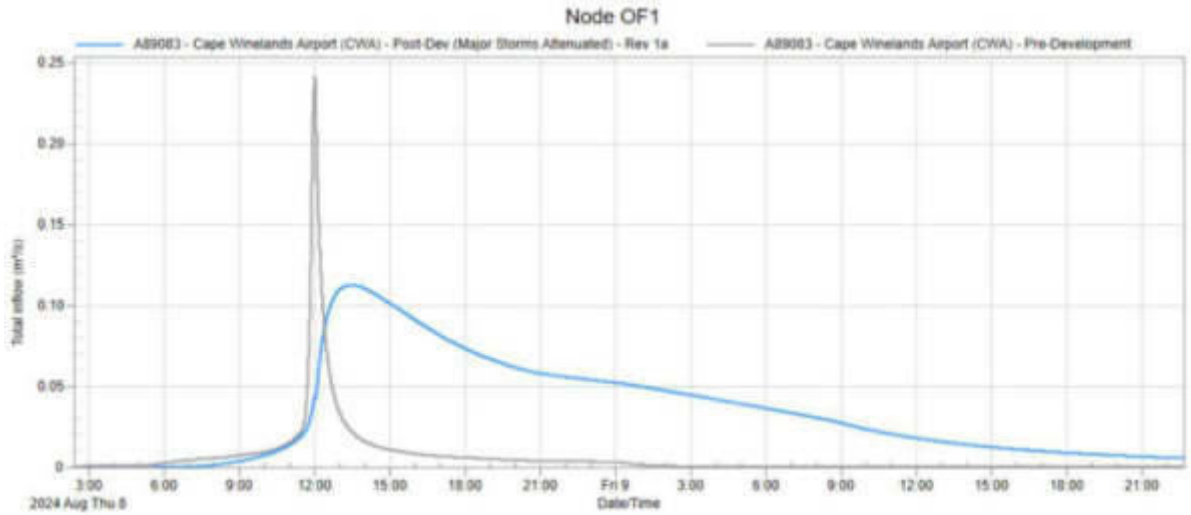

Figure 16: Pond 1 – Outfall Junction showing Extended Detention achieved on Site

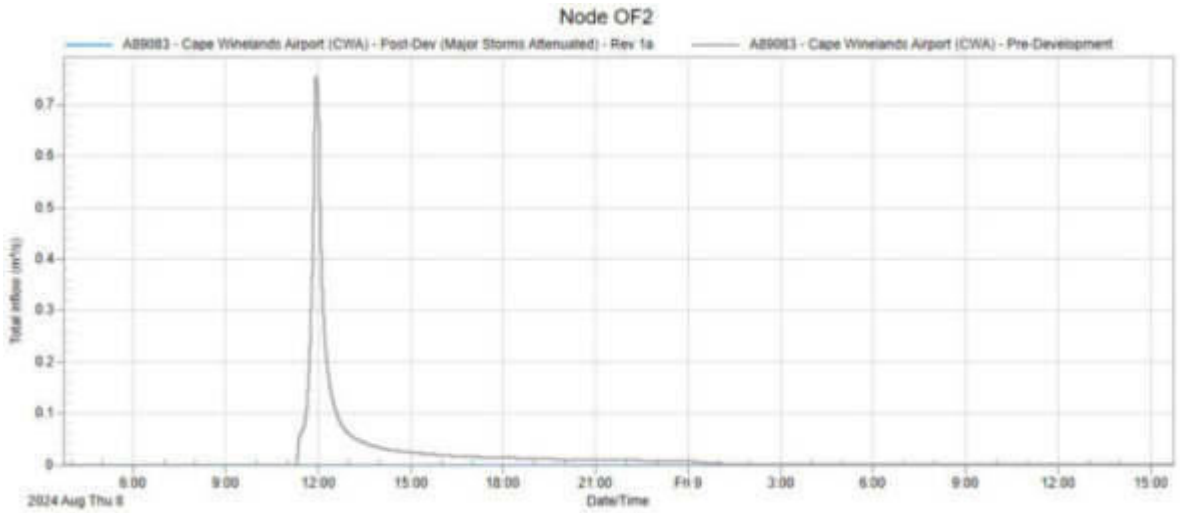

Figure 17: Pond 2 – Outfall Junction showing Extended Detention achieved on Site

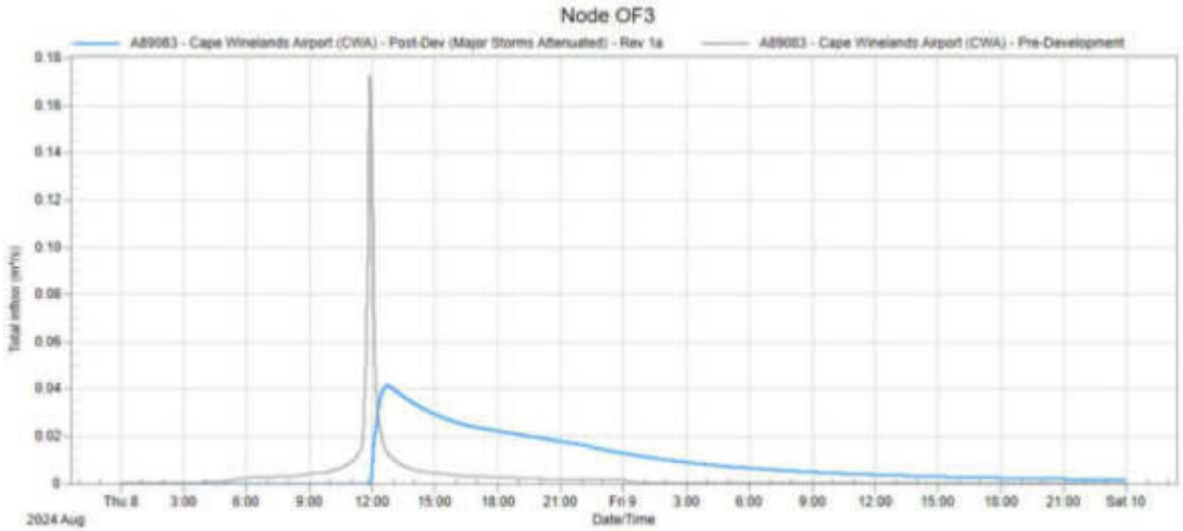

Figure 18: Pond 3 – Outfall Junction showing Extended Detention achieved on Site

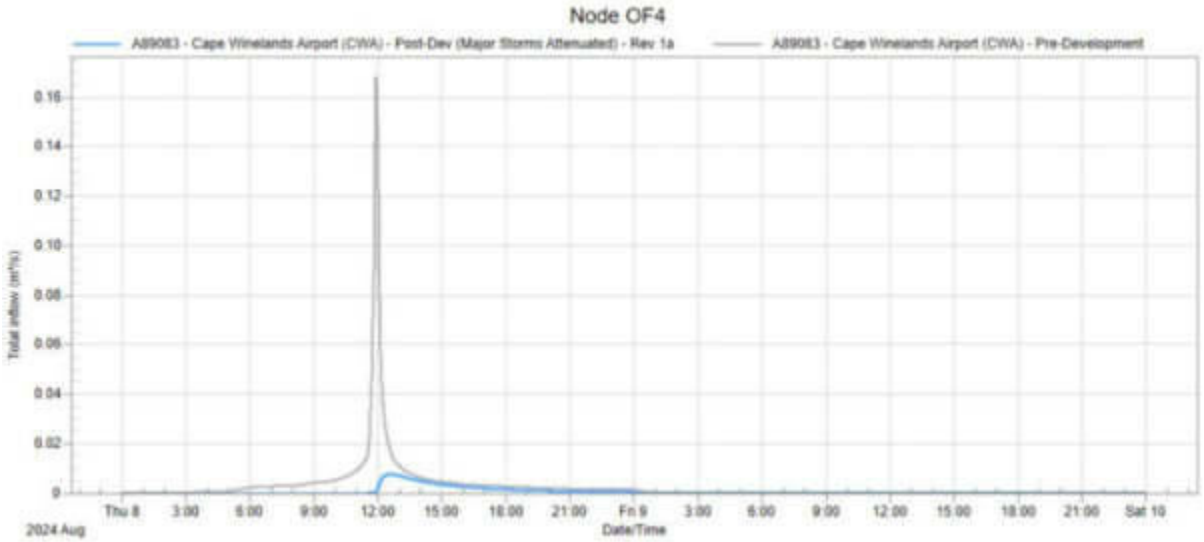

Figure 19: Pond 4 – Outfall Junction showing Extended Detention achieved on Site

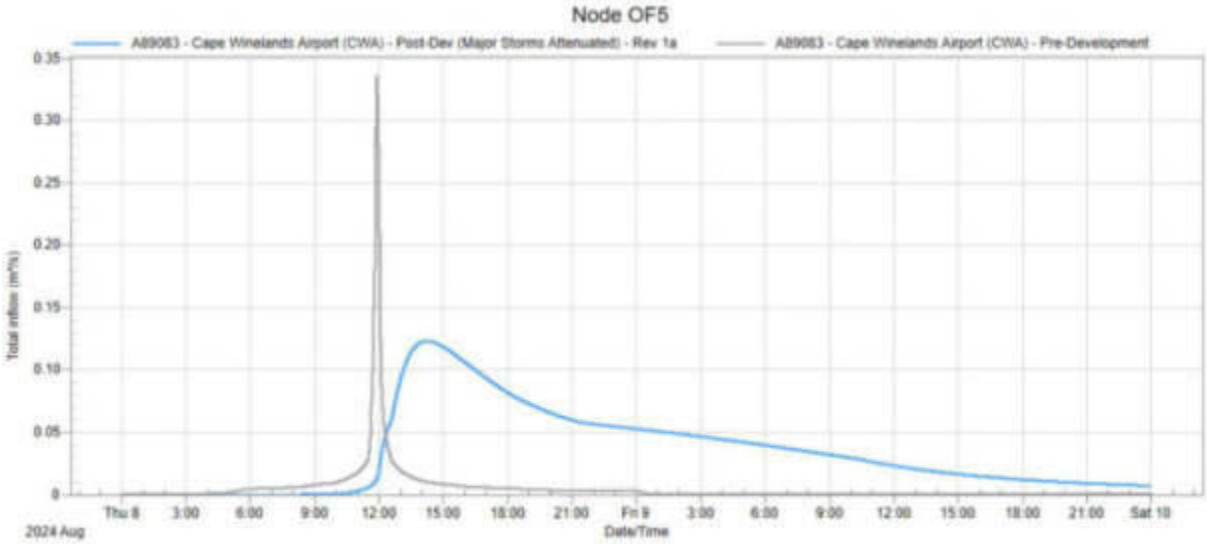

Figure 20: Pond 5 – Outfall Junction showing Extended Detention achieved on Site

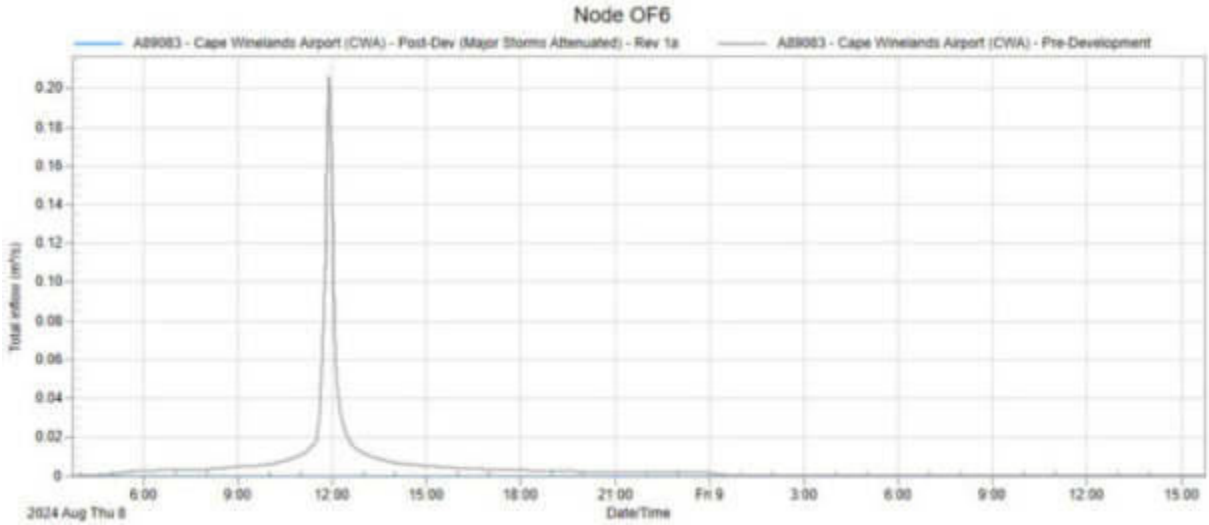

Figure 21: Pond 6 – Outfall Junction showing Extended Detention achieved on Site

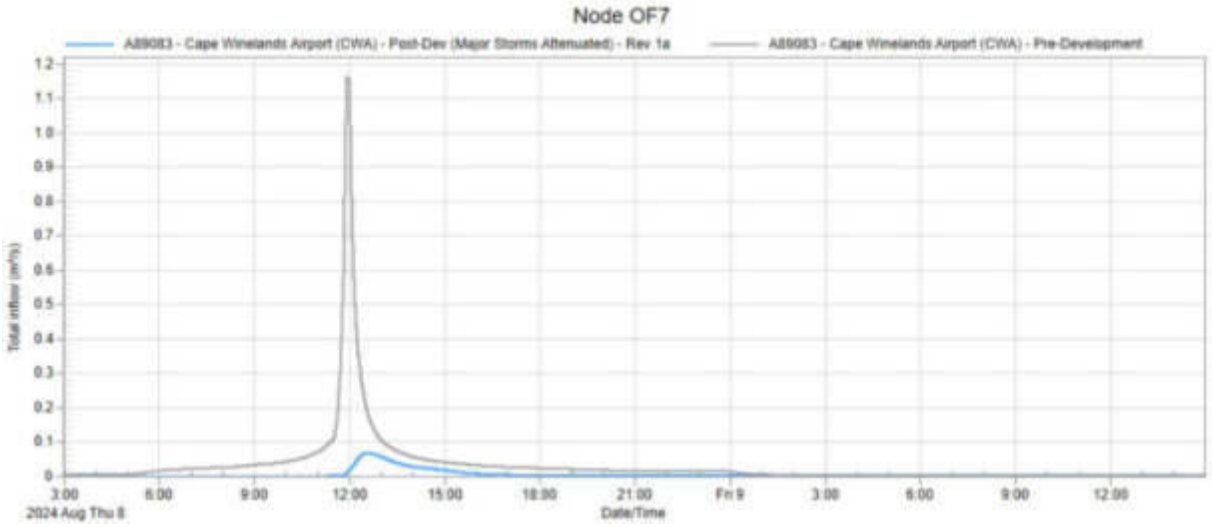

Figure 22: Pond 7 – Outfall Junction showing Extended Detention achieved on Site

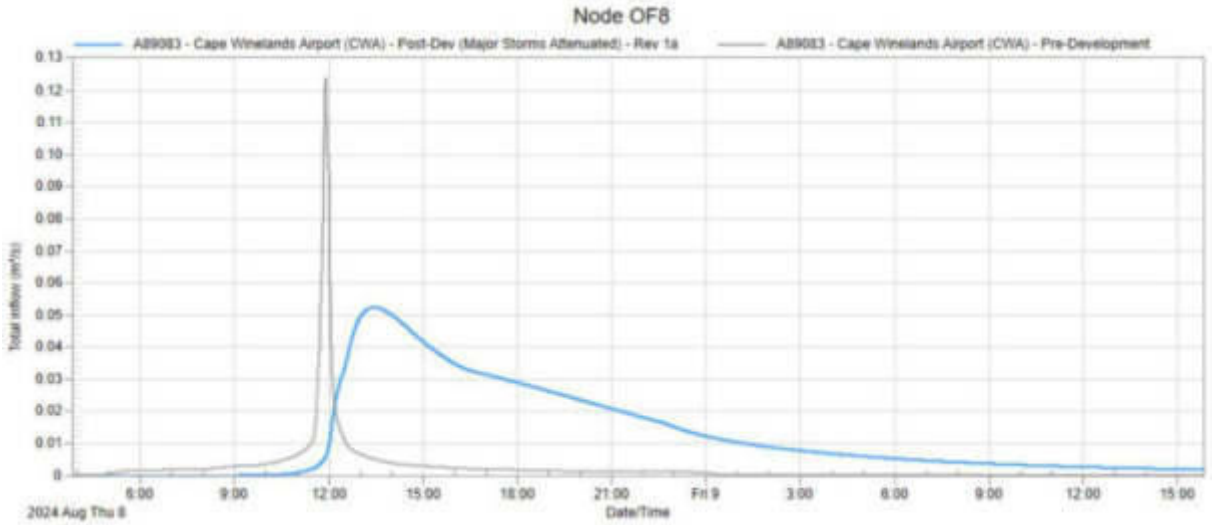

Figure 23: Pond 8 – Outfall Junction showing Extended Detention achieved on Site

4.5 Storm Event Management

4.5.1 Stormwater Attenuation

The implementation of treatment measures will inherently reduce peak flows as it will include storage capacity while facilitating infiltration, slow down velocities and provide extra storage in the underlying layers. Pre-Development run-offs were modelled to compare the different scenarios with the post-development model. Peak run-off outputs for pre-development and post-development are summarised in the tables below for each of the proposed ponds.

The peak run-off values for stormwater Pond 1 can be seen summarised in Table 10 below.

Storm Event (24h duration)	Peak Runoff values for the Stormwater Pond 1 at Cape Winelands Airport		
	Pre-Development	Post-Development (Unattenuated)	Post-Development (Attenuated)
2yr	0.350	2.419	0.168
5yr	0.492	3.379	0.278
10yr	0.596	4.059	0.353
20yr	0.706	4.748	0.411
50yr	0.873	5.57	0.808

Table 10: Pond 1 – Peak Run-off Values for Various Design Storm Events

The peak flows detailed in Table 10 above are presented graphically in Figure 24 below:

Figure 24: Pond 1 – Peak Run-off Values for Various Storm Events

The peak run-off values for stormwater Pond 2 can be seen summarised in Table 11 below.

Storm Event (24h duration)	Peak Runoff values for the Stormwater Pond 2 at Cape Winelands Airport		
	Pre-Development	Post-Development (Unattenuated)	Post-Development (Attenuated)
2yr	1.085	8.289	0.057
5yr	1.520	11.713	0.212
10yr	1.838	14.334	0.365
20yr	2.174	17.135	0.474
50yr	2.654	21.416	2.105

Table 11: Pond 2 – Peak Run-off Values for Various Design Storm Events

The peak flows detailed in Table 11 above are presented graphically in Figure 25 below:

Figure 25: Pond 2 – Peak Run-off Values for Various Storm Events

The peak run-off values for stormwater Pond 3 can be seen summarised in Table 12 below.

Storm Event (24h duration)	Peak Runoff values for the Stormwater Pond 3 at Cape Winelands Airport		
	Pre-Development	Post-Development (Unattenuated)	Post-Development (Attenuated)
2yr	0.243	2.116	0.082
5yr	0.334	2.959	0.141
10yr	0.400	3.582	0.177
20yr	0.469	4.235	0.206
50yr	0.567	5.212	0.438

Table 12: Pond 3 – Peak Run-off Values for Various Design Storm Events

The peak flows detailed in Table 12 above are presented graphically in Figure 26 below:

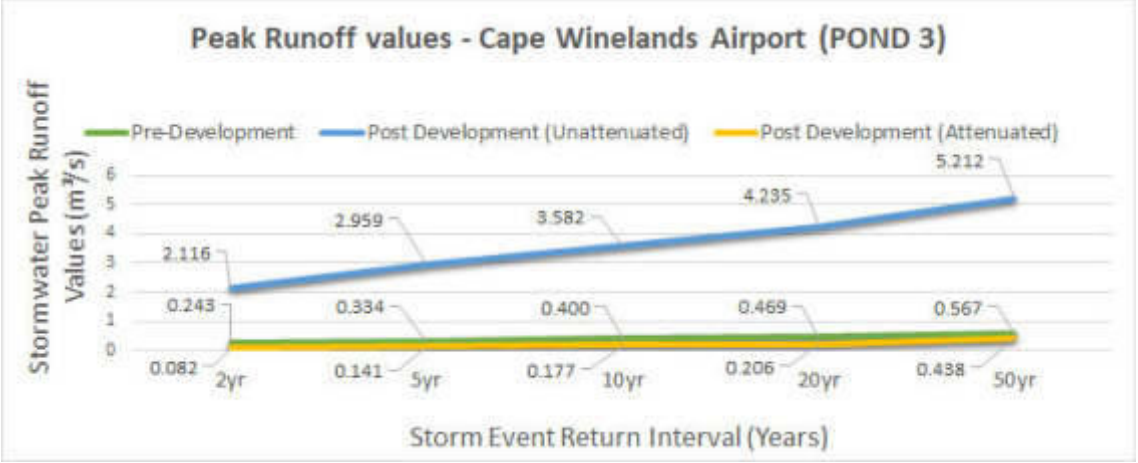

Figure 26: Pond 3 – Peak Run-off Values for Various Storm Events

The peak run-off values for stormwater Pond 4 can be seen summarised in Table 13 below.

Storm Event (24h duration)	Peak Runoff values for the Stormwater Pond 4 at Cape Winelands Airport		
	Pre-Development	Post-Development (Unattenuated)	Post-Development (Attenuated)
2yr	0.238	0.106	0.014
5yr	0.330	0.148	0.020
10yr	0.396	0.179	0.024
20yr	0.466	0.212	0.027
50yr	0.565	0.259	0.036

Table 13: Pond 4 – Peak Run-off Values for Various Design Storm Events

The peak flows detailed in Table 13 above are presented graphically in Figure 27 below:

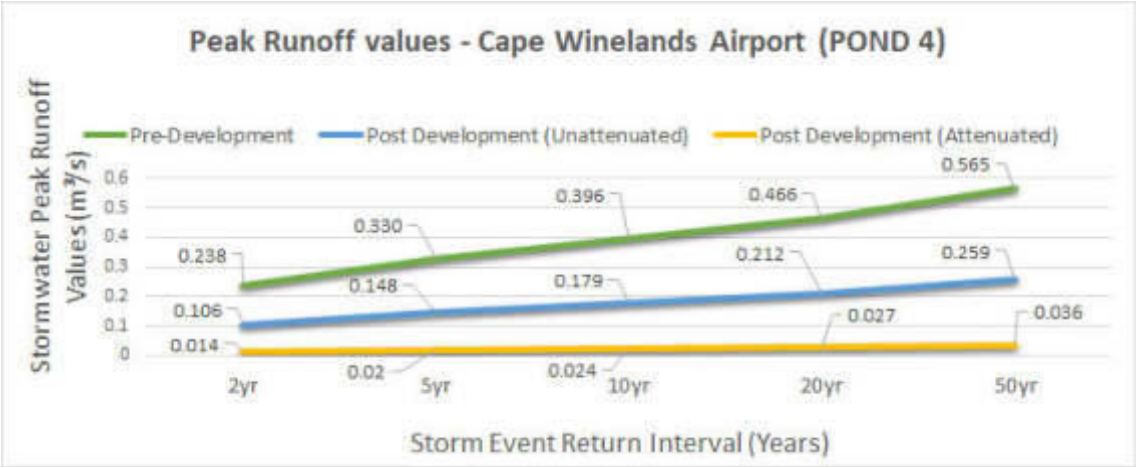

Figure 27: Pond 4 – Peak Run-off Values for Various Storm Events

The peak run-off values for stormwater Pond 5 can be seen summarised in Table 14 below.

Storm Event (24h duration)	Peak Runoff values for the Stormwater Pond 5 at Cape Winelands Airport		
	Pre-Development	Post-Development (Unattenuated)	Post-Development (Attenuated)
2yr	0.470	1.763	0.205
5yr	0.642	2.553	0.272
10yr	0.767	3.099	0.311
20yr	0.897	3.563	0.346
50yr	1.082	3.85	0.95

Table 14: Pond 5 – Peak Run-off Values for Various Design Storm Events

The peak flows detailed in Table 14 above are presented graphically in Figure 28 below:

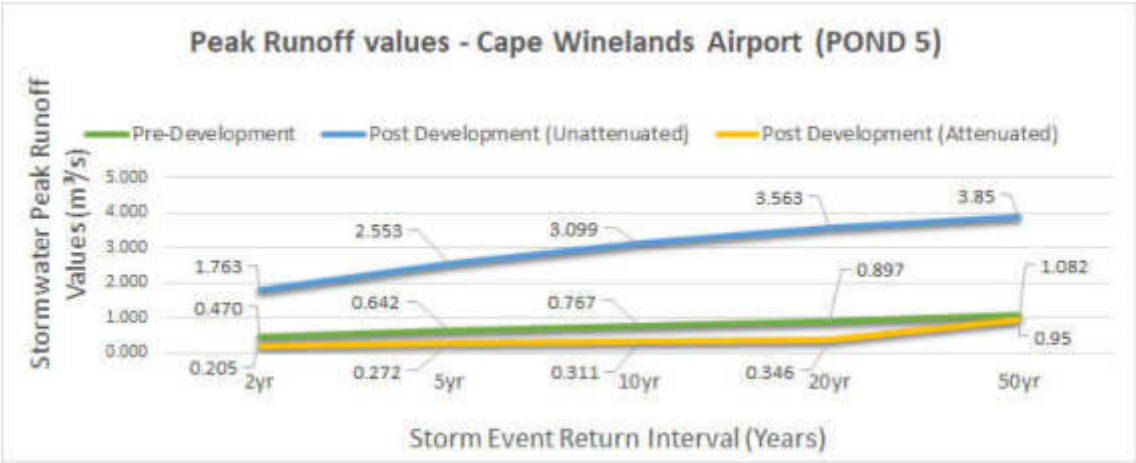

Figure 28: Pond 5 – Peak Run-off Values for Various Storm Events

The peak run-off values for stormwater Pond 6 can be seen summarised in Table 15 below:

Storm Event (24h duration)	Peak Runoff values for the Stormwater Pond 6 at Cape Winelands Airport		
	Pre-Development	Post-Development (Unattenuated)	Post-Development (Attenuated)
2yr	0.289	0.099	0.000
5yr	0.396	0.144	0.001
10yr	0.473	0.177	0.001
20yr	0.553	0.213	0.002
50yr	0.668	0.265	0.004

Table 15: Pond 6 – Peak Run-off Values for Various Design Storm Events

The peak flows detailed in Table 15 above are presented graphically in Figure 29 below:

Figure 29: Pond 6 – Peak Run-off Values for Various Storm Events

The peak run-off values for stormwater Pond 7 can be seen summarised in Table 16 below:

Storm Event (24h duration)	Peak Runoff values for the Stormwater Pond 7 at Cape Winelands Airport		
	Pre-Development	Post-Development (Unattenuated)	Post-Development (Attenuated)
2yr	1.691	0.322	0.094
5yr	2.392	0.465	0.120
10yr	2.909	0.571	0.237
20yr	3.457	0.683	0.412
50yr	4.245	0.844	0.649

Table 16: Pond 7 – Peak Run-off Values for Various Design Storm Events

The peak flows detailed in Table 16 above are presented graphically in Figure 30 below:

Figure 30: Pond 7 – Peak Run-off Values for Various Storm Events

The peak run-off values for stormwater Pond 8 can be seen summarised in Table 17 below:

Storm Event (24h duration)	Peak Runoff values for the Stormwater Pond 8 at Cape Winelands Airport		
	Pre-Development	Post-Development (Unattenuated)	Post-Development (Attenuated)
2yr	0.189	0.639	0.088
5yr	0.256	0.933	0.116
10yr	0.304	1.155	0.131
20yr	0.356	1.395	0.146
50yr	0.428	1.738	0.163

Table 17: Pond 8 – Peak Run-off Values for Various Design Storm Events

The peak flows detailed in Table 17 above are presented graphically in Figure 31 below:

Figure 31: Pond 8 – Peak Run-off Values for Various Storm Events

When comparing the pre-development and post-development peak flow rates for Cape Winelands Airport as demonstrated in the figures above, it can be seen that the post development attenuated peak flows are reduced to below pre-development levels.

The focus of the proposed concept design was to ensure that peak run-offs for the post-development scenario are sufficiently reduced to mitigate damage to existing stormwater infrastructure, downstream properties and receiving water bodies from the post development flows.

4.5.2 Water Quality Targets

The CoCT policy requires treatment of the runoff from the 0.5-year, 24-hour storm (design storm), which is the Water Quality Volume (WQv). In terms of the CCT's "Management of Urban Stormwater Impacts Policy", acceptable improvement in the quality of stormwater runoff may be achieved through the removal of pollutants by a combination of reducing and / or disconnecting impervious areas from the drainage system and the use of LIDS (Low impact drainage systems) that infiltrate and / or capture and treat stormwater runoff. Sub-catchment types and impervious areas used in the calculations are summarised in Table 18 below.

Sub-Catchment Type	Total Area (ha)	Impervious (%)	Impervious Area (ha)	Pervious Area (ha)
Pond/Bioretention Area	5.25	0%	0.00	5.25
Roads	97.59	100%	97.59	0.00
Buildings	75.97	100%	75.97	0.00
Other (Development)	15.59	75%	11.69	3.90
Grassed/Public Open Spaces	235.19	0%	0.00	235.19
Total	**429.59**		**185.26**	**244.34**
Resultant Impervious Percentage (%)		**43.1%**		

Table 18: Water Quality Volume Calculations

The Calculation of the WQv is calculated from the following formula (Atlanta Regional Commission, 2016)

$$\mathrm{WQv} = \frac{P.R_v.\mathrm{A}}{1000}$$

Where:

WQv = Water Quality Volume (Ml)
P = ½ year, 24-hour storm, precipitation (mm)
Rv =Volumetric runoff coefficient
A = Site area (m^2)

The Volumetric runoff coefficient is calculated as follows:

$$R_v = 0.05 + 0.009(I)$$

Where:

I = Site impervious percentage

Therefore, the Volumetric runoff coefficient R_v can be calculated as: $R_v = 0.05 + 0.009(43.1) = 0.438$

The Water Quality Volume calculation is therefore as follows:

$$\mathrm{WQv} = \frac{(20.1).(0.438).(4295930)}{(1000)}$$

$$\mathrm{WQv} = 37820.5m^3$$

The WQv calculated above was used to size the bottom of pond area.

The total treated volume which entered the LID's for the 0.5-year RI 24-hour storm event is 73.79ML as can be seen in Table 19 below. This total run-off volume infiltrated the engineered layerworks before discharging into the downstream system through the sub-surface drains.

Name	Description	Area (ha)	Infiltration (mm)	Runon (mm)	Runoff Depth (mm)	Precipitation (mm)	Total Volume Treated (ML)
S1_4	Grass	0.3307	20.1	0	0	20.1	0.0665
S12_1	Grass	0.4631	20.1	0	0	20.1	0.0931
S12_2	Grass	0.3307	20.1	0	0	20.1	0.0665
S12_3	Grass	0.8082	20.1	0	0	20.1	0.1624
S12_5	Grass	0.4882	20.1	0	0	20.1	0.0981
S12_6	Grass	0.4429	20.1	0	0	20.1	0.0890
S12_7	Grass	0.64	20.1	0	0	20.1	0.1286
S12_8	Grass	0.3765	20.1	0	0	20.1	0.0757
S13	Grass	4.4598	20.1	0	0	20.1	0.8964
S15_3	Grass	0.6131	20.1	0	0	20.1	0.1232
S15_4	Grass	0.6073	20.1	0	0	20.1	0.1221
S18	Grass	2.1429	22.44	2.34	0	20.1	0.4809
S18_6	Grass	3.2386	20.1	0	0	20.1	0.6510
S183	Grass	0.5514	20.1	0	0	20.1	0.1108
S184_1	Grass	0.0808	20.1	0	0	20.1	0.0162
S184_3	Grass	0.0804	20.1	0	0	20.1	0.0162
S184_4	Grass	0.6383	20.1	0	0	20.1	0.1283
S185	Grass	0.1687	20.1	0	0	20.1	0.0339
S186	Grass	0.2872	20.1	0	0	20.1	0.0577
S187	Grass	0.3972	20.1	0	0	20.1	0.0798
S189	Grass	0.0903	20.1	0	0	20.1	0.0182
S19	Grass	0.0543	20.1	0	0	20.1	0.0109
S190	Grass	0.7908	20.1	0	0	20.1	0.1590
S191	Grass	0.3845	20.1	0	0	20.1	0.0773
S193_2	Grass	0.423	20.1	0	0	20.1	0.0850
S193_3	Grass	0.7555	20.1	0	0	20.1	0.1519
S193_4	Grass	0.6987	20.1	0	0	20.1	0.1404
S193_5	Grass	0.2076	20.1	0	0	20.1	0.0417
S193_6	Grass	0.5185	20.1	0	0	20.1	0.1042
S193_7	Grass	0.7365	20.1	0	0	20.1	0.1480
S195_1	Grass	0.5457	20.1	0	0	20.1	0.1097
S195_2	Grass	0.9104	20.1	0	0	20.1	0.1830
S197_1	Grass	0.5532	20.1	0	0	20.1	0.1112
S197_3	Grass	0.3629	20.1	0	0	20.1	0.0729
S197_4	Grass	0.2028	20.1	0	0	20.1	0.0408
S197_5	Grass	0.116	20.1	0	0	20.1	0.0233
S197_6	Grass	0.3071	20.1	0	0	20.1	0.0617
S198_1	Grass	0.338	20.1	0	0	20.1	0.0679
S198_10	Grass	0.0743	20.1	0	0	20.1	0.0149
S198_2	Grass	0.3601	20.1	0	0	20.1	0.0724
S198_3	Grass	0.3197	20.1	0	0	20.1	0.0643
S198_4	Grass	0.1222	20.1	0	0	20.1	0.0246
S198_5	Grass	0.1467	20.1	0	0	20.1	0.0295
S198_6	Grass	0.3309	20.1	0	0	20.1	0.0665
S198_7	Grass	0.1941	20.1	0	0	20.1	0.0390
S198_8	Grass	0.1324	20.1	0	0	20.1	0.0266
S199	Grass	0.309	20.1	0	0	20.1	0.0621
S200_1	Grass	0.3474	20.1	0	0	20.1	0.0698
S200_2	Grass	0.4685	20.1	0	0	20.1	0.0942
S201	Grass	0.27	20.1	0	0	20.1	0.0543
S202	Grass	0.5447	20.1	0	0	20.1	0.1095
S203	Grass	0.1518	20.1	0	0	20.1	0.0305
S204	Grass	0.1672	20.1	0	0	20.1	0.0336
S205	Grass	0.162	20.1	0	0	20.1	0.0326
S206_1	Grass	0.2851	20.1	0	0	20.1	0.0573
S206_2	Grass	0.414	20.1	0	0	20.1	0.0832
S206_3	Grass	0.2117	20.1	0	0	20.1	0.0426
S207	Grass	0.453	20.1	0	0	20.1	0.0911
S208_1	Grass	0.5643	20.1	0	0	20.1	0.1134
S208_2	Grass	0.1272	20.1	0	0	20.1	0.0256
S208_3	Grass	0.312	20.1	0	0	20.1	0.0627
S208_4	Grass	0.2359	20.1	0	0	20.1	0.0474
S209	Grass	0.6781	20.1	0	0	20.1	0.1363
S21	Grass	3.4882	20.1	0	0	20.1	0.7011
S210_1	Grass	0.2153	20.1	0	0	20.1	0.0433
S210_3	Grass	0.2828	20.1	0	0	20.1	0.0568
S210_4	Grass	0.1065	20.1	0	0	20.1	0.0214
S210_5	Grass	0.2299	20.1	0	0	20.1	0.0462
S211_1	Grass	0.9571	20.1	0	0	20.1	0.1924
S211_2	Grass	2.1091	20.1	0	0	20.1	0.4239
S212_1	Grass	0.2361	20.1	0	0	20.1	0.0475
S212_2	Grass	1.5663	20.1	0	0	20.1	0.3148

Name	Description	Area (ha)	Infiltration (mm)	Runon (mm)	Runoff Depth (mm)	Precipitation (mm)	Total Volume Treated (ML)
S213_1	Grass	0.4712	20.1	0	0	20.1	0.0947
S213_2	Grass	0.1444	20.1	0	0	20.1	0.0290
S213_3	Grass	1.4522	20.1	0	0	20.1	0.2919
S214	Grass	0.1355	20.1	0	0	20.1	0.0272
S215	Grass	0.3375	20.1	0	0	20.1	0.0678
S216	Grass	1.1982	20.1	0	0	20.1	0.2408
S217_1	Grass	0.39	20.1	0	0	20.1	0.0784
S217_2	Grass	0.5325	20.1	0	0	20.1	0.1070
S217_3	Grass	0.885	20.1	0	0	20.1	0.1779
S218	Grass	0.2	20.1	0	0	20.1	0.0402
S219	Grass	0.1902	20.1	0	0	20.1	0.0382
S22	Grass	4.487	20.1	0	0	20.1	0.9019
S220	Grass	0.0274	20.1	0	0	20.1	0.0055
S221	Grass	0.3031	20.1	0	0	20.1	0.0609
S222	Grass	0.1232	20.1	0	0	20.1	0.0248
S223_1	Grass	0.1515	20.1	0	0	20.1	0.0305
S223_2	Grass	1.2694	20.1	0	0	20.1	0.2551
S224	Grass	0.0499	20.1	0	0	20.1	0.0100
S225	Grass	0.0297	20.1	0	0	20.1	0.0060
S226	Grass	0.3987	20.1	0	0	20.1	0.0801
S227	Grass	0.4756	20.1	0	0	20.1	0.0956
S228	Grass	0.0537	20.1	0	0	20.1	0.0108
S229_1	Grass	0.1344	20.1	0	0	20.1	0.0270
S229_2	Grass	0.1093	20.1	0	0	20.1	0.0220
S229_3	Grass	0.2684	20.1	0	0	20.1	0.0539
S229_4	Grass	0.069	20.1	0	0	20.1	0.0139
S230_1	Grass	0.336	20.1	0	0	20.1	0.0675
S230_2	Grass	0.2926	20.1	0	0	20.1	0.0588
S231	Grass	0.1566	20.1	0	0	20.1	0.0315
S232	Grass	0.0252	20.1	0	0	20.1	0.0051
S233	Grass	0.0476	20.1	0	0	20.1	0.0096
S234	Grass	0.0572	20.1	0	0	20.1	0.0115
S235	Grass	0.302	20.1	0	0	20.1	0.0607
S236	Grass	0.0157	20.1	0	0	20.1	0.0032
S237	Grass	0.1674	20.1	0	0	20.1	0.0336
S238	Grass	0.0874	20.1	0	0	20.1	0.0176
S239	Grass	0.4724	20.1	0	0	20.1	0.0950
S240_1	Grass	0.2282	20.1	0	0	20.1	0.0459
S240_2	Grass	0.3818	20.1	0	0	20.1	0.0767
S241	Grass	0.2344	20.1	0	0	20.1	0.0471
S242	Grass	0.8934	20.1	0	0	20.1	0.1796
S28	Grass	0.6137	20.1	0	0	20.1	0.1234
S29	Grass	2.3307	22.93	2.83	0	20.1	0.5344
S3	Grass	4.463	20.1	0	0	20.1	0.8971
S3_119	Grass	1.5332	20.1	0	0	20.1	0.3082
S3_122	Grass	1.921	23.16	3.06	0	20.1	0.4449
S3_124	Grass	3.594	26.53	6.43	0	20.1	0.9535
S3_126	Grass	2.9847	20.1	0	0	20.1	0.5999
S3_127	Grass	3.0986	29.55	9.45	0	20.1	0.9156
S3_17	Grass	2.9314	27.12	7.02	0	20.1	0.7950
S3_18	Grass	1.1744	20.1	0	0	20.1	0.2361
S3_19	Grass	0.9188	20.1	0	0	20.1	0.1847
S3_20	Grass	2.9278	31	10.9	0	20.1	0.9076
S3_21	Grass	1.662	29.39	9.29	0	20.1	0.4885
S3_23	Grass	1.6534	20.1	0	0	20.1	0.3323
S3_24	Grass	1.2164	20.1	0	0	20.1	0.2445
S3_27	Grass	2.9873	20.1	0	0	20.1	0.6004
S3_32	Grass	1.3324	30.22	10.12	0	20.1	0.4027
S3_42	Grass	0.4377	20.1	0	0	20.1	0.0880
S3_69	Grass	1.38	20.1	0	0	20.1	0.2774
S3_7	Grass	0.2614	20.1	0	0	20.1	0.0525
S3_8	Grass	1.6619	20.1	0	0	20.1	0.3340
S32	Grass	0.1018	20.1	0	0	20.1	0.0205
S32_1	Grass	0.2138	20.1	0	0	20.1	0.0430
S32_10	Grass	1.0169	20.1	0	0	20.1	0.2044
S32_11	Grass	0.6588	20.1	0	0	20.1	0.1324
S32_12	Grass	0.548	20.1	0	0	20.1	0.1101
S32_13	Grass	0.0756	20.1	0	0	20.1	0.0152
S32_3	Grass	0.5271	20.1	0	0	20.1	0.1059
S32_6	Grass	0.5857	20.1	0	0	20.1	0.1177
S32_8	Grass	0.6524	20.1	0	0	20.1	0.1311
S36	Grass	3.2245	20.1	0	0	20.1	0.6481
S37	Grass	0.7418	20.1	0	0	20.1	0.1491
S38	Grass	6.0018	24.36	4.26	0	20.1	1.4620
S4	Grass	1.1763	43.58	23.48	0	20.1	0.5126

Name	Description	Area (ha)	Infiltration (mm)	Runon (mm)	Runoff Depth (mm)	Precipitation (mm)	Total Volume Treated (ML)
S4S_11	Grass	0.166	20.1	0	0	20.1	0.0334
S4S_12	Grass	0.1515	20.1	0	0	20.1	0.0305
S4S_14	Grass	0.1155	20.1	0	0	20.1	0.0232
S4S_16	Grass	0.1027	20.1	0	0	20.1	0.0206
S4S_17	Grass	0.1004	20.1	0	0	20.1	0.0202
S4S_19	Grass	0.0996	20.1	0	0	20.1	0.0200
S4S_2	Grass	0.0706	20.1	0	0	20.1	0.0142
S4S_20	Grass	0.0968	20.1	0	0	20.1	0.0195
S4S_22	Grass	0.1331	20.1	0	0	20.1	0.0268
S4S_23	Grass	0.056	20.1	0	0	20.1	0.0113
S4S_25	Grass	0.1246	20.1	0	0	20.1	0.0250
S4S_26	Grass	0.1226	20.1	0	0	20.1	0.0246
S4S_28	Grass	0.1202	20.1	0	0	20.1	0.0242
S4S_29	Grass	0.1104	20.1	0	0	20.1	0.0222
S4S_3	Grass	0.0707	20.1	0	0	20.1	0.0142
S4S_31	Grass	0.1584	20.1	0	0	20.1	0.0318
S4S_32	Grass	0.0259	20.1	0	0	20.1	0.0052
S4S_34	Grass	0.1121	20.1	0	0	20.1	0.0225
S4S_37	Grass	0.0951	20.1	0	0	20.1	0.0191
S4S_38	Grass	0.0742	20.1	0	0	20.1	0.0149
S4S_40	Grass	0.0654	20.1	0	0	20.1	0.0131
S4S_42	Grass	0.2917	20.1	0	0	20.1	0.0586
S4S_43	Grass	0.0268	20.1	0	0	20.1	0.0054
S4S_45	Grass	0.077	20.1	0	0	20.1	0.0155
S4S_46	Grass	0.0261	20.1	0	0	20.1	0.0052
S4S_47	Grass	0.0863	20.1	0	0	20.1	0.0173
S4S_48	Grass	0.0478	20.1	0	0	20.1	0.0096
S4S_49	Grass	0.092	20.1	0	0	20.1	0.0185
S4S_5	Grass	0.1644	20.1	0	0	20.1	0.0330
S4S_6	Grass	0.1202	20.1	0	0	20.1	0.0242
S4S_7	Grass	0.0692	20.1	0	0	20.1	0.0139
S4S_8	Grass	0.1316	20.1	0	0	20.1	0.0265
S5	Grass	1.679	20.1	0	0	20.1	0.3375
S51_1	Grass	0.3084	20.1	0	0	20.1	0.0620
S51_2	Grass	0.2899	20.1	0	0	20.1	0.0583
S54	Grass	7.3951	20.1	0	0	20.1	1.4864
S6	Grass	3.8232	20.1	0	0	20.1	0.7685
S66_3	Grass	7.9683	20.1	0	0	20.1	1.6016
S66_4	Grass	5.6638	20.1	0	0	20.1	1.1384
S66_5	Grass	2.4406	20.1	0	0	20.1	0.4906
S67	Grass	6.2018	20.1	0	0	20.1	1.2466
S7_1	Grass	0.5354	20.1	0	0	20.1	0.1076
S7_11	Grass	1.6543	20.1	0	0	20.1	0.3325
S7_12	Grass	0.4761	20.1	0	0	20.1	0.0957
S7_3	Grass	3.8494	20.1	0	0	20.1	0.7737
S7_39	Grass	0.4525	20.1	0	0	20.1	0.0910
S7_4	Grass	1.2187	20.1	0	0	20.1	0.2450
S7_41	Grass	4.353	23.71	3.61	0	20.1	1.0321
S7_44	Grass	3.2677	20.1	0	0	20.1	0.6568
S7_45	Grass	8.0963	23.56	3.46	0	20.1	1.9075
S7_46	Grass	6.3093	23.76	3.66	0	20.1	1.4991
S7_48	Grass	5.241	23.59	3.49	0	20.1	1.2364
S7_5	Grass	1.3015	20.1	0	0	20.1	0.2616
S7_50	Grass	6.9122	20.1	0	0	20.1	1.3894
S7_51	Grass	2.0226	20.1	0	0	20.1	0.4065
S7_53	Grass	7.9924	23.7	3.6	0	20.1	1.8942
S7_6	Grass	0.3656	20.1	0	0	20.1	0.0735
S7_7	Grass	0.5805	20.1	0	0	20.1	0.1167
S7_8	Grass	8.4494	20.1	0	0	20.1	1.6983
S70_1	Grass	0.0629	20.1	0	0	20.1	0.0126
S70_4	Grass	2.1595	20.1	0	0	20.1	0.4341
S71_1	Grass	0.1697	20.1	0	0	20.1	0.0341
S71_10	Grass	0.2056	20.1	0	0	20.1	0.0413
S71_11	Grass	0.5037	20.1	0	0	20.1	0.1012
S71_3	Grass	0.2287	20.1	0	0	20.1	0.0460
S71_5	Grass	0.5007	20.1	0	0	20.1	0.1006
S71_6	Grass	0.9087	20.1	0	0	20.1	0.1826
S71_7	Grass	0.4584	20.1	0	0	20.1	0.0921
S71_8	Grass	2.0617	20.1	0	0	20.1	0.4144
S71_9	Grass	1.2004	20.1	0	0	20.1	0.2413
S8	Grass	2.4899	20.1	0	0	20.1	0.5005
S8_1	Grass	0.3446	20.1	0	0	20.1	0.0693
S8_2	Grass	0.0385	20.1	0	0	20.1	0.0077
S8_4	Grass	0.4417	20.1	0	0	20.1	0.0888
S9	Grass	0.115	20.1	0	0	20.1	0.0231

Name	Description	Area (ha)	Infiltration (mm)	Runon (mm)	Runoff Depth (mm)	Precipitation (mm)	Total Volume Treated (ML)
S10	Grass	0.0274	20.1	0	0	20.1	0.0055
S39_1	Grass	0.1002	20.1	0	0	20.1	0.0201
S39_2	Grass	3.1992	21.45	1.35	0	20.1	0.6862
S39_4	Grass	0.0905	20.1	0	0	20.1	0.0182
S39	Grass	0.1296	20.1	0	0	20.1	0.0260
S40	Grass	0.0372	20.1	0	0	20.1	0.0075
S173_1	Other	0.1263	5.03	0	13.99	20.1	0.0064
S173_2	Other	0.2799	5.03	0	13.99	20.1	0.0141
S173_3	Other	0.2705	5.03	0	13.99	20.1	0.0136
S173_5	Other	0.3134	5.03	0	13.99	20.1	0.0158
S173_6	Other	0.3854	5.02	0	13.99	20.1	0.0193
S173_7	Other	0.6522	5.02	0	13.99	20.1	0.0327
S174_1	Other	0.3036	5.02	0	13.99	20.1	0.0152
S174_2	Other	0.1225	5.03	0	13.99	20.1	0.0062
S175_1	Other	0.6458	5.02	0	13.99	20.1	0.0324
S175_3	Other	0.4175	5.03	0	13.99	20.1	0.0210
S175_4	Other	0.546	5.02	0	13.99	20.1	0.0274
S176_1	Other	0.6518	5.03	0	13.99	20.1	0.0328
S176_3	Other	0.4128	5.02	0	13.99	20.1	0.0207
S176_4	Other	0.5468	5.03	0	13.99	20.1	0.0275
S177_1	Other	0.9674	5.03	0	13.99	20.1	0.0487
S177_2	Other	1.3616	5.02	0	13.99	20.1	0.0684
S178_1	Other	0.9746	5.02	0	13.99	20.1	0.0489
S178_2	Other	1.358	5.03	0	13.99	20.1	0.0683
S179_1	Other	0.773	5.02	0	13.99	20.1	0.0388
S179_2	Other	0.3155	5.03	0	13.99	20.1	0.0159
S179_3	Other	0.2267	5.02	0	13.99	20.1	0.0114
S180	Other	0.1434	5.02	0	13.99	20.1	0.0072
S181	Other	0.3693	5.03	0	13.99	20.1	0.0186
S182_2	Other	0.273	5.02	0	13.99	20.1	0.0137
S182_3	Other	0.8996	5.03	0	13.99	20.1	0.0452
S182_4	Other	0.6964	5.02	0	13.99	20.1	0.0350
S188_1	Other	0.1164	5.03	0	13.99	20.1	0.0059
S188_2	Other	0.1918	5.03	0	13.99	20.1	0.0096
S194_1	Other	0.1845	5.03	0	13.99	20.1	0.0093
S194_3	Other	0.1137	5.02	0	13.99	20.1	0.0057
S_Pond1	Pond	0.2098	18	1730.61	1534.45	20.1	0.0378
S_Pond2	Pond	3.2903	598.39	650.59	73.72	20.1	19.6888
S_Pond3	Pond	0.6095	440.98	517.44	98.94	20.1	2.6878
S_Pond4	Pond	0.1253	3.18	129.35	37.43	20.1	0.0040
S_Pond5	Pond	0.4485	16.41	923.67	721.03	20.1	0.0736
S_Pond6	Pond	0.0918	0	0	0	20.1	0.0000
S_Pond7	Pond	0.2703	10.25	219.76	81.94	20.1	0.0277
S_Pond8	Pond	0.2045	16.51	608.74	418.21	20.1	0.0338
S844	POS	1.6538	20.1	0	0	20.1	0.3324
						Total Treated Volume (ML)	73.79

Table 19: LID Control Treatment Achieved during the ½ year 24-hour Storm

Comparing the Water Quality Volume calculated (37.82ML) with the total volume of treated runoff (73.79ML), we see that the 0.5-year RI storm is infiltrated and that the Water Quality Volume is sufficiently treated by the proposed LID's at the Cape Winelands Airport development – There is a total surplus treated volume of 35.97ML.

4.6 Effects of the 1:100-Year Storm Event

The combined systems on site have been designed to attenuate up to and including the 1:50-year flood. The stormwater attenuation ponds, positioned strategically across the site, will each have dedicated variable outlet structures as well as overflows sized accordingly to convey the run-off from larger storms in excess of the 1:50 year event towards the overland escape routes as can be seen on Figure 32 below:

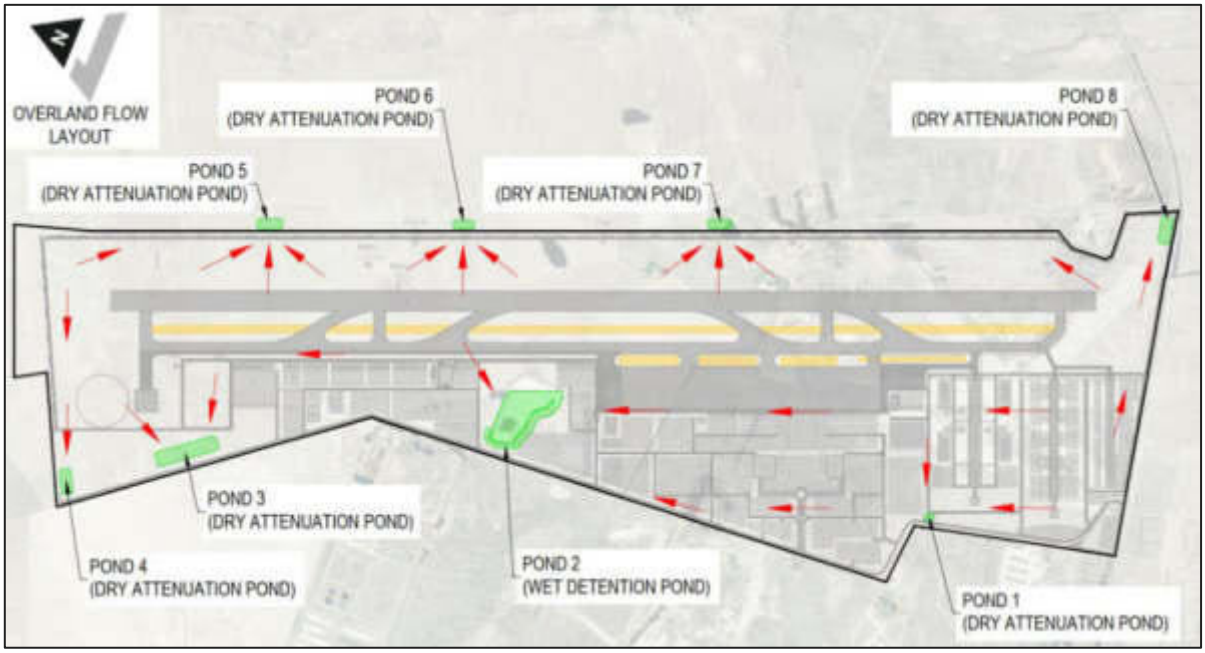

Figure 32: Overland Escape Routes

PCSWMM Simulations of the 1:100-year RI storm event have been modelled to ensure that no flooding occurs across the site and that the overland escape routes can convey the excess runoff away from critical infrastructure on the site towards the adjacent aquatic ecosystems namely the Mosselbank River and the Klapmuts River tributaries.

In the event that there is a blockage or failure within the system, the overland escape routes provided on the site will provide relief and can be seen detailed in Table 20 below.

Outfall	Description
Outfall 1	Discharges into the future Lucullus Road extension proposed stormwater infrastructure and drains towards Pond 2 / Outfall 2 after which it will be routed into the proposed future Bella Riva development stormwater BMP's.
Outfall 2	Discharges from the detention pond and will be routed into the proposed future Bella Riva development stormwater BMP's.
Outfall 3	Discharges into the delineated catchment situated to the West of the Cape Winelands Airport development ultimately leading into the Mosselbank River
Outfall 4	Discharges into the delineated catchment situated to the West of the Cape Winelands Airport development ultimately leading into the Mosselbank River
Outfall 5	Discharges into the delineated catchment situated to the East of the Cape Winelands Airport development ultimately leading into the Klapmuts River
Outfall 6	Discharges into the delineated catchment situated to the East of the Cape Winelands Airport development ultimately leading into the Klapmuts River
Outfall 7	Discharges into the delineated catchment situated to the East of the Cape Winelands Airport development ultimately leading into the Klapmuts River
Outfall 8	Discharges along the R312 (Lichtenburg Road) open earth drain which will act as an overland channel in the event of system failure and from there into the Klapmuts river tributary

Table 20: Summary – Overland Escape Routes

In additional to the above, a further hydraulic analysis was carried out in HEC-RAS to review the impact that the post development 1:100-year flood scenario, discharged from the Cape Winelands Airport site, will have on the downstream environment and has been assessed as part of the Flood Risk Assessment Report attached hereto as Appendix B.

4.7 Landscaping and Security

Landscaping for the proposed dry attenuation ponds will be as per the CoCT prescribed plant list and best practice. More detail pertaining to the landscaping plan, fencing, security, and erection of safety signage will be provided in the detailed Stormwater Management Plan.

Further to the above, appropriate signage as indicated in Figure 33 below is to be displayed at all stormwater drainage elements to mitigate against the following:

- Hardening of surfaces within the stormwater element area. Hardening of surfaces and the placement of obstructions will reduce the infiltration and treatment capacities and alter the intended attenuation and drainage path.
- Health & Safety risks associated with the element. These risks are associated with both the quality and quantity of water which will fill up when a storm event occurs. In terms of quality the water may be polluted, and consumption of the water will pose health risks. The severity of rainfall events and the subsequent quantities of water which enter the element can lead to unsafe conditions within the element due to the potential rapid rise in flow rates and water levels.
- Another security consideration is the attraction of birds to the wet pond. Birds present a risk to aviation safety and thus preventing birds from gathering at standing water bodies will need to be addressed during the detail design. Measures that may be contemplated included netting placed over the water body or bespoke products to cover the water surface.

The signage will serve as a guide and a warning and must be displayed at all entrances/access points to the ponds on site.

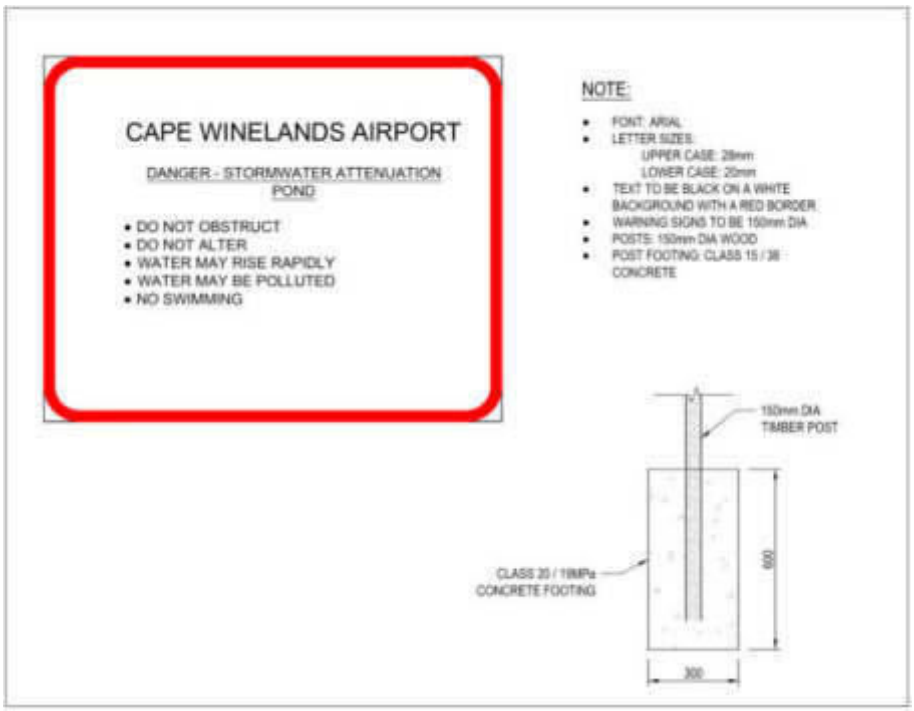

Figure 33: Typical Stormwater Pond Safety Signage

In principle there will be signage erected for safety, warning, and education for each of the dry attenuation ponds and wet detention pond to ensure the safeguarding of all personnel on the property. It is also noted that the site and its stormwater infrastructure is not accessible to the public.

5 Operations and Maintenance

Operation and maintenance procedures will be prepared as part of the closeout procedures for the project. The maintenance agreement will require the Cape Winelands Airport to periodically clean the structures, monitor the vegetation and sediment accumulation, and provide occasional watering to preserve the vegetation during the dry season. Once the stormwater system has been completed, the maintenance and monitoring thereof will remain the sole responsibility of the Cape Winelands Airport, who will take financial responsibility for the operations and necessary maintenance of the system.

5.1 Dry Attenuation Pond Maintenance Requirements

Adequate maintenance is essential to ensure that the dry attenuation pond operates correctly to prevent poor functionality and poor aesthetics. Typical periodic maintenance activities are provided in (Woods Ballard *et al.*, 2015) and the Cape Winelands Airport will implement the most suitable of these activities for the specific site conditions or as required during the lifecycle of the dry attenuation pond:

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly
	Manage vegetation	Monthly
	Inspect inlets, outlets, and overflows for blockages	Monthly
	Inspect inlets and basin for sediment accumulation. Determine appropriate frequencies.	Monthly, then as required
	Tidy dead vegetation before growth season	Annually
	Manage wetland plants in pools – where provided	Annually
Occasional maintenance	Reseed or replant in dilapidated areas	As required
	Prune and trim plants where necessary and remove cuttings	Every 2 years or as required
	Remove sediment from inlets, outlets and forebays	Annually, or as required
Remedial actions	Repair erosion or other damage	As required
	Repair or rehabilitate inlets, outlets, and overflows	As required
	Relevel uneven surfaces and reinstate design levels	As required
	Realign riprap, gabions, and/or Reno mattresses	As required

Table 21: Typical Operating and Maintenance activities for Dry Attenuation Ponds

In addition to the items listed above, some comments regarding maintenance procedures are provided below:

- Litter clearing: A litter clean-up is to take place monthly or as required.
- Cleaning of kerbs and channels: Sand, litter and refuse should be removed from kerbs and channels monthly or as required.
- Cleaning of pipes: Refuse should be removed from pipes monthly. Sand and silt should also be removed by using high pressure jetting.
- Cleaning of covers and frames: The covers and frames should be inspected monthly and need to be replaced, repositioned, or repaired where necessary.
- Earth embankment inspection: Embankments should be inspected monthly or after each rain. If the embankment is compromised, it should be reshaped to tie in with the original slope.
- Headwalls inspection: The headwalls should be inspected monthly or after each rain. Any blockage should be removed, and the natural vegetation trimmed to allow free drainage of water.

Many of the specific maintenance activities for dry ponds can be undertaken as part of a general landscape management contract and therefore, if landscape management is already required at site, should have marginal cost implications whilst creating local employment opportunities in the long-term.

5.2 Dry Swale Maintenance Requirements

Adequate maintenance is essential to ensure that the dry swales operate correctly to prevent poor functionality and poor aesthetics. Typical periodic maintenance activities are provided in (Woods Ballard *et al.*, 2015) and the Cape Winelands Airport will implement the most suitable of these activities for the specific site conditions or as required during the lifecycle of the dry swale:

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly
	Manage vegetation, retain vegetation to design levels	Monthly
	Inspect inlets, outlets, and overflows for blockages	Monthly
	Inspect inlets and basin for sediment accumulation. Determine appropriate frequencies.	Monthly, then as required
	Tidy dead vegetation before growth season	Annually
	Manage wetland plants in pools – where provided	Annually
Occasional maintenance	Reseed or replant in dilapidated areas	As required
	Prune and trim plants where necessary and remove cuttings	Every 2 years or as required
	Remove sediment from inlets, outlets and forebays	Annually, or as required
Remedial actions	Repair erosion or other damage	As required
	Repair or rehabilitate inlets, outlets, and overflows	As required
	Relevel uneven surfaces and reinstate design levels	As required
	Realign Riprap, gabions, and/or Reno mattresses	As required

Table 22: Typical Operating and Maintenance activities for Dry Swales

In addition to the items listed above, some comments regarding maintenance procedures are provided below:

- Litter clearing: A litter clean-up is to take place monthly or as required.
- Embankment inspection: Embankments should be inspected monthly or after each rain. If the embankment is compromised, it should be reshaped to tie in with the original slope.
- Cleaning of headwalls: Refuse should be removed from headwalls within the dry swale monthly. Sand and silt should also be removed by using high pressure jetting.
- Headwalls inspection: The headwalls should be inspected monthly or after each rain. Any blockage should be removed, and the natural vegetation trimmed to allow free drainage of water.

Many of the specific maintenance activities for dry swales can be undertaken as part of a general landscape management contract and therefore, if landscape management is already required at site, should have marginal cost implications whilst creating local employment opportunities in the long term (Woods Ballard *et al.*, 2015).

5.3 Wet Pond / Detention Basin Maintenance Requirements

Adequate maintenance is essential to ensure that the detention basin operates correctly to prevent poor functionality and poor aesthetics. Typical periodic maintenance activities are provided in (Woods Ballard *et al.*, 2015) and the Cape Winelands Airport will implement the most suitable of these activities for the specific site conditions or as required during the lifecycle of the detention basin:

Activity	Typical frequency
Remove litter and debris from Inlet and outlet structures	Monthly
Mow vegetation (Side slopes)	Monthly
Inspect inlets, outlets, and overflows for blockages	Monthly
Inspect inlet and forebay for sediment accumulation	Semi-Annually
Inspect for invasive vegetation	Semi-Annually
Manage wetland plants in pools – where provided	Annually
Check for signs of Hydrocarbon buildup and remove appropriately	Inspection
Prune and trim plants where necessary and remove cuttings	Every 2 years or as required
Remove sediment from inlets, outlets and forebays	Annually, or as required
Inspect for damage paying attention to the variable outlet control structure	Annually
Remove sediment from forebay	5 to 7 years or when 50% of forebay capacity is lost
Repair undercut or eroded areas	As required
Realign riprap, gabions, and/or Reno mattresses	As required

Table 23: Typical Operating and Maintenance activities for Detention Basins

In addition to the items listed above, some comments regarding maintenance procedures are provided below:

- Irrigation system: It will take some time for the vegetation in the pond to be fully established. As such, it is proposed that an irrigation system or procedure be put in place to ensure the vegetation survive the initial dry seasons. Suitable inspections to identify potential faulty elements should be conducted on the irrigation system to ensure its proper functioning.
- Litter clearing: A litter clean-up is to take place monthly or as required.
- Alien and problem vegetation: It is proposed that the pond must be inspected for invasive alien vegetation routinely by the appointed landscaper. As far as possible all alien vegetation should be manually removed. Where manual removal is not possible, alien vegetation should be treated with an appropriate herbicide using the correct application method and to the manufacturer's directions and specifications. Herbicides should not be applied when conditions are windy, so as to avoid spray drift. No herbicides should be applied when rain is forecast within 2 days. Colour dyes should be used with the herbicides to clearly mark areas that have been treated, taking exceptional care when working near water. It must be recognized that under certain conditions some indigenous vegetation may become problematic and may require intervention.
- Cleaning of silt traps: The sedimentation forebay as well as the apron of the outlet headwalls must be inspected every six months, with one of the inspections taking place just before the first seasonal rains. These must be inspected for build-up of silt, dirt, mud, and similar material. All silt and other material must be removed and disposed of at a suitable landfill site. Care must be taken to ensure that no silt enters the stormwater system during the cleaning process.

Should a situation arise where there are persistent or recurring problems with the pond such as poor water quality, problems with vegetation and similar issues, an aquatic specialist should be consulted for input and advice on the matter. If then required or requested by the specialist, water sampling will be undertaken.

6 Conclusion and Recommendations

The proposed stormwater management interventions for the Cape Winelands Airport development align with the City of Cape Town's stormwater management policies. The stormwater management interventions have been designed such that they will manage, control, and treat the stormwater runoff for larger infrequent storm events as well as smaller more frequent storms.

Given the nature of the project and the coordination and integration required across various disciplines, it is noted that there are specialist reports which are on-going, and copies of these reports shall be made available to the City of Cape Town's CSRM branch upon completion to support this Concept Stormwater Management Plan. The ultimate scenario was considered in the current modelling scenarios and the proposed BMP's are capable of addressing the stormwater management for both the medium- and long-term developments. Appropriate energy dissipation structures shall be implemented to ensure that the outflows from the pond across the site have a minimal impact on the surrounding and downstream environments.

The extent to which the Cape Winelands Airport conceptual stormwater interventions complies with the stormwater management policy requirements and targets are summarized in Table 24 below:

SuDS Objectives		**Requirements**	**Achieved**
Improve quality of stormwater runoff	Remove pollutants through a combination of: - Reducing and/or disconnecting impervious areas - Using BMPs/SuDS to infiltrate, capture, and/or treat stormwater runoff	Design storm event for water quality treatment is the 0.5-year or 6-month RI, 24-hour storm event	Yes
		Target pollutant removal aimed at reducing the annual stormwater pollutant load discharged from the developed site by <u>on-site treatment measures</u> to achieve: - A reduction of suspended solids (SS) by 80% - A reduction of total Phosphorus (TP) by 45%	Yes
		All developments must trap litter, oil, and grease at source	Yes
Control quantity and rate of runoff Using on-site measures	Protect the stability of downstream channels	24-hour extended detention of the 1-year RI, 24-hour storm event	Yes
	Protect downstream properties from frequent floods	Up to 10-year RI peak flow reduced to pre-development levels	Yes
	Protect floodplain developments and floodplains from extreme floods	Up to 50-year RI peak flow reduced to existing development levels	Yes
		Evaluate the effects of the 100-year RI storm event on the stormwater system, adjacent property, and downstream facilities and property.	Yes
		Manage the impacts through detention controls and/or floodplain management	Yes
		Developments adjacent to floodplains must adhere to the requirements stipulated in the *Floodplain and River Corridor Management Policy* (CCT, 2009b)	Yes
Encourage natural groundwater recharge		Where appropriate, site-specific requirements to be considered in consultation with Council.	Yes

Table 24: Management of Urban Stormwater Impacts Policy Requirements (Compliance)

It is to be concluded that this report outlines the stormwater management objectives for the proposed development. Through strict adherence to the Concept Stormwater Management Plan, the potential adverse effects the stormwater runoff pose on the development and downstream infrastructure, can be successfully mitigated. Zutari trusts that the stormwater interventions as described in this Concept Stormwater Management Plan are acceptable to City of Cape Town's CSRM branch and sufficient to obtain the required support.

7 References

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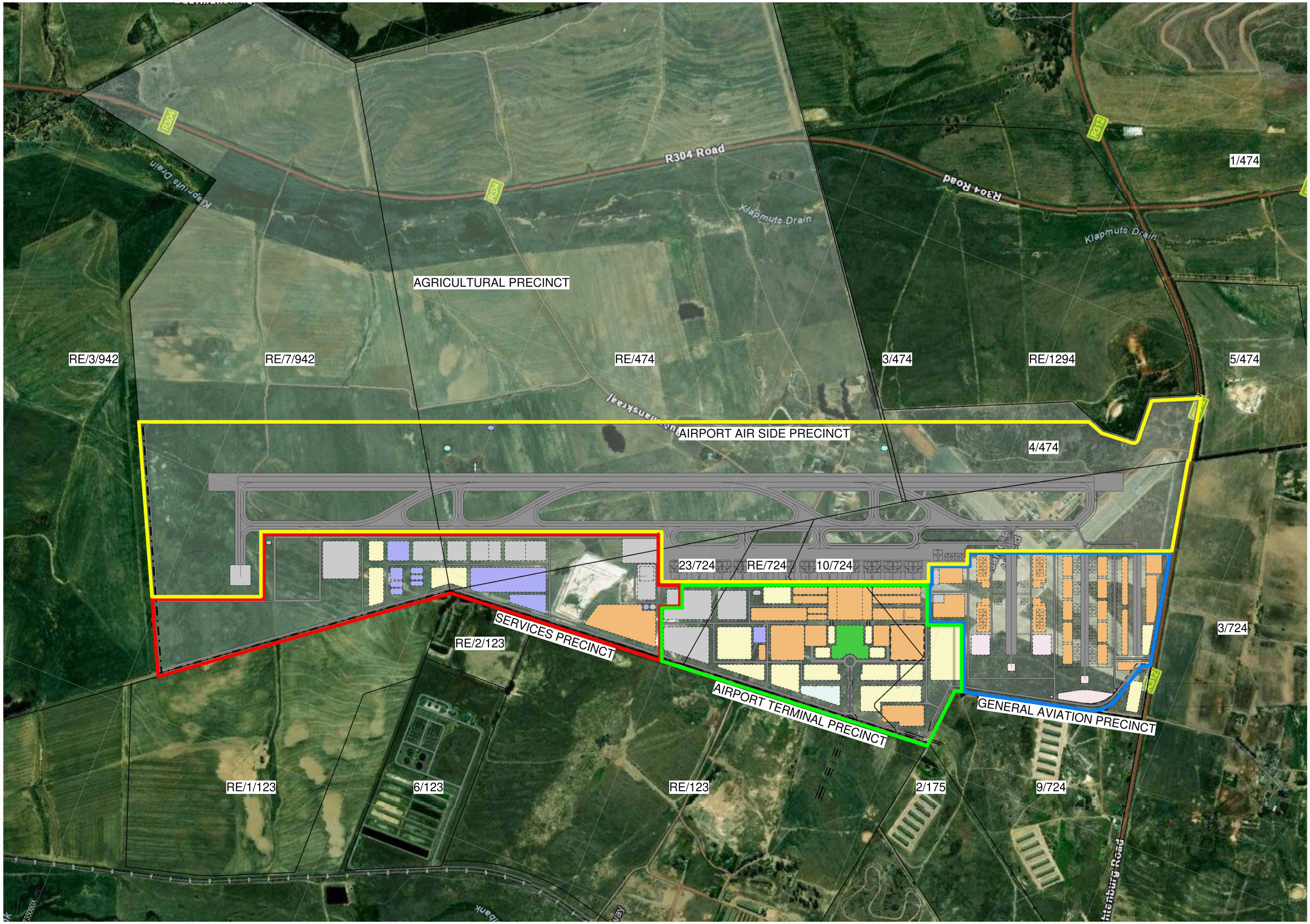
Appendix A

Drawings

- **2311-VIVID-A-9002 - Site Development Plan (PAL4)**
- **A89083-0000-DRG-CC-001 Locality Map**
- **A89083-0000-DRG-CC-101 Concept Grading Plan**
- **A89083-0000-DRG-CC-302 Concept Stormwater Layout**
- **A89083-0000-DRG-CC-303 Concept Stormwater Ponds Layout**
- **A89083-0000-DRG-CC-310 Quarry as Stormwater Attenuation Pond**



N E S W

SITE PLAN - PHASE 2

0 62.5 m 125.0 m 250.0 m

SCALE: 1:5000

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* REINFORCED CONCRETE AND STRUCTURAL STEELWORK IS TO BE IN ACCORDANCE WITH THE STRUCTURAL ENGINEER'S DESIGN AND SPECIFICATIONS.

DRAINAGE NOTES

* ALL DRAINAGE RUNS TO BE ACCESSIBLE ALONG THEIR ENTIRE LENGTH.
* V.P.'s TO BE CARRIED UP TO 2m ABOVE ANY WINDOW OR DOOR OPENING IN THE BUILDING OR ANY OTHER BUILDING WITHIN A DISTANCE OF 6m.
* INSPECTION EYES (i.e.'s) TO BE PROVIDED AT ALL BENDS AND JUNCTIONS OF SOIL AND WASTE PIPES.
* RODDING EYES (r.e.'s) TO BE PROVIDED AT HEADS OF DRAINS AND AT A MAXIMUM OF 25m SPACINGS ALONG RUNS OF DRAINS.
* MARKED COVERS TO BE PROVIDED AT GROUND LEVEL FOR i.e's BELOW PAVING
* RESEAL TRAPS TO BE PROVIDED TO ALL WASTE FITTINGS.
* SOIL WATER DRAINS PASSING UNDER BUILDINGS TO BE ENCASED IN 150mm CONCRETE ALL ROUND AND BE PROVIDED WITH r.e.'s AS CLOSE TO THE BUILDING AS POSSIBLE AT BOTH ENDS.
* SOIL WATER PIPES HAVING A VERTICAL DROP EXCEEDING 1200mm TO THE MAIN DRAIN TO BE ANTI-SYPHONED.
* ALL BRANCH DRAINS EXCEEDING 6m IN LENGTH TO BE VENTED.
* uPVC PIPES ARE TO BE LAID IN ACCORDANCE WITH THE MANUFACTURERS TECHNICAL SPECIFICATIONS.

FIRE DEPARTMENT'S REQUIREMENTS

* ALL WORK IS TO COMPLY WITH SABS 400.
* a) EXTINGUISHERS TO BE INSTALLED IN ACCORDANCE WITH SABS 0105.
  b) HOSE REELS TO BE INSTALLED IN ACCORDANCE WITH SABS 543.
  c) HYDRANTS TO BE INSTALLED IN ACCORDANCE WITH SABS 1128 PART 1
* PORTABLE FIRE EXTINGUISHERS TO BE HUNG ON PURPOSE MADE BOARDS AND LOCATED IN SECURE POSITIONS AS INDICATED ON PLAN.
* CLASS "B" FIRE DOORS TO COMPLY WITH SABS 1253 AND TO BE FITTED WITH APPROVED SELF CLOSING OR AUTOMATIC CLOSING DEVICES.
* STRUCTURAL ELEMENTS AND COMPONENTS TO COMPLY WITH TT7.
* FIRE EXIT DOORS ARE TO BE FITTED WITH EMERGENCY EXIT LOCKSETS.
* SYMBOLIC SAFETY SIGNS TO BE IN ACCORDANCE WITH S.A.B.S. CODE 1186 AND POSITIONED AS REQUIRED BY THE FIRE DEPARTMENT.

Rev	Description	Revision Date
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9	ISSUED	2024-07-24
8	ISSUED	2024-07-23
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4	FOR REVIEW	2024-04-10
3	FOR REVIEW	2024-04-03
2	FOR REVIEW	2024-04-03
1	FOR REVIEW	2024-03-28

CAPEX PROJECTS
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BOSKRUIN
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2188
Tel: 011 792 4260/ 8189

CLIENT: CAPE WINELANDS AERO

Client

Engineer

Registration NO: Designer

SACAP NO:

CLIENT: ENVIRONMENTAL CONSULTANT

TITLE: PHASE 2

DRAWING: CWA - PRECINCT PLANS

SIZE: A0 | ORG NO: 2024-3297 400 | REV: 11

SCALE: 1: 5000 | DATE: 2024-07-24 | DRAWN BY: CW DENNIS

Appendix B

Flood Line Risk Assessment Report

ZUTARI
IMPACT. ENGINEERED.

Project report

Cape Winelands Airport Development

Cape Winelands Airport Development Flood Risk Assessment

Cape Winelands

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Document number: A89083-0000-REP-CC-0002

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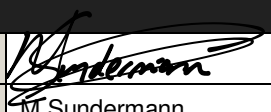
Author signature		Approver signature	
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1 Introduction

1.1 Purpose of Report

This report presents a flood risk assessment conducted for the Cape Winelands Airport Development project located north of Durbanville. The aim of the assessment is to determine the impact of the development on flood risk in surrounding areas for the 1:100-Year recurrence interval (RI) flood. The evaluation considers the geographical location, hydrological characteristics, and the hydraulic structures within the site boundary and included hydraulic modelling to determine flood risk.

1.2 Study Area

The Cape Winelands Airport study area is bordered by three main roadways, R312, R302, and R304, forming a distinct boundary. It is located on the highest elevation within the study area. To the west of the site flows the Mosselbank River, which is a relatively significant river. To the east lies a tributary of the Klapmuts River. Furthermore, the site drains to sixteen tributaries that serve as conduits for runoff, which is directed to the Mosselbank River and Klapmuts tributary. These tributaries play an important role in drainage from the airport site. Figure 1-1 describes the study area.

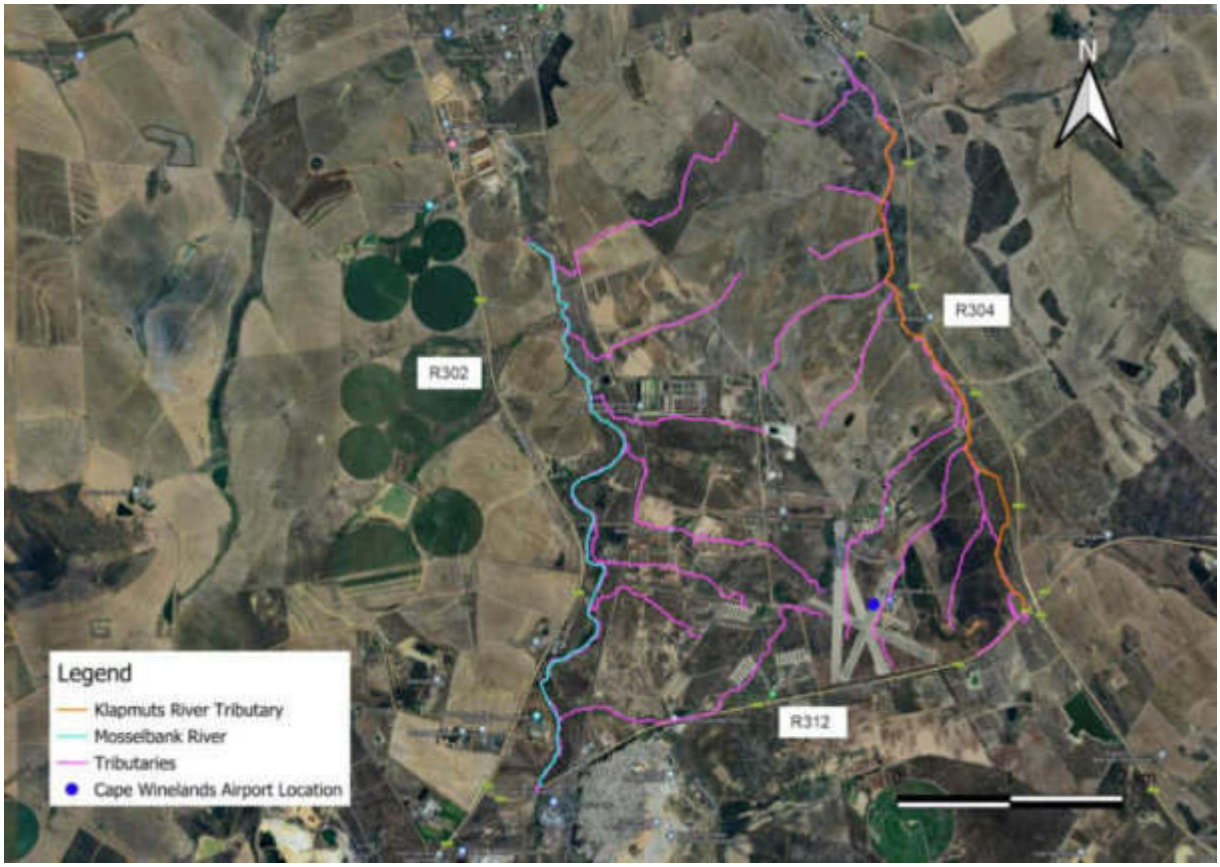

Figure 1-1: Flood Risk Assessment study area for Cape Winelands Airport Development.

Figure 1-2 shows the location and layout of the proposed airport along the watershed between the Mosselbank and Klapmuts Rivers.

Figure 1-2: Proposed Cape Winelands Airport Development layout.

1.3 Methodology

The determination of flood risk for the study area included the following components, which are explained in more detail in the following sections:

- Data collection
- Catchment delineation
- Flood risk assessment.
- Hydraulic model configuration and execution
- Floodplain mapping and analysis

2 Design Flood Determination

2.1 Introduction

Catchments were delineated to determine catchment characteristics using a 5 m Digital Elevation Model that was developed using Light Detection and Ranging (LiDAR) information, obtained from the City of Cape Town. The characteristics and rainfall were used as parameters for deterministic methods to calculate flow peaks and hydrographs.

The peak flows for the tributary catchments were determined using a Personal Computer Storm Water Management Model (PCSWMM) model, while deterministic methods were utilized to calculate the peak flows for the main river catchments.

2.2 Catchment Delineation

Catchments for each tributary within the study area were delineated. Additionally, the upstream catchments for the Mosselbank and Klapmuts Rivers were delineated to determine the inflows for the two main rivers. The basic catchment characteristics included catchment area, longest water course, water course slope, and average catchment slope. Catchment characteristics for the main rivers, are shown in Table 2-1.

Table 2-1: Main rivers catchment characteristics.

Catchment	Area (sq. km)	Longest Water Course (km)	Water Course Slope (%)	Avg. Catchment Slope (%)
Mosselbank	105	17	0.399	4.18
Klapmuts	7	4	1.131	4.96

The upstream catchments for both the Mosselbank River and Klapmuts River were delineated to calculate the inflow contributions that derive from the areas beyond the study area. The catchments delineated for the tributaries, and the water courses are shown in Figure 2-1 and Figure 2-2, respectively.

Figure 2-1: Delineated catchments for tributaries within study area.

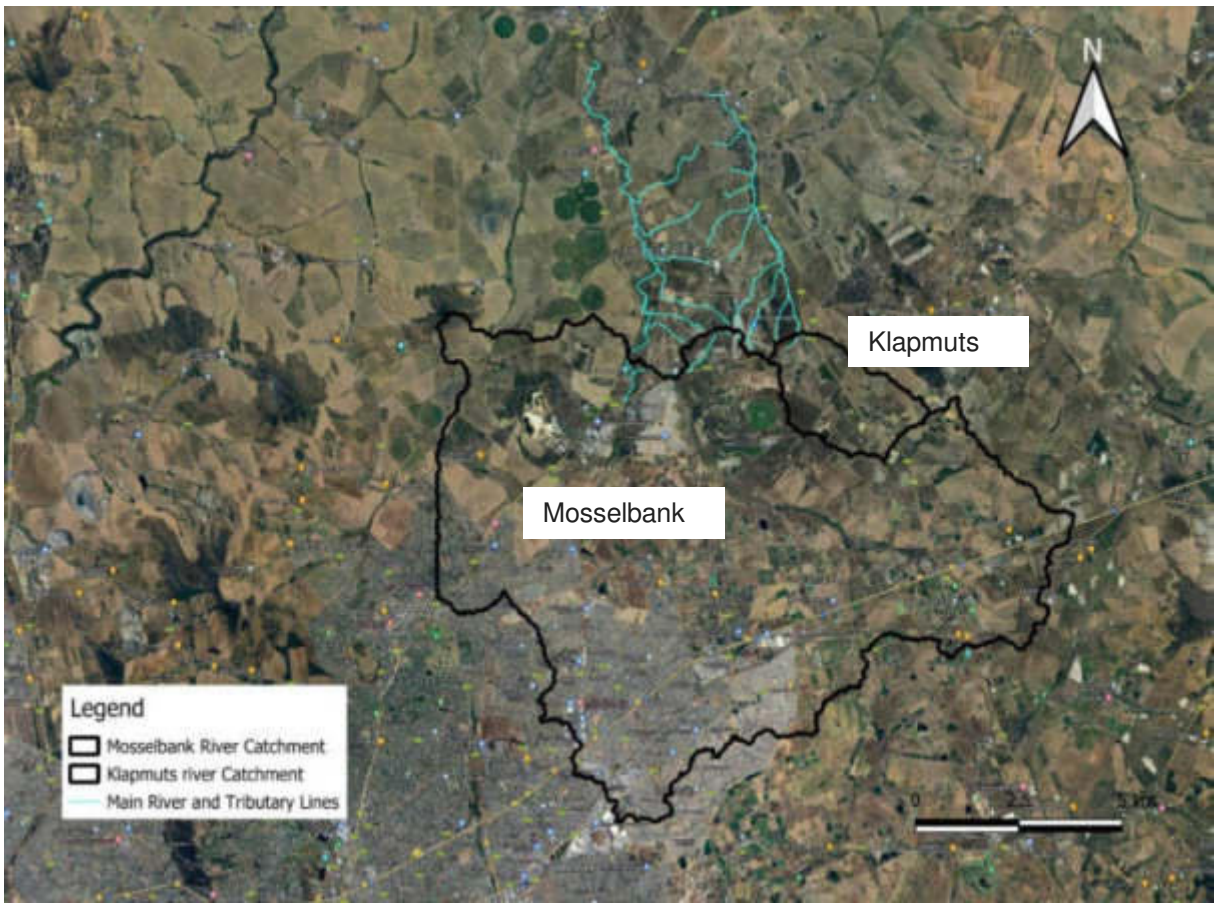

Figure 2-2: Delineated catchments for main rivers.

2.3 Design Rainfall

The design rainfall data was sourced from the City of Cape Town Rainfall Grid for the study area.

Table 2-2: CCT Rainfall Grid 24-hour design rainfall.

Return Period (Years)	24hr CCT Rainfall Grid (Includes 15% for climate change)
2	44.9
5	60.3
10	71.4
20	83
50	99.4
100	112.7
200	127

2.4 Flood Peak Results

The catchment areas were determined for both the tributaries and main rivers. The 100-Year RI flood peaks for the tributaries were estimated using a PCSWMM model configured with the United States Soil Conservation Service (SCS) design flood determination method, while the flood peaks for the main river

catchments were estimated using the SCS method directly. Table 2-3 presents the flood peaks for the main river catchments, and Figure 2-3 illustrates the food peaks for each tributary catchment.

Table 2-3: 1:100-Year RI flood peaks for the Mosselbank River and Klapmuts tributary.

Catchment	100-year Flood Peak (m^3/s)
Klapmuts River	37
Mosselbank River	325

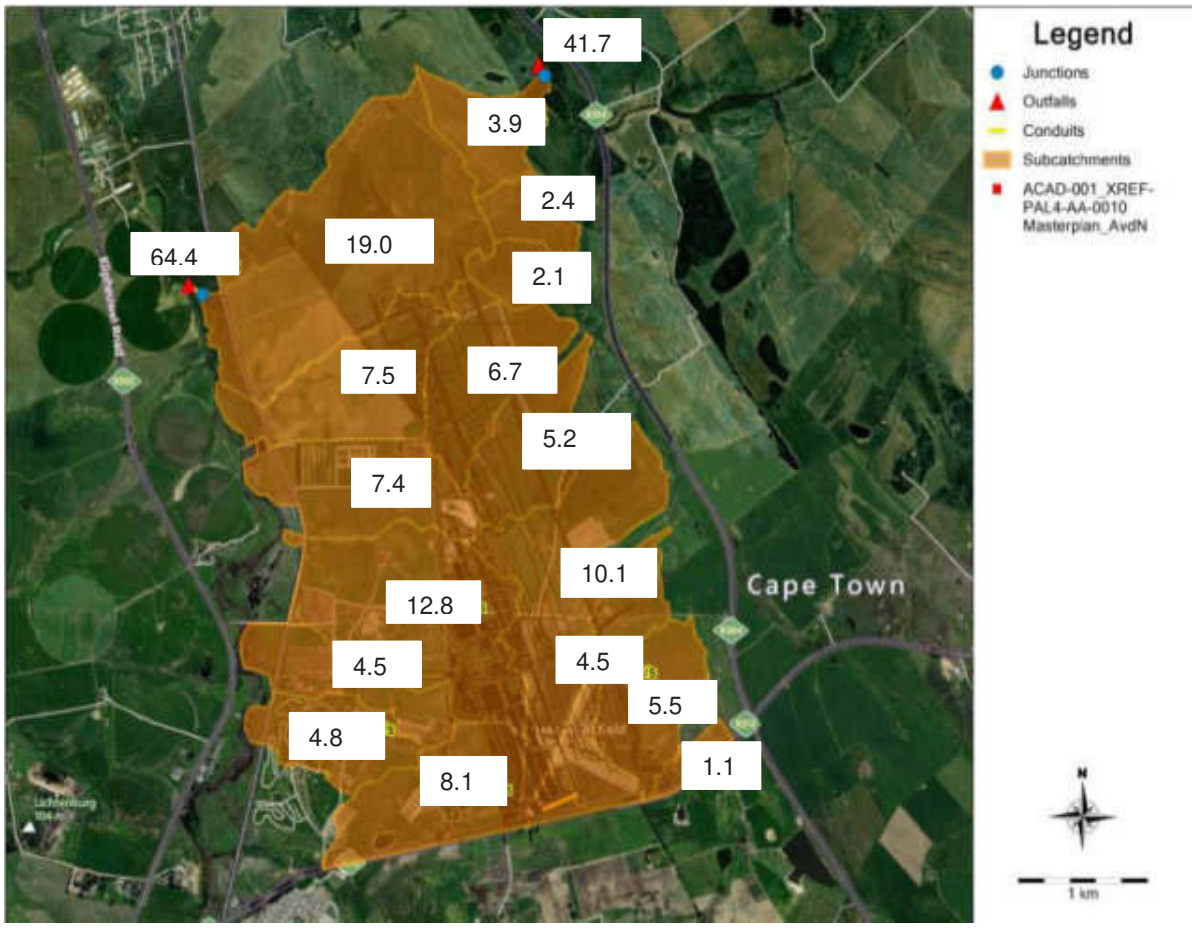

Figure 2-3: The pre-development 1:100-Year RI flood peaks for each tributary catchment area determined using PCSWMM.

Table 2-4 displays the 1:100-year RI design floods at the outfalls from the airport site. The post development floods have been attenuated in ponds on the airport property, upstream of the outfalls. None of the post development flood peaks at the airport outfalls exceed the pre-development values, and in some cases, they have been attenuated significantly by the ponds. In the case of Pond 6 the flood peak is reduced to 1% of its pre-development value.

Table 2-4: 1:100-year airport design floods for the pre- and post-development stages.

Pond ID	1:100yr Pre-Dev (m^3/s)	1:100yr Post-Dev (m^3/s)
Pond 1	1.01	1.33
Pond 2	3.05	2.59
Pond 3	0.65	1.09

Pond 4	0.65	0.92
Pond 5	1.23	1.65
Pond 6	0.76	0.01
Pond 7	4.89	0.83
Pond 8	0.04	0.01

3 Hydraulic Analysis

3.1 Introduction

An extensive hydraulic model was required to assess the flood risk impact of the proposed airport on the surrounding study area. The United States Army Corps of Engineers' Hydrologic Engineering Centre's River Analysis System (HEC-RAS) software was utilized to simulate the hydraulics of the watercourses in the study area. The hydraulic model was configured as a two-dimensional (2D) HEC-RAS model with a 24-hour simulation run time. The model included the representation of tributaries as steady-state flow hydrographs from the proposed airport site and the incorporation of unsteady-state flow hydrographs for the inflows of the main rivers. Hydraulic structures in the watercourses have been incorporated in the model including two box culverts and a stormwater pipe.

3.2 Hydraulic Model Configuration

3.2.1 Digital Elevation Model

A Digital Elevation Model (DEM) of the Cape Winelands Airport study area was used to model the terrain in the hydraulic model. The DEM is a 3D map of the topography of the study area and was generated from Lidar data with a 5m resolution (Figure 3-1).

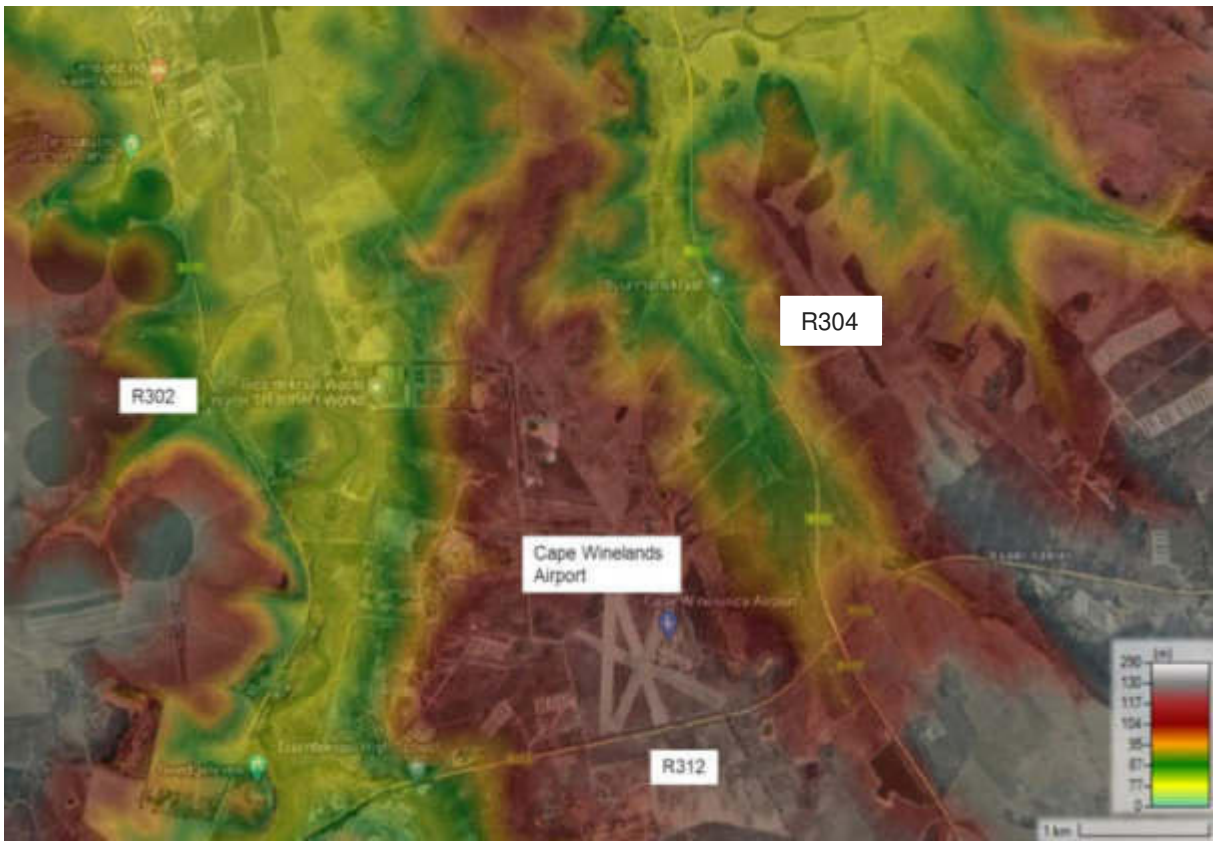

Figure 3-1: Digital Elevation Model shown in HEC-RAS for study area.

3.2.2 Computational Mesh

The 2D computational mesh in HEC-RAS for the Cape Winelands Airport study was configured with a 25m grid resolution. The centrelines of the main rivers and tributaries are represented as breaklines, indicated in red in Figure 3-2.

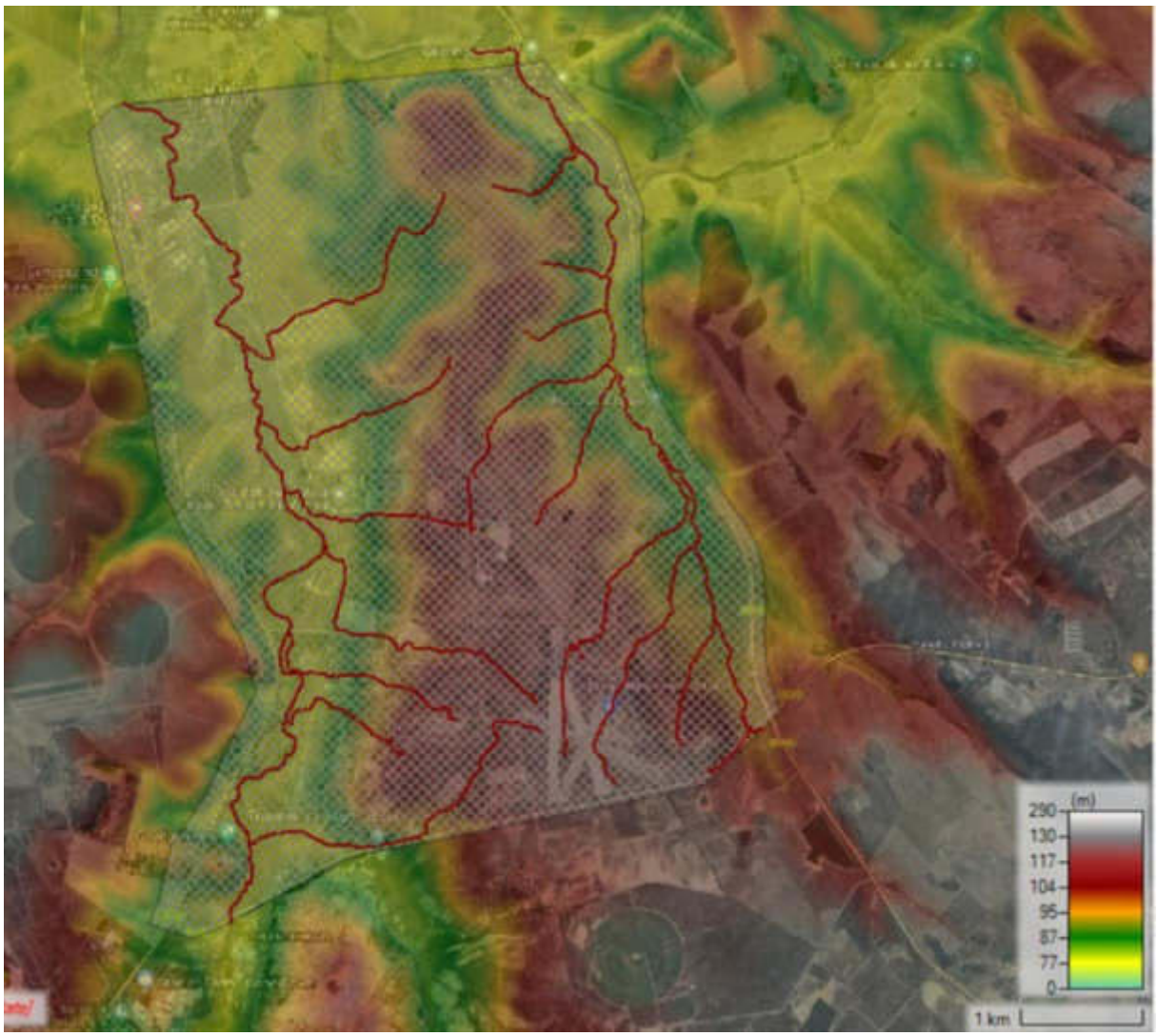

Figure 3-2: Computational mesh, perimeter, and modelled breaklines in red.

3.2.3 Hydraulic Structures

Hydraulic structures were included in the model and were configured considering typical dimensions for culvert and pipe structures. Structure data were configured based on dimensions measured from Lidar data, Google Earth, ArcGIS Earth, and Google Street View, considering typical dimensions for culvert and pipe structures. Typical dimensions required to configure the culverts included their span, rise, and length where pipes required internal diameter and length.

Four hydraulic structures were included, and these structures are presented in Figure 3-3. The structures were labelled according to their names and were included in the HEC-RAS model.

Table 3-1: Hydraulic structure descriptions.

Structure Name	Structure Type
Structure 1	Box Culvert
Structure 2	Box Culvert
Structure 3	Stormwater Pipe
Structure 4	Box Culvert

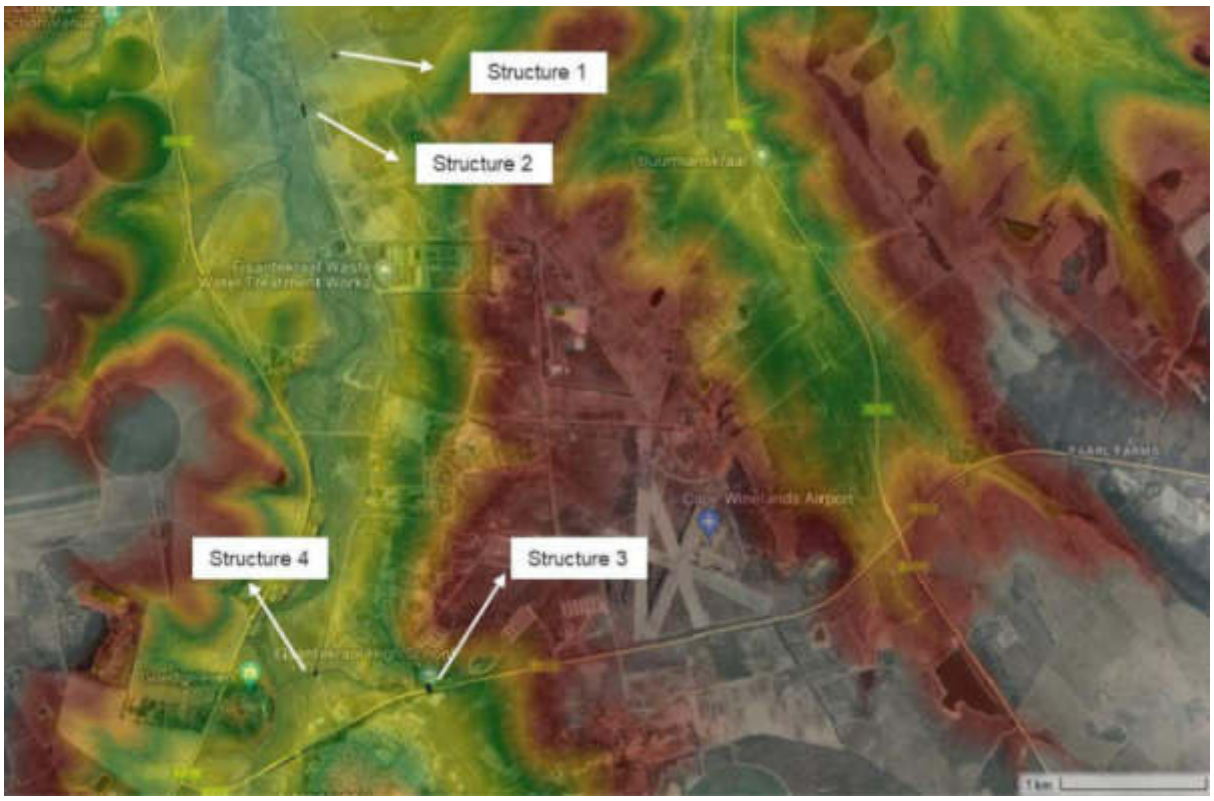

Figure 3-3: Positions of hydraulic structures.

3.2.4 Hydraulic Roughness

The hydraulic roughness was represented using the Manning's n values, which were assigned based on land cover characteristics. Manning's roughness values were assigned to specific land cover types. The South African National Land Cover (SANLC, 2018) was utilized in the model. Figure 3-4 represents the land cover layer for the study area.

Table 3-2: Top three main land cover types used.

Rank	Land Cover Type	Manning's Roughness Value
1	Commercial Annuals Crops Rain-Fed / Dryland / Non-Irrigated	0.05
2	Low Shrubland (Fynbos)	0.1
3	Herbaceous Wetlands	0.085

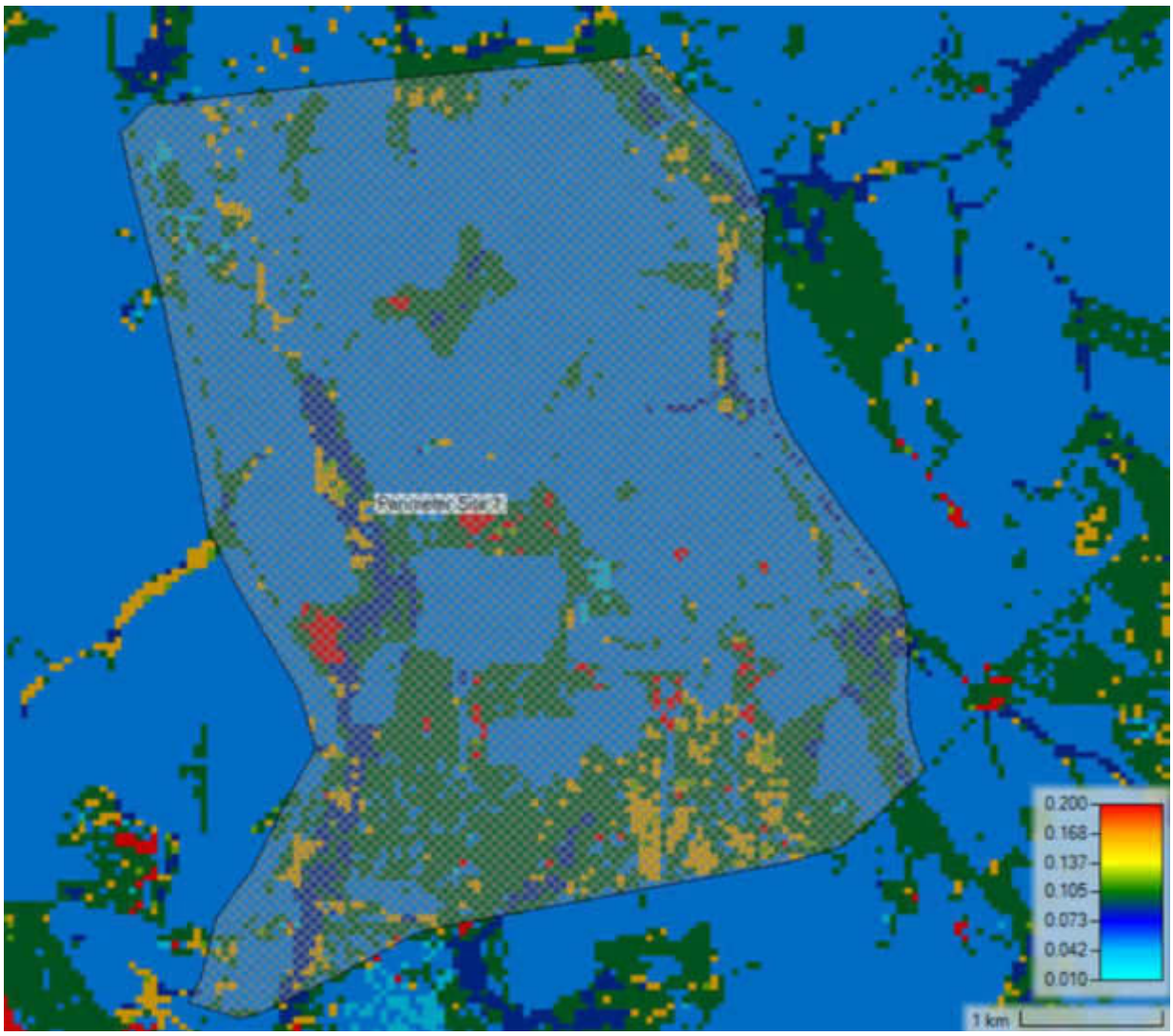

Figure 3-4: Land cover layer in association with Manning's roughness values.

3.2.5 Boundary Conditions

The model included four external boundaries: two upstream and two downstream boundaries. The two upstream boundaries were configured with the flood peak hydrographs from the catchments of the two main rivers, as mentioned in Section 2.4. The downstream boundaries were set as Normal Depth boundaries, necessitating frictional slope information. Internal boundaries were also configured, arranged with respect to the pre- and post-development of the Cape Winelands Airport. The tributary catchments will include a portion of the proposed airport in their upper parts, with the rest of the catchments remaining in their current condition. The model was configured to reflect this by including the outfall points from the airport site as internal boundaries, and the balance of the catchment contribution modelled pro-rata down the watercourse centreline to the downstream end. An example of this is illustrated in Figure 3-5.

Figure 3-5: The portion of the catchment located inside the airport is bordered in white, and the rest of the catchment which will remain unchanged is bordered in red.

The flood risk assessment utilized steady-state hydrographs for the design flood peaks in the tributaries which are all relatively small catchments, and unsteady-state hydrographs for the two main rivers. This is conservative because it is likely that the flood peaks of the small catchments surrounding the airport site will occur before the peaks arrive from the main river catchments, but it was modelled assuming that they would occur at the same time.

The locations of the various model boundaries are shown in Figure 3-6.

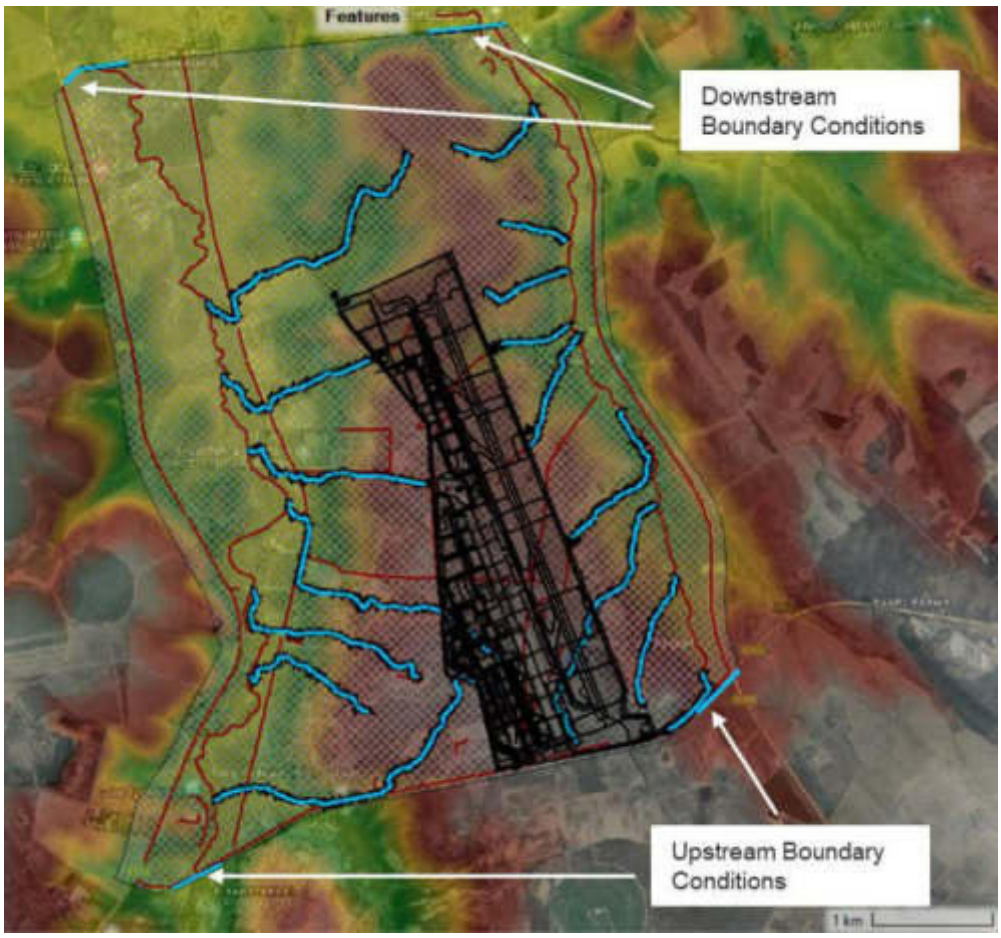

Figure 3-6: External and internal boundary conditions with proposed airport layout.

3.3 Hydraulic Model Results

3.3.1 1:100-Year RI Pre- and Post- Development Flood Extents

Figure 3-8 shows the 1:100-year RI flood inundations for the pre- and post-development scenarios. The effect of attenuation by the ponds decreased the post-development flood peaks at the outfalls from the airport site to values that were equal to or less than the pre-development flood peaks, resulting in the post-development flood inundation extents remaining similar to, or reducing in area from the pre-development flood peaks.

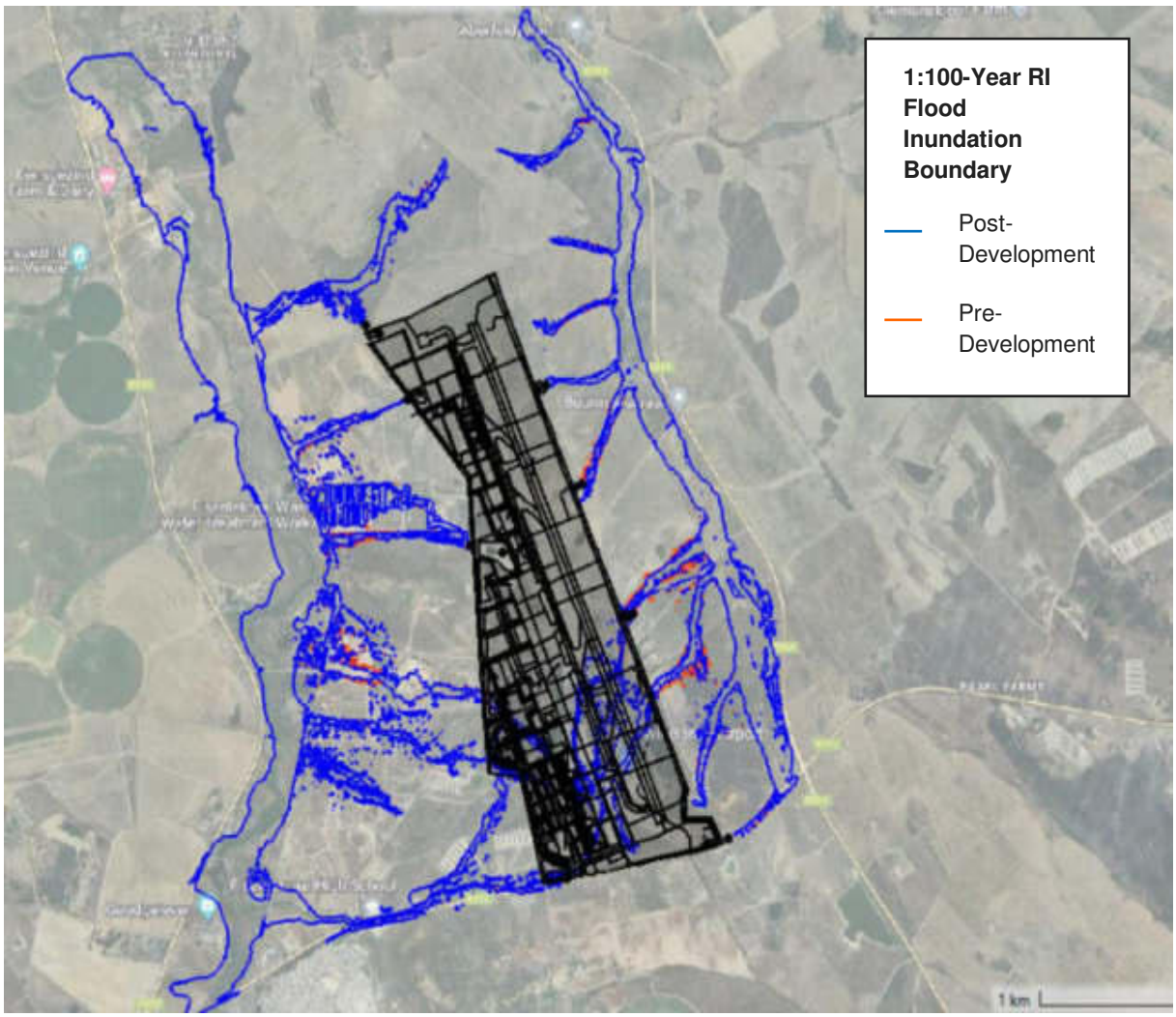

Figure 3-7: 1:100-Year RI flood inundation boundaries for Pre- and Post-Development scenarios.

4 Conclusion

This report details a study to determine the flood risk impact of the proposed Cape Winelands Airport on the downstream receiving catchments in the surrounding area. The proposed airport will be located on the watershed between the Mosselbank River and a tributary of the Klapmuts River. The airport site itself has zero risk of flooding from the surrounding rivers because of its elevated position, but runoff from the site will be altered by the airport development due to an increase in hardened surfaces (such as the runways, roads and roofs) and changes to the slopes and drainage patterns on the site due to the massive earthworks which are planned. The airport will therefore change flood risk in the catchments downstream, which has been mitigated by 8 detention ponds proposed on the airport site.

A 2D HEC-RAS hydraulic model was configured to determine the design flood inundations and depths for the 1:100-Year RI event for the pre- and post-development scenarios. It included the Mosselbank River and Klapmuts River tributary which lie to the west and east of the proposed airport site respectively, and several small tributaries that drain from the locations of the proposed detention ponds on the airport site. The model was configured incorporating flood peaks from a PCSWMM model for the tributary catchments and the proposed airport site, while employing the SCS Method to generate flood hydrographs for the Mosselbank and Klapmuts Rivers. The Zutari Land Infrastructure team developed the PCSWMM model to determine the pre- and post-development flood peaks for the outfalls from the airport site and these are detailed in a separate report.

The detention ponds have been sized to reduce the post-development flood peaks to magnitudes no greater than the pre-development flood peaks for recurrence intervals up to the 1:100-year recurrence interval. Many of the flood peaks have been reduced compared to the pre-development situation. The results of the pre- and post-development flood risk modelling indicate similar or slightly reduced flood inundations in the post-development situation compared to the pre-development situation.

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Appendix C

Geotechnical Investigation Report

Geotechnical Reconnaissance Investigation for Proposed Cape Winelands Airport, Fisantekraal, Western Cape.

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(Version 2.0)

31 May 2022

GROUNDWATER AND EARTH SCIENCES
GEOSS
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EXECUTIVE SUMMARY

GEOSS South Africa (Pty) Ltd was requested by Mr Paul Slabbert of PHS Consulting, on behalf of Capex Projects, to complete a geotechnical investigation for the proposed Cape Winelands Airport (CWA).

The investigation involved undertaking a desk study, a site walk-over, an intrusive investigation (i.e. trial pit investigation), field and laboratory testing, and compilation and interpretation of the gathered data. This report covers aspects of preliminary road, drainage, foundation and pavement design and construction.

The most pertinent findings highlighted in this report are as follows:

- Five Geotechnical Zones have been delineated based on the investigation results:
  - A – Residual materials derived from granitoid sources.
  - B – Residual Materials derived from pelitic sources.
  - C – Area falling within Zones A and B with residual soils exhibiting characteristics of potentially expansive materials, and/or soils that are prone to settlement.
  - D - Areas of relatively deep/thick transported aeolian sand.
  - E – Areas of surficial ferricrete and/or silcrete.
- From a geotechnical standpoint, site development should proceed.
- Potential geotechnical challenges are associated with the intended development.
- All materials encountered in the trial pits classified as soft to intermediate excavation (SANS 1200D). The hardpan ferricrete horizons may require rock-breaking apparatus in areas of the site.
- A series of site-specific follow-up geotechnical investigations will be required prior to the construction of individual structures.
- In the case of structures with heavy structural loadings, where deeper foundations/piling are/is required, it would be prudent to consider a series of exploratory drilling as part of the site-specific investigations to determine whether core stones exist at depth, particularly in areas underlain by residual granitoids.
- A perched groundwater table was intersected on-site at between 0.85 and 1.4 mbgl. Excavations deeper than 1.0 mbgl will require battering to ensure safe working conditions. Final designs will have to cater for aggressive and corrosive groundwater and/or soil conditions. Drainage precaution will be required.
- The foundation solutions adopted for each structure on-site will depend on the cost of implementation, and the risk associated with the said solution.
- Due to the variation in topography within the northern extent of the property, considerable fill will be required
- During construction, potential geotechnical variations in the subsurface should be inspected and approved by a suitably qualified professional.

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ABBREVIATIONS & SYMBOLS

BH	Borehole
CBR	California bearing ratio
CGS	Council for Geoscience
c’	Effective cohesion (kPa)
DCP	Dynamic Cone Penetrometer
DWS	Department of Water Affairs and Sanitation
EAM	Engineering and Asset Management
EC	electrical conductivity
EOH	End of hole
kPa	Kilopascals
LL	Liquid Limit
LS	Linear Shrinkage
L/s	Litres per second
m	metres
MCCSSO	Moisture content, colour, consistency, structure, soil type, and origin.
MDD	Maximum Dry Density
mm	millimetre
MOD	Modified AASHTO
mS/m	milli-Siemens per metre
NGA	National Groundwater Archive
NHBRC	National Home Builders Registration Council
OMC	Optimum moisture content
PI	Plasticity index
SABS	South African Bureau of Standards
SANS	South African National Standards
TLB	Tractor loader backhoe
Q3	Third quartile
φ'	Effective angle of internal friction

GLOSSARY OF TERMS

Quartile: Equal groups into which a population can be divided according to the distribution of values of a particular variable. Here, the third quartile represents the value under which all data points (within the given group) fall.

Dynamic Cone Penetrometer: Device with a 20 mm 60° cone driven into the ground by an 8 kg weight dropped through 575 mm. The penetration resistance is recorded in mm/blow. This provides an indication of soil consistency (relative density).

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Photo south-eastern corner of the site, near TP04.

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2021_09-4505 (Phase E)

1. INTRODUCTION

1.1 Terms of Reference

GEOSS South Africa (Pty) Ltd was requested by Mr Paul Slabbert of PHS Consulting, on behalf of Capex Projects, to complete a geotechnical investigation for the proposed Cape Winelands Airport (CWA). The site that has been proposed to be upgraded and developed is located at the existing Fisantekraal airfield, some 2 km north-east of the township of Fisantekraal (**Map 1**).

1.2 Objectives and Methodology

The primary aim of the geotechnical investigation was to establish the soil conditions and associated soil engineering properties across the site. The intention of this report is to enable preliminary design of the proposed development. The aim of this investigation was met by undertaking of a desk study, a site walk-over, and intrusive investigation (i.e. trial pit investigation), field and laboratory testing and compilation and interpretation of the gathered data. This report covers aspects of road, pavement and foundation construction, drainage, and excavatability of the substratum.

1.3 Proposed Development

CWA is proposed to be built on the existing Fisantekraal Airfield which is an old South African Air Force airfield built circa 1943. It's existing foot print covers approximately 150 ha. Several of the neighbouring properties have been acquired therefore taking the proposed development area up to 660 ha. There are currently four concrete strips of 90m width each, in varying lengths between 700m and 1500m.

A site development plan has been provided which is included in **Appendix F** with the following information about the proposed facility:

- Runways (to be developed in phases).
- Taxiways.
- Roads.
- Stormwater lines and stormwater management system.
- Hangars.
- Aprons.
- Commercial/Industrial/Retail facilities.
- Hotel/Accommodation.
- Control Tower.
- Rescue & Firefighting facilities.
- Terminal buildings.
- Aviation Fuel Farm.
- Retail Service Station.
- Admin and office space.

- Electric Charging Stations.
- Renewable energy alternatives.
- Outdoor Media, e.g., signage and billboards.

In-depth descriptions of the above components of the project have been presented in GEOSS (2022).

Further, a possible extension has been proposed, and at this stage, for planning purposes, the additional area has been preliminarily investigated from a geotechnical standpoint. The possible extension is proposed to comprise the following elements:

- 3.0 km runway.
- Development of a full commercial terminal on the East of runway 01/19.
- Bulk still to be determined.
- Site plan still to be determined.
- Largest aircraft operable would be a Boeing 777 or Airbus A350.
- Commencement date would depend on demand.

1.4 Preliminary Loading

At present, because the project is in the planning phase the proposed structures and their final loadings and ultimate locations are still being finalised, the loading conditions are unknown. For the sake of this report, loadings of between 100 and 250 kPa have been used for preliminary modelling. Specific details pertaining to the proposed structures are not available at present.

1.5 SANS 10160-5 Classification Category

Based on the information available for the proposed structures and the conditions encountered on-site, the site can be classified as 'Category 2', i.e. the proposed development includes "conventional structures and foundations for which design methods are well established, where there are no exceptional risks in terms of overall stability or difficult ground conditions (e.g. conventional buildings on spread footings, rafts or piled foundations" (Day and Retief, 2009). This classification is defined by the following:

- The site presents no abnormal risks
- Routine field and laboratory tests have yielded estimated design parameters.
- No quantitative design has been presented by the Structural Engineer.
- Supervision/QC and follow up testing may be required prior to, or at the construction stage.
- Monitoring program - only if considered appropriate.

1.6 Scope and Limitations of Assessment

The geotechnical investigation had one primary aim, to determine the geotechnical character of the site.

1.7 Information Available

Ahead of the preparation of this report, the document titled "Cape Winelands Airport Development Project Description", dated 19 April 2022, was provided.

During the planning, desk study and compilation of the report, data was acquired from the following geological, geotechnical and hydrogeological sources:

- The 1: 50 000 geological series map – Sheet 3318DC Bellville.
- The 1: 50 000 geotechnical series map – Sheet 3318DC Bellville.
- The 1: 50 000 topocadastral map – Sheet 3318DC Bellville.
- The 1: 250 000 geological series map – Sheet 3318, Cape Town.
- The 1: 500 000 hydrogeological map – Sheet 3126, Cape Town.

Map 1: Locality map showing the location of the proposed Cape Winelands Airport, Western Cape.

2. SETTING

2.1 Site Location and Description

The site that has been proposed for development is situated some 2 km north-east of the existing Fisantekraal township, and approximately 25 km northeast of Cape Town International Airport (**Map 1**). The site is mainly surrounded by cultivated land, livestock farms and poultry farms. Some areas are also used for recreational activity, and a waste water treatment facility is also located to the north-west of the boundary.

The Cape Winelands Airport (CWA) development is proposed to be constructed across several farm portions, including those presently occupied by the existing Fisantekraal airfield. The proposed CWA is to fall across several properties with a total cumulative extent of approximately 885 ha (Cape Farm Mapper, 2022). The proposed development extends across the following Farm portions (area of each farm shown in brackets):

- 23/724 (31.2 ha).
- RE/724 (42.3 ha).
- 10/724 (114.0 ha).
- 4/474 (36.5 ha).
- RE/474 (402.4 ha).
- 7/942 (257.8 ha).

2.2 Topography, Existing Infrastructure and Site History

The topography of the site and surrounds is characterised by typical grass-covered low-relief rolling hills. The typical on-site elevation is between 90 - 130 m above mean sea level (mamsl). With natural slope surfaces rarely exceeding 12° (Stapelberg, 2009). In this region, there is a low drainage density (Stapelberg, 2009). Drainage channels and small tributaries usually occupy the lower-lying areas between the low-relief hills.

The area that is presently occupied by the airfield is characterised by generally flat terrain, with little undulation. The northern extent of the proposed development area (i.e. region earmarked for future development of extended runway) is characterised by undulous terrain with rolling hills.

2.3 Climate

The Fisantekraal area experiences a Mediterranean Climate with mild wet winters and warm dry summers. **Figure 1** shows the monthly average air temperature and **Figure 2** shows the monthly median rainfall and evaporation distribution for the Fisantekraal area (Schulze, 2009). The long term (1950 – 2000) mean annual precipitation for the Fisantekraal area is 532 mm/a. The rainfall typically exceeds evaporation rates in the winter months between May and August.

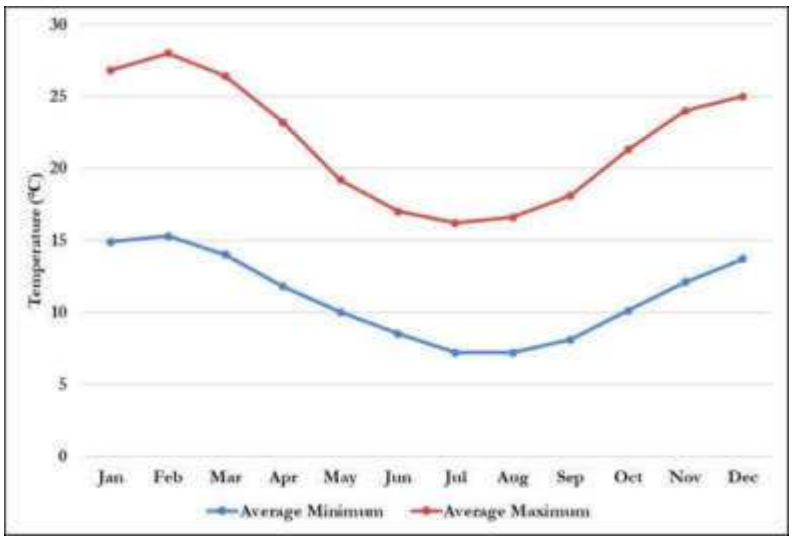


Figure 1: Monthly average air temperature for the Fisantekraal area (Schulze, 2009).

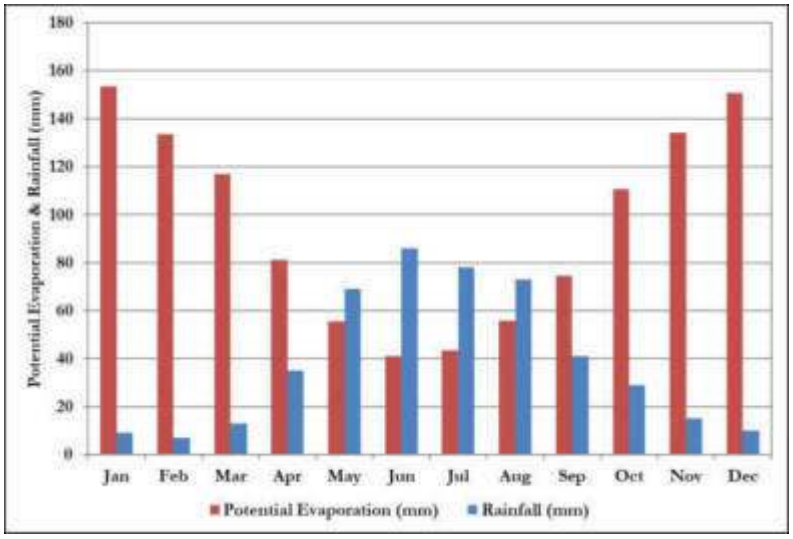


Figure 2: Monthly average air temperature for the Fisantekraal area (Schulze, 2009).

2.4 ***Behaviour of Existing Structures***

The structures on site were briefly examined for any typical tell-tale signs of geotechnical risks/problem soils, e.g. settlement/differential heave. The structures on the site are located predominantly in the south-eastern extent of the property, none of these showed clear evidence of typical foundation-related cracks. It is important to note that none of these structures appear to be heavily loaded. In the north-western extent of the site; however, the structures located on the Remainder of Erf 724 did show signs of foundation related cracks (**Appendix C**).

2.5 ***Weinert 'N' Value***

The present and past climate is a useful indicator of the typical soil conditions that may be encountered on a particular site (Weinert, 1975). Weinert (1975) developed a general model to categorise the climate of southern Africa based on what he termed the 'N'-value **Figure 3**.

The Weinert 'N'-value for the project area is shown to be less than 5 (Brink, 1983; Stapelberg, 2009). Weinert (1975) showed that where 'N'-values are less than 5, chemical decomposition is the

dominant mode of rock weathering and relatively thin transported soil cover can be expected with deep residual profiles. Where pedocretes are developed they are generally ferricrete (Brink, 1983).

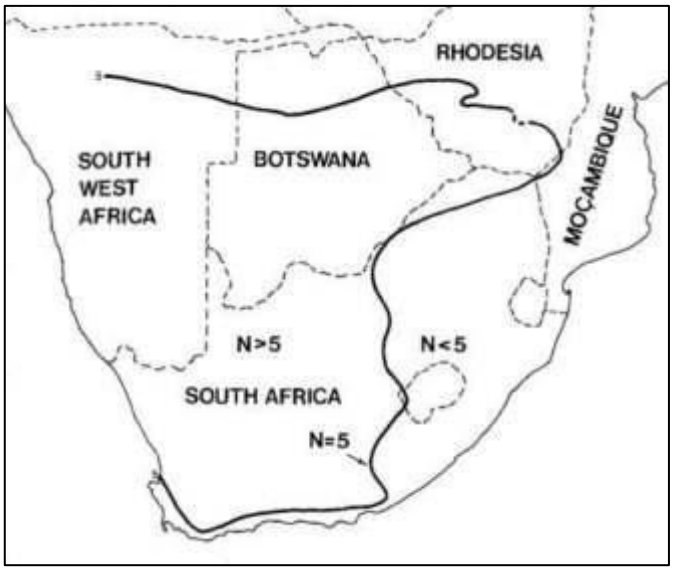


Figure 3: Climatic 'N' value = 5 plotted for southern Africa (after Weinert, 1967).

2.6 ***Geology & Engineering Geology***

The Council for Geoscience (CGS) has mapped the area at a scale of 1: 250 000 (3318, Cape Town). The geological setting is shown in **Map 3** and the main geology of the area is listed in **Table 1**. The geology underneath the proposed Cape Winelands Airport is shale of the Tygerberg Formation (Nt), which is part of the Malmesbury Group and it is the basement rock of the area. Regionally the Malmesbury Group is overlain by different (younger) quaternary formations (Qgg, Qg, Qf and Qs).

The bedrock in the region is shown to be predominantly Malmesbury Group (Nt) rocks; these are often associated with overlying ferricrete gravels/nodules. The Malmesbury Group rocks typically dip steeply to the northwest (Stapelberg, 2006). Rapid transitions occur within this unit between easy-weathering siltstone/phyllite to more competent greywacke/sandstone. This can lead to large differences in depth of weathering/depth and development of the soil profile over relatively short distances (Stapelberg, 2006).

Although intrusions of the Cape Granite Suite are not indicated (**Map 3**), indications of minor intrusive, or fault-bounded bodies of granite occur in this region (Stapelberg, 2006). These are considered extensions/satellite intrusions of the Kuilsriver–Helderberg pluton.

Table 1: Geological formations within the study area.

Code	Formation/Pluton	Group/Suite	Description
~	Alluvium	Quaternary Group	Unconsolidated sand
Qgg	-		Gravelly clay/loam soil
Qg	-		Loam and sandy loam
Qf	-		Limestone and calcrete
Qs	Springfontyn Formation		Light-grey to pale red sandy soil
Cpo	Populierbos Formation	Klipheuwel Group	Shale, mudstone and sandy shale, mainly reddish
Cm	Magrug Formation		Conglomerate, grit and sandstone, often reddish brown
Nf	Franschhoek Formation	Malmesbury Group	Grey, feldspathic conglomerate, grit and sandstone, with minor shale
Nt	Tygerberg Formation		Nt - Greywacke, phyllite and quartzitic sandstone, interbedded lava and tuff
Nm	Moorreesburg Formation		Greywacke and phyllite with beds and lenses of quartz schist, limestone and grit; quartz-sericite schist with occasional limestone lenses

Note: N/A – Not Applicable.

2.7 ***Geotechnical Conditions***

The geotechnical conditions of the region were mapped at 1:50 000 scale by the CGS in 2006 (3318DC Bellville - Geotechnical Series), see **Map 4**. The geotechnical series provide an indication of the likely soil conditions and construction constraints at a particular location, for example, the soil beneath the site has been classified (according to the CGS) as 'M8', indicating that "*some precautionary measures needed to overcome engineering-geological problems*". Potential problems/conditions that may be experienced with subsoils of this classification are shown in **Table 2**. Note that the map codes in the legend correspond to the map codes shown in **Table 2.**

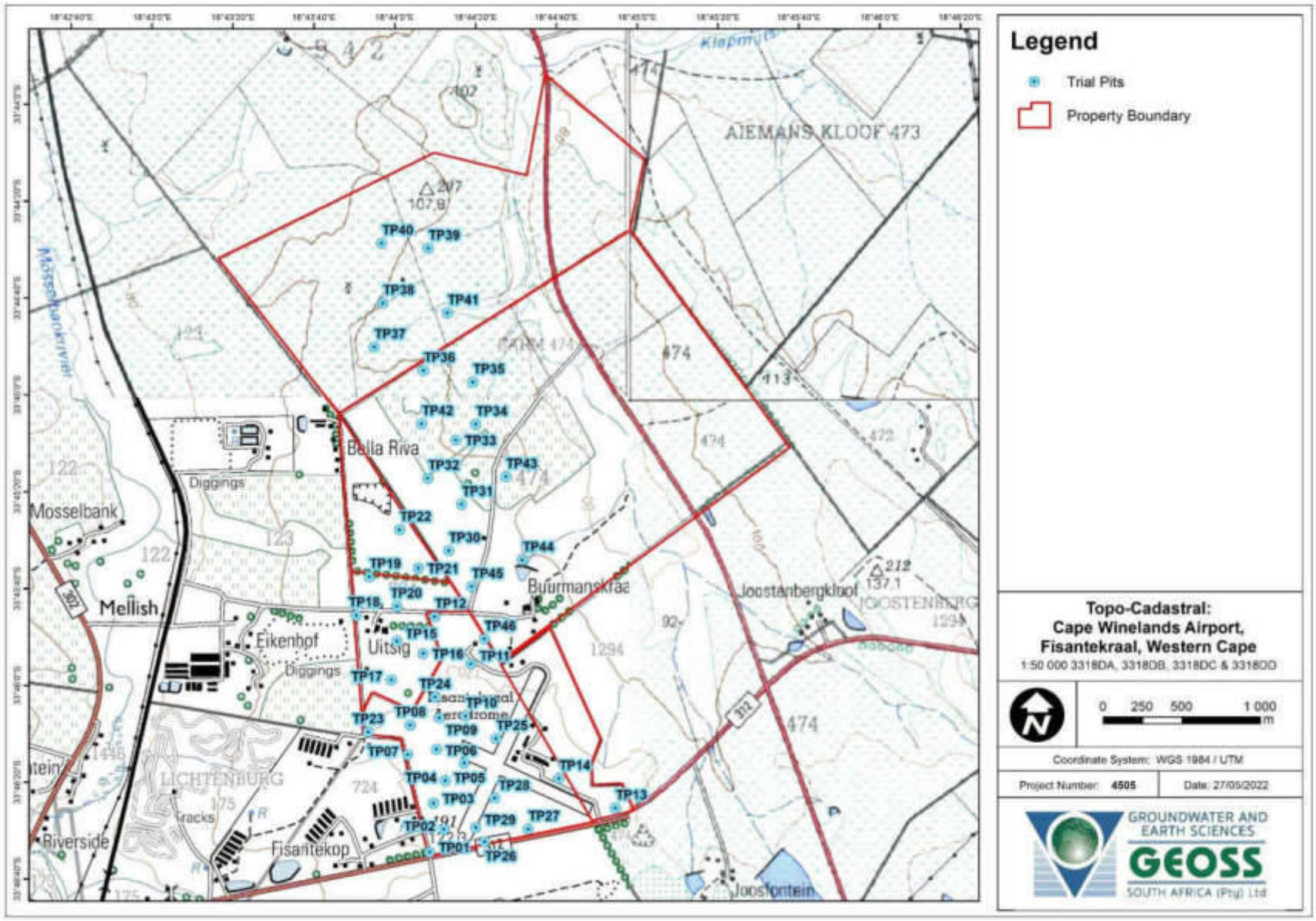
Table 2: Potential geological constraints in the region of the site (after CGS, 2009).

Geotechnical Condition/ Property	**Description**	**Severity Class / Resulting Cost Implication**
Permeability (Map Code: Per)	Permeability measures the flow of water through saturated soil. This is determined by the grain size and shape and the degree of compaction of the soil.	Low permeability (< 3 x 10 cm/s)
Shallow water table (Map Code: Sha)	Water table occurring at shallow depth - often seasonal.	Moderate
Loose sand (consolidation) (Map Code: Con)	Material susceptible to excessive consolidation when used as foundation horizon. Non-cohesive sands.	Low
Active clay (Map Code: Act2-Act3)	The degree of expansion experienced when dry clayey soils are moistened to full saturation. In addition to the activity, the clay horizon depth and thickness contribute towards determining the amount of surface movement (expansion/contraction).	The residual soils of the Tygerberg Formation may exhibit low to medium expansiveness. Medium cost implications may be incurred due to this type of material

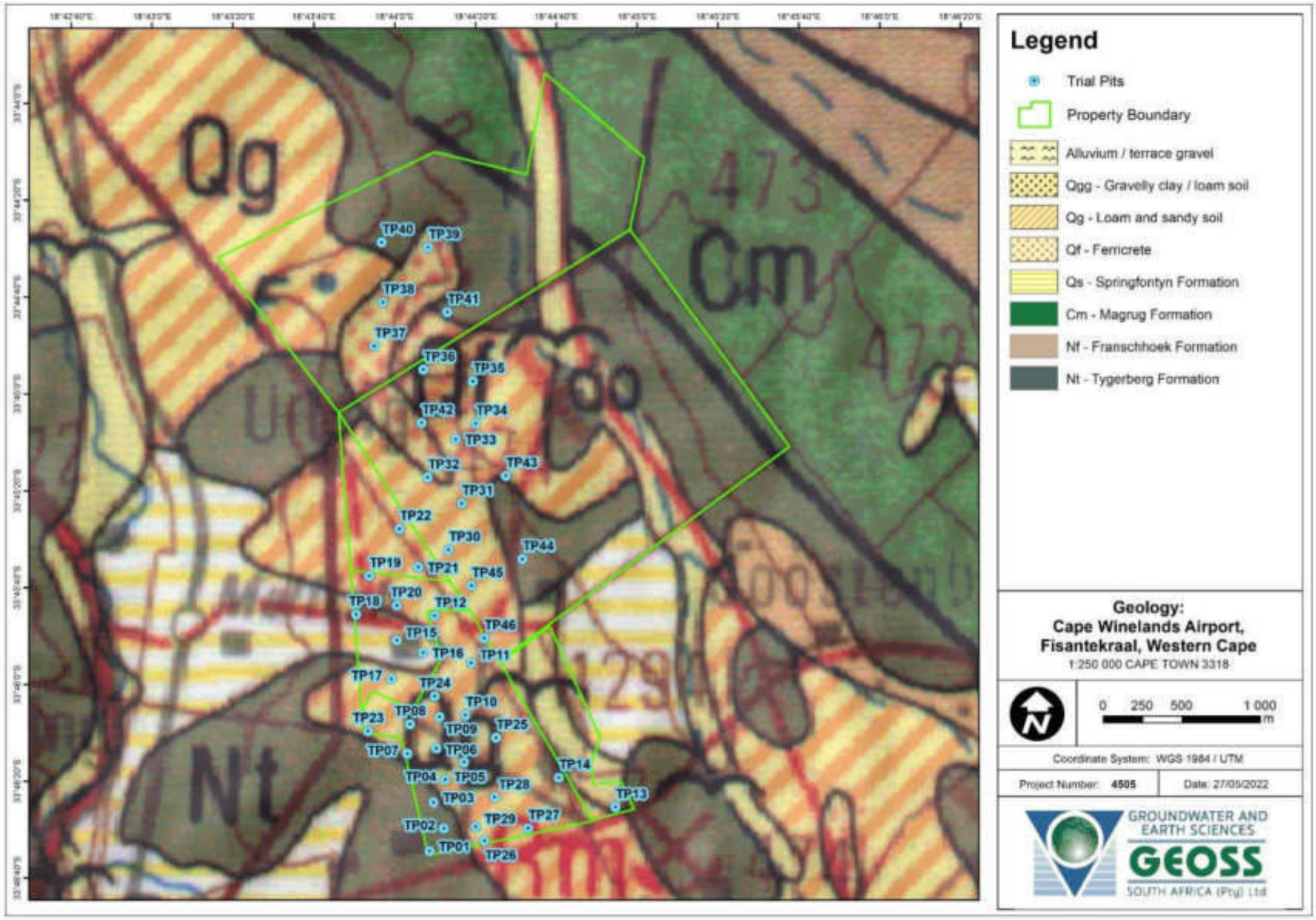
Selected results from Stapelberg (2009) have been presented in **Table 14** that were collected in the region (**Appendix G**). Relative to the existing CWA infrastructure Sample 5/3 is located to the north on Erf RE/474; Sample 5/8 within the development area on Erf 10/724, and; Sample 5/10 to the south on Erf 4. Of interest is the variation indicated between the lithologies, i.e., soils of granitic/intrusive (Cape Granite Suite) and pelitic/sedimentary (Malmesbury Group) origin. Similar conditions were encountered during the undertaking of the field investigation. The representative trial pit logs devised by F. Stapelberg were also consulted during compilation of this report.

2.8 Hydrogeology

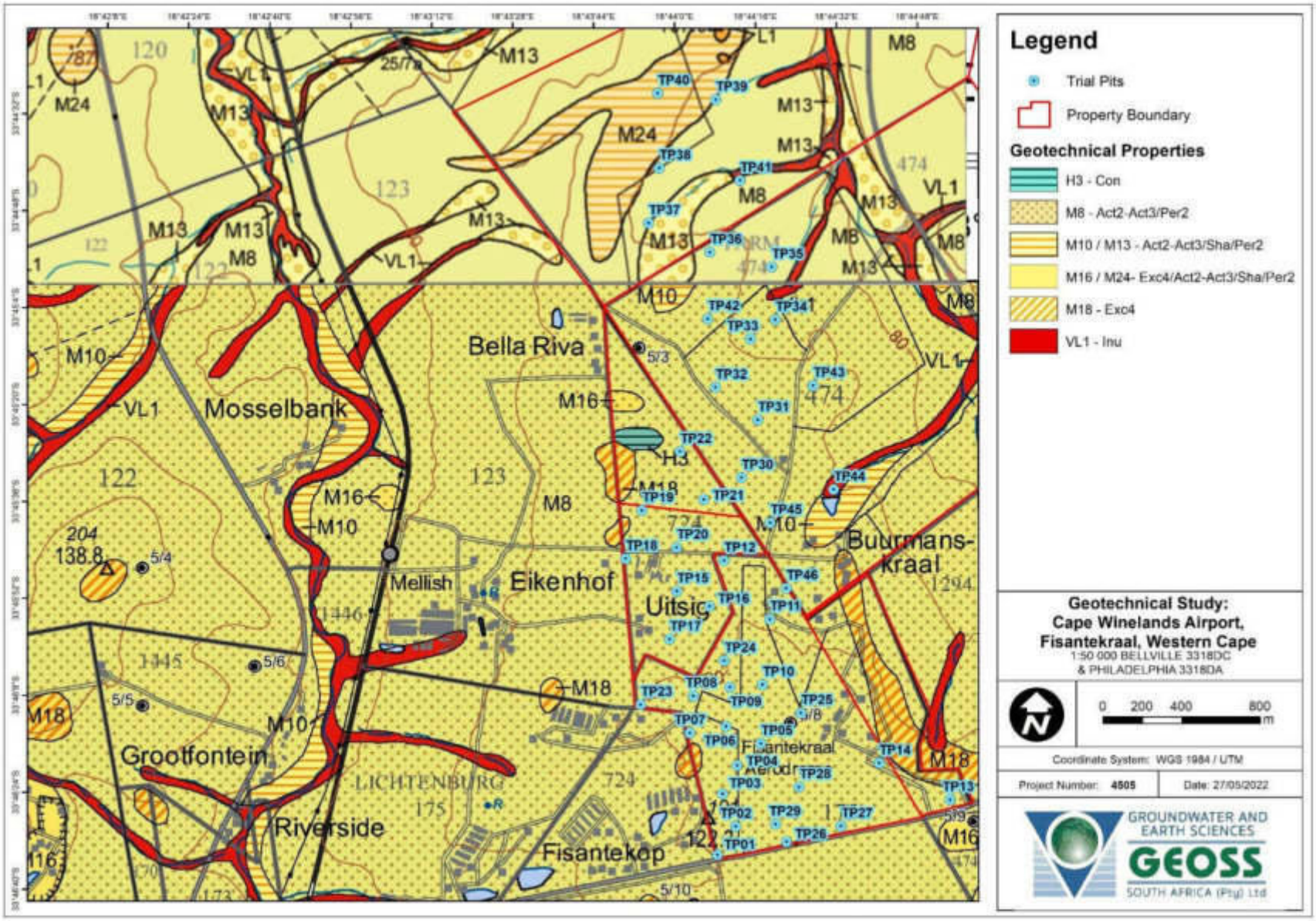
The regional aquifer directly underlying the site is classified by the Department of Water Affairs and Forestry (DWAF, 2002) as a fractured aquifer with an average yield potential that range from 0.5 – 0.5 L/s. A fractured aquifer describes an aquifer where groundwater only occurs in narrow fractures within the bedrock. The groundwater quality for study area ranges from "ideal" to "poor" with an associated electrical conductivity (EC) of between 70 – 1000 mS/m generally improving in quality (i.e. reducing EC) toward the south (DWAF, 2002). This information was derived from regional datasets. For more information on the groundwater status of the site, consult GEOSS (2022).



Map 2: Topocadastral map showing the locations of trial pits in relation to the proposed Cape Winelands Airport and surrounds.



Map 3: Geological setting of the area (3318DC – Bellville, GCS 1984).



Map 4: Geotechnical conditions of the site and surrounds showing the positions of the trial pits (3318DC – Bellville, GCS 2008).

3. INVESTIGATION METHODOLOGY

The geotechnical assessment has been undertaken primarily to characterise the engineering properties of soils underlying the site, confirm the local geology and the hydrogeological conditions. This investigation was also aimed to identify any potential geotechnical risks or 'problem soils' that may be present beneath the site.

The procedure adopted for this study involved a desktop study followed by site work. The initial desktop study involved gathering and reviewing all relevant data to the project. During this time, the GEOSS internal database was consulted, and geotechnical and hydrogeological investigation reports for work previously undertaken in the area were reviewed.

A site visit was then conducted to verify as much of this data as possible, collect additional data and make on-site observations (e.g. describe and document soil profiles), and collect representative soil samples from the trial pits to be submitted for laboratory analysis.

The following tasks were conducted on site, these are discussed and included in this report:

- A total of forty six (46) trial pits were excavated using a JCB 3DX Super Tractor Loader Backhoe. An image of the TLB is supplied in **Appendix C**.
    - Twenty nine (29) trial pits (TP01 to TP29) were excavated over a three (3) day period, from the 25 to the 27 January, during the summer of 2022.
    - Seventeen (17) trial pits (TP30 to TP46) were excavated over a two (2) day period, on 13 and 14 April, during the Autumn of 2022.
- The soil profiles exposed were described in terms of standard terminology as recommended by Jennings et al. (1973) and SAIEG (2001). A representative photograph of each trial pit has been supplied (**Appendix A**) and the trial logs have been captured using a commercially available hatching software dotPLOT (**Appendix B**). The spatial locations of the 29 trial pits is shown in relation to the topocadastral series map (**Map 2**).
- Dynamic Cone Penetrometer (DCP) tests were conducted adjacent to several trial pits to confirm and analyse representative soil consistencies / relative density across the site.
- Bulk samples of the dominant soil types were extracted from to best represent the soil profile(s) on-site. The following laboratory tests were undertaken on the collected bulk samples, and the results are presented in **Section 4**:
    - Foundation Indicators (Grading analysis, Hydrometer Analysis, Atterberg Limits);
    - Moisture/Density relationship (Mod. AASHTO)
    - California Bearing Ratio (CBR);
    - Basson Index test (on groundwater sample collected from TP25).
- A single undisturbed sample was collected, and the are presented in **Section 4**:

All of the collected data was analysed and interpreted to assess the potential geotechnical risks associated with the intended development, general recommendations have been made, and guidance on preliminary foundation solutions have been presented.

4. RESULTS

4.1 Field Investigation

The geotechnical reconnaissance investigation involved a site walk over, the excavation of a total of forty-six (46) trial pits and the performance of thirty five (35) drop-weight cone penetrometer (DCP) tests across the site. Excavation and documenting of trial pits TP01 to TP29 took place between 25 and 27 January 2022; and trial pits TP30 to TP46 between 13 and 14 April 2022. The reconnaissance investigation sought to identify and confirm hydrological, hydrogeological and geotechnical features of interest. Relevant surface features were also documented, trial pits excavation was supervised and notes were made on the relative ease of excavation, exposed soil profiles were documented, and representative bulk soil samples were extracted from the exposed soil profiles (**Table 7**). Following excavation of the trial pits each exposed soil profile was logged and photographed (**Appendix A & Appendix B**).

The locations of the trial pits and DCP tests are listed in **Table 7**; spatial locations of the trial pits are shown in on the aerial imagery in **Map 5**. The DCP tests were labelled according to the trial pits next to which they were conducted. The DCP tests were conducted in selected horizons within the trial pits to confirm the soil consistencies recorded during profiling. The DCP results are elaborated upon in **Section 4.3.**

Once the trial pits were logged, DCP tests were conducted and representative soil samples were collected, the general soil conditions across the site were evaluated.

4.2 General Soil Profile & Geotechnical Zones

Following the completion of trial pits, DCP testing and the site walkover, the site was divided into several zones which exhibit similar soil profile characteristics based on the descriptions of the material encountered in the trial pits. Five Geotechnical Zones were delineated, based on laboratory tests and observations made in the trial pits, the Zones have been named and are defined by the following:

- Zone A: Weathered relics fault-bounded blocks/satellite intrusions of the Kuilsriver-Helderberg granitoid of the Cape Granite Suite which is of igneous origin (**Table 3**).
- Zone B: Weathered Tygerberg Formation of the Malmesbury Group rocks of pelitic/sedimentary origin (**Table 4**).
- Zone C: Areas exhibiting characteristics of potentially expansive material, or material prone to settlement, derived from sediments of either the Kuilsriver-Helderberg intrusion or the Weathered sediments of the Tygerberg Formation (or a combination of both) (**Table 5**).
- Zone D: Areas of relatively deep transported aeolian sand (**Table 6**).
- Zone E: Areas with visible ferricrete and/or silcrete present on surface/in outcrop (**Figure 58**).

Note that the descriptions contained in the tables set out below are based on disturbed samples excavated from the trial pits. The Geotechnical Zones are shown spatially in **Map 6.**

Table 3: Generalised soil profile for Geotechnical Zone A.

Depth (mbgl)	Generalised Soil Profile
0.0 – 0.1/0.9	Pale grey to grey-brown to black (humified) intact to slightly voided very loose to medium dense SAND to gravelly SAND. Transported/hillwash. Note: (i) Roots generally present in upper 200 to 500 mm of horizon. (ii) Often includes ferricrete nodules and/or gravels. (i) Poorly developed in areas.
0.0/0.1 – 0.3/1.4	Red-, yellow- and/or orange-brown medium dense to very dense intact partially cemented NODULAR to HARDPAN FERRICRETE in a sandy matrix. Pedogenic. Note: (i) Many times induced refusal. (ii) Nodular and Hardpan horizons often exhibiting honeycomb texture.
0.3/1.4 – 0.6/1.4	Yellow-/orange-/grey-brown very loose to medium dense intact to pinholed sandy fine GRAVEL. Transported. Note: (i) Often partially cemented. (ii) Poorly developed or not present in places. (iii) Typically encountered beneath the ferricrete horizon, except for in TP24.
0.6/1.4 – 0.8/2.2+	Grey to white blotched/streaked/speckled/strained red-yellow-orange firm to very stiff intact to fissured/shattered gravelly sandy SILT/sandy SILT/sandy clayey SILT/silty CLAY to medium dense to very dense silty SAND or gravelly silty SAND. Residual. Note: (i) Often contains ferricrete nodules which increases the gravel content. (ii) Believed to be derived from weathered granitic Kuilsriver-Helderberg Pluton rocks. (iii) Perched water table at between 0.85 and 1.4 mbgl.

Table 4: Generalised soil profile for Geotechnical Zone B.

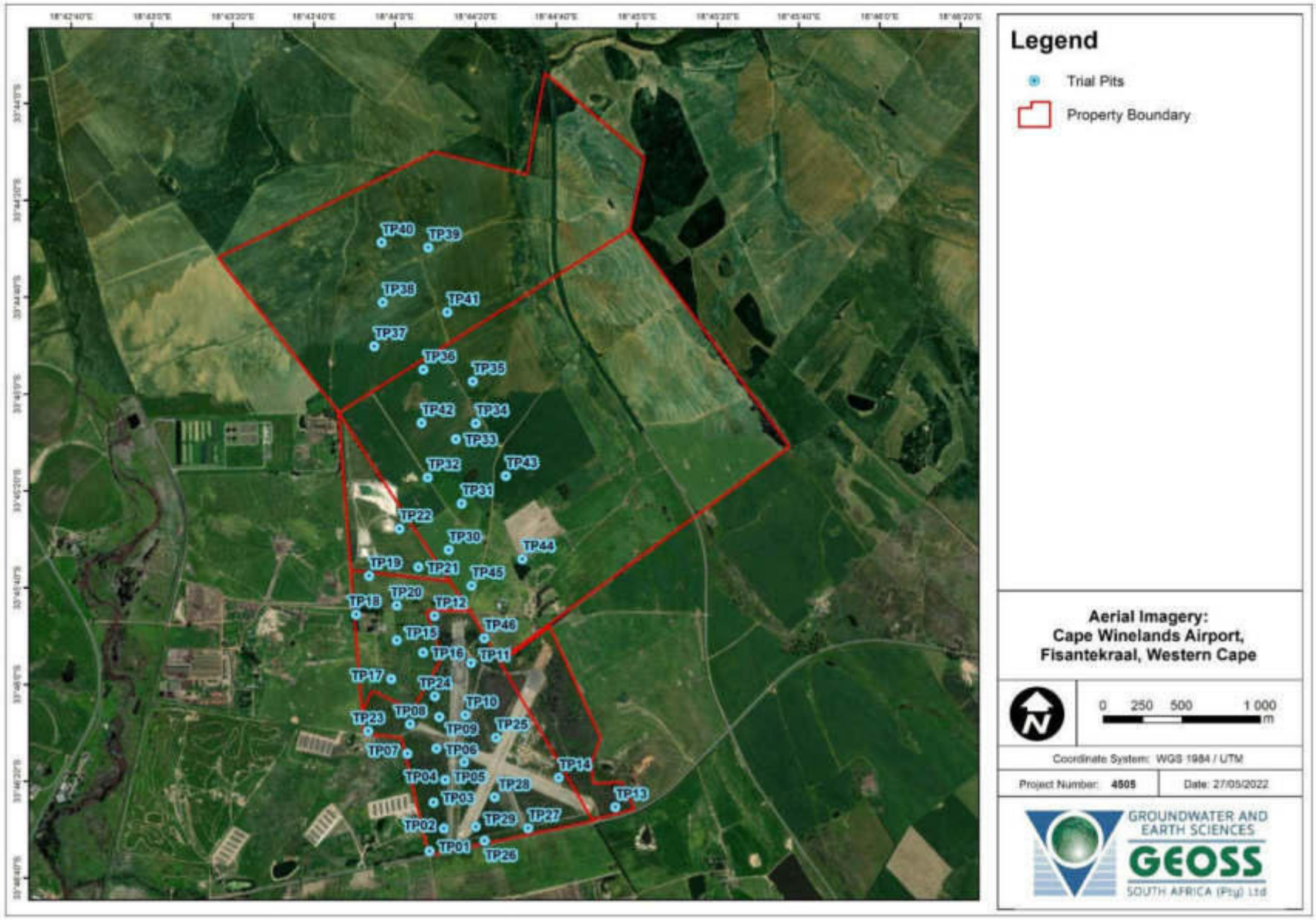
Depth (mbgl)	Generalised Soil Profile
0.0 – 0.15/0.6	Light brown to black (humified) very loose to medium dense intact to slightly voided SAND with variable amounts and sizes of ferricrete nodules and/or gravels. Transported/hillwash.
0.15/0.6 – 0.25/0.9	Red-, yellow- and/or orange-brown medium dense to very dense intact partially cemented NODULAR to HARDPAN FERRICRETE in a sandy matrix. Pedogenic. Note: (i) Many times induced refusal. (ii) Nodular and Hardpan horizons often exhibiting honeycomb texture. (iii) This could be considered an extension of the uppermost horizon as the ferricrete nodule concentration typically increases with depth.
0.25/0.9 – 1.6+	Grey-orange very dense intact gravelly clayey to silty SAND. Residual. Note: (i) Usually encountered in the southern areas. (ii) Believed to underly hardpan ferricrete. OR Grey blotched/streaked/speckled brown-orange-red and yellow firm to very stiff slightly shattered/fissured silty CLAY. Residual. Note: Believed to be derived from pelitic Malmsbury Group rocks.

Table 5: Generalised soil profile for Geotechnical Zone C.

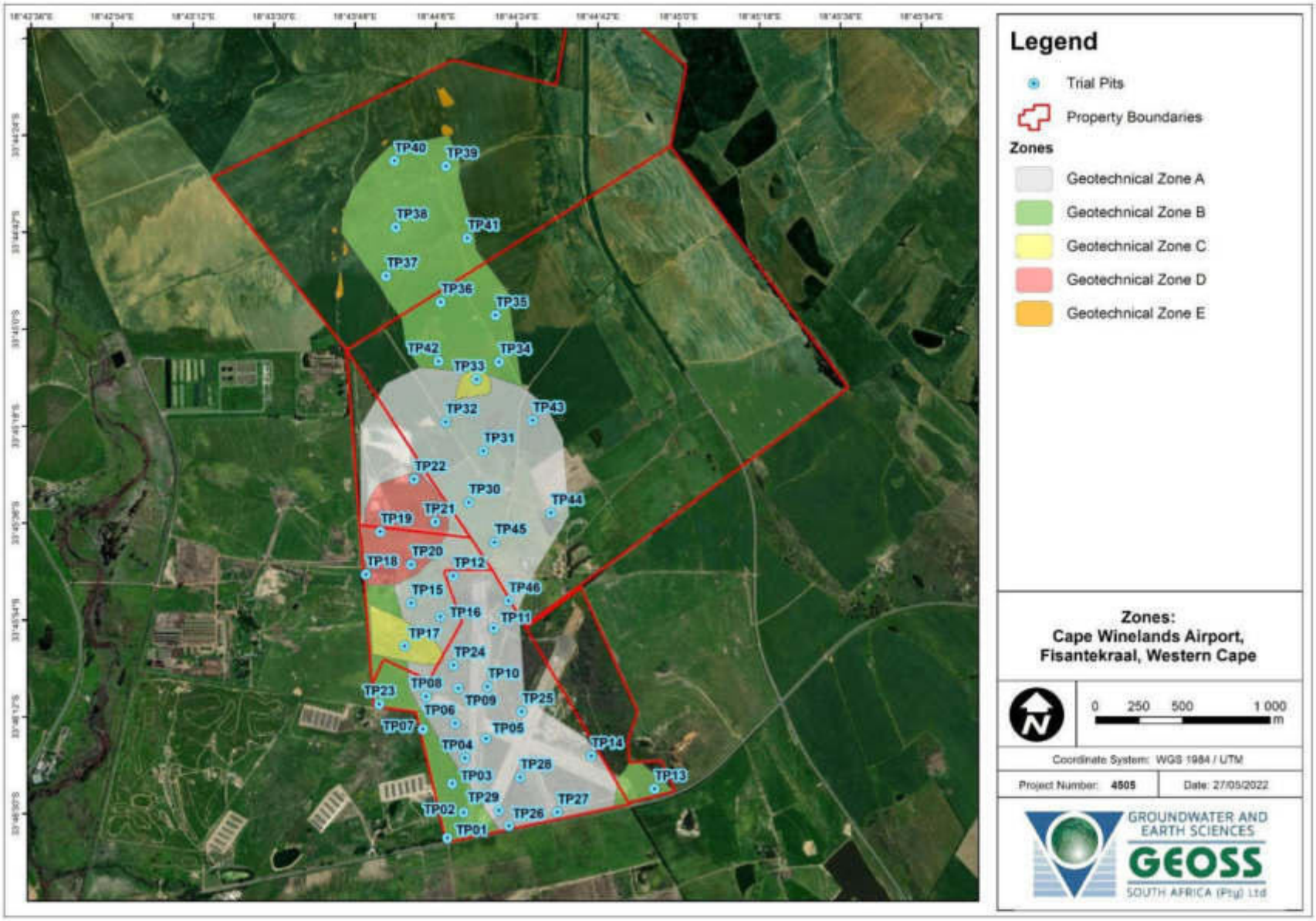
Depth (mbgl)	Generalised Soil Profile
0.0 – 0.1/0.9	Light brown to black (humified) very loose to medium dense intact to slightly voided SAND with variable amounts and sizes of ferricrete nodules and/or gravels. Transported/hillwash. OR Pale grey to grey-brown to black (humified) intact to slightly voided very loose to medium dense SAND to gravelly SAND. Transported/hillwash. Note: (i) Roots generally present in upper 200 to 500 mm of horizon. (ii) Often includes ferricrete nodules and/or gravels. (i) Poorly developed in areas.
0.1/0.9 – 0.3/1.4	Red-, yellow- and/or orange-brown medium dense to very dense intact partially cemented NODULAR to HARDPAN FERRICRETE in a sandy matrix. Pedogenic. Note: (i) Many times induced refusal. (ii) Nodular and Hardpan horizons often exhibiting interlocked honeycomb texture. (iii) This could be considered an extension of the nodular horizon as the ferricrete nodule concentration typically increases with depth.
0.3/1.4 – 0.6/1.4	Yellow-/orange-/grey-brown very loose to medium dense intact to pinholed sandy fine GRAVEL. Transported. Note: (i) Most often overlies sediments of weathered residual Malmesbury Group.
0.6/1.4 – 0.8/2.2+	Grey blotched/streaked/speckled brown-orange-red and yellow shattered/fissured firm to very stiff silty CLAY. Residual. Note: (i) Typically derived from Malmesbury Group. OR Grey to white blotched/streaked/speckled/strained red-yellow-orange firm to very stiff intact to shattered/fissured sandy SILT/sandy clayey SILT/silty CLAY Note: (i) Typically derived from Kuilsriver-Helderberg Pluton.

Table 6: Generalised soil profile for Geotechnical Zone D.

Depth (mbgl)	Generalised Soil Profile
0.0 - >0.5	Yellow-brown loose to medium dense slightly voided to intact medium SAND. Transported. Note: (i) Area of substantial transported cover. (ii) Underlain by either Malmesbury Group or Cape Granite residual soils and/or bedrock. (iii) Fine grass roots in upper 0.5 m.



Map 5: Aerial imagery showing trial pit positions in relation to the property boundaries.



Map 6: Aerial imagery showing interpreted Geotechnical Zone boundaries.

4.3 DCP Test Results

Drop-weight cone penetrometer (DCP) tests were undertaken at selected locations across the site (**Table 7**). A summary of the DCP test data collected on site is shown in **Figure 4.** The DCP tests undertaken within the uppermost (<1 mbgl) transported/hillwash material revealed a high degree of variability. The consistency of the mostly cohesionless SAND with ferricrete and/or gravel showed variation between very loose and very dense (or very soft and very stiff; **Figure 4**). The variation is believed to be due to the considerable variation in depth at which the NODULAR to HARPAN FERRICRETE pedogenic was intersected (ranging from surface to about 1.1 mbgl. The NODULAR to HARPAN FERRICRETE pedogenic horizon exhibited variation in consistency between loose and very/extremely dense (or soft to very stiff; **Figure 4**). Generally, the greater the degree of cementation was greater the consistency was greater. The material underlying the ferricrete ranged from mostly granular to mostly cohesive materials with consistencies ranging between medium dense and dense or firm and very stiff (**Figure 4**).

To gain an appreciation of the general consistencies of the materials beneath the site, the third quartile (Q3) of the DCP data was plotted with depth increments of 0.3 mbgl (**Figure 4**). These data show that for the same units described above (that 75% of all data points/on average) range in consistency as indicated below (the bounds of consistencies shown in brackets are displayed on figure):

- Transported materials (assumed to be ~0.3 mbgl): loose (or firm).
- Mostly ferricrete horizons (assumed to be between 0.3 and 1.0 mbgl): medium dense (or very stiff).
- Mostly residual materials (assumed >1.5 mbgl): stiff to very stiff; increasing with depth (medium dense to very dense with depth).

The high degree of variability (and outliers) displayed by most (if not all) horizons is likely due to notes mentioned above as well as the disturbed nature of some of the soils when undertaking the DCP tests. Disturbance is due to excavation of the respective horizons, e.g. to expose the underlying material beneath the nodular to hardpan ferricrete horizon the TLB excavated the ferricrete out exposing and disturbing the uppermost surface of the underlying material.

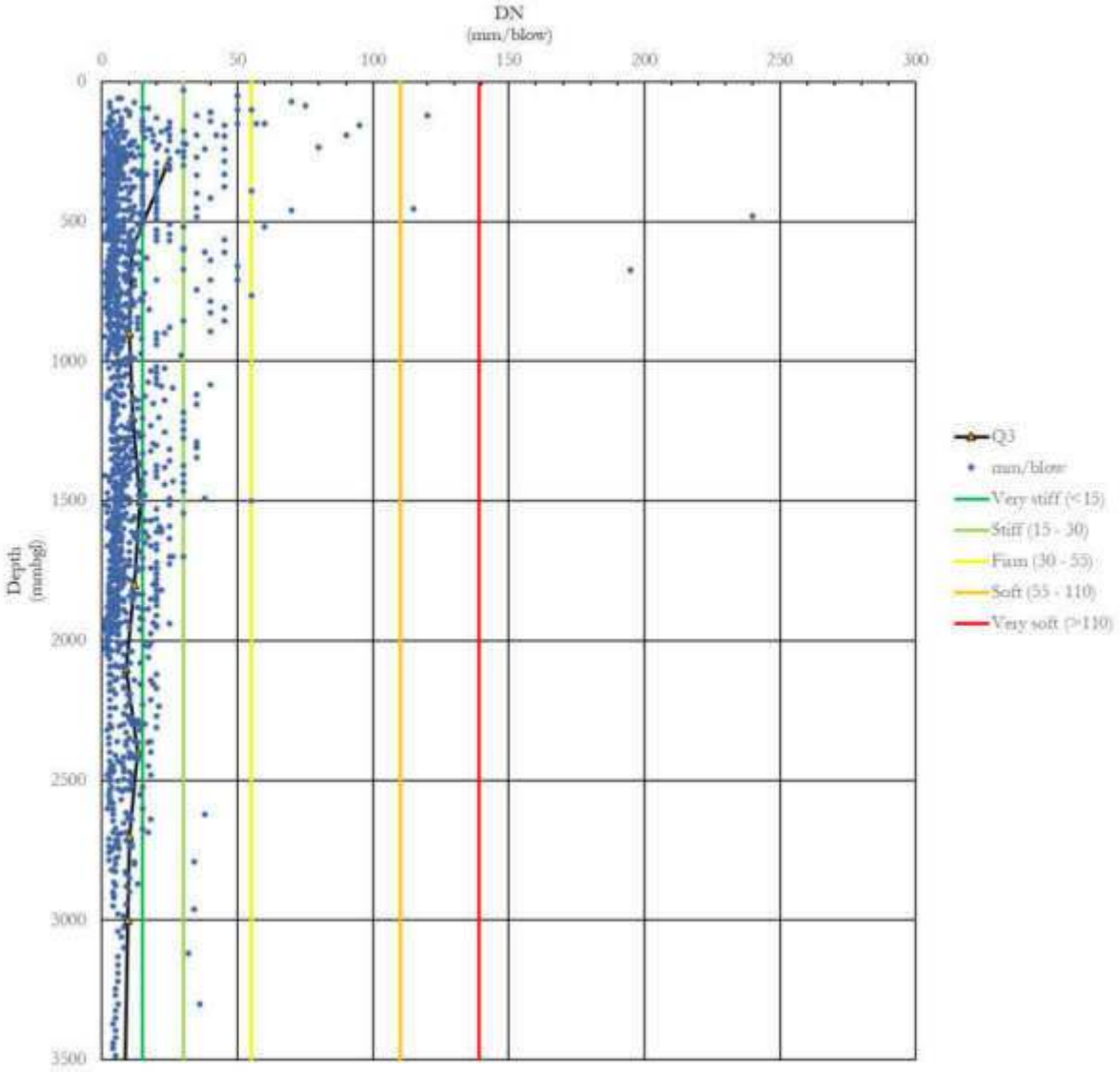


Figure 4: DCP Test results plotted with the third quartile (Q3) of all tests undertaken; cohesive material interpretation boundaries shown.

4.4 Laboratory Test Results

A total of sixteen (16) bulk disturbed soil samples were collected from selected trial pits and submitted to a commercial laboratory for analysis. The laboratory classification tests served to determine the general mechanical/engineering properties of the soils encountered on-site. The samples were analysed for the following:

- Foundation Indicators (particle size/grading, hydrometer, and Atterberg Limits tests) (**Table 8**) and/or;
- Moisture density relationships, Specific Gravity (SG) and California Bearing Ratios (**Table 9**).
- Double oedometer analysis (**Appendix E**).

The single double oedometer test sought to determine the compressibility and heave properties of the residual material, as a typical example for the area. It should be noted; however, that conditions may vary locally.

Further, groundwater was intersected in two trial pits TP15 and TP25 in January 2022, and in a single trial pit TP33 in April 2022. A single groundwater sample was collected from TP25 and was submitted to a commercial laboratory for chemical analysis (**Appendix E**). A summary of the results is contained in **Table 10**. The pH of the groundwater sample is 6.7, which classes the water as moderately aggressive (Basson 1989). The Final Aggressiveness Index of 1777 classes the water as Very highly aggressive (Basson, 1989). Therefore, counter measures will be required, i.e. the concrete of the foundation bases in contact with groundwater will require protection, and any steel reinforcement within such bases should be covered by at least 30 mm of concrete. The advice of a specialist concrete and/or steel technologist/manufacturer should be sought in regard to final designs of cement coating and concrete protection of steel reinforcement. General guides for the assessment of the Final Aggressiveness Index have been presented in **Appendix E & G**.

Table 7: Summary of trial pit data.

ID	Latitude (DD, WGS84)	Longitude (DD, WGS84)	Elevation (mamsl)	TP EOH (mbgl)	Samples	DCP No.:
TP01	-33.7763	18.7356	125	0.7	-	-
TP02	-33.7750	18.7366	127	0.7	-	-
TP03	-33.7735	18.7359	126	0.6	-	-
TP04	-33.7722	18.7367	126	1.8	18589	4
TP05	-33.7712	18.7380	126	0.8	-	-
TP06	-33.7704	18.7361	126	2.0	-	6
TP07	-33.7707	18.7341	123	2.0	-	7
TP08	-33.7690	18.7343	124	1.9	-	
TP09	-33.7686	18.7363	125	0.8	-	-
TP10	-33.7685	18.7381	124	0.8	-	10
TP11	-33.7655	18.7385	123	2.1	-	11
TP12	-33.7628	18.7360	120	2.0	18590; 18591	12
TP13	-33.7738	18.7484	126	1.6	-	-
TP14	-33.7721	18.7445	128	2.0	18592; 18593	14
TP15	-33.7642	18.7334	117	1.7	18594	15
TP16	-33.7649	18.7352	119	1.6	-	-
TP17	-33.7664	18.7330	119	1.9	18595	17
TP18	-33.7627	18.7306	122	1.2	18596; 18597	18
TP19	-33.7605	18.7315	117	0.8	-	-
TP20	-33.7622	18.7334	120	0.8	-	-
TP21	-33.7600	18.7349	119	2.2	-	21
TP22	-33.7578	18.7336	119	1.8	18598	22
TP23	-33.7694	18.7314	121	1.9	-	23
TP24	-33.7674	18.7360	123	2.0	-	24
TP25	-33.7698	18.7402	125	1.4	18599; 18600	25
TP26	-33.7757	18.7394	128	1.7	18601	26
TP27	-33.7750	18.7424	127	1.9	-	27
TP28	-33.7732	18.7401	126	1.75	-	28
TP29	-33.7749	18.7388	126	0.8	-	-
TP30	-33.7590	18.7370	115	1.5	-	30
TP31	-33.7564	18.7379	113	3.0	-	31
TP32	-33.7549	18.7356	112	2.4	-	32
TP33	-33.7527	18.7375	103	2.5	-	33
TP34	-33.7518	18.7389	97	3.0	20003	34
TP35	-33.7493	18.7387	94	1.6	-	35
TP36	-33.7487	18.7353	105	1.5	-	36
TP37	-33.7473	18.7319	99	1.5	-	37
TP38	-33.7448	18.7325	100	1.4	-	38
TP39	-33.7417	18.7356	97	1.6	-	39
TP40	-33.7414	18.7324	107	2.1	20001	40
TP41	-33.7454	18.7369	89	1.7	-	41
TP42	-33.7517	18.7351	111	1.5	20002	42
TP43	-33.7548	18.7409	106	2.0	-	43
TP44	-33.7596	18.7420	104	1.6	-	44
TP45	-33.7611	18.7386	116	2.0	-	45
TP46	-33.7641	18.7394	120	1.6	-	46

Note: EOH – End of Hole.

Table 8: Summary of grading analysis.

Sample No. (TP##)	Depth (m)	Soil Type	Grading Analysis				LS %	LL %	PI %	Pot. Exp.	GM	USCS
			Clay %	Silt %	Sand %	Gravel %						
18589 (TP4)	1.7	Red-white sandy clayey SILT	17	19	47	17	8.1	33	15	Low	1.10	SC
18590 (TP12)	0.0 – 0.6	Brown gravelly SAND	2	7	82	9	0.0	NP	NP	Low	1.42	SP
18591 (TP12)	0.75 – 1.2	Yellow-brown/orange gravelly SAND	2	5	66	27	0.0	NP	NP	Low	1.82	SP
18592 (TP14)	0.0 – 0.45	Orange-brown sandy GRAVEL	1	3	34	62	0.0	NP	NP	Low	2.35	SP
18593 (TP14)	1.5 – 2.0	Red-grey gravelly silty SAND	12	11	58	19	7.9	32.2	15.7	Low	1.44	SC
18594 (TP15)	0.9 – 1.7	Orange-grey gravelly silty SAND	16	11	61	12	6.0	27	9.8	Low	1.17	SC
18595 (TP17)	0.0 – 1.9	Brown SAND	3	3	93	1	0.0	NP	NP	Low	1.13	SW
18596 (TP18)	0.2 – 0.6	Brown sandy GRAVEL	6	1	32	61	0.0	NP	NP	Low	2.29	GP
18597 (TP18)	0.6 – 1.0	Red-brown silty CLAY	55	30	11	4	18.9	79.9	41.8	V.High	0.25	MH or OH
18598 (TP22)	0.5 – 2.0	White-grey silty CLAY	24	74	1	1	6.2	48	16.8	Med.	0.04	ML or OL
18599 (TP25)	0.0 – 0.7	Reddish-brown gravelly SAND	3	5	47	45	0.0	NP	NP	Low	2.02	SP - SC
18600 (TP25)	0.9 – 1.4	Orange-grey sandy SILT	15	18	60	7	4.5	24	8.6	Low	1.06	SC
18601 (TP26)	1.0 – 1.7	Orange-grey gravelly silty SAND	12	10	66	12	7.3	36.9	13	Low	1.38	SC
20003 (TP34)	1.2	Brown sandy CLAY	44	7	49	-	9.2	43.5	19.2	Low		
20001 (TP40)	0.5 – 1.1	Orange clayey SILT	19	62	18	1	7.8	28.8	14.6	Med.		
20002 (TP42)	0.8	Grey-orange clayey SILT	24	69	5	2	7.6	34.6	15.6	Med.		

NOTES: LL - Liquid Limit LS - Linear Shrinkage USCS – Unified Soil Classification System
NP – Non-plastic GM – Grading Modulus Pot. Exp. – Potential Expansiveness
PI - Plasticity index

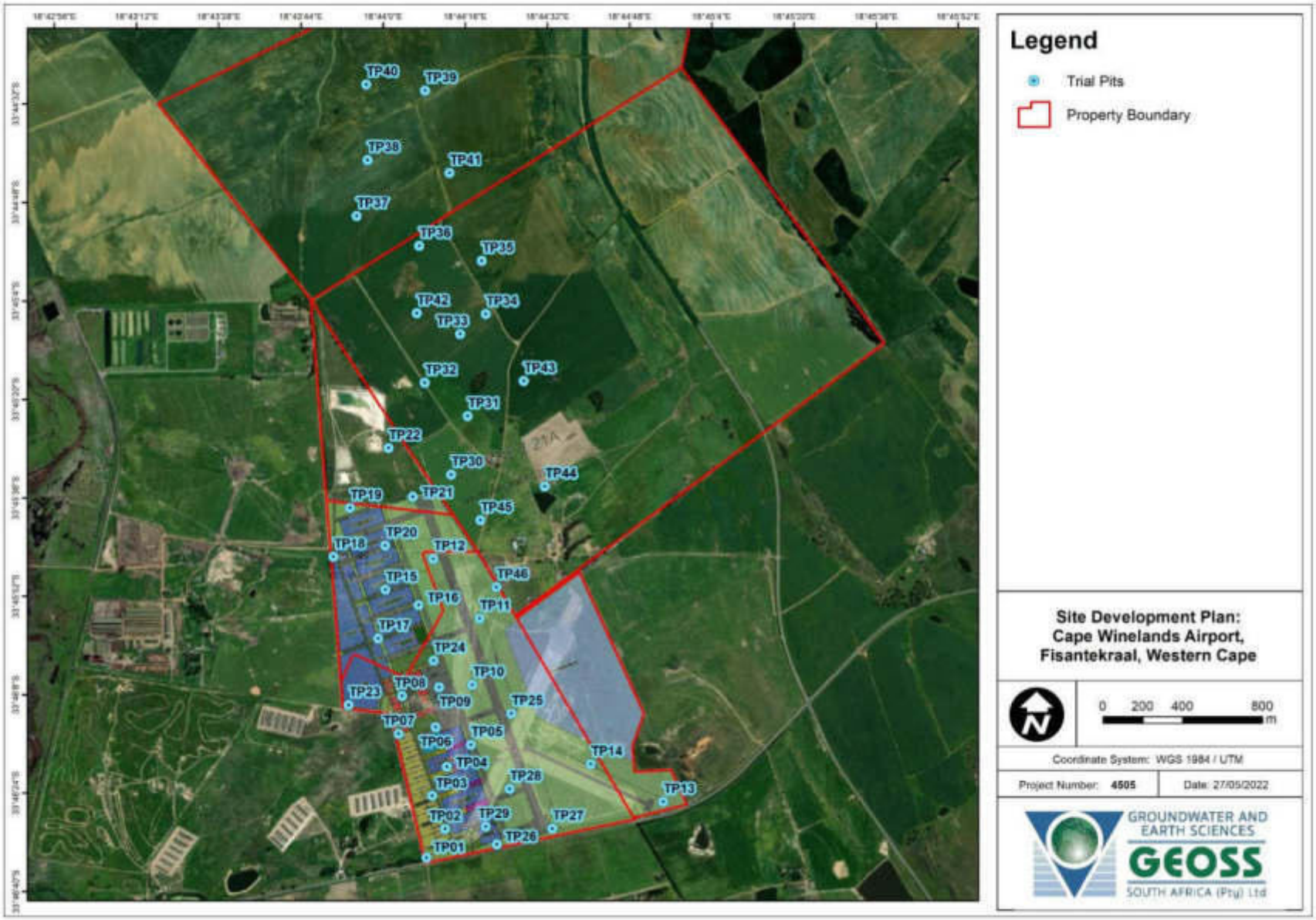
Table 9: Summary of CBR and moisture density analyses.

Sample No. (TP##)	Sample depth (mbgl)	CBR @ (##%)					Gs	MDD kg/m³	OMC %	NMC %
		100	98	95	93	90				
18589 (TP4)	1.7	4	3	2	1	1	2.660	2102	10.2	1.5
18590 (TP12)	0.0 – 0.6	17	14	10	8	5	2.604	1909	12.1	2.1
18591 (TP12)	0.75 – 1.2	16	13	9	7	5	2.577	2030	9.2	1.2
18592 (TP14)	0.0 – 0.45	75	50	40	30	21	2.604	2120	8.3	1.2
18593 (TP14)	1.5 – 2.0	19	14	8	5	3	2.632	2025	12.2	4.2
18594 (TP15)	0.9 – 1.7	17	11	5	3	2	2.660	2022	12.5	7.3
18595 (TP17)	0.0 – 1.9	14	10	7	6	4	2.577	1808	12.3	4.5
18596 (TP18)	0.2 – 0.6	50	39	26	20	13	2.632	2240	7.3	4.5
18597 (TP18)	0.6 – 1.0	1	1	1	1	1	2.747	1788	14.3	15.8
18598 (TP22)	0.5 – 2.0	1	1	1	1	1	2.747	1745	13.4	15.6
18599 (TP25)	0.0 – 0.7	27	20	13	10	6	2.577	2047	9.2	4.4
18600 (TP25)	0.9 – 1.4	14	12	9	7	5	2.632	2143	8.2	4.5
18601 (TP26)	1.0 – 1.7	15	11	8	6	4	2.632	2008	12.4	5.9
20003 (TP34)	1.2	-	-	-	-	-	2.747	-	-	13.5
20001 (TP40)	0.5 – 1.1	-	-	-	-	-	2.660	-	-	15.7
20002 (TP42)	0.8	-	-	-	-	-	2.688	-	-	11.4

NOTES: CBR - California bearing ratio Gs – Specific Gravity MDD - Maximum Dry Density
OMC - Optimum moisture content NP – Non-plastic NMC – Natural Moisture Content

Table 10: Summary of Basson Index analyses results.

Sample No. (Trial Pit No.)	4505_C_TP25 (TP25)
Depth (mbgl)	0.85
pH	6.7
EC (mS/m)	31.8
Chloride as Cl	31
Sulphate as SO_4	34
Langelier Index	-2.0
Leaching Index	1772
Ryznar Index	10.7
Corrosivity Ratio	2.5
Spalling Index	5
Final Aggressiveness Index	1777



Map 7: Aerial map showing locations of trial pits superimposed on the Site Development Plan.

5. GEOTECHNICAL INTERPRETATION & RECOMMENDATIONS

5.1 Site Geology and Soils Profile

Based on the following:

- Published geological data,
- Geological, geotechnical and geophysical investigations undertaken by GEOSS in the region, and;
- Geotechnical reconnaissance investigations carried out by the Council for Geoscience in the area,

the site is known to be situated an area that typically shows surficial sandy and/or loamy quaternary/transported sediments of variable thickness and quantities of quartzitic sand and ferricrete gravel (which may also be present at the surface). These more recent deposits overly a basement rocks that are of variable origins, i.e. either of igneous (granitic) or sedimentary (pelitic).

5.2 Groundwater and drainage

Groundwater was intersected in trial pits TP14 and TP25 in February 2022; and in TP33 in April 2022. General seepages were encountered at 1.5, 0.9, and 1.4 mbgl, respectively in TP14, TP25, and TP33. These seepages were observed to emanate from the lower transported sandy angular fine GRAVEL unit, which typically occurred beneath the pedogenic horizon. The perched water table rose to 1.0 and 0.85, respectively for TP14 and TP25 after approximately 1 hour of the trial pits remaining open.

Although groundwater/seepage was not encountered in the other trial pits excavated across the site, the development of a perched water table should not be discounted; particularly after periods of heavy rainfall, or following a winter season of above average annual rainfall. Due to occurrence of perched water table and low permeability of substratum across the site - storm water that cannot be directed to natural topographic run-offs will need to be directed to appropriately designed & engineered soakaways.

Open excavations in sand-dominated materials exceeding 1 m in depth should be shored to 30°, and excavations in cohesive soils can be battered to 45°.

Stormwater should be directed to municipal stormwater infrastructure, or an appropriately designed stormwater soakaway.

5.3 Slope stability and bracing

It is important to mention that beneath a depth as shallow as 0.85 mbgl groundwater seepage is encountered. This induces slumping/collapse of the granular mostly cohesionless material horizons. Excavations should be suitably battered for foundation placement, additional support in the form of sand bags (placed at toe of excavations) or other suitable temporary support measures may be required.

Hazardous conditions must be expected when the trenches are exposed to wet weather conditions. Collapse of the sidewalls normally occurs without any warning. Safe working conditions must therefore be ensured in all trenches deeper than 1.0 mbgl, or beneath the nodular to hardpan ferricrete horizons. This can be achieved by either shoring the sidewalls or battering them back at a safe angle, e.g. 30° for mostly cohesionless materials and 45° for materials which are largely cohesive.

5.4 Excavation Conditions

5.4.1 Transported materials

The granular surficial gravelly sands are classified as soft excavation in terms of SANS 1200D.

5.4.2 Pedogenic materials

The pedogenic material encountered in the trial pits is variably cemented across the site. In general, the pedogenic material classifies as soft to intermediate excavation (SANS 1200D). Indurated hardpan ferricrete horizons may require pneumatic/hydraulic rock-breaking apparatus (e.g. a Montabert) during excavation.

5.4.3 Residual materials

Residual horizons showed excavation of soft to intermediate with depth (SANS 1200D).

5.5 Preliminary Foundation Modelling

5.5.1 Pad foundations

Based on the observations made in the trial pits, the results of the dynamic cone penetrometer tests, and preliminary modelling, the maximum bearing capacities have been calculated based on Meyerhoff method (**Table 11**). The following parameters were used during the preliminary modelling:

- Friction angle (φ'): 33°
- Cohesion (c'): 0 kPa
- Bulk unit weight: 19.5 kN/m^3
- Saturated unit weight: 21 kN/m^3
- Water table depth: 0.5 mbgl (worst case).
- Founding depth: 1.0 mbgl.

Table 11: Allowable bearing capacities

Pad Dimension (m^2)	Allowable Bearing Capacity (kPa)
0.75	278
1.00	282
1.25	291
1.50	301
2.00	325

The final depth and design of the founding(s) should be subject to the discretion of the engineer and based on site specific geotechnical investigations for each of the structures as per the SAICE code of practice.

5.5.2 Strip footings

The nodular to hardpan ferricrete horizons will very likely provide more than adequate bearing capacity for typical supporting infrastructure, e.g. single story masonry structures. However, due to the laterally discontinuous nature of the ferricrete horizon, site specific investigations should be conducted for such structures.

5.5.3 Anticipated settlements

Estimated immediate settlements range between 17 and 29 mm, depending on the loads imposed on the founding stratum (**Table 12**).

Table 12: Estimated immediate settlement results

	Settlement (mm) for a given pressure (*kPa*) :		
Pad dimensions (m^2)	***150***	***200***	***250***
2.0	16.6	22.7	28.9

5.5.4 Anticipated heave

The area delineated as 'Geotechnical Zone D', has been interpreted to be potentially expansive, based on observations made in the trial pits and the characterisation test results obtained from the laboratory. Anticipated heave was calculated based on the Weston (1980) method of heave determination. Weston's method of heave determination is based on the weighted liquid limit, moisture content and overburden pressure the material is subjected to, the following percentage swell can be expected at the surface (**Table 13**). The predicted heave varied between 0.05% and 50% of the layer thickness. It is important to point out that heave has been predicted by Weston (1980) outside the region delineated as potentially expansive due to elevated liquid limits of the residual material encountered in TP4 (sample 18598).

Table 13: Anticipated heave at given pressures and layer thicknesses for pad footings.

Pressure (kPa)		1	1	1	50	50	50	200	200	200
Layer thickness beneath footing (mm)		*500*	*1000*	*2000*	*500*	*1000*	*2000*	*500*	*1000*	*2000*
TP04 (1.7m)	Heave at surface (mm)	249	499	998	55	110	220	32	65	129
TP14 (1.5 – 2.0)		5	9	18	1	2	4	1	1	2
TP15 (0.9 – 1.7)		3	5	10	1	1	2	0	1	1
TP18 (0.6 – 1.0)		180	360	721	40	80	159	23	47	93
TP22 (0.5 – 2.0)		33	67	134	7	15	30	4	9	17
TP25 (0.9 – 1.4)		5	9	19	1	2	4	1	1	2
TP26 (1.0 – 1.7)		4	7	15	1	2	3	0	1	2

Potentially expansive materials were also encountered within the region that has been proposed for future development, i.e. within trial pits TP30 to TP46. The materials tested showed low to medium potential expansiveness, which are similar to the results presented in the table above. Structures should be preliminarily designed accordingly.

5.5.5 Compressibility Index

A sample of undisturbed residual material was extracted at a depth of 0.8 mbgl from trial pit TP42. This sample was submitted to an accredited laboratory for the determination of compressibility and expansive properties. The coefficient of volume compressibility (M_v) of this sample was computed based on the results of the saturated double oedometer test:

$M_v = 0.0004431\ m^2/kN$

A stress increment of 100 kN/m^2 was used to determine the above result (Knappett and Craig, 2012).

5.6 Sub-Grade Modulus

5.6.1 Transported Materials

The modulus variation (n_h) of the sand-dominated materials is anticipated to be as low as 2.5 MN/m^3, or less, to about 20.0 MN/m^3 with depth. Based on the modulus of variation the expected modulus of subgrade reaction (k_h) can be calculated for piles using the following formula:

$$k_h = {}^{n_h x\ Z}/_{B}$$

Where, Z is the depth in metres and B is the pile breadth (m) (after, Franki 2019).

5.6.2 Transported Materials

The modulus subgrade reaction of the firm mostly cohesive residual materials is anticipated to be greater than 18 MN/m^3, increasing proportionally with increased consistency (after, Franki 2019).

*5.7 **Reuse of in-situ soil***

5.7.1 Material classifications according to TRH14

The transported materials encountered in Geotechnical Zone D do not meet the classification criteria of G9 materials, due to insufficient CBR values at 93% Mod AASHTO density.

The transported sediments mixed with considerable proportions of ferricrete nodules and gravels classify as at least G8. With increasing proportions of ferricrete nodules this CBR value is anticipated to increase.

The residual materials encountered in all of the trial pits classify as G9 or worse due to the often low CBR values.

5.7.2 Runway & Layer Works

Regarding the preparation of the runway, all surficial materials (0 – 0.2 mbgl) containing vegetation or other organics must be removed and either spoiled off site, or stockpiled for later incorporation in future landscaping operations. The resultant surface (that is free of organics) should be 'ripped and mixed' to a depth of about 0.5 m below the prepared surface of the transported horizon, which is devoid of organics. This serves to blend the remaining transported sediments and nodular ferricrete horizon (refer to samples 18599, 18596, 18590, 18592). The ripped and mixed material should be placed in 150 mm thick layers and compacted to at least 95% MOD AASHTO density. The resultant surface must yield a minimum CBR value of 15 (once compacted). The resultant prepared surface is anticipated to serve as an appropriate lower and upper subbase. The project engineer is to advise on the final design for the subbase, base and seal for runway and taxiing areas according to expected design air traffic loadings.

The resultant densities achieved for the respective layer works horizons should checked in 10 m intervals using a Troxler density device, for the length of the runway.

It is important to mention that material encountered in the northern extent of the property, i.e. north of trial pits TP12 and TP15, residual materials possess considerably greater cohesive components, which dramatically reduce the CBR values (TP18 to TP22, refer samples 18591, 18597, 18598). For reference see **Table 7**. Such cohesive materials should be removed and spoiled off site.

The ripped and compacted material from the southern extent of the site should be sufficient to infill the resultant 'void' created by the removal of the spoiled mostly cohesive material in the northern extent of the present site. Further, any additional material required to supplement the construction of the runway and taxiing area, could be sourced from south- and north-western portions of the site, particularly from excavations required for the construction of the commercial and aviation development areas in the southwestern portion of the site.

Reuse of excavated material for general pavement construction should be at the site engineers' discretion, and is expected to only be suitable for LSSG course. The following generalised layer works are recommended:

• Seal	Cape Seal	13/19 mm	to be specified by engineer
• Base	Imported G2/G3	150 mm	100% MMD
• Subbase	Imported G5	150 mm	95% MDD
• USSG	Imported G7	150 mm	93% MDD
• LSSG	Imported / in-situ G7	150 mm	100 % MMD

6. CONCLUSIONS

This report summarises the results from a Phase I Geotechnical Investigation that aimed to determine and classify the engineering properties on the site proposed for development, and to provide preliminary recommendations for the geotechnical design and further investigations required for the proposed structures. The most pertinent findings from this Phase I investigation are as follows:

- The site is covered by a surficial horizon of mostly cohesive transported soil, which is underlain by a laterally discontinuous and variably cemented nodular to hardpan ferricrete pedogenic horizon. These strata are underlain by residual materials derived from either the Cape Granite Suite or the Malmesbury Group.
- From a geotechnical standpoint, site development should proceed; however, there are potential geotechnical challenges with development of this site. There is a great degree of variability within the composition of the residual materials, and consequently, there are areas across the site that present a risk of highly expansive soils, and may be subject to high consolidation.
- Due to the variation in topography within the northern extent of the property, considerable fill will be required, should the development be extended from the present level at which the Fisantekraal Airport is situated. In this case a suitable granular fill will need to be imported; materials could be sourced locally, but would need to be sieved and mixed in appropriate proportions.
- The tractor loader backhoe was unable to penetrate materials with consistencies of very dense and/or very stiff, and beyond. However, it is anticipated that in unrestricted excavations, and/or with prior ripping, conventional light earth-moving equipment could carry out the bulk of the earthworks. All materials encountered in the trial pits classified as soft to intermediate excavation (SANS 1200D). The hardpan ferricrete horizons may require rock-breaking apparatus in areas of the site.
- A series of site-specific follow-up geotechnical investigations will be required prior to the construction of individual structures, which should include field and laboratory tests to more accurately reflect/characterise the mechanical properties (e.g. consolidation settlement) of the variable residual soils.
- In the case of larger structures, where deeper foundations/piling is required, it would be prudent to consider a series of exploratory drilling to determine whether core stones exist within the areas underlain by residual granite as these may present challenges for construction. Consolidation settlement is anticipated to guide the foundation design of larger structures.
- The site is characterised by a laterally discontinuous perched water table, which may be seasonally exacerbated. The perched groundwater table was intersected on-site at between 0.85 and 1.0 mbgl in trial pits TP14 and TP25, respectively; and at 1.4 mbgl in TP33. Excavations deeper than 1.0 mbgl will require battering to ensure safe working conditions. Excavation required should be undertaken during the summer, when rainfall is at a minimum, which provides for more favourable safe working conditions.
- Final designs should appropriately cater for aggressive and corrosive groundwater and/or soil conditions.

- Drainage precaution will be required on-site, this would entail diverting rainwater away from the perimeter walls of structures and paved areas (i.e. taxi areas and runway) to limit the ingress of moisture into the founding stratum and basecourse horizons.
- Preliminary modelling has been carried out to determine potential bearing capacities, using assumed loads and several foundation dimensions. Structure specific investigations and additional testing would be required to verify these results. The foundation solution that is to be adopted each structure on-site will depend on the cost and of implementation, and the risk associated with the said solution.
- Every effort has been made to ensure the accuracy of the information presented in this report. It must be stressed that naturally occurring materials are never uniform, and results of a field investigation only provide a limited view of the subsurface conditions. Considerable lateral and vertical variation can occur over short distances, and deviations from the presented results may be encountered on-site. Therefore, as a precautionary measure, potential geotechnical variations in the subsurface (i.e. inspection of excavation slopes, pile and founding conditions) should be inspected and approved by a suitably qualified professional.

7. ASSUMPTIONS AND LIMITATIONS

It should be noted that the results of the laboratory analyses presented in this report were undertaken on representative bulk disturbed samples, and therefore, some degree of variability may be encountered on-site. We have assumed that the laboratory results accurately reflect the in-situ conditions.

The results presented are based on trial pits excavated to depths of between 0.6 and 2.2 mbgl, this only provides information at discrete locations across the site, and interpolation was conducted across considerable distances. Geotechnical zones have been delineated using such interpolation, using trial pit, dynamic cone penetrometer and laboratory data; therefore, variation across/within the zone boundaries may be encountered on-site. Geotechnical Zone D was delineated based on two trial pits (TP17 and TP33), which have been interpreted to be transported sediments that had infilled a low-lying areas.

Due to the variability in soil conditions encountered on-site, the results contained in this report cannot be applied to all structures across the site. The settlement results presented reflect settlements expected during the construction period, more investigation should be undertaken prior to modelling of consolidation settlements. Little information is available for the design of the proposed structures, and therefore, the results presented in this report are of a preliminary nature. The results presented are subject to confirmation during site specific investigation and more detailed testing.

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9. APPENDIX A: TRIAL PIT PHOTOS

TP01	*TP02*
TP03	*TP04*

Figure 5: TP01 to TP04.

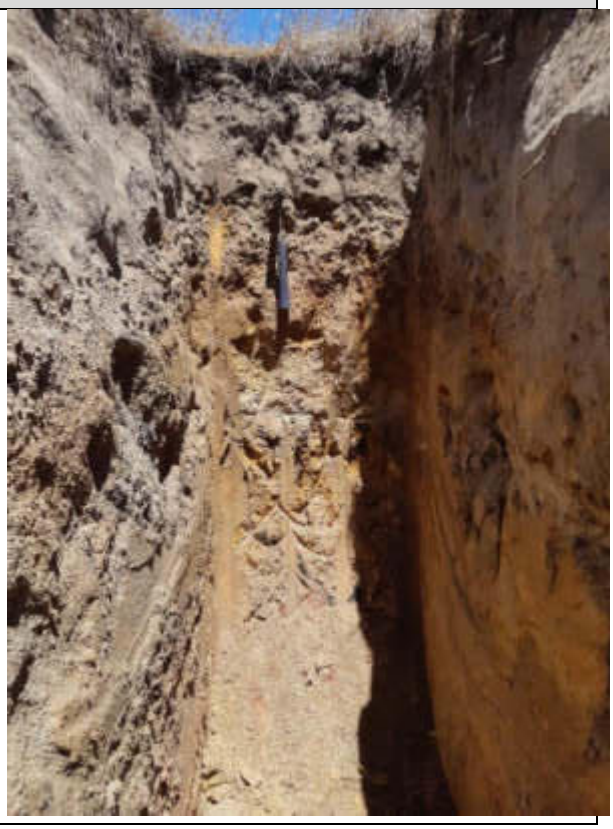
TP05	*TP06*
TP07	*TP08*
	

Figure 6: TP05 to TP08.

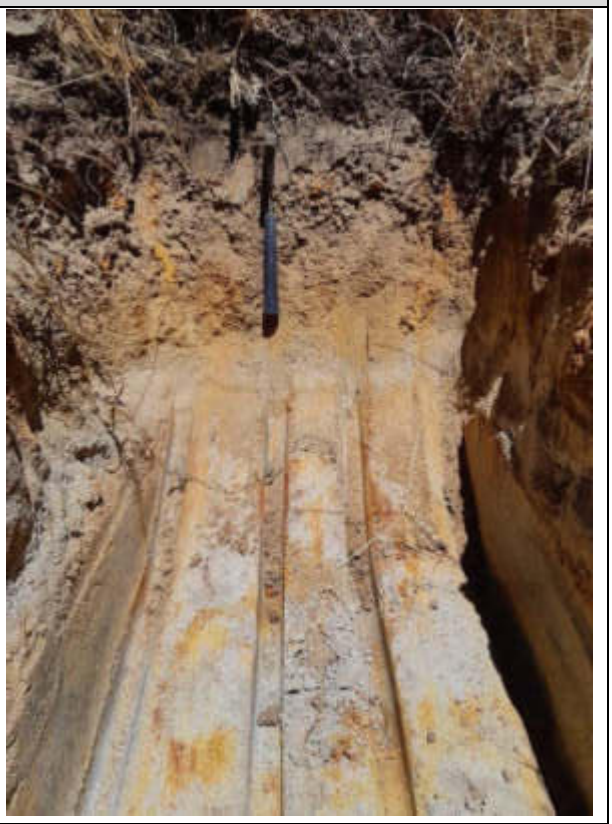
TP09	*TP10*
	
TP11	*TP12*

Figure 7: TP09 to TP12.

TP13	*TP14*
TP15	*TP16*

Figure 8: TP13 to TP16.

TP17	*TP18*
TP19	*TP20*

Figure 9: TP17 to TP20.

Figure 10: TP21 to TP24.

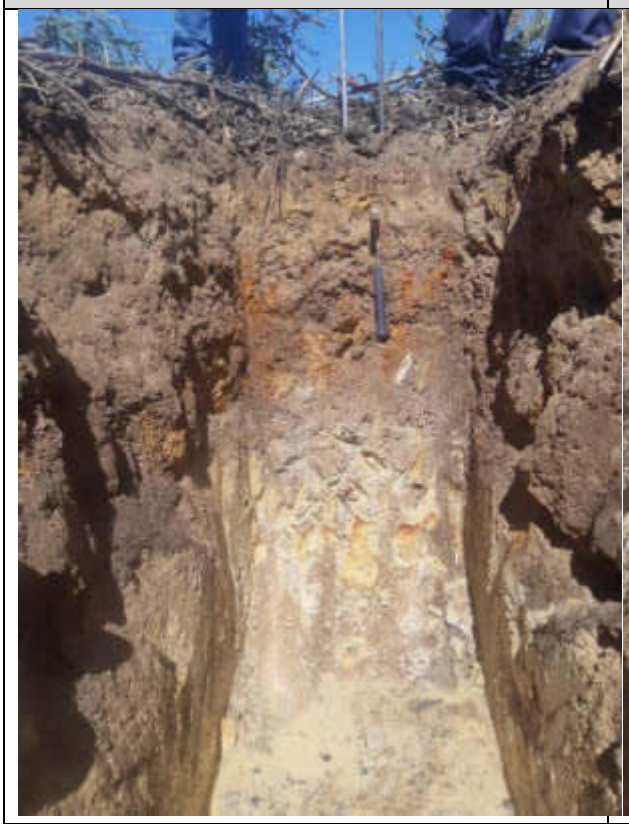
TP25	*TP26*
	
TP27	*TP28*

Figure 11: TP25 to TP28.

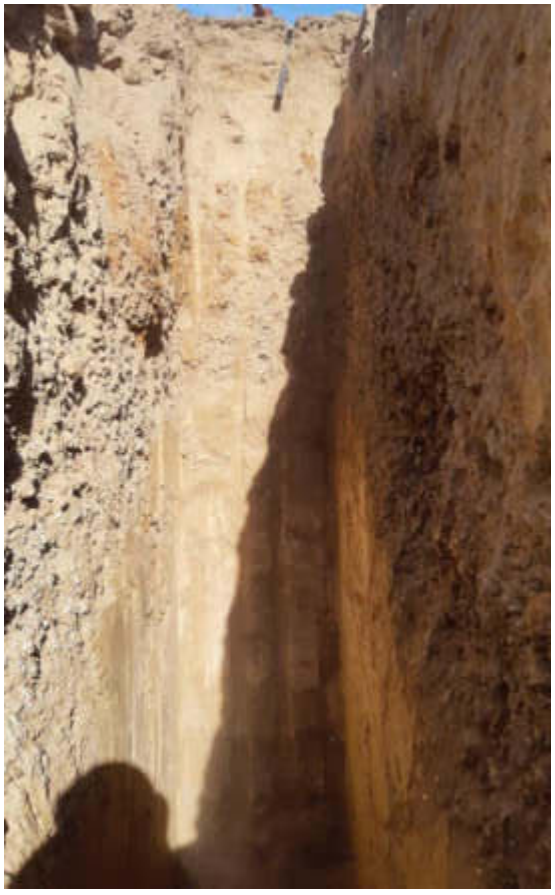
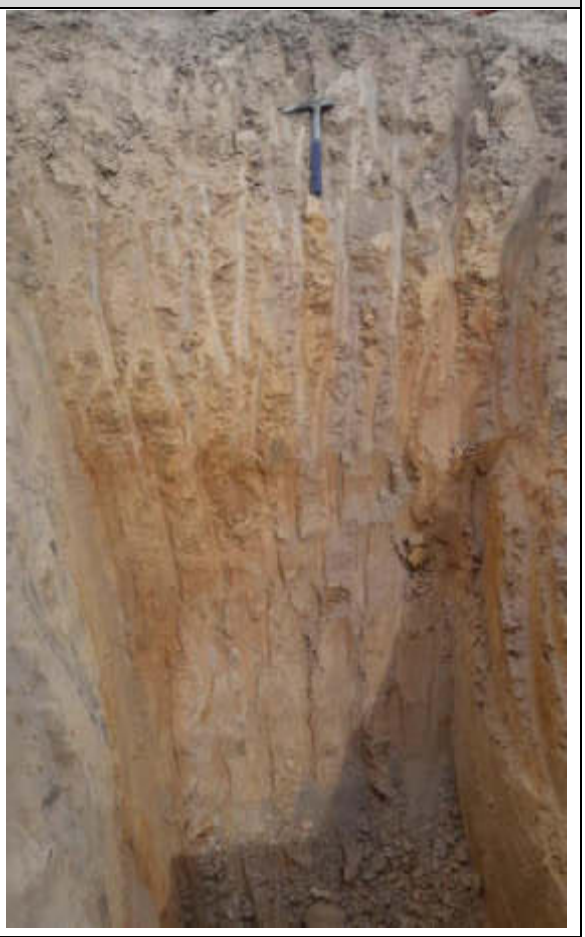
TP29	*TP30*
TP31	*TP32*
	

Figure 12: TP29 to TP32.

TP33	*TP34*
TP35	*TP36*

Figure 13: TP33 to TP36.

TP37	*TP38*
TP39	*TP40*

Figure 14: TP37 to TP40.

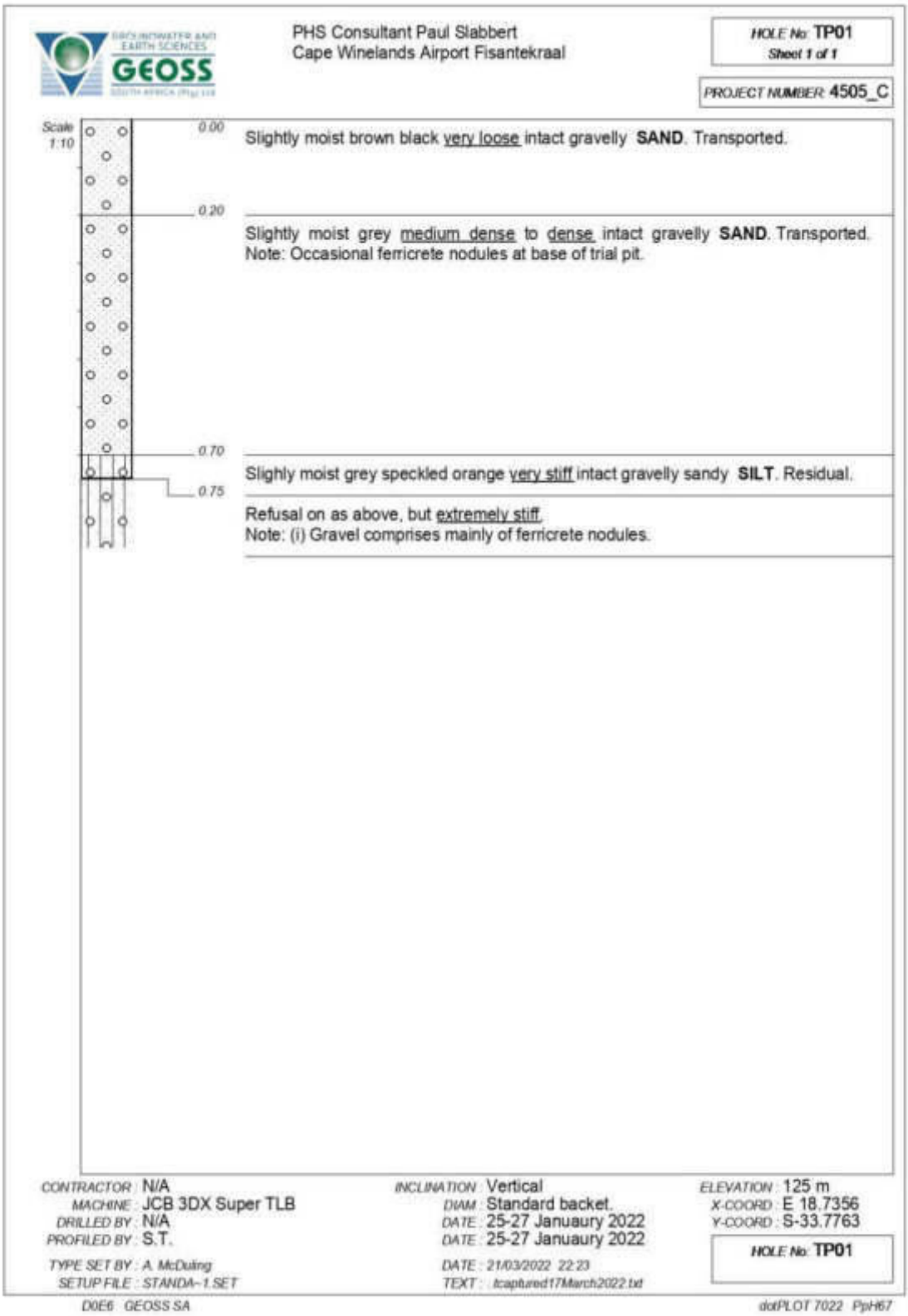
TP41	*TP42*
TP43	*TP44*

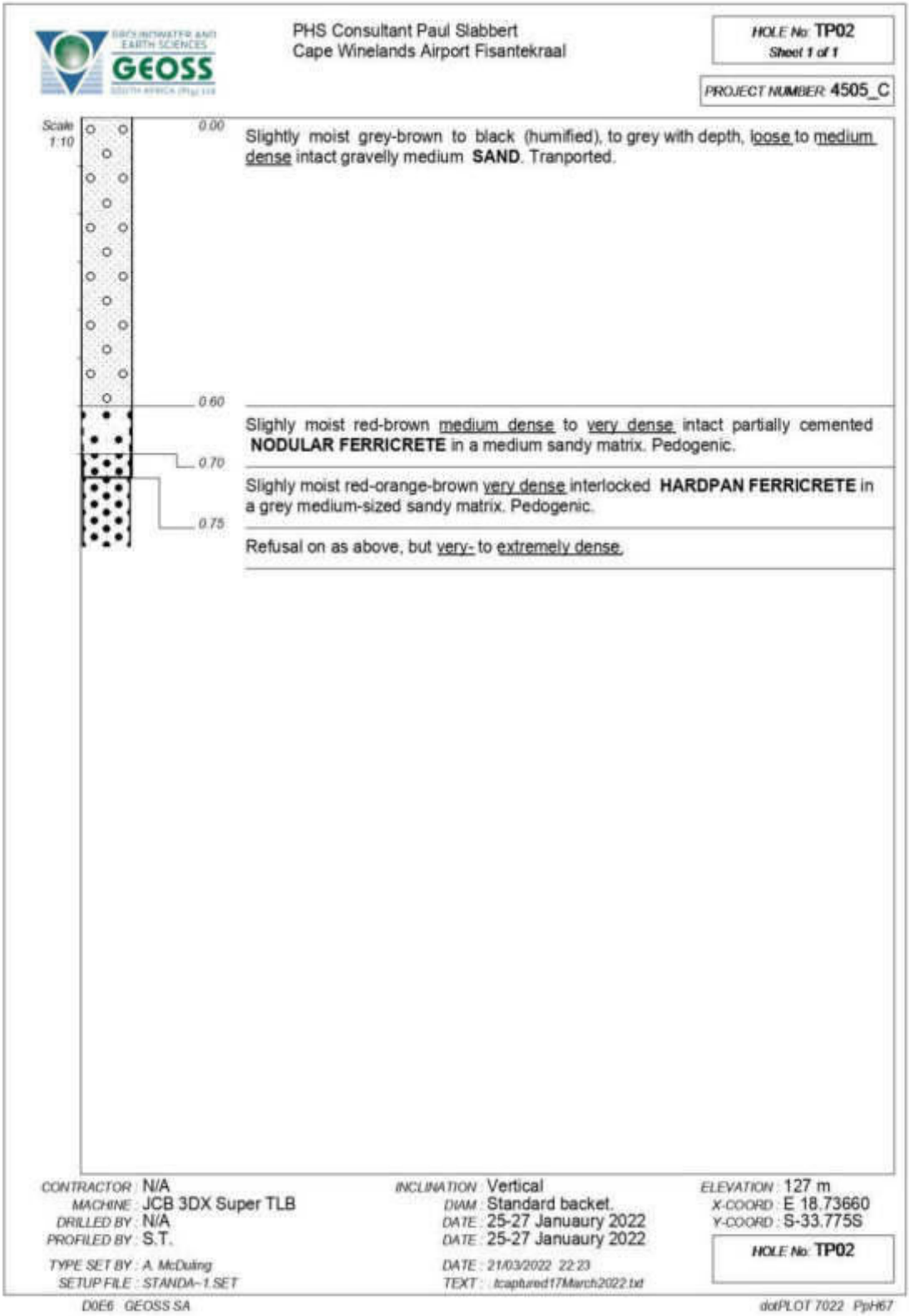
Figure 15: TP41 to TP44.

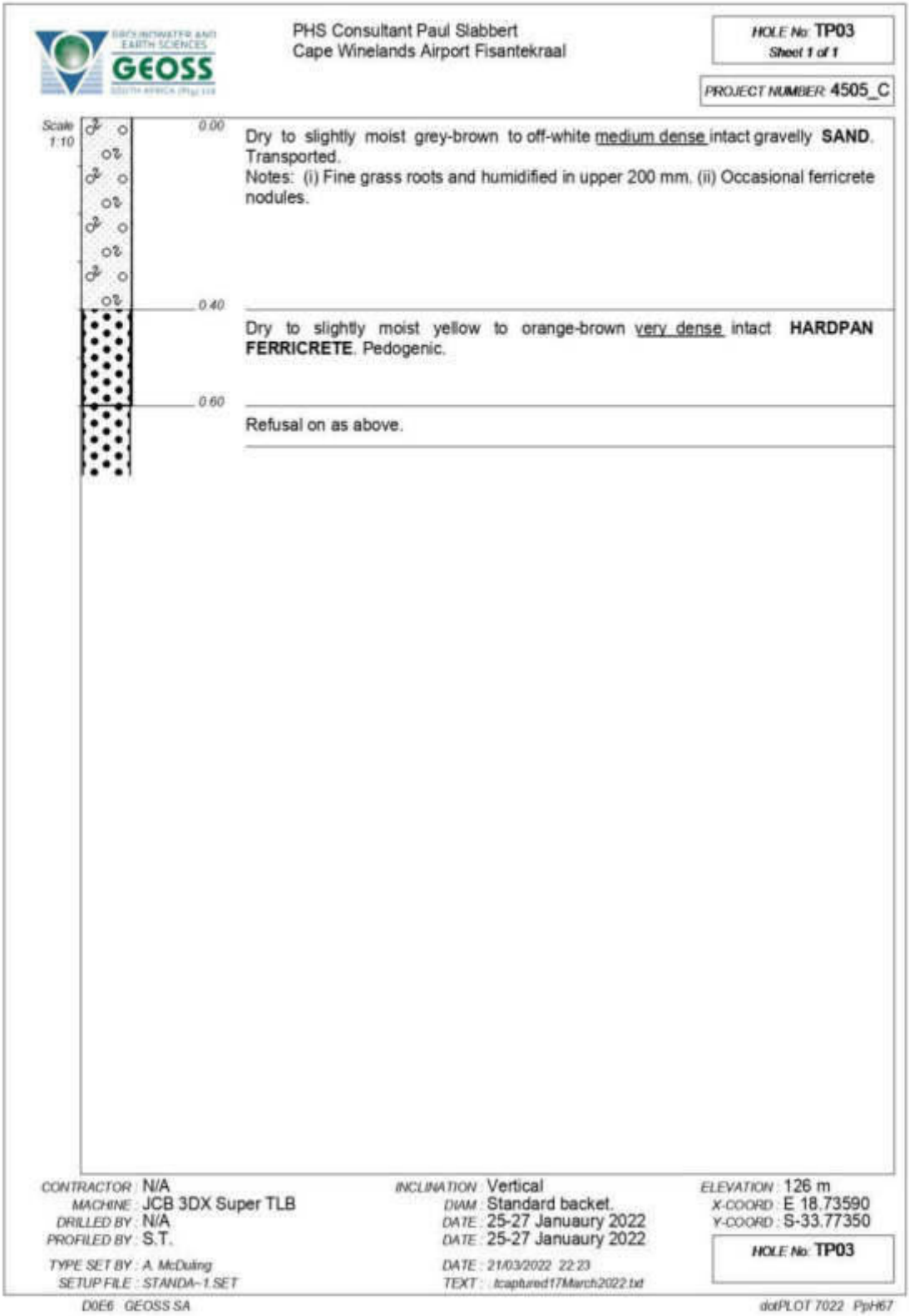
TP45	*TP46*
No Photo Available	

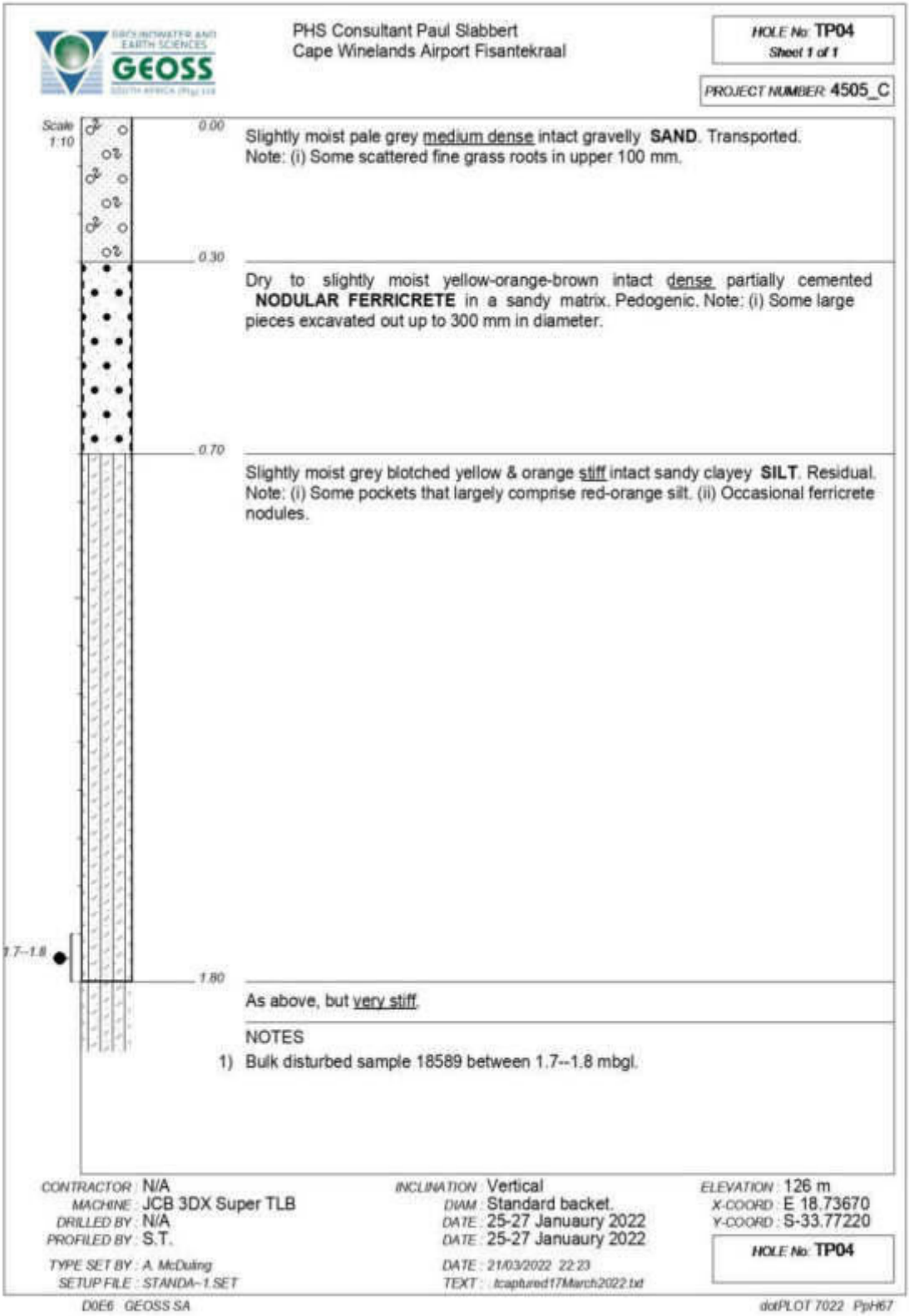
Figure 16: TP45 to TP46.

10. APPENDIX B: TRIAL PIT LOGS


GEOSS
PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP01
Sheet 1 of 1
PROJECT NUMBER: 4505_C
Scale 1:10
0.00
Slightly moist brown black very loose intact gravelly SAND. Transported.
0.20
Slightly moist grey medium dense to dense intact gravelly SAND. Transported.
Note: Occasional ferricrete nodules at base of trial pit.
0.70
Slighly moist grey speckled orange very stiff intact gravelly sandy SILT. Residual.
0.75
Refusal on as above, but extremely stiff.
Note: (i) Gravel comprises mainly of ferricrete nodules.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 21/03/2022 22:23
TEXT : tcaptured17March2022.txt
ELEVATION : 125 m
X-COORD : E 18.7356
Y-COORD : S-33.7763
HOLE No: TP01
D0E6 GEOSS SA
dotPLOT 7022 PpH67


GEOSS
PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP02
Sheet 1 of 1
PROJECT NUMBER: 4505_C
Scale 1:10
0.00
Slightly moist grey-brown to black (humified), to grey with depth, loose to medium dense intact gravelly medium SAND. Tranported.
0.60
Slighly moist red-brown medium dense to very dense intact partially cemented NODULAR FERRICRETE in a medium sandy matrix. Pedogenic.
0.70
Slighly moist red-orange-brown very dense interlocked HARDPAN FERRICRETE in a grey medium-sized sandy matrix. Pedogenic.
0.75
Refusal on as above, but very- to extremely dense.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 21/03/2022 22:23
TEXT : tcaptured17March2022.txt
ELEVATION : 127 m
X-COORD : E 18.73660
Y-COORD : S-33.775S
HOLE No: TP02
D0E6 GEOSS SA
dotPLOT 7022 PpH67

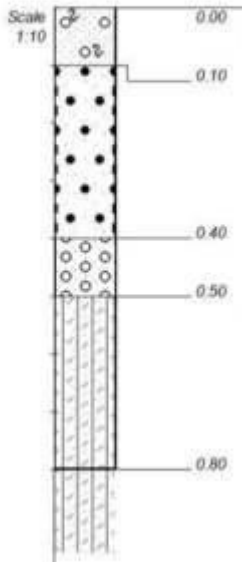

GEOSS
PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP03
Sheet 1 of 1
PROJECT NUMBER: 4505_C
Scale 1:10
0.00
Dry to slightly moist grey-brown to off-white medium dense intact gravelly SAND. Transported.
Notes: (i) Fine grass roots and humidified in upper 200 mm. (ii) Occasional ferricrete nodules.
0.40
Dry to slightly moist yellow to orange-brown very dense intact HARDPAN FERRICRETE. Pedogenic.
0.60
Refusal on as above.
CONTRACTOR: N/A
MACHINE: JCB 3DX Super TLB
DRILLED BY: N/A
PROFILED BY: S.T.
TYPE SET BY: A. McDuling
SETUP FILE: STANDA~1.SET
INCLINATION: Vertical
DIAM: Standard backet.
DATE: 25-27 Januaury 2022
DATE: 25-27 Januaury 2022
DATE: 21/03/2022 22:23
TEXT: tcaptured17March2022.txt
ELEVATION: 126 m
X-COORD: E 18.73590
Y-COORD: S-33.77350
HOLE No: TP03
D0E6 GEOSS SA
dotPLOT 7022 PpH67


GEOSS
PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP04
Sheet 1 of 1
PROJECT NUMBER: 4505_C
Scale 1:10
0.00
Slightly moist pale grey medium dense intact gravelly SAND. Transported.
Note: (i) Some scattered fine grass roots in upper 100 mm.
0.30
Dry to slightly moist yellow-orange-brown intact dense partially cemented NODULAR FERRICRETE in a sandy matrix. Pedogenic. Note: (i) Some large pieces excavated out up to 300 mm in diameter.
0.70
Slightly moist grey blotched yellow & orange stiff intact sandy clayey SILT. Residual.
Note: (i) Some pockets that largely comprise red-orange silt. (ii) Occasional ferricrete nodules.
1.7--1.8
1.80
As above, but very stiff.
NOTES
1) Bulk disturbed sample 18589 between 1.7--1.8 mbgl.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 21/03/2022 22:23
TEXT : tcaptured17March2022.txt
ELEVATION : 126 m
X-COORD : E 18.73670
Y-COORD : S-33.77220
HOLE No: TP04
D0E6 GEOSS SA
dotPLOT 7022 PpH67

PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal

HOLE No: TP05
Sheet 1 of 1

PROJECT NUMBER: 4505_C



0.00 – 0.10: Slightly moist grey-brown loose to medium dense intact gravelly **SAND**. Transported. Note: (i) Fine grass roots & humified in upper 100 mm.

0.10 – 0.40: Slightly moist grey loose to medium dense intact partially cemented **NODULAR FERRICRETE** in a sandy matrix. Pedogenic. Notes: (i) Undlose contact. (ii) Laterally discontinuous. (iii) Ant nest encountered at base of layer.

0.40 – 0.50: Slightly moist grey loose pinholed sandy fine **GRAVEL**. Transported.

0.50 – 0.80: Slighlty moist grey intact stiff sandy clayey **SILT**. Residual.

0.80 – : As above, but very- to extremely stiff.

CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET

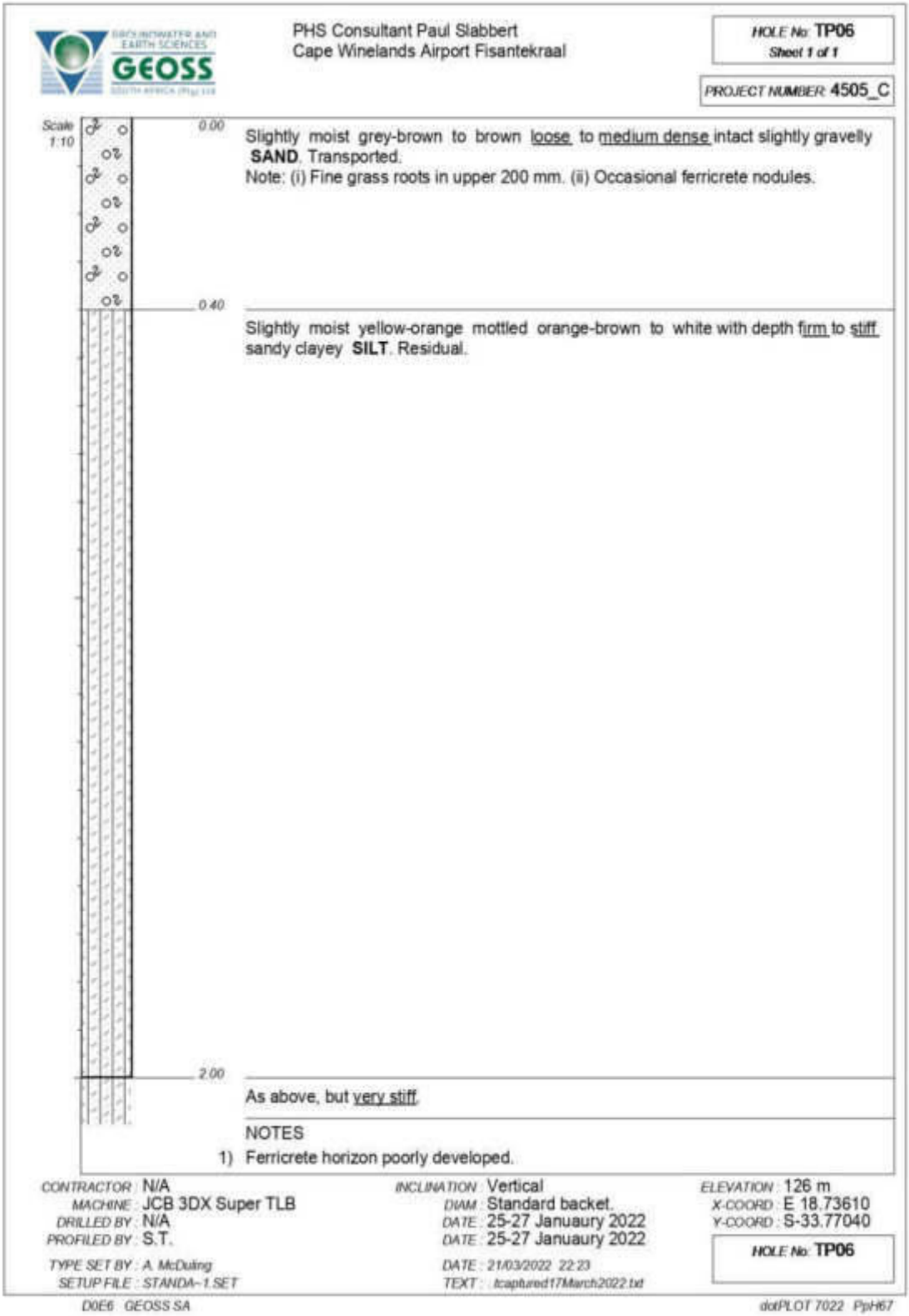
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 21/03/2022 22:23
TEXT : tcaptured17March2022.txt

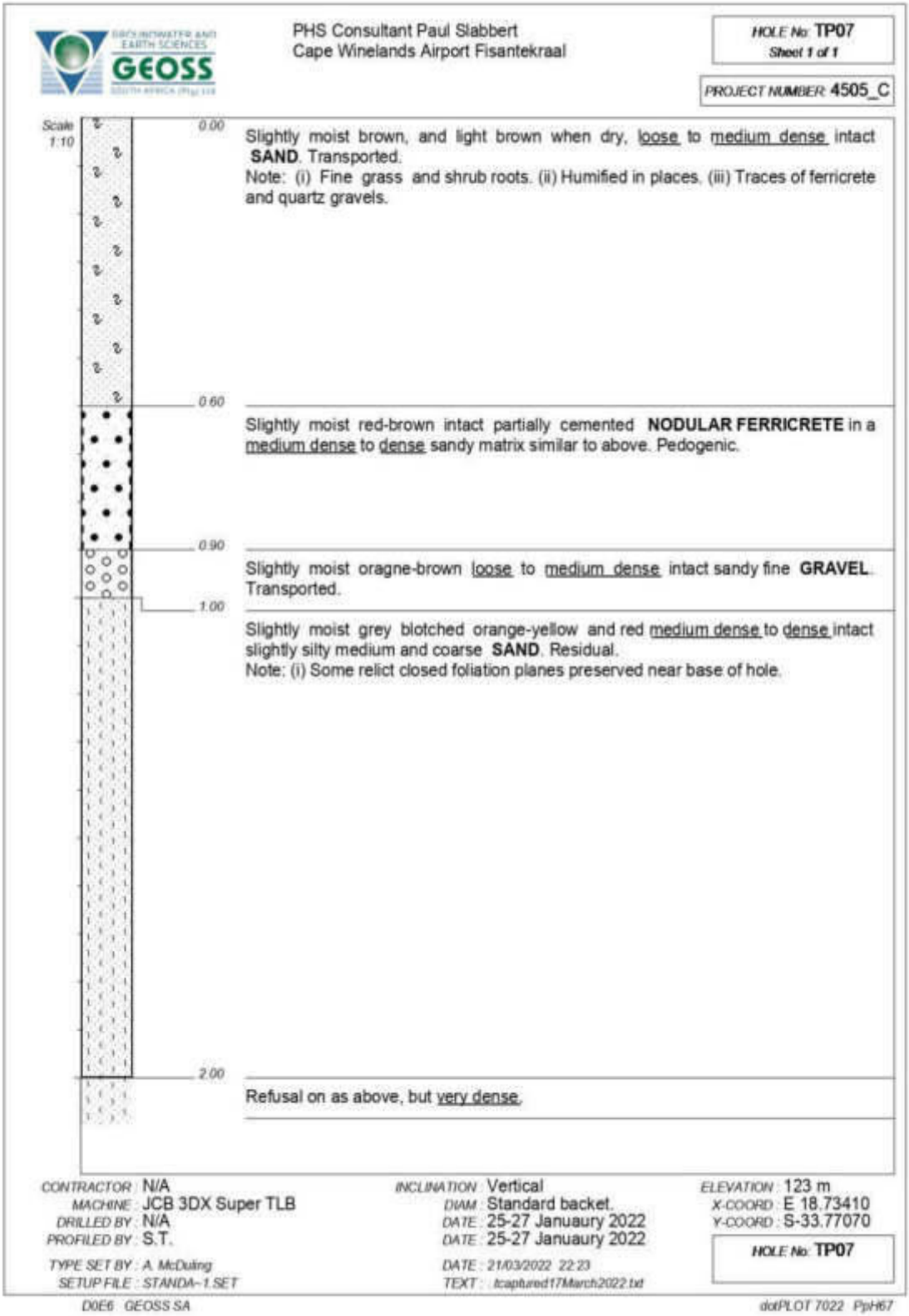
ELEVATION : 126 m
X-COORD : E 18.73800
Y-COORD : S-33.77120

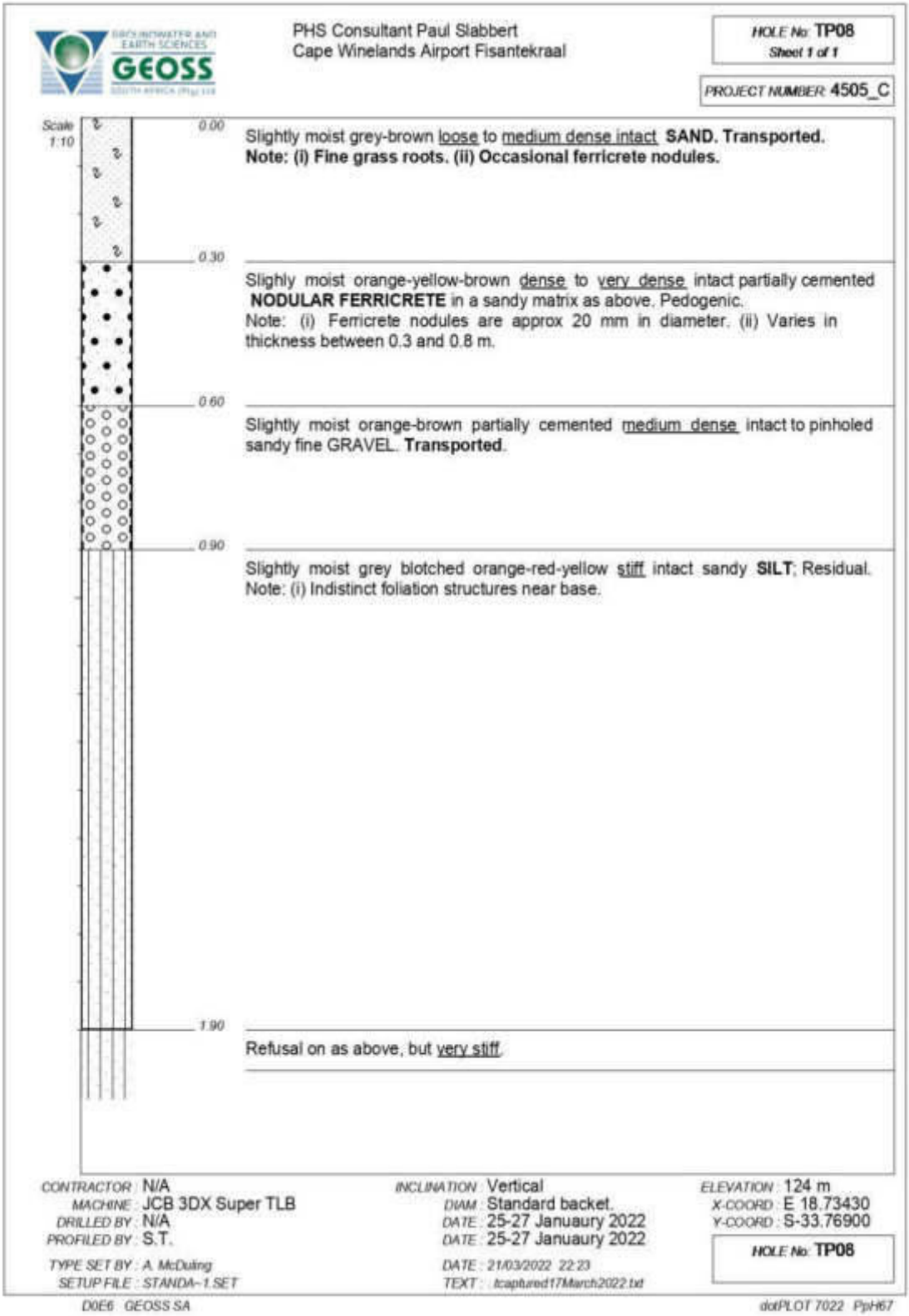
HOLE No: TP05

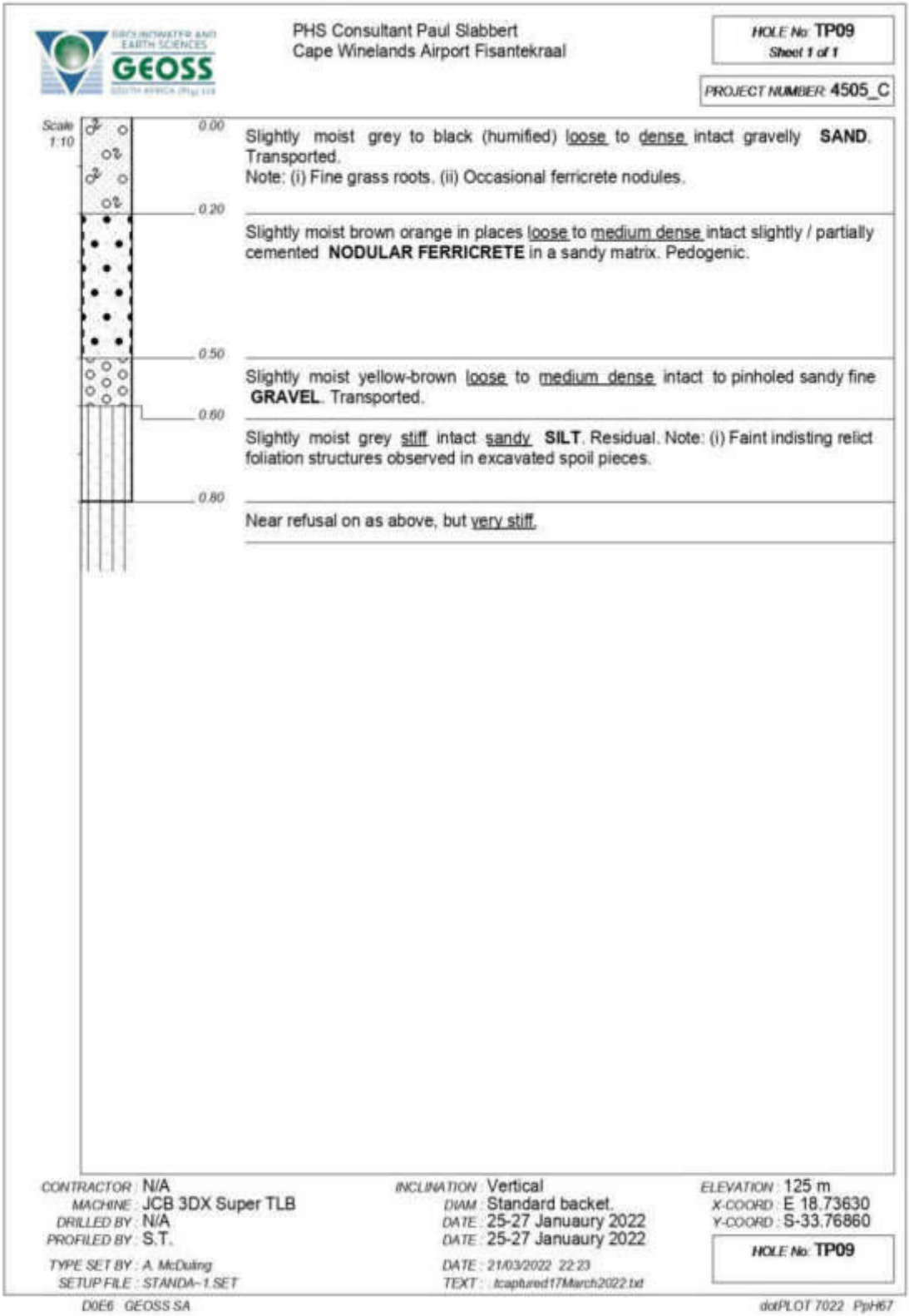
D0E6 GEOSS SA

dotPLOT 7022 PpH67


GEOSS
PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP06
Sheet 1 of 1
PROJECT NUMBER: 4505_C
Scale 1:10
0.00
Slightly moist grey-brown to brown loose to medium dense intact slightly gravelly SAND. Transported.
Note: (i) Fine grass roots in upper 200 mm. (ii) Occasional ferricrete nodules.
0.40
Slightly moist yellow-orange mottled orange-brown to white with depth firm to stiff sandy clayey SILT. Residual.
2.00
As above, but very stiff.
NOTES
1) Ferricrete horizon poorly developed.
CONTRACTOR: N/A
MACHINE: JCB 3DX Super TLB
DRILLED BY: N/A
PROFILED BY: S.T.
TYPE SET BY: A. McDuling
SETUP FILE: STANDA~1.SET
INCLINATION: Vertical
DIAM: Standard backet.
DATE: 25-27 Januaury 2022
DATE: 25-27 Januaury 2022
DATE: 21/03/2022 22:23
TEXT: tcaptured17March2022.txt
ELEVATION: 126 m
X-COORD: E 18.73610
Y-COORD: S-33.77040
HOLE No: TP06
D0E6 GEOSS SA
dotPLOT 7022 PpH67


GEOSS
PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP07
Sheet 1 of 1
PROJECT NUMBER: 4505_C
Scale 1:10
0.00
Slightly moist brown, and light brown when dry, loose to medium dense intact SAND. Transported.
Note: (i) Fine grass and shrub roots. (ii) Humified in places. (iii) Traces of ferricrete and quartz gravels.
0.60
Slightly moist red-brown intact partially cemented NODULAR FERRICRETE in a medium dense to dense sandy matrix similar to above. Pedogenic.
0.90
Slightly moist oragne-brown loose to medium dense intact sandy fine GRAVEL. Transported.
1.00
Slightly moist grey blotched orange-yellow and red medium dense to dense intact slightly silty medium and coarse SAND. Residual.
Note: (i) Some relict closed foliation planes preserved near base of hole.
2.00
Refusal on as above, but very dense.
CONTRACTOR: N/A
MACHINE: JCB 3DX Super TLB
DRILLED BY: N/A
PROFILED BY: S.T.
TYPE SET BY: A. McDuling
SETUP FILE: STANDA~1.SET
INCLINATION: Vertical
DIAM: Standard backet.
DATE: 25-27 Januaury 2022
DATE: 25-27 Januaury 2022
DATE: 21/03/2022 22:23
TEXT: tcaptured17March2022.txt
ELEVATION: 123 m
X-COORD: E 18.73410
Y-COORD: S-33.77070
HOLE No: TP07
D0E6 GEOSS SA
dotPLOT 7022 PpH67

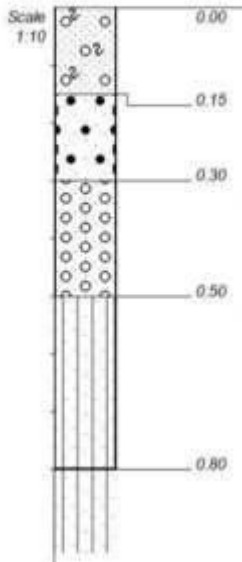

GEOSS
PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP08
Sheet 1 of 1
PROJECT NUMBER: 4505_C
Scale 1:10
0.00
Slightly moist grey-brown loose to medium dense intact SAND. Transported.
Note: (i) Fine grass roots. (ii) Occasional ferricrete nodules.
0.30
Slighly moist orange-yellow-brown dense to very dense intact partially cemented NODULAR FERRICRETE in a sandy matrix as above. Pedogenic.
Note: (i) Ferricrete nodules are approx 20 mm in diameter. (ii) Varies in thickness between 0.3 and 0.8 m.
0.60
Slightly moist orange-brown partially cemented medium dense intact to pinholed sandy fine GRAVEL. Transported.
0.90
Slightly moist grey blotched orange-red-yellow stiff intact sandy SILT; Residual.
Note: (i) Indistinct foliation structures near base.
1.90
Refusal on as above, but very stiff.
CONTRACTOR: N/A
MACHINE: JCB 3DX Super TLB
DRILLED BY: N/A
PROFILED BY: S.T.
TYPE SET BY: A. McDuling
SETUP FILE: STANDA~1.SET
INCLINATION: Vertical
DIAM: Standard backet.
DATE: 25-27 Januaury 2022
DATE: 25-27 Januaury 2022
DATE: 21/03/2022 22:23
TEXT: tcaptured17March2022.txt
ELEVATION: 124 m
X-COORD: E 18.73430
Y-COORD: S-33.76900
HOLE No: TP08
D0E6 GEOSS SA
dotPLOT 7022 PpH67


GEOSS
PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP09
Sheet 1 of 1
PROJECT NUMBER: 4505_C
Scale 1:10
0.00
Slightly moist grey to black (humified) loose to dense intact gravelly SAND. Transported.
Note: (i) Fine grass roots. (ii) Occasional ferricrete nodules.
0.20
Slightly moist brown orange in places loose to medium dense intact slightly / partially cemented NODULAR FERRICRETE in a sandy matrix. Pedogenic.
0.50
Slightly moist yellow-brown loose to medium dense intact to pinholed sandy fine GRAVEL. Transported.
0.60
Slightly moist grey stiff intact sandy SILT. Residual. Note: (i) Faint indisting relict foliation structures observed in excavated spoil pieces.
0.80
Near refusal on as above, but very stiff.
CONTRACTOR: N/A
MACHINE: JCB 3DX Super TLB
DRILLED BY: N/A
PROFILED BY: S.T.
TYPE SET BY: A. McDuling
SETUP FILE: STANDA~1.SET
INCLINATION: Vertical
DIAM: Standard backet.
DATE: 25-27 Januaury 2022
DATE: 25-27 Januaury 2022
DATE: 21/03/2022 22:23
TEXT: tcaptured17March2022.txt
ELEVATION: 125 m
X-COORD: E 18.73630
Y-COORD: S-33.76860
HOLE No: TP09
D0E6 GEOSS SA
dotPLOT 7022 PpH67

PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal

HOLE No: TP10
Sheet 1 of 1

PROJECT NUMBER: 4505_C



0.00 – 0.15: Dry to slightly moist grey blotched black (humified) loose intact gravelly **SAND**. Transported.
Note: (i) Fine grass roots throughout. (ii) Occasional ferricrete nodules.

0.15 – 0.30: Slightly moist orange-brown and red partially cemented dense **NODULAR FERRICRETE** in a medium sandy matrix. Pedogenic.

0.30 – 0.50: Slightly moist grey-orange-brown intact to slightly pinholed medium dense sandy fine **GRAVEL**. Transported.

0.50 – 0.80: Slighly moist grey stiff intact sandy **SILT**. Residual.

0.80 +: As above, but very stiff.

CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET

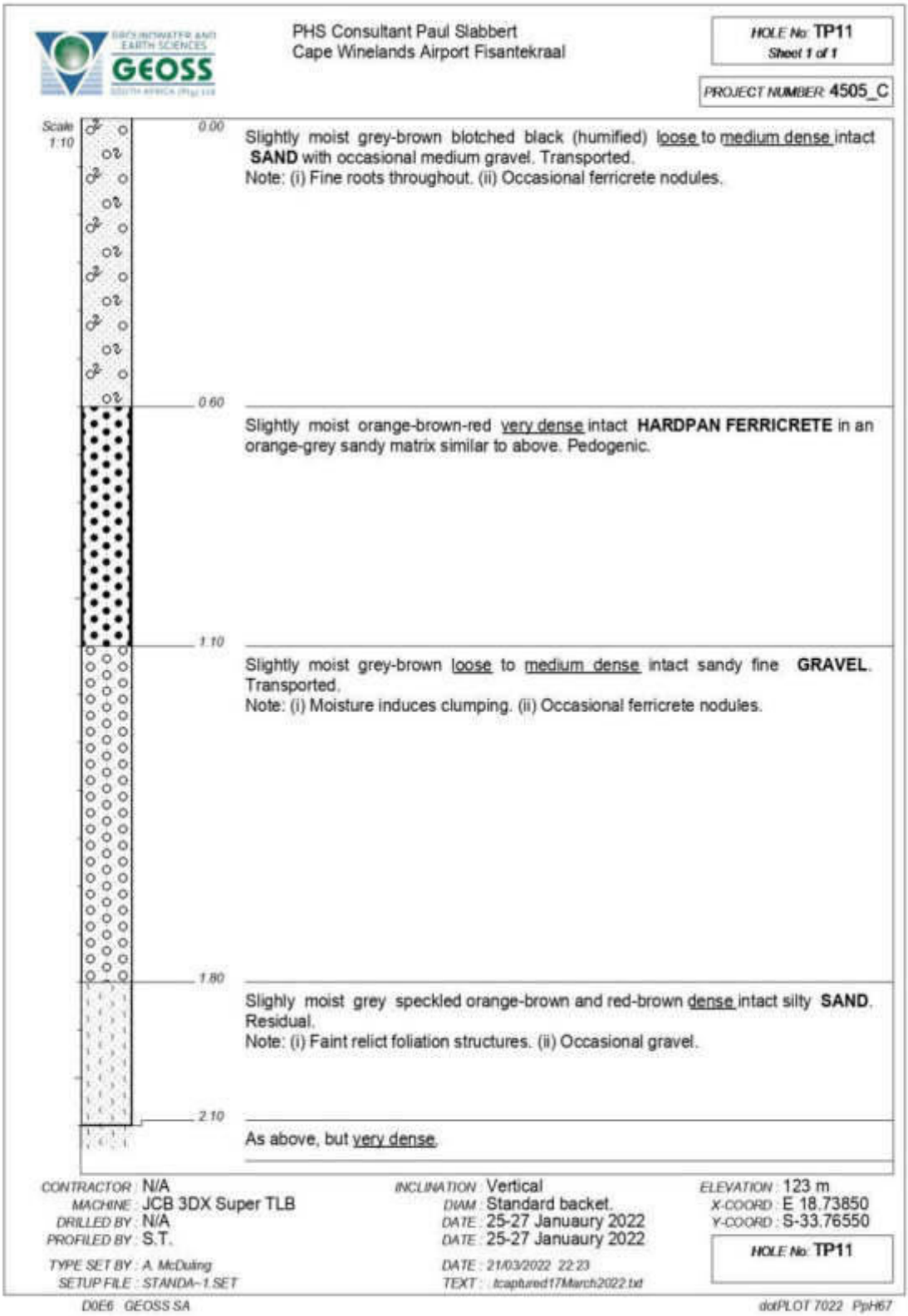
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 21/03/2022 22:23
TEXT : tcaptured17March2022.txt

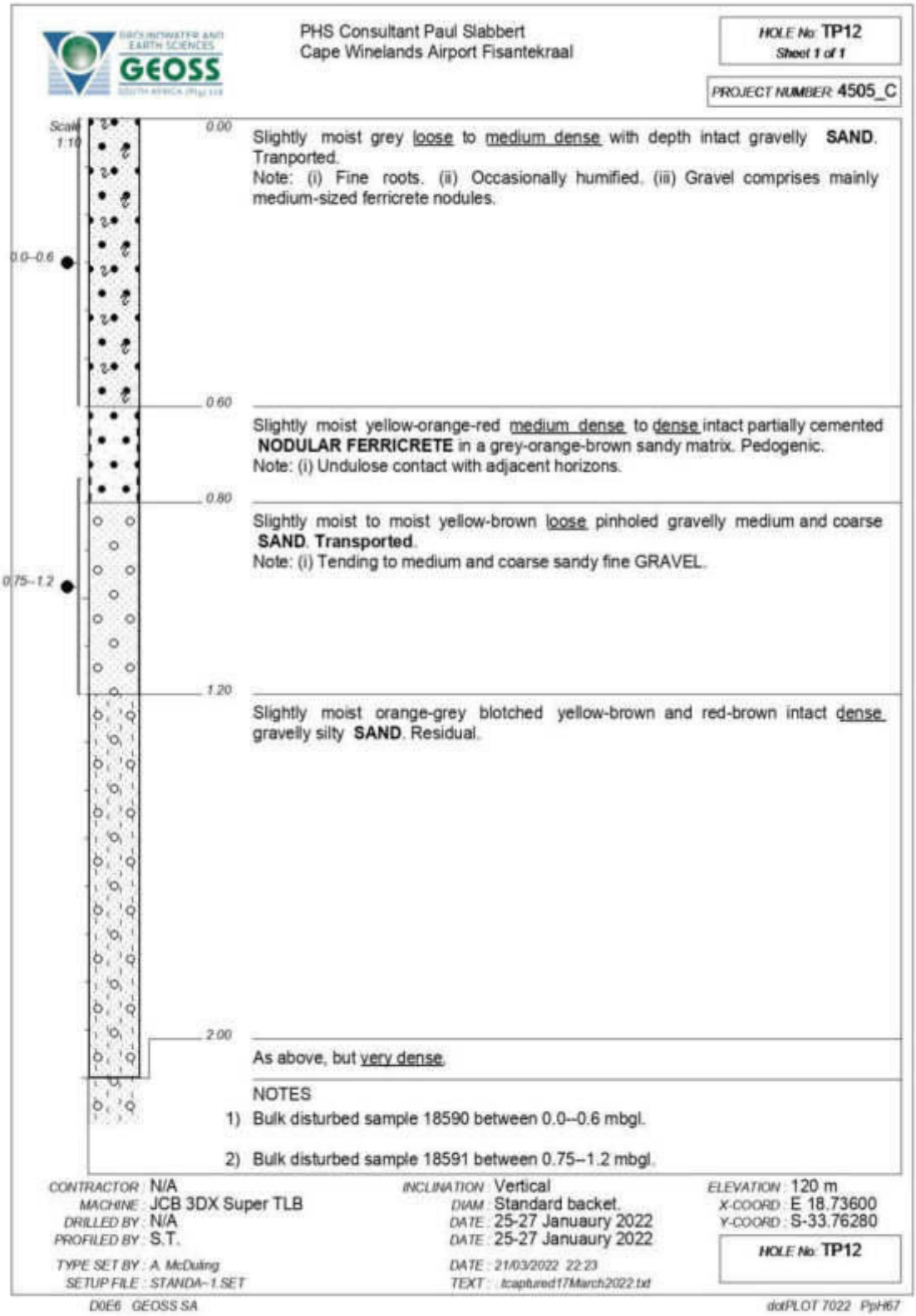
ELEVATION : 124 m
X-COORD : E 18.73810
Y-COORD : S-33.76850

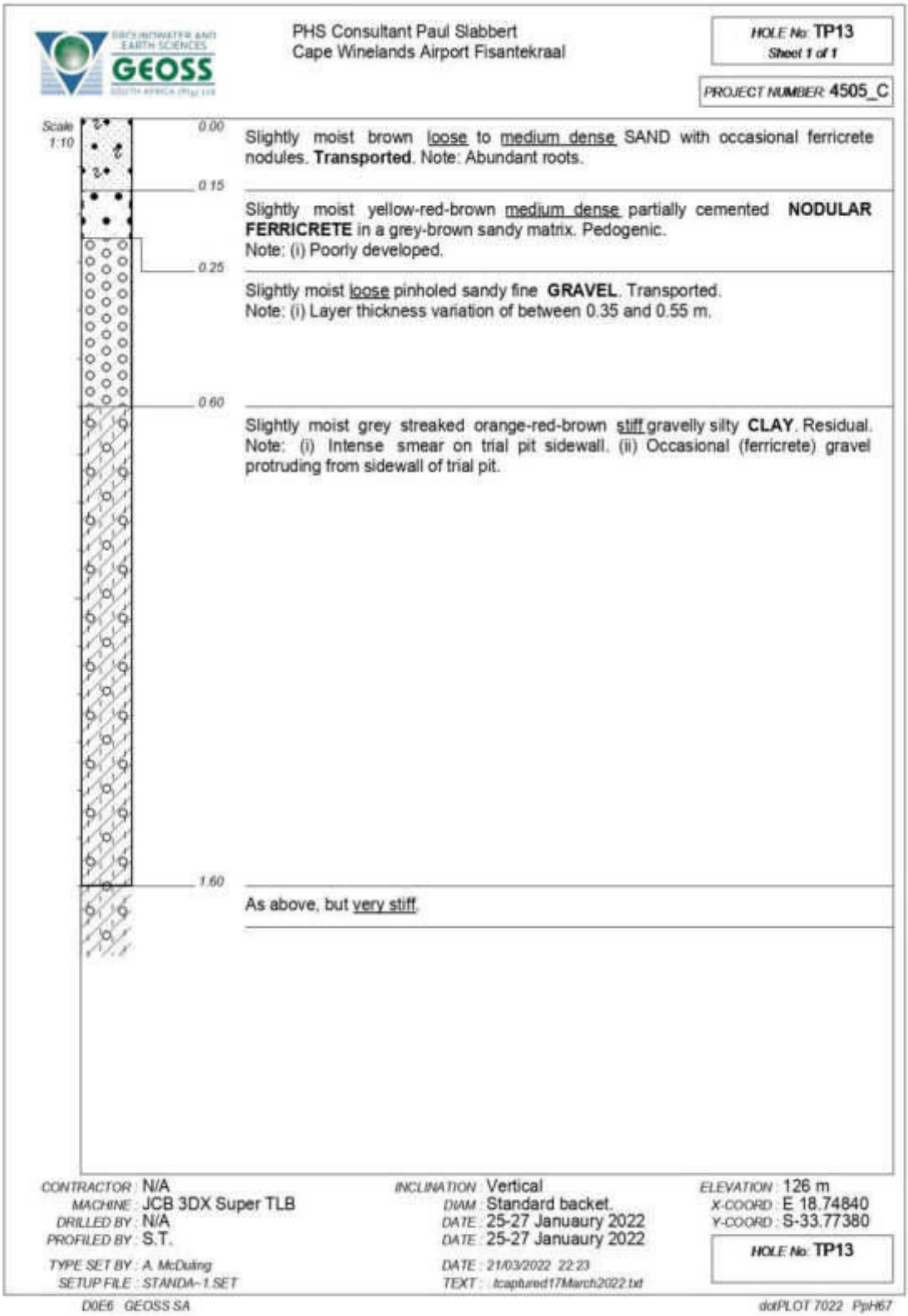
HOLE No: TP10

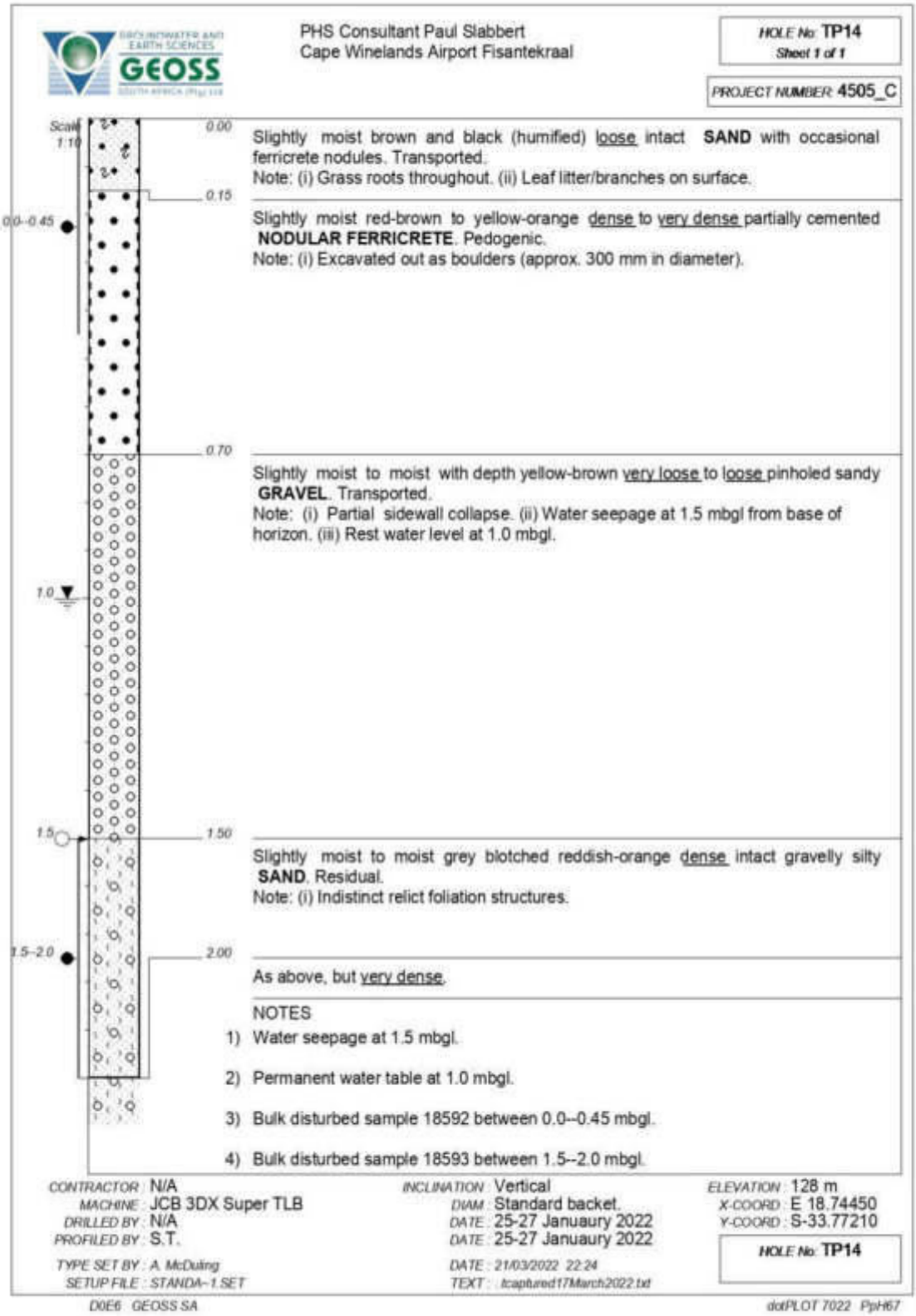
D0E6 GEOSS SA

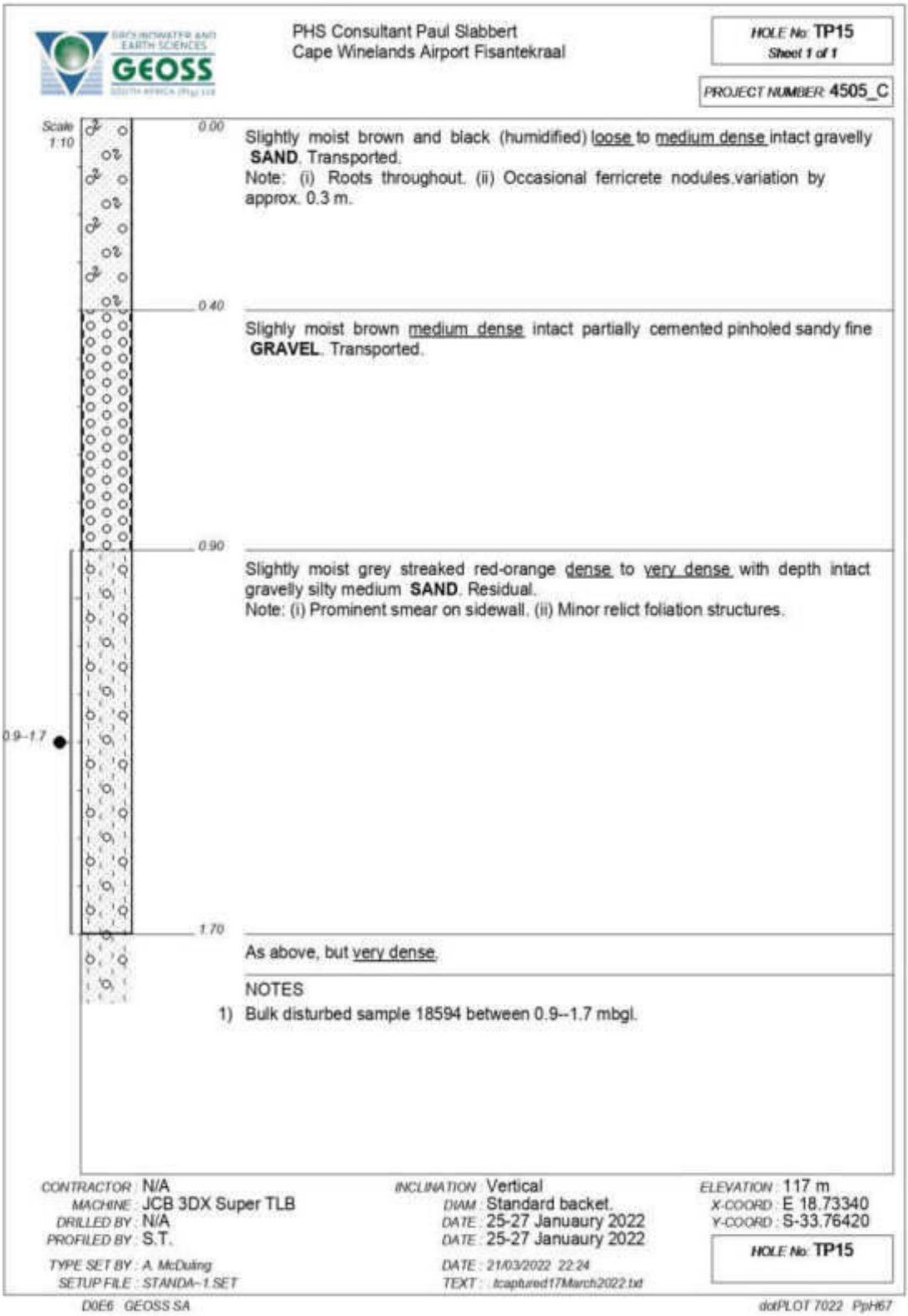
dotPLOT 7022 PpH67

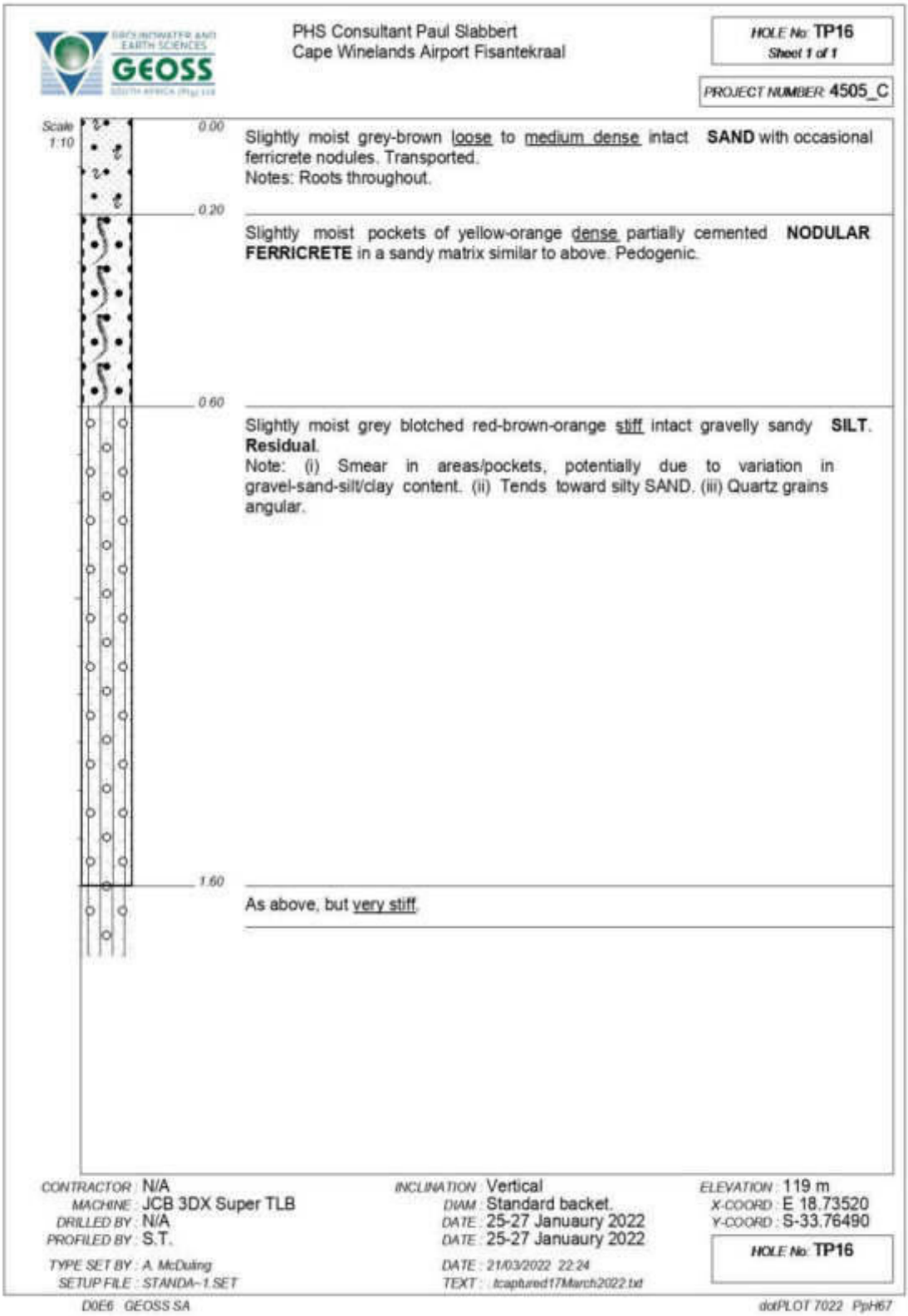

GEOSS
PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP11
Sheet 1 of 1
PROJECT NUMBER: 4505_C
Scale 1:10
0.00
Slightly moist grey-brown blotched black (humified) loose to medium dense intact SAND with occasional medium gravel. Transported.
Note: (i) Fine roots throughout. (ii) Occasional ferricrete nodules.
0.60
Slightly moist orange-brown-red very dense intact HARDPAN FERRICRETE in an orange-grey sandy matrix similar to above. Pedogenic.
1.10
Slightly moist grey-brown loose to medium dense intact sandy fine GRAVEL. Transported.
Note: (i) Moisture induces clumping. (ii) Occasional ferricrete nodules.
1.80
Slighly moist grey speckled orange-brown and red-brown dense intact silty SAND. Residual.
Note: (i) Faint relict foliation structures. (ii) Occasional gravel.
2.10
As above, but very dense.
CONTRACTOR: N/A
MACHINE: JCB 3DX Super TLB
DRILLED BY: N/A
PROFILED BY: S.T.
TYPE SET BY: A. McDuling
SETUP FILE: STANDA~1.SET
INCLINATION: Vertical
DIAM: Standard backet.
DATE: 25-27 Januaury 2022
DATE: 25-27 Januaury 2022
DATE: 21/03/2022 22:23
TEXT: tcaptured17March2022.txt
ELEVATION: 123 m
X-COORD: E 18.73850
Y-COORD: S-33.76550
HOLE No: TP11
D0E6 GEOSS SA
dotPLOT 7022 PpH67

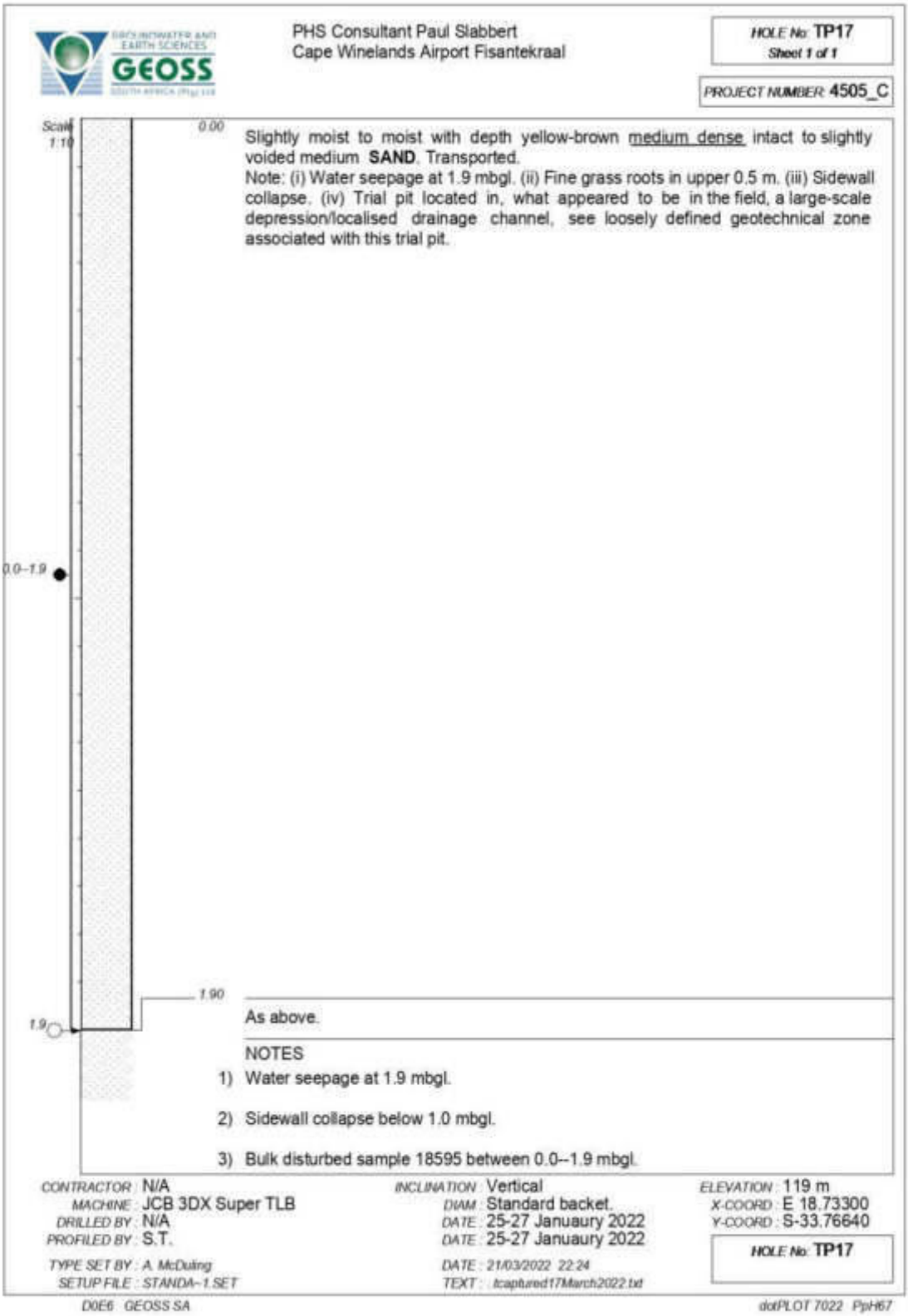

PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP12
Sheet 1 of 1
PROJECT NUMBER: 4505_C
Scale 1:10
0.00
Slightly moist grey loose to medium dense with depth intact gravelly SAND. Tranported.
Note: (i) Fine roots. (ii) Occasionally humified. (iii) Gravel comprises mainly medium-sized ferricrete nodules.
0.0--0.6
0.60
Slightly moist yellow-orange-red medium dense to dense intact partially cemented NODULAR FERRICRETE in a grey-orange-brown sandy matrix. Pedogenic.
Note: (i) Undulose contact with adjacent horizons.
0.80
Slightly moist to moist yellow-brown loose pinholed gravelly medium and coarse SAND. Transported.
Note: (i) Tending to medium and coarse sandy fine GRAVEL.
0.75--1.2
1.20
Slightly moist orange-grey blotched yellow-brown and red-brown intact dense gravelly silty SAND. Residual.
2.00
As above, but very dense.
NOTES
1) Bulk disturbed sample 18590 between 0.0--0.6 mbgl.
2) Bulk disturbed sample 18591 between 0.75--1.2 mbgl.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 21/03/2022 22:23
TEXT : tcaptured17March2022.txt
ELEVATION : 120 m
X-COORD : E 18.73600
Y-COORD : S-33.76280
HOLE No: TP12
D0E6 GEOSS SA
dotPLOT 7022 PpH67

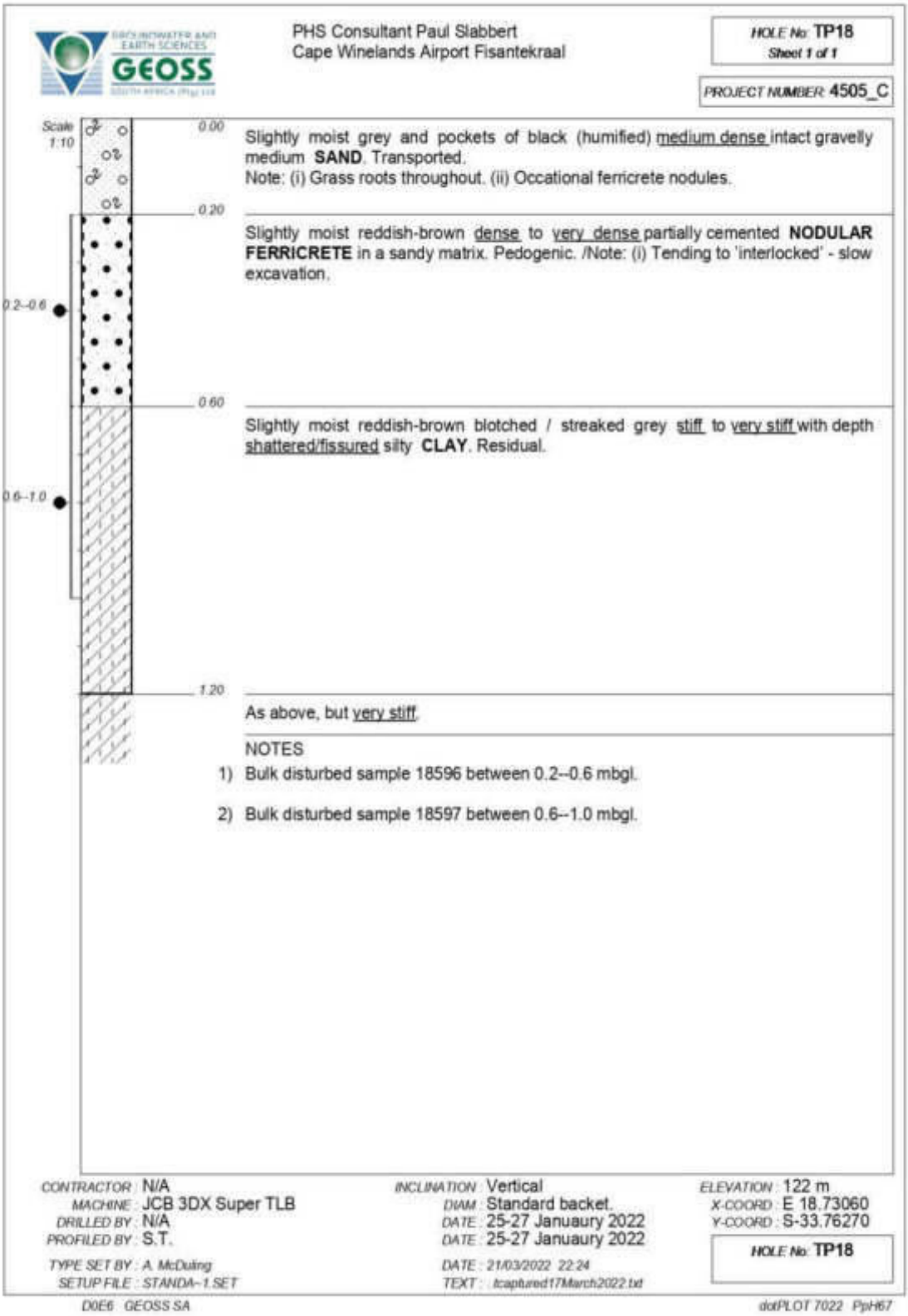

PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP13
Sheet 1 of 1
PROJECT NUMBER: 4505_C
Scale 1:10
0.00
Slightly moist brown loose to medium dense SAND with occasional ferricrete nodules. Transported. Note: Abundant roots.
0.15
Slightly moist yellow-red-brown medium dense partially cemented NODULAR FERRICRETE in a grey-brown sandy matrix. Pedogenic.
Note: (i) Poorly developed.
0.25
Slightly moist loose pinholed sandy fine GRAVEL. Transported.
Note: (i) Layer thickness variation of between 0.35 and 0.55 m.
0.60
Slightly moist grey streaked orange-red-brown stiff gravelly silty CLAY. Residual.
Note: (i) Intense smear on trial pit sidewall. (ii) Occasional (ferricrete) gravel protruding from sidewall of trial pit.
1.60
As above, but very stiff.
CONTRACTOR: N/A
MACHINE: JCB 3DX Super TLB
DRILLED BY: N/A
PROFILED BY: S.T.
TYPE SET BY: A. McDuling
SETUP FILE: STANDA~1.SET
INCLINATION: Vertical
DIAM: Standard backet.
DATE: 25-27 Januaury 2022
DATE: 25-27 Januaury 2022
DATE: 21/03/2022 22:23
TEXT: tcaptured17March2022.txt
ELEVATION: 126 m
X-COORD: E 18.74840
Y-COORD: S-33.77380
HOLE No: TP13
D0E6 GEOSS SA
dotPLOT 7022 PpH67

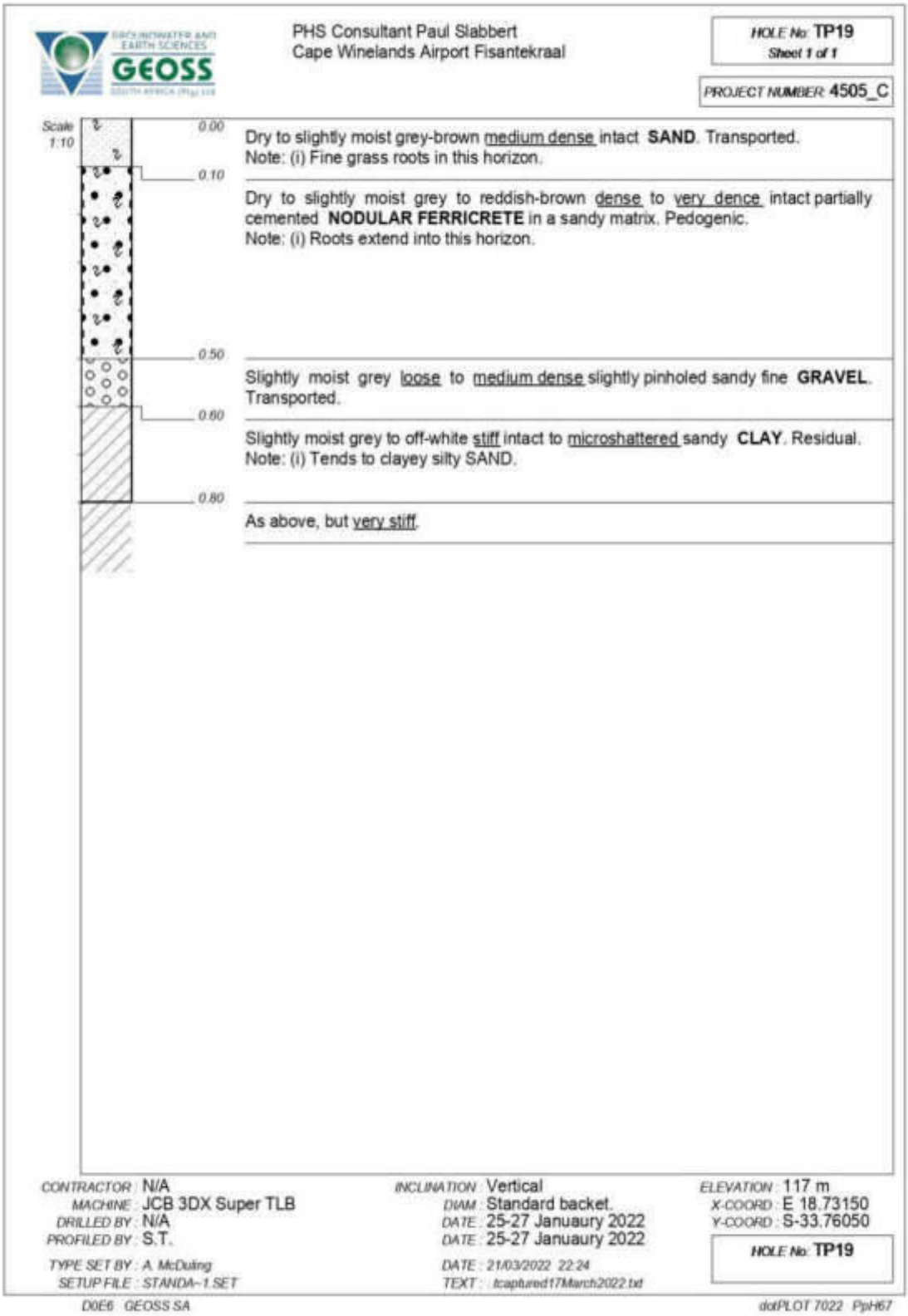

PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP14
Sheet 1 of 1
PROJECT NUMBER: 4505_C
Scale 1:10
0.00
Slightly moist brown and black (humified) loose intact SAND with occasional ferricrete nodules. Transported.
Note: (i) Grass roots throughout. (ii) Leaf litter/branches on surface.
0.15
0.0--0.45
Slightly moist red-brown to yellow-orange dense to very dense partially cemented NODULAR FERRICRETE. Pedogenic.
Note: (i) Excavated out as boulders (approx. 300 mm in diameter).
0.70
Slightly moist to moist with depth yellow-brown very loose to loose pinholed sandy GRAVEL. Transported.
Note: (i) Partial sidewall collapse. (ii) Water seepage at 1.5 mbgl from base of horizon. (iii) Rest water level at 1.0 mbgl.
1.0
1.5
1.50
Slightly moist to moist grey blotched reddish-orange dense intact gravelly silty SAND. Residual.
Note: (i) Indistinct relict foliation structures.
1.5--2.0
2.00
As above, but very dense.
NOTES
1) Water seepage at 1.5 mbgl.
2) Permanent water table at 1.0 mbgl.
3) Bulk disturbed sample 18592 between 0.0--0.45 mbgl.
4) Bulk disturbed sample 18593 between 1.5--2.0 mbgl.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 21/03/2022 22:24
TEXT : tcaptured17March2022.txt
ELEVATION : 128 m
X-COORD : E 18.74450
Y-COORD : S-33.77210
HOLE No: TP14
D0E6 GEOSS SA
dotPLOT 7022 PpH67


PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP15
Sheet 1 of 1
PROJECT NUMBER: 4505_C
Scale 1:10
0.00
Slightly moist brown and black (humidified) loose to medium dense intact gravelly SAND. Transported.
Note: (i) Roots throughout. (ii) Occasional ferricrete nodules.variation by approx. 0.3 m.
0.40
Slighly moist brown medium dense intact partially cemented pinholed sandy fine GRAVEL. Transported.
0.90
Slightly moist grey streaked red-orange dense to very dense with depth intact gravelly silty medium SAND. Residual.
Note: (i) Prominent smear on sidewall. (ii) Minor relict foliation structures.
0.9--1.7
1.70
As above, but very dense.
NOTES
1) Bulk disturbed sample 18594 between 0.9--1.7 mbgl.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 21/03/2022 22:24
TEXT : tcaptured17March2022.txt
ELEVATION : 117 m
X-COORD : E 18.73340
Y-COORD : S-33.76420
HOLE No: TP15
D0E6 GEOSS SA
dotPLOT 7022 PpH67


GEOSS
PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP16
Sheet 1 of 1
PROJECT NUMBER: 4505_C
Scale 1:10
0.00
Slightly moist grey-brown loose to medium dense intact SAND with occasional ferricrete nodules. Transported.
Notes: Roots throughout.
0.20
Slightly moist pockets of yellow-orange dense partially cemented NODULAR FERRICRETE in a sandy matrix similar to above. Pedogenic.
0.60
Slightly moist grey blotched red-brown-orange stiff intact gravelly sandy SILT. Residual.
Note: (i) Smear in areas/pockets, potentially due to variation in gravel-sand-silt/clay content. (ii) Tends toward silty SAND. (iii) Quartz grains angular.
1.60
As above, but very stiff.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 21/03/2022 22:24
TEXT : tcaptured17March2022.txt
ELEVATION : 119 m
X-COORD : E 18.73520
Y-COORD : S-33.76490
HOLE No: TP16
D0E6 GEOSS SA
dotPLOT 7022 PpH67


PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP17
Sheet 1 of 1
PROJECT NUMBER: 4505_C
Scale 1:10
0.00
Slightly moist to moist with depth yellow-brown medium dense intact to slightly voided medium SAND. Transported.
Note: (i) Water seepage at 1.9 mbgl. (ii) Fine grass roots in upper 0.5 m. (iii) Sidewall collapse. (iv) Trial pit located in, what appeared to be in the field, a large-scale depression/localised drainage channel, see loosely defined geotechnical zone associated with this trial pit.
0.0--1.9
1.90
1.9
As above.
NOTES
1) Water seepage at 1.9 mbgl.
2) Sidewall collapse below 1.0 mbgl.
3) Bulk disturbed sample 18595 between 0.0--1.9 mbgl.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 21/03/2022 22:24
TEXT : tcaptured17March2022.txt
ELEVATION : 119 m
X-COORD : E 18.73300
Y-COORD : S-33.76640
HOLE No: TP17
D0E6 GEOSS SA
dotPLOT 7022 PpH67

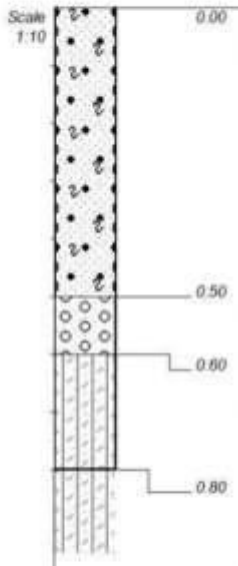

PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP18
Sheet 1 of 1
PROJECT NUMBER: 4505_C
Scale 1:10
0.00
Slightly moist grey and pockets of black (humified) medium dense intact gravelly medium SAND. Transported.
Note: (i) Grass roots throughout. (ii) Occational ferricrete nodules.
0.20
Slightly moist reddish-brown dense to very dense partially cemented NODULAR FERRICRETE in a sandy matrix. Pedogenic. /Note: (i) Tending to 'interlocked' - slow excavation.
0.2--0.6
0.60
Slightly moist reddish-brown blotched / streaked grey stiff to very stiff with depth shattered/fissured silty CLAY. Residual.
0.6--1.0
1.20
As above, but very stiff.
NOTES
1) Bulk disturbed sample 18596 between 0.2--0.6 mbgl.
2) Bulk disturbed sample 18597 between 0.6--1.0 mbgl.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 21/03/2022 22:24
TEXT : tcaptured17March2022.txt
ELEVATION : 122 m
X-COORD : E 18.73060
Y-COORD : S-33.76270
HOLE No: TP18
D0E6 GEOSS SA
dotPLOT 7022 PpH67


PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP19
Sheet 1 of 1
PROJECT NUMBER: 4505_C
Scale 1:10
0.00
Dry to slightly moist grey-brown medium dense intact SAND. Transported.
Note: (i) Fine grass roots in this horizon.
0.10
Dry to slightly moist grey to reddish-brown dense to very dence intact partially cemented NODULAR FERRICRETE in a sandy matrix. Pedogenic.
Note: (i) Roots extend into this horizon.
0.50
Slightly moist grey loose to medium dense slightly pinholed sandy fine GRAVEL. Transported.
0.60
Slightly moist grey to off-white stiff intact to microshattered sandy CLAY. Residual.
Note: (i) Tends to clayey silty SAND.
0.80
As above, but very stiff.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 21/03/2022 22:24
TEXT : tcaptured17March2022.txt
ELEVATION : 117 m
X-COORD : E 18.73150
Y-COORD : S-33.76050
HOLE No: TP19
D0E6 GEOSS SA
dotPLOT 7022 PpH67

PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal

HOLE No: TP20
Sheet 1 of 1

PROJECT NUMBER: 4505_C



0.00 – Slightly moist dark brown to greyish-brown with depth medium dense intact partially cemented **SAND** with occasional ferricrete nodules. **Transported**.
Note: (i) Fine grass roots. (ii) Humified in upper 200 mm.

0.50 – Slightly moist grey loose to medium dense slightly pinholed sandy fine **GRAVEL**. Transported.

0.60 – Slightly moist grey blotched red-orange firm to stiff intact clayey sandy **SILT**. Residual.
Note: (i) Occasional gravel / ferricrete nodules. (ii) Intense sidewall 'smear'. (iii) Tends to sandy CLAY.

0.80 – As above, but very stiff.

NOTES
1) Profile recorded from trial pit sidewall where deepest depth was attained.

CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.

TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET

INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022

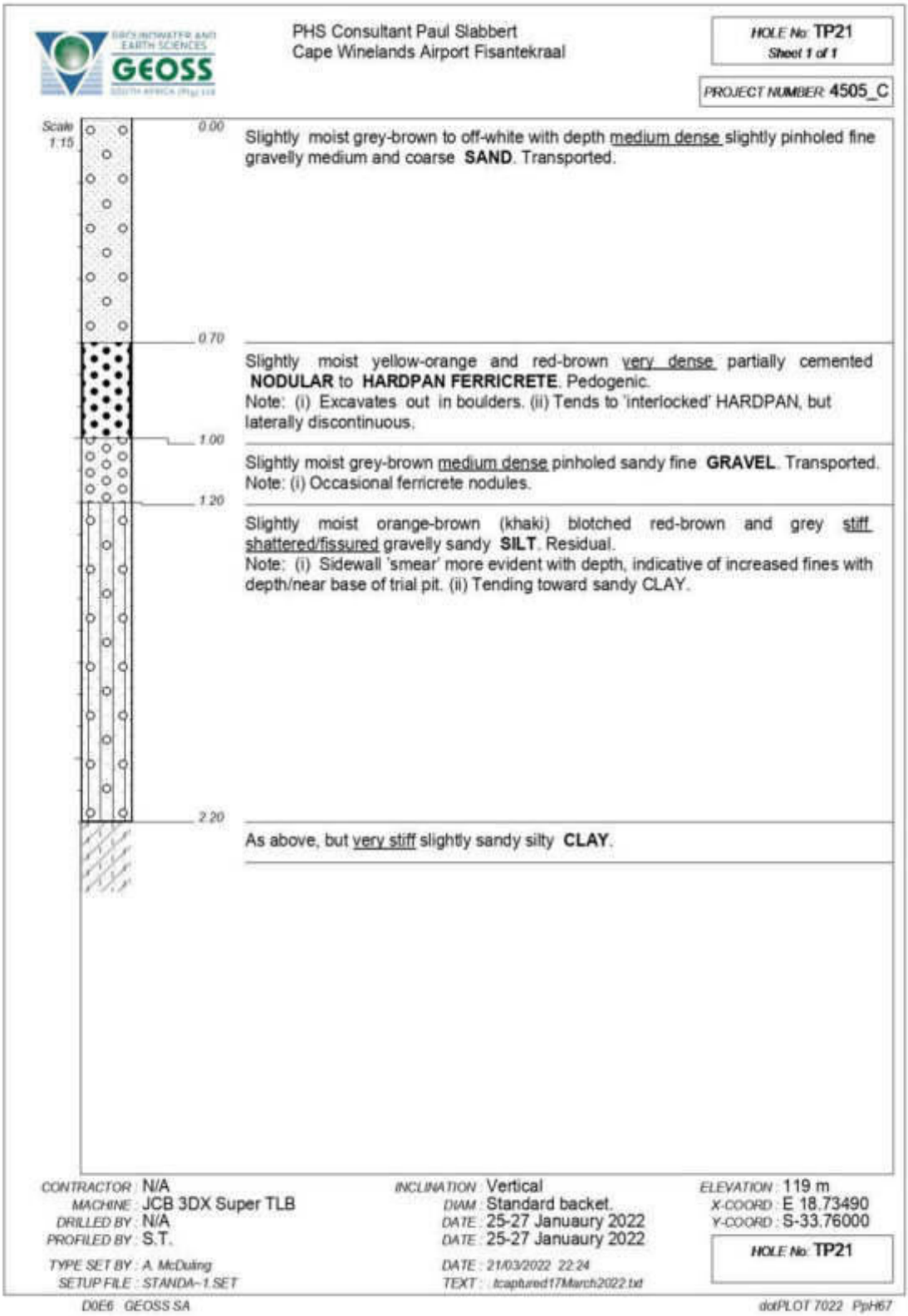
DATE : 21/03/2022 22:24
TEXT : tcaptured17March2022.txt

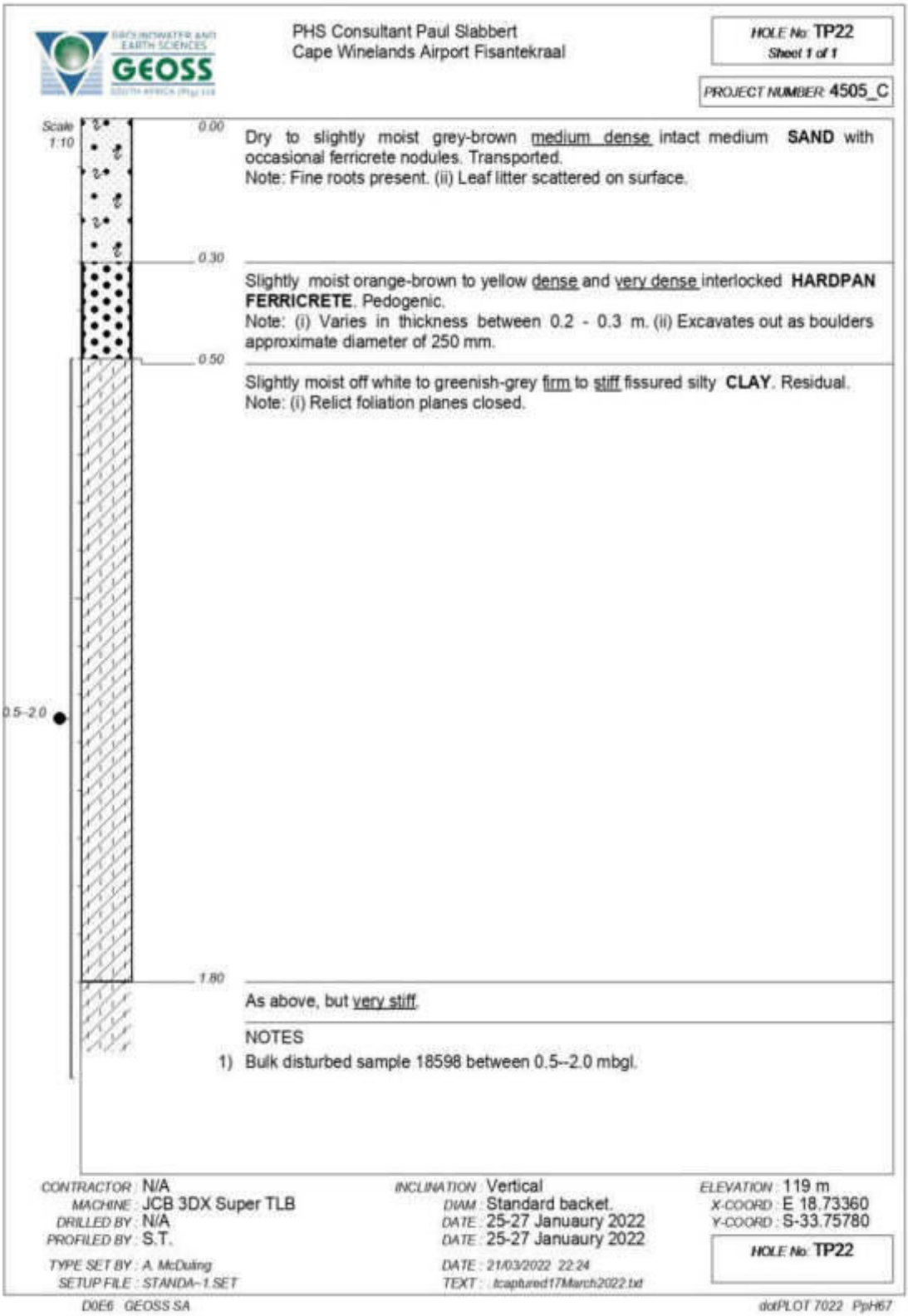
ELEVATION : 120 m
X-COORD : E 18.73340E
Y-COORD : S-33.76220S

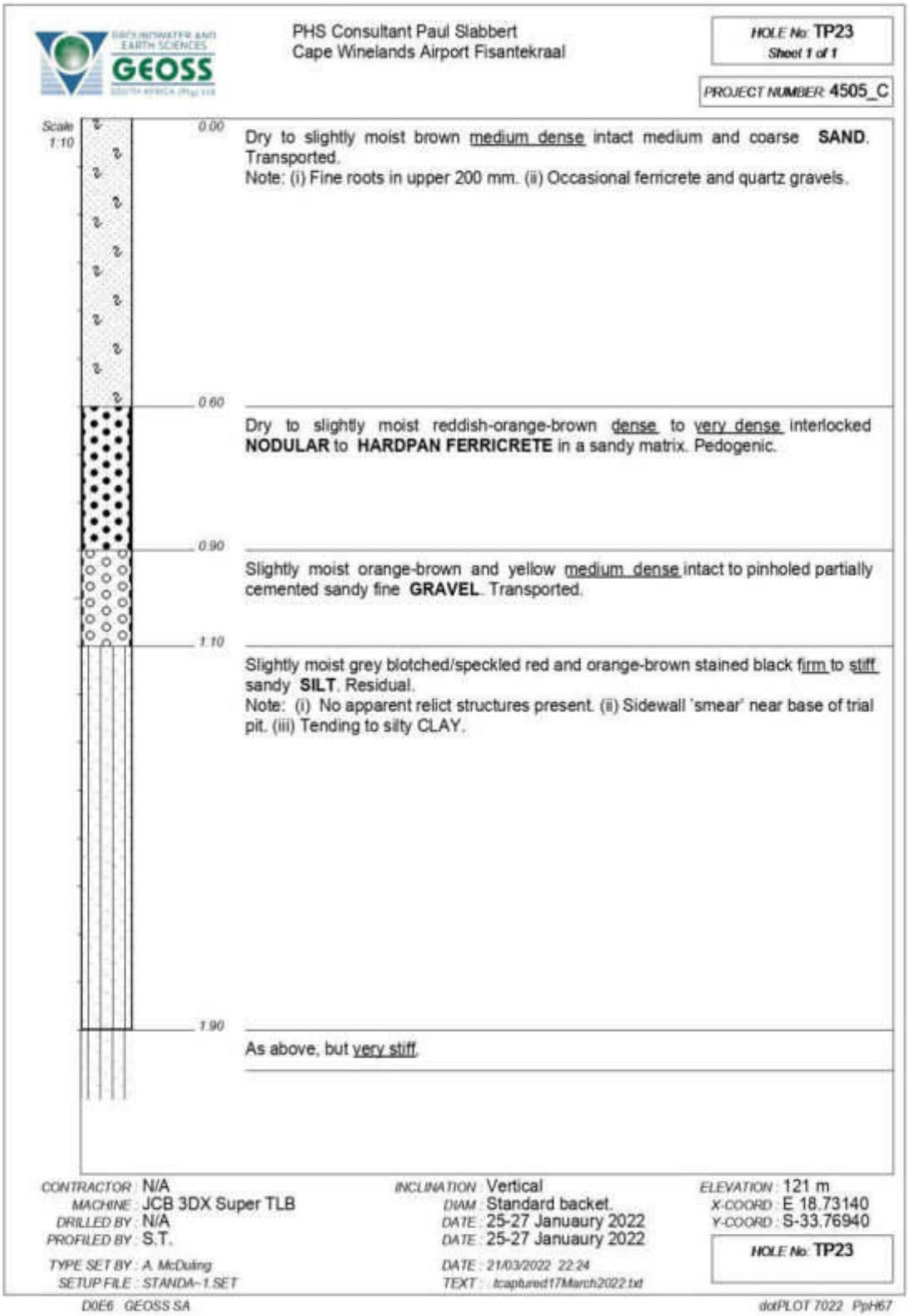
HOLE No: TP20

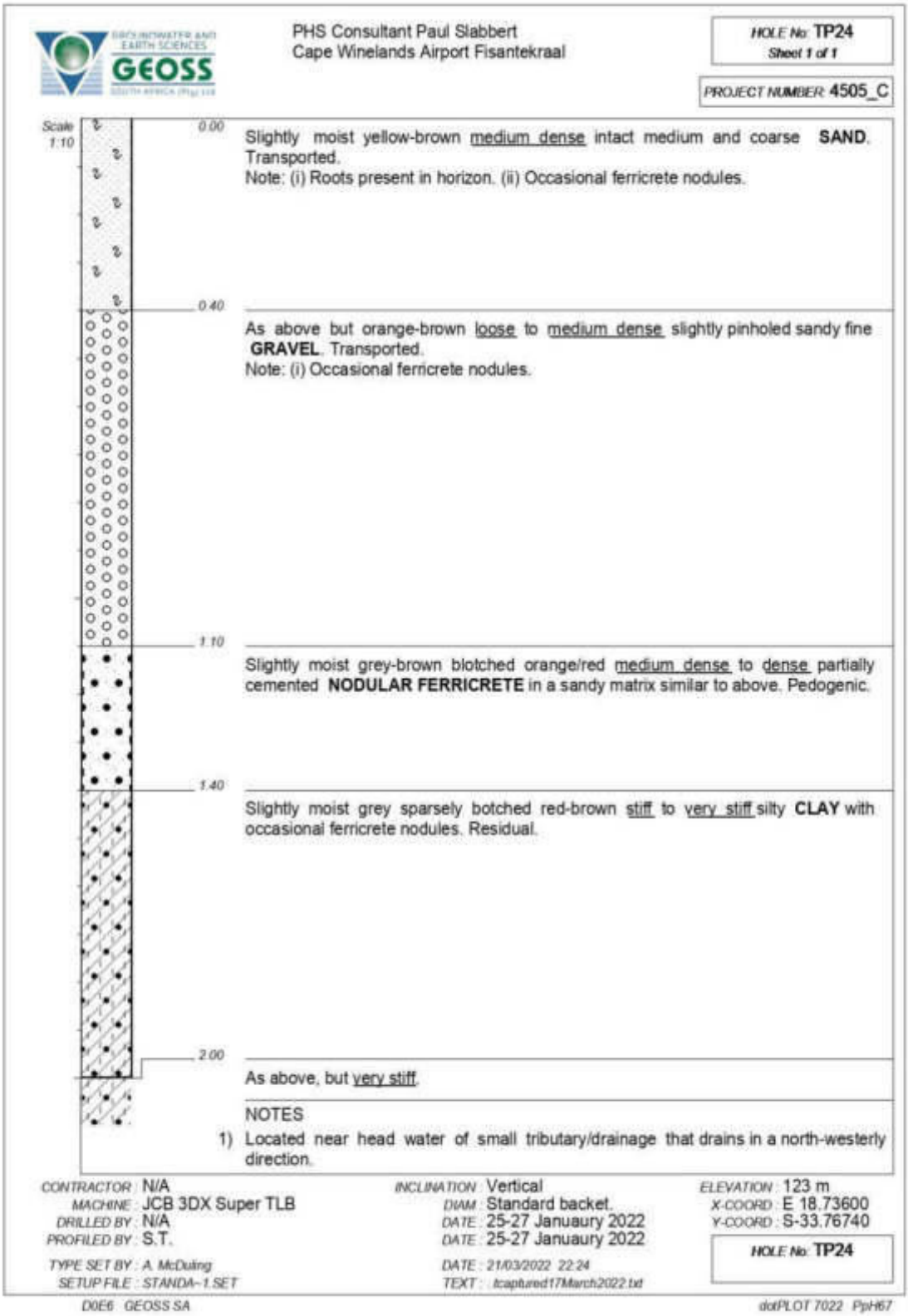
D0E6 GEOSS SA

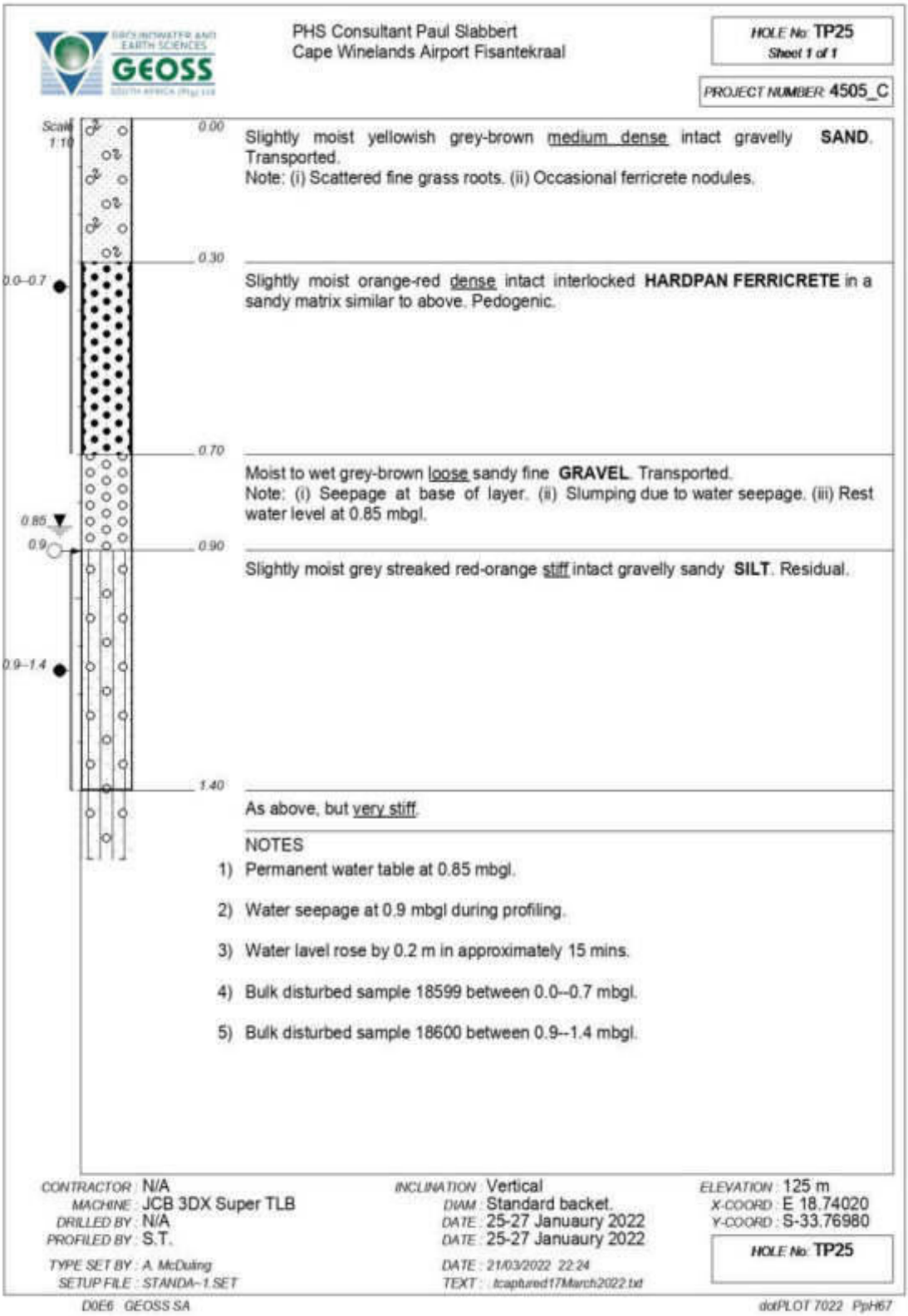
dotPLOT 7022 PpH67

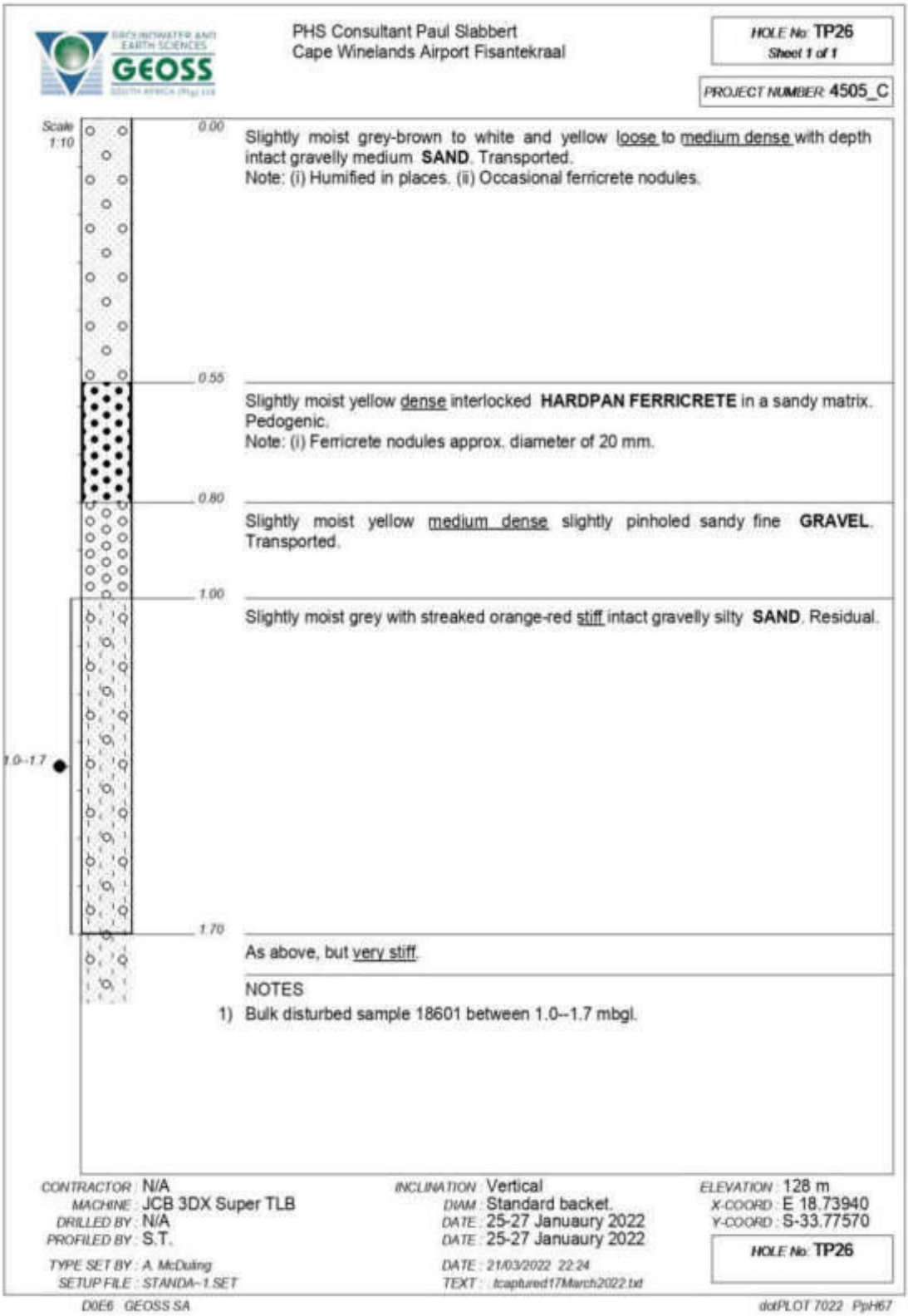

PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP21
Sheet 1 of 1
PROJECT NUMBER: 4505_C
Scale 1:15
0.00
Slightly moist grey-brown to off-white with depth medium dense slightly pinholed fine gravelly medium and coarse SAND. Transported.
0.70
Slightly moist yellow-orange and red-brown very dense partially cemented NODULAR to HARDPAN FERRICRETE. Pedogenic.
Note: (i) Excavates out in boulders. (ii) Tends to 'interlocked' HARDPAN, but laterally discontinuous.
1.00
Slightly moist grey-brown medium dense pinholed sandy fine GRAVEL. Transported.
Note: (i) Occasional ferricrete nodules.
1.20
Slightly moist orange-brown (khaki) blotched red-brown and grey stiff shattered/fissured gravelly sandy SILT. Residual.
Note: (i) Sidewall 'smear' more evident with depth, indicative of increased fines with depth/near base of trial pit. (ii) Tending toward sandy CLAY.
2.20
As above, but very stiff slightly sandy silty CLAY.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 21/03/2022 22:24
TEXT : tcaptured17March2022.txt
ELEVATION : 119 m
X-COORD : E 18.73490
Y-COORD : S-33.76000
HOLE No: TP21
D0E6 GEOSS SA
dotPLOT 7022 PpH67

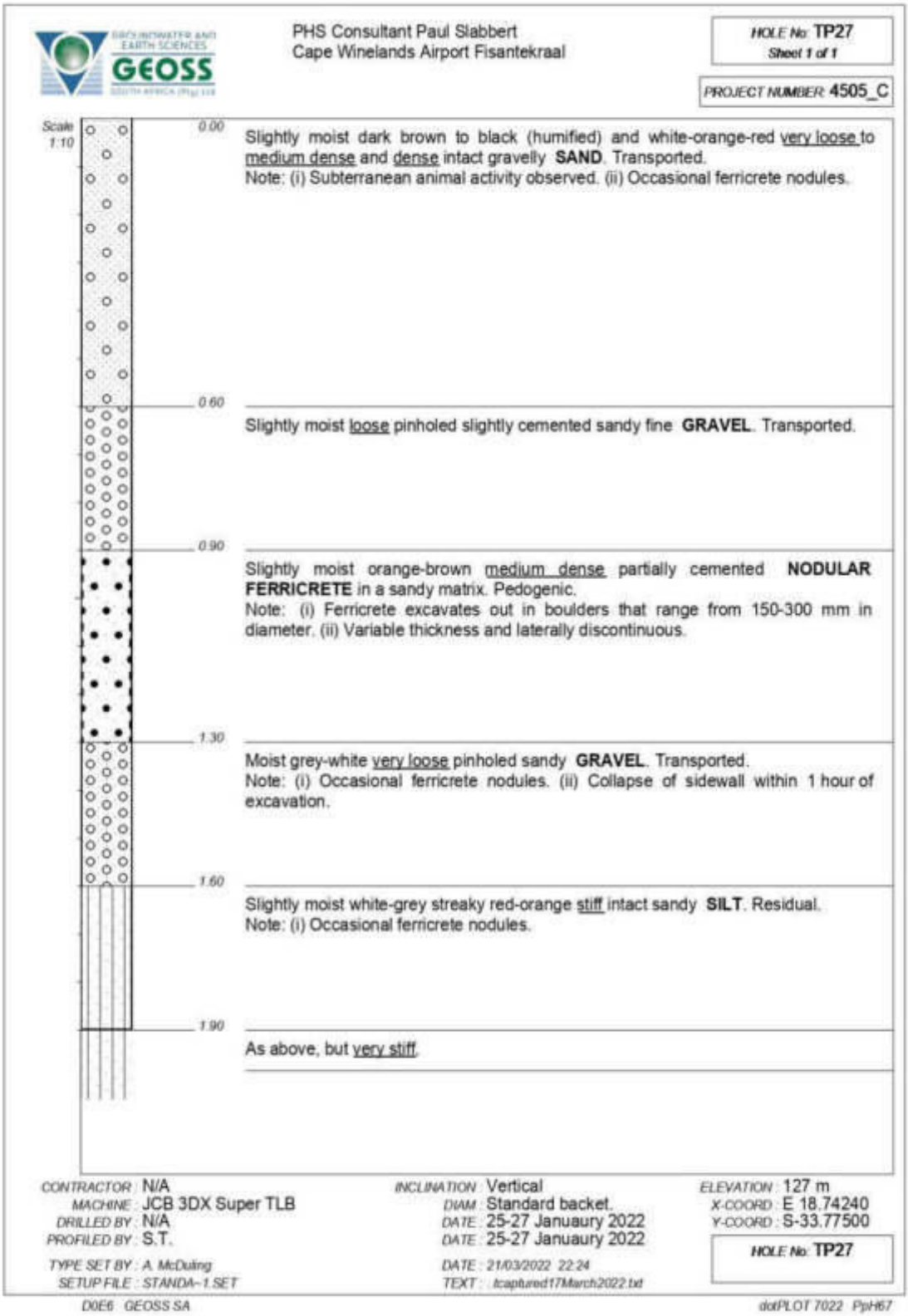

PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP22
Sheet 1 of 1
PROJECT NUMBER: 4505_C
Scale 1:10
0.00
Dry to slightly moist grey-brown medium dense intact medium SAND with occasional ferricrete nodules. Transported.
Note: Fine roots present. (ii) Leaf litter scattered on surface.
0.30
Slightly moist orange-brown to yellow dense and very dense interlocked HARDPAN FERRICRETE. Pedogenic.
Note: (i) Varies in thickness between 0.2 - 0.3 m. (ii) Excavates out as boulders approximate diameter of 250 mm.
0.50
Slightly moist off white to greenish-grey firm to stiff fissured silty CLAY. Residual.
Note: (i) Relict foliation planes closed.
0.5-2.0
1.80
As above, but very stiff.
NOTES
1) Bulk disturbed sample 18598 between 0.5--2.0 mbgl.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 21/03/2022 22:24
TEXT : tcaptured17March2022.txt
ELEVATION : 119 m
X-COORD : E 18.73360
Y-COORD : S-33.75780
HOLE No: TP22
D0E6 GEOSS SA
dotPLOT 7022 PpH67

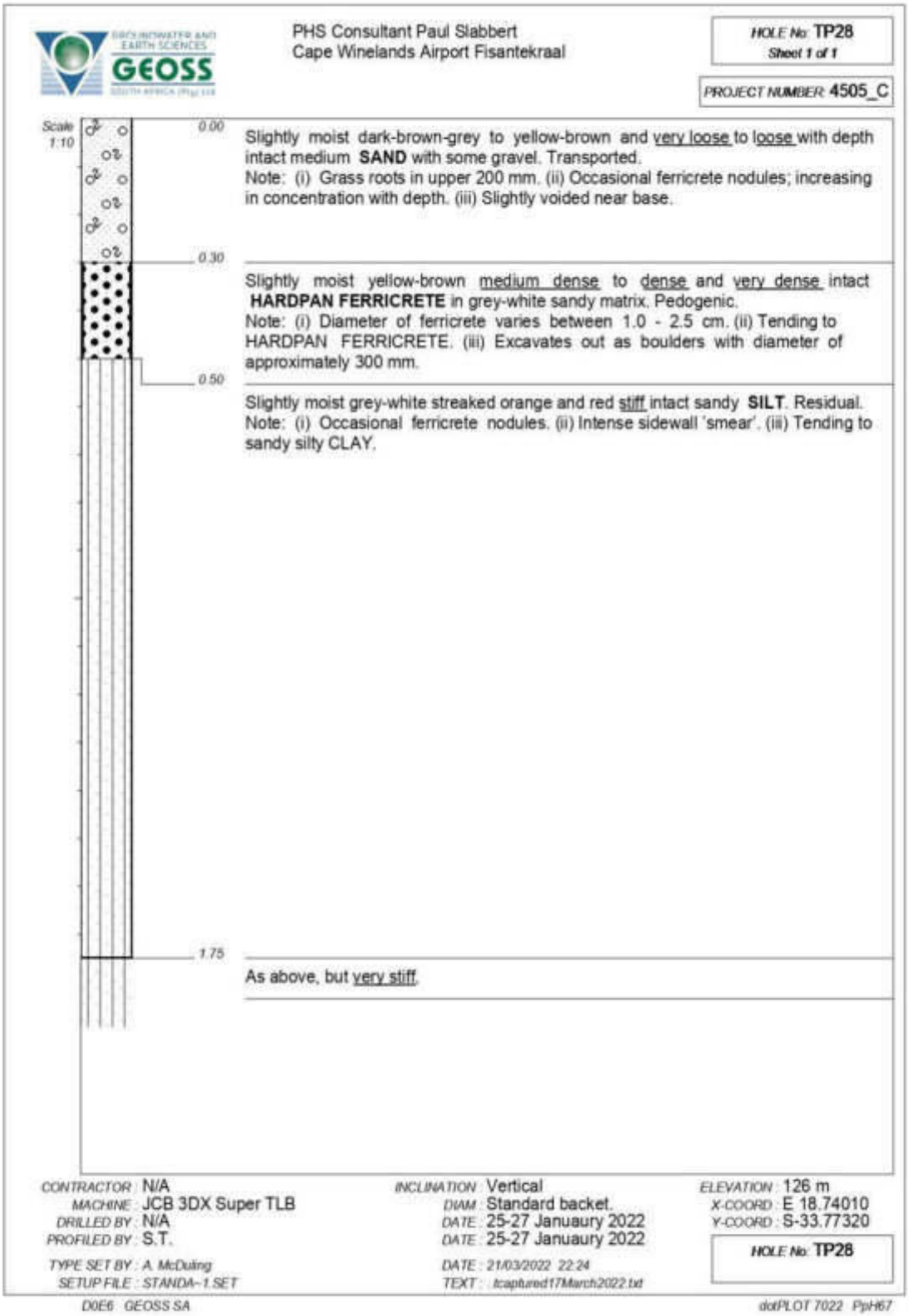

PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP23
Sheet 1 of 1
PROJECT NUMBER: 4505_C
Scale 1:10
0.00
Dry to slightly moist brown medium dense intact medium and coarse SAND. Transported.
Note: (i) Fine roots in upper 200 mm. (ii) Occasional ferricrete and quartz gravels.
0.60
Dry to slightly moist reddish-orange-brown dense to very dense interlocked NODULAR to HARDPAN FERRICRETE in a sandy matrix. Pedogenic.
0.90
Slightly moist orange-brown and yellow medium dense intact to pinholed partially cemented sandy fine GRAVEL. Transported.
1.10
Slightly moist grey blotched/speckled red and orange-brown stained black firm to stiff sandy SILT. Residual.
Note: (i) No apparent relict structures present. (ii) Sidewall 'smear' near base of trial pit. (iii) Tending to silty CLAY.
1.90
As above, but very stiff.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 21/03/2022 22:24
TEXT : tcaptured17March2022.txt
ELEVATION : 121 m
X-COORD : E 18.73140
Y-COORD : S-33.76940
HOLE No: TP23
D0E6 GEOSS SA
dotPLOT 7022 PpH67


GEOSS
PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP24
Sheet 1 of 1
PROJECT NUMBER: 4505_C
Scale 1:10
0.00
Slightly moist yellow-brown medium dense intact medium and coarse SAND. Transported.
Note: (i) Roots present in horizon. (ii) Occasional ferricrete nodules.
0.40
As above but orange-brown loose to medium dense slightly pinholed sandy fine GRAVEL. Transported.
Note: (i) Occasional ferricrete nodules.
1.10
Slightly moist grey-brown blotched orange/red medium dense to dense partially cemented NODULAR FERRICRETE in a sandy matrix similar to above. Pedogenic.
1.40
Slightly moist grey sparsely botched red-brown stiff to very stiff silty CLAY with occasional ferricrete nodules. Residual.
2.00
As above, but very stiff.
NOTES
1) Located near head water of small tributary/drainage that drains in a north-westerly direction.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 21/03/2022 22:24
TEXT : tcaptured17March2022.txt
ELEVATION : 123 m
X-COORD : E 18.73600
Y-COORD : S-33.76740
HOLE No: TP24
D0E6 GEOSS SA
dotPLOT 7022 PpH67


PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP25
Sheet 1 of 1
PROJECT NUMBER: 4505_C
Scale 1:10
0.00
Slightly moist yellowish grey-brown medium dense intact gravelly SAND. Transported.
Note: (i) Scattered fine grass roots. (ii) Occasional ferricrete nodules.
0.30
0.0–0.7
Slightly moist orange-red dense intact interlocked HARDPAN FERRICRETE in a sandy matrix similar to above. Pedogenic.
0.70
Moist to wet grey-brown loose sandy fine GRAVEL. Transported.
Note: (i) Seepage at base of layer. (ii) Slumping due to water seepage. (iii) Rest water level at 0.85 mbgl.
0.85
0.9
0.90
Slightly moist grey streaked red-orange stiff intact gravelly sandy SILT. Residual.
0.9–1.4
1.40
As above, but very stiff.
NOTES
1) Permanent water table at 0.85 mbgl.
2) Water seepage at 0.9 mbgl during profiling.
3) Water lavel rose by 0.2 m in approximately 15 mins.
4) Bulk disturbed sample 18599 between 0.0--0.7 mbgl.
5) Bulk disturbed sample 18600 between 0.9--1.4 mbgl.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 21/03/2022 22:24
TEXT : tcaptured17March2022.txt
ELEVATION : 125 m
X-COORD : E 18.74020
Y-COORD : S-33.76980
HOLE No: TP25
D0E6 GEOSS SA
dotPLOT 7022 PpH67


GEOSS
PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP26
Sheet 1 of 1
PROJECT NUMBER: 4505_C
Scale 1:10
0.00
Slightly moist grey-brown to white and yellow loose to medium dense with depth intact gravelly medium SAND. Transported.
Note: (i) Humified in places. (ii) Occasional ferricrete nodules.
0.55
Slightly moist yellow dense interlocked HARDPAN FERRICRETE in a sandy matrix. Pedogenic.
Note: (i) Ferricrete nodules approx. diameter of 20 mm.
0.80
Slightly moist yellow medium dense slightly pinholed sandy fine GRAVEL. Transported.
1.00
Slightly moist grey with streaked orange-red stiff intact gravelly silty SAND. Residual.
1.0-1.7
1.70
As above, but very stiff.
NOTES
1) Bulk disturbed sample 18601 between 1.0--1.7 mbgl.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 21/03/2022 22:24
TEXT : tcaptured17March2022.txt
ELEVATION : 128 m
X-COORD : E 18.73940
Y-COORD : S-33.77570
HOLE No: TP26
D0E6 GEOSS SA
dotPLOT 7022 PpH67

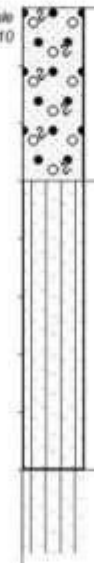

PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP27
Sheet 1 of 1
PROJECT NUMBER: 4505_C
Scale 1:10
0.00
Slightly moist dark brown to black (humified) and white-orange-red very loose to medium dense and dense intact gravelly SAND. Transported.
Note: (i) Subterranean animal activity observed. (ii) Occasional ferricrete nodules.
0.60
Slightly moist loose pinholed slightly cemented sandy fine GRAVEL. Transported.
0.90
Slightly moist orange-brown medium dense partially cemented NODULAR FERRICRETE in a sandy matrix. Pedogenic.
Note: (i) Ferricrete excavates out in boulders that range from 150-300 mm in diameter. (ii) Variable thickness and laterally discontinuous.
1.30
Moist grey-white very loose pinholed sandy GRAVEL. Transported.
Note: (i) Occasional ferricrete nodules. (ii) Collapse of sidewall within 1 hour of excavation.
1.60
Slightly moist white-grey streaky red-orange stiff intact sandy SILT. Residual.
Note: (i) Occasional ferricrete nodules.
1.90
As above, but very stiff.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 21/03/2022 22:24
TEXT : tcaptured17March2022.txt
ELEVATION : 127 m
X-COORD : E 18.74240
Y-COORD : S-33.77500
HOLE No: TP27
D0E6 GEOSS SA
dotPLOT 7022 PpH67


GEOSS
PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP28
Sheet 1 of 1
PROJECT NUMBER: 4505_C
Scale 1:10
0.00
Slightly moist dark-brown-grey to yellow-brown and very loose to loose with depth intact medium SAND with some gravel. Transported.
Note: (i) Grass roots in upper 200 mm. (ii) Occasional ferricrete nodules; increasing in concentration with depth. (iii) Slightly voided near base.
0.30
Slightly moist yellow-brown medium dense to dense and very dense intact HARDPAN FERRICRETE in grey-white sandy matrix. Pedogenic.
Note: (i) Diameter of ferricrete varies between 1.0 - 2.5 cm. (ii) Tending to HARDPAN FERRICRETE. (iii) Excavates out as boulders with diameter of approximately 300 mm.
0.50
Slightly moist grey-white streaked orange and red stiff intact sandy SILT. Residual.
Note: (i) Occasional ferricrete nodules. (ii) Intense sidewall 'smear'. (iii) Tending to sandy silty CLAY.
1.75
As above, but very stiff.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 21/03/2022 22:24
TEXT : tcaptured17March2022.txt
ELEVATION : 126 m
X-COORD : E 18.74010
Y-COORD : S-33.77320
HOLE No: TP28
D0E6 GEOSS SA
dotPLOT 7022 PpH67

PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal

HOLE No: TP29
Sheet 1 of 1

PROJECT NUMBER: 4505_C



0.00 Slightly moist dark-brown / black (humic) to grey with depth very loose intact gravelly medium and coarse **SAND**. Transported.
Note: (i) Grass roots provide stabilisation. (ii) Humified in places. (iii) Occasional ferricrete nodules; diameter of ferricrete varies from 10 to 15 mm, and up to 25 cm, where more interlocked/indurated/cemented.

0.30 Slightly moist grey with streaks of yellow and red very stiff intact sandy **SILT**. Residual.
Note: (i) Tending to silty CLAY.

0.80 As above, but extremely stiff.

NOTES
1) Excavation with TLB particularly time consuming; difficult excavation.

CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.

TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET

INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022

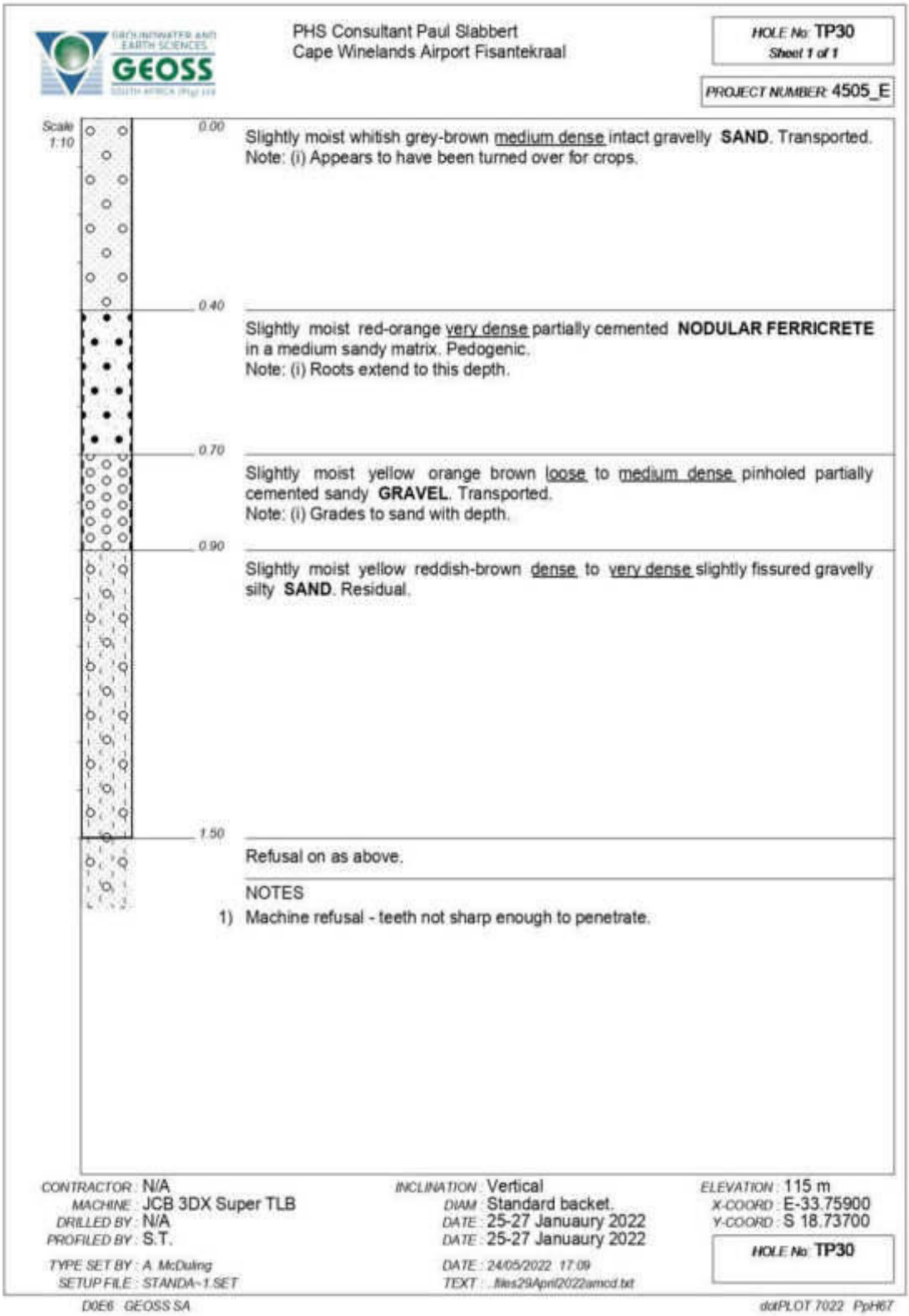
DATE : 21/03/2022 22:24
TEXT : tcaptured17March2022.txt

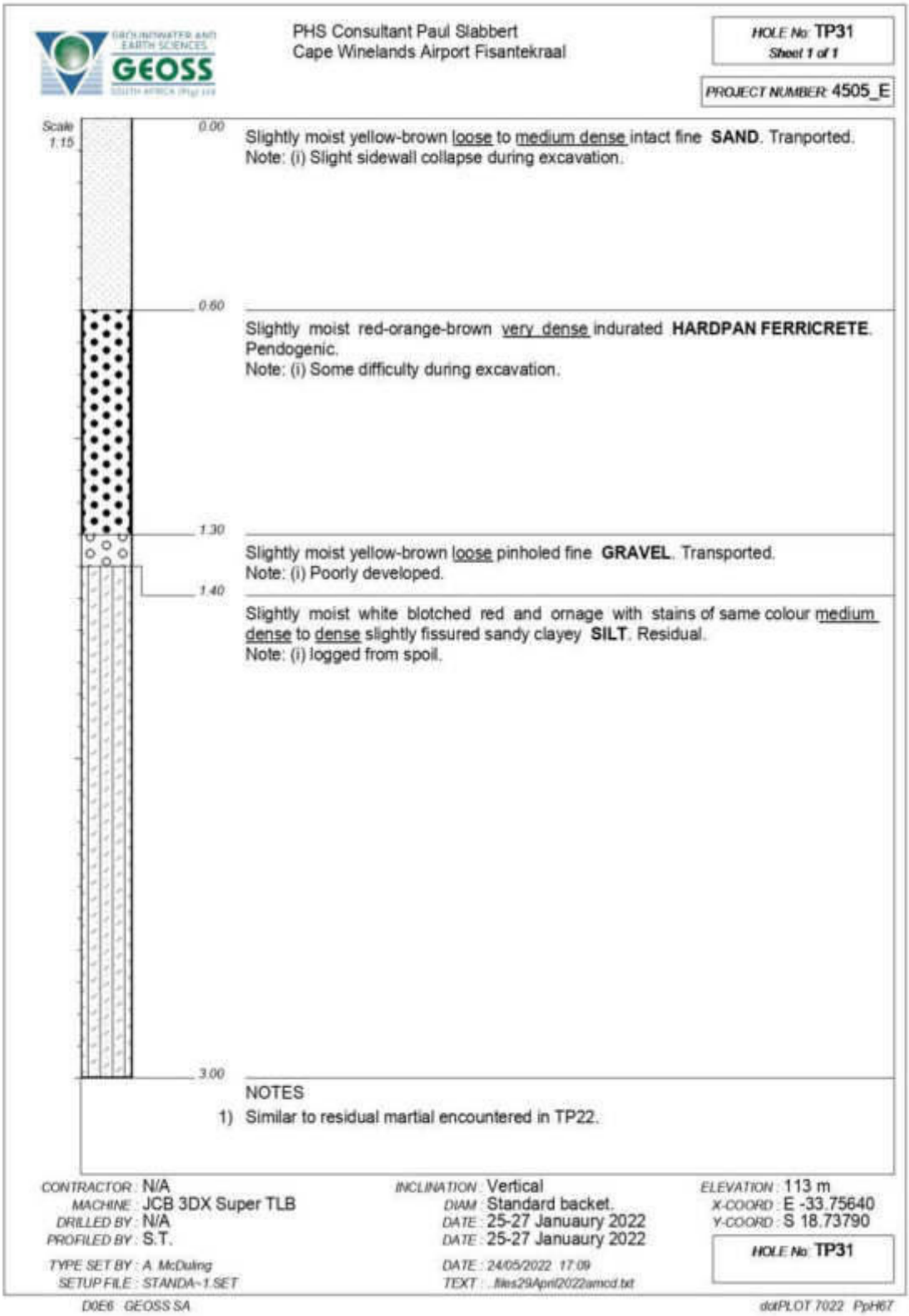
ELEVATION : 126 m
X-COORD : E 18.73880
Y-COORD : S-33.77490

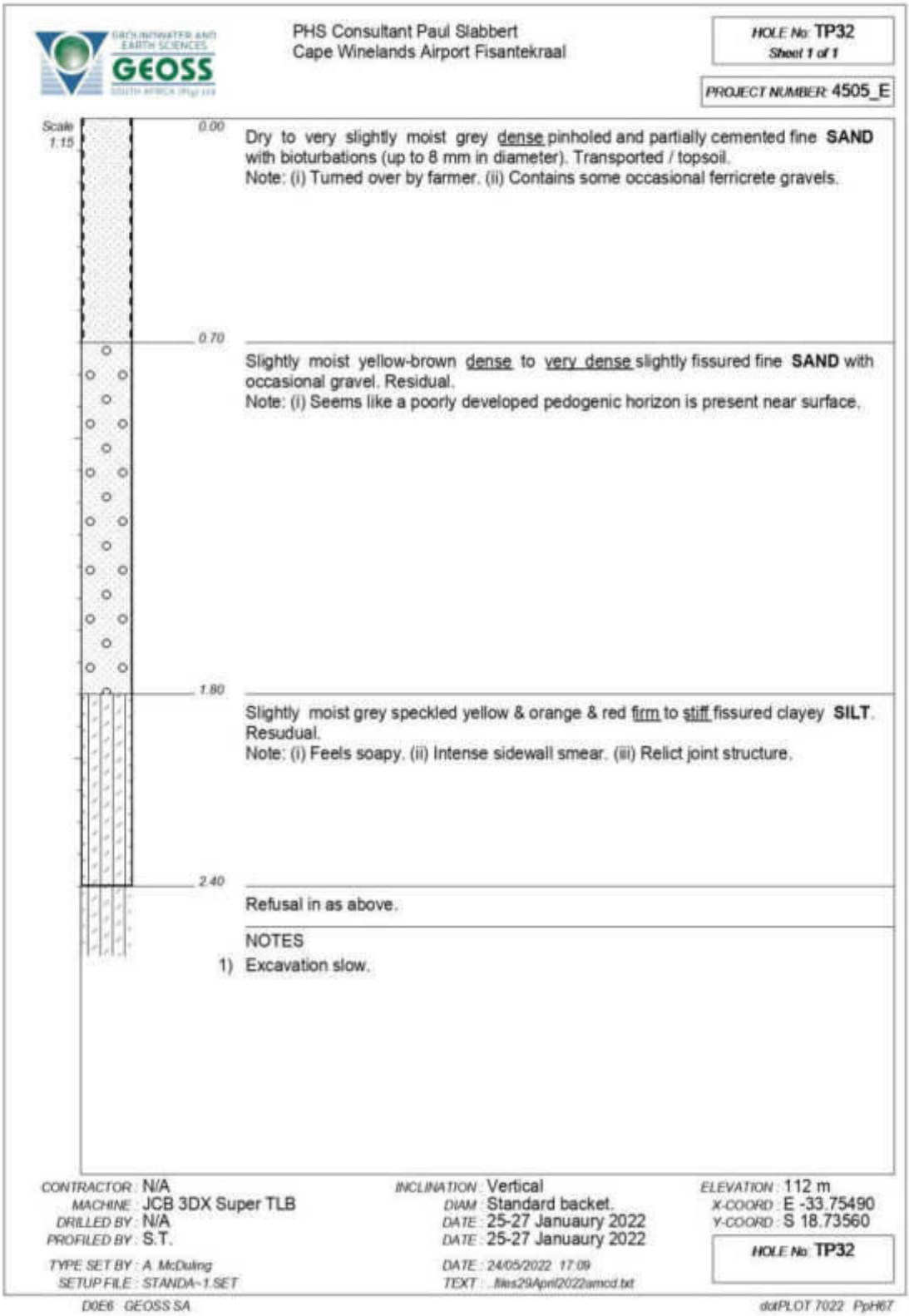
HOLE No: TP29

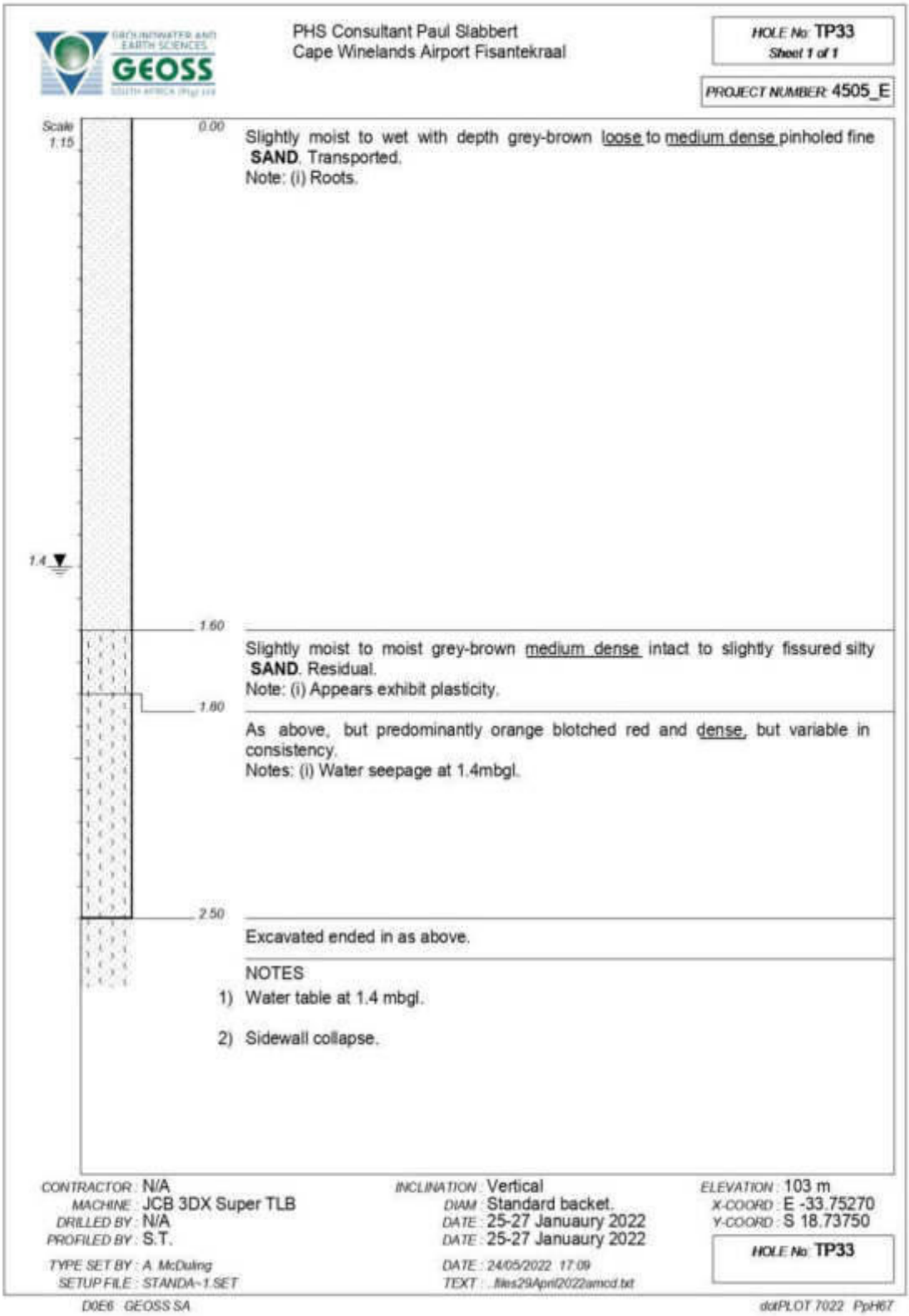
D0E6 GEOSS SA

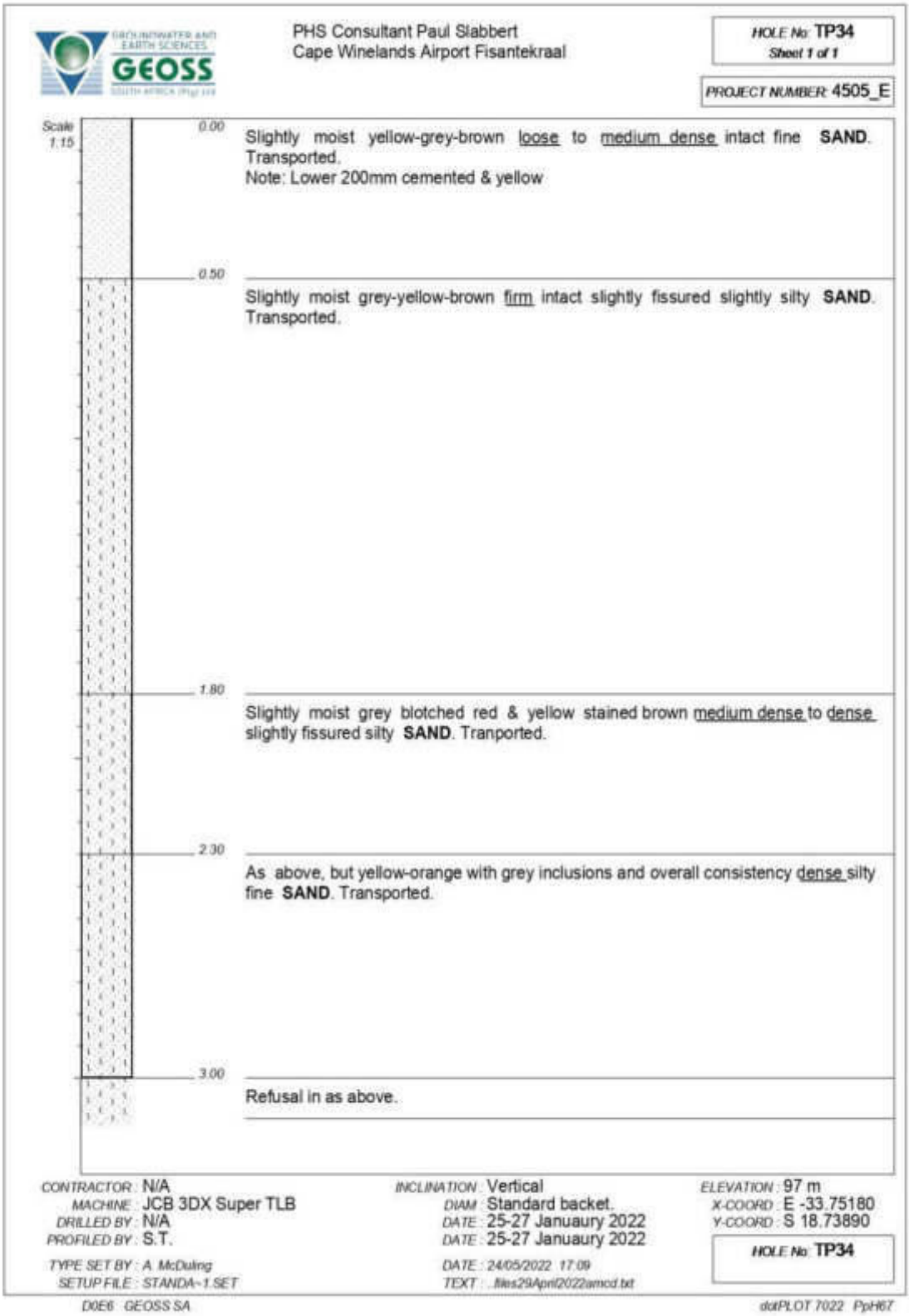
dotPLOT 7022 PpH67

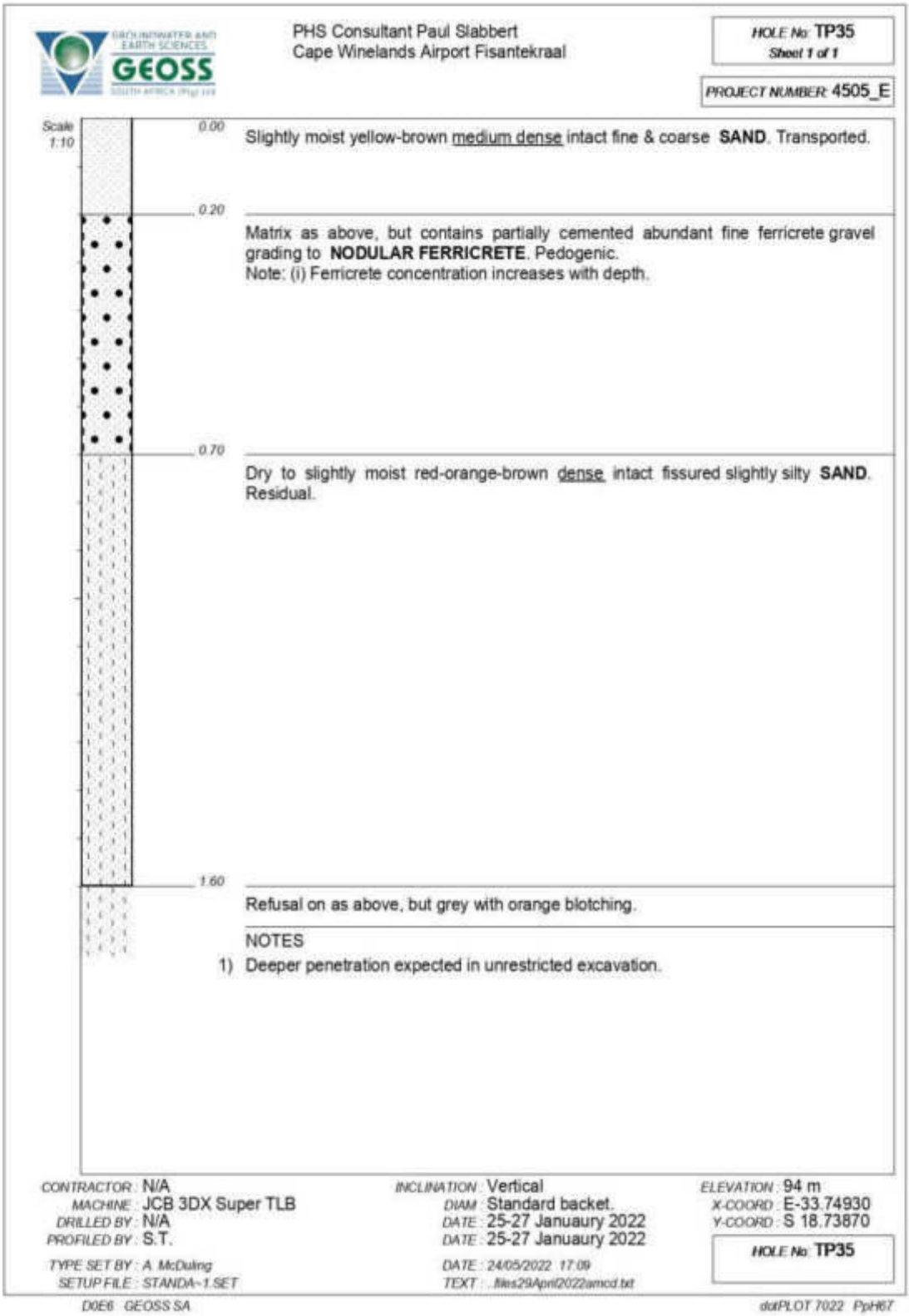

GEOSS
PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP30
Sheet 1 of 1
PROJECT NUMBER: 4505_E
Scale 1:10
0.00
Slightly moist whitish grey-brown medium dense intact gravelly SAND. Transported.
Note: (i) Appears to have been turned over for crops.
0.40
Slightly moist red-orange very dense partially cemented NODULAR FERRICRETE in a medium sandy matrix. Pedogenic.
Note: (i) Roots extend to this depth.
0.70
Slightly moist yellow orange brown loose to medium dense pinholed partially cemented sandy GRAVEL. Transported.
Note: (i) Grades to sand with depth.
0.90
Slightly moist yellow reddish-brown dense to very dense slightly fissured gravelly silty SAND. Residual.
1.50
Refusal on as above.
NOTES
1) Machine refusal - teeth not sharp enough to penetrate.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 24/05/2022 17:09
TEXT : ..files29April2022amod.txt
ELEVATION : 115 m
X-COORD : E-33.75900
Y-COORD : S 18.73700
HOLE No: TP30
D0E6 GEOSS SA
dotPLOT 7022 PpH67

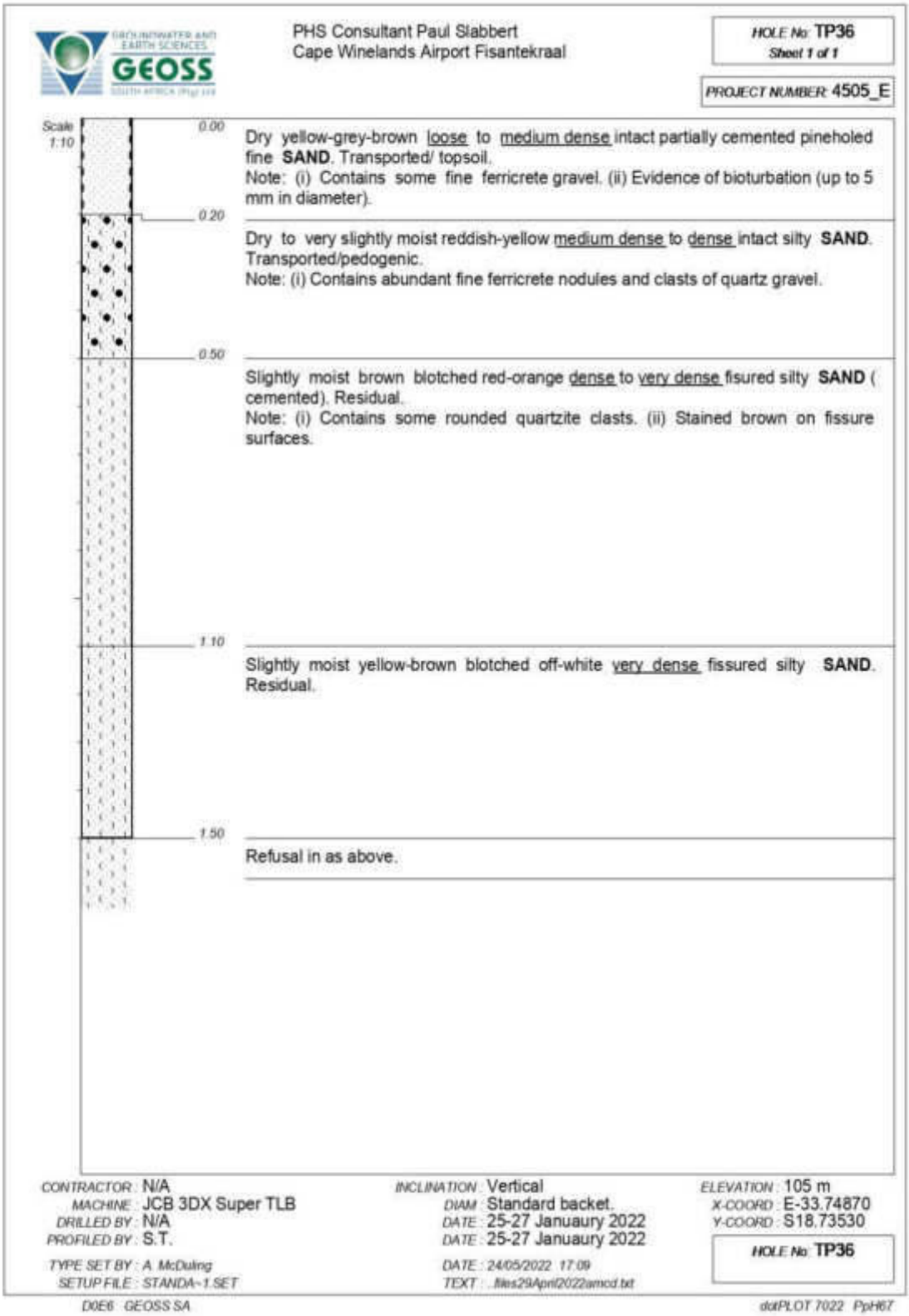

GEOSS
PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP31
Sheet 1 of 1
PROJECT NUMBER: 4505_E
Scale 1:15
0.00
Slightly moist yellow-brown loose to medium dense intact fine SAND. Tranported.
Note: (i) Slight sidewall collapse during excavation.
0.60
Slightly moist red-orange-brown very dense indurated HARDPAN FERRICRETE. Pendogenic.
Note: (i) Some difficulty during excavation.
1.30
Slightly moist yellow-brown loose pinholed fine GRAVEL. Transported.
Note: (i) Poorly developed.
1.40
Slightly moist white blotched red and ornage with stains of same colour medium dense to dense slightly fissured sandy clayey SILT. Residual.
Note: (i) logged from spoil.
3.00
NOTES
1) Similar to residual martial encountered in TP22.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 24/05/2022 17:09
TEXT : ..files29April2022amod.txt
ELEVATION : 113 m
X-COORD : E -33.75640
Y-COORD : S 18.73790
HOLE No: TP31
D0E6 GEOSS SA
dotPLOT 7022 PpH67

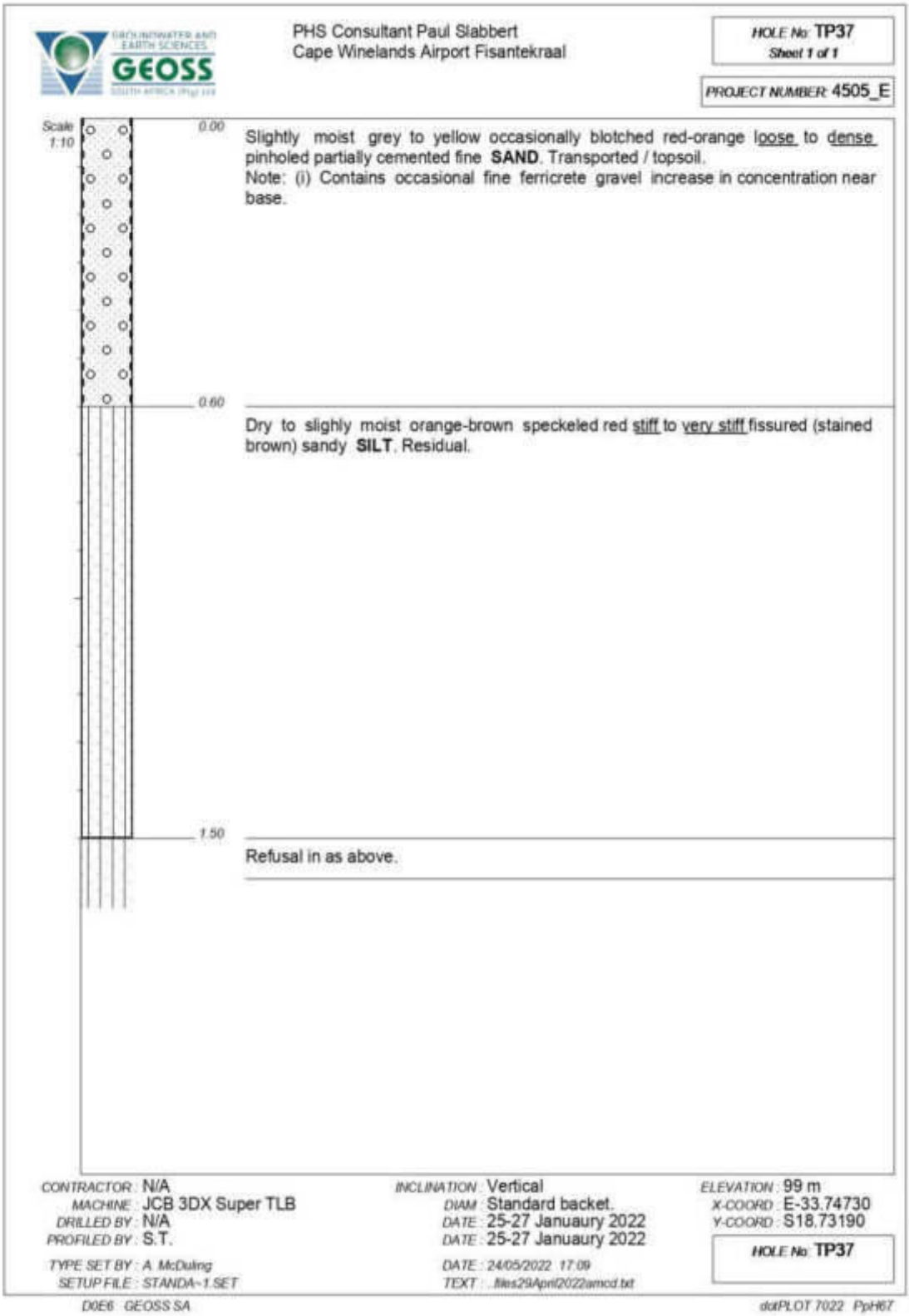

GEOSS
PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP32
Sheet 1 of 1
PROJECT NUMBER: 4505_E
Scale 1:15
0.00
Dry to very slightly moist grey dense pinholed and partially cemented fine SAND with bioturbations (up to 8 mm in diameter). Transported / topsoil.
Note: (i) Turned over by farmer. (ii) Contains some occasional ferricrete gravels.
0.70
Slightly moist yellow-brown dense to very dense slightly fissured fine SAND with occasional gravel. Residual.
Note: (i) Seems like a poorly developed pedogenic horizon is present near surface.
1.80
Slightly moist grey speckled yellow & orange & red firm to stiff fissured clayey SILT. Resudual.
Note: (i) Feels soapy. (ii) Intense sidewall smear. (iii) Relict joint structure.
2.40
Refusal in as above.
NOTES
1) Excavation slow.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 24/05/2022 17:09
TEXT : ..files29April2022amod.txt
ELEVATION : 112 m
X-COORD : E -33.75490
Y-COORD : S 18.73560
HOLE No: TP32
D0E6 GEOSS SA
dotPLOT 7022 PpH67

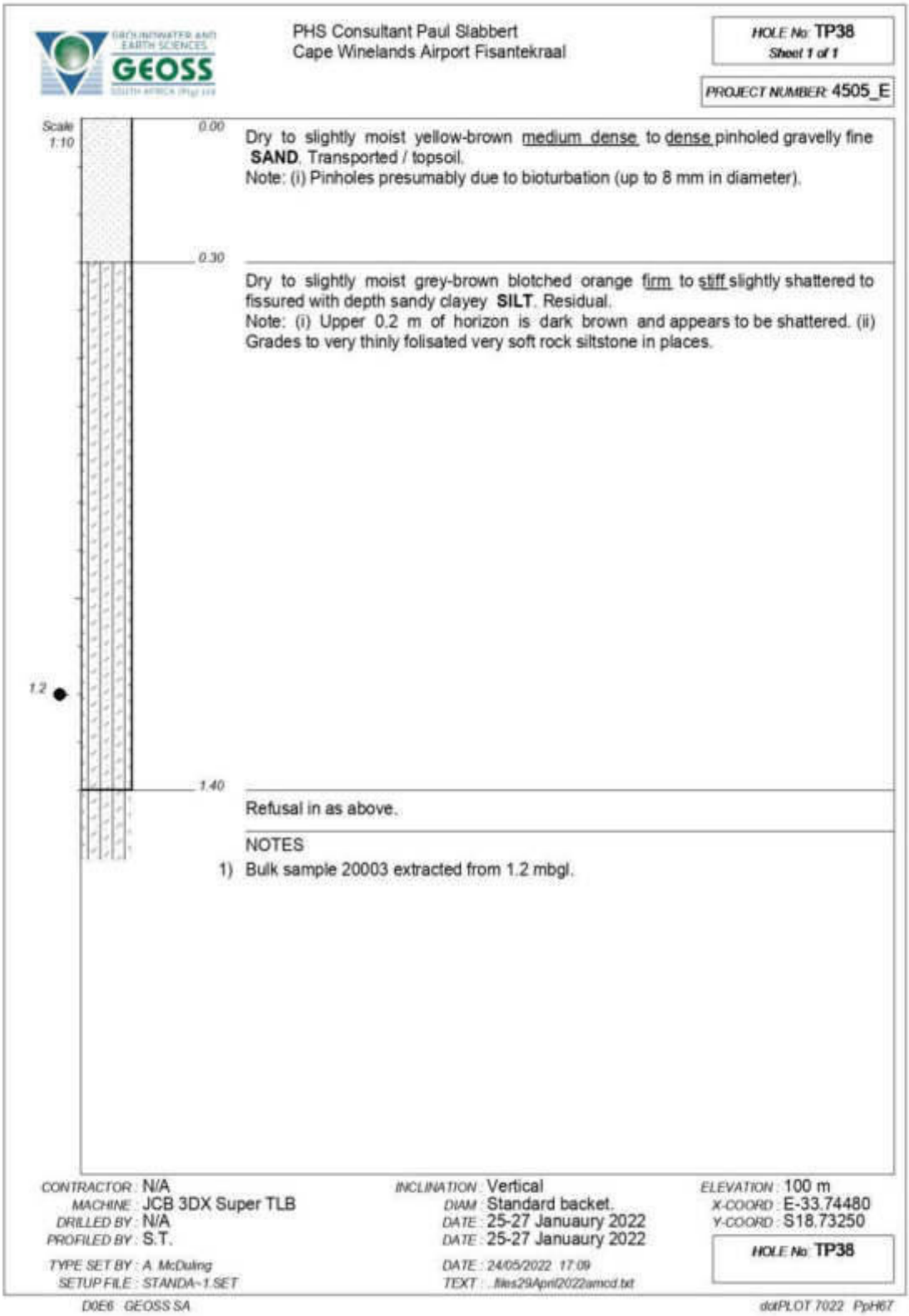

GEOSS
PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP33
Sheet 1 of 1
PROJECT NUMBER: 4505_E
Scale 1:15
0.00
Slightly moist to wet with depth grey-brown loose to medium dense pinholed fine SAND. Transported.
Note: (i) Roots.
1.4
1.60
Slightly moist to moist grey-brown medium dense intact to slightly fissured silty SAND. Residual.
Note: (i) Appears exhibit plasticity.
1.80
As above, but predominantly orange blotched red and dense, but variable in consistency.
Notes: (i) Water seepage at 1.4mbgl.
2.50
Excavated ended in as above.
NOTES
1) Water table at 1.4 mbgl.
2) Sidewall collapse.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 24/05/2022 17:09
TEXT : ..files29April2022amod.txt
ELEVATION : 103 m
X-COORD : E -33.75270
Y-COORD : S 18.73750
HOLE No: TP33
D0E6 GEOSS SA
dotPLOT 7022 PpH67

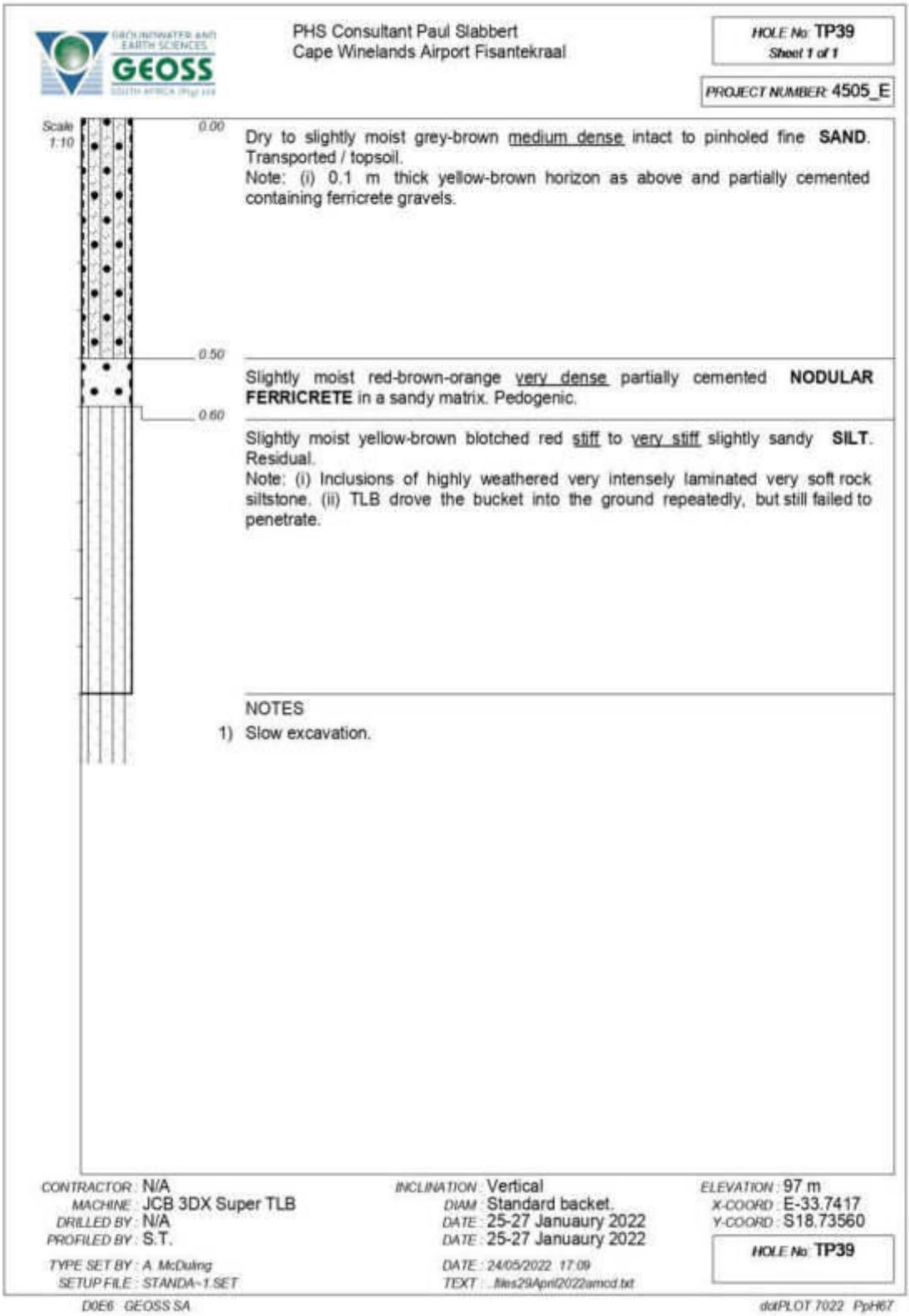

PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP34
Sheet 1 of 1
PROJECT NUMBER: 4505_E
Scale 1:15
0.00
Slightly moist yellow-grey-brown loose to medium dense intact fine SAND. Transported.
Note: Lower 200mm cemented & yellow
0.50
Slightly moist grey-yellow-brown firm intact slightly fissured slightly silty SAND. Transported.
1.80
Slightly moist grey blotched red & yellow stained brown medium dense to dense slightly fissured silty SAND. Tranported.
2.30
As above, but yellow-orange with grey inclusions and overall consistency dense silty fine SAND. Transported.
3.00
Refusal in as above.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 24/05/2022 17:09
TEXT : ..files29April2022amod.txt
ELEVATION : 97 m
X-COORD : E -33.75180
Y-COORD : S 18.73890
HOLE No: TP34
D0E6 GEOSS SA
dotPLOT 7022 PpH67

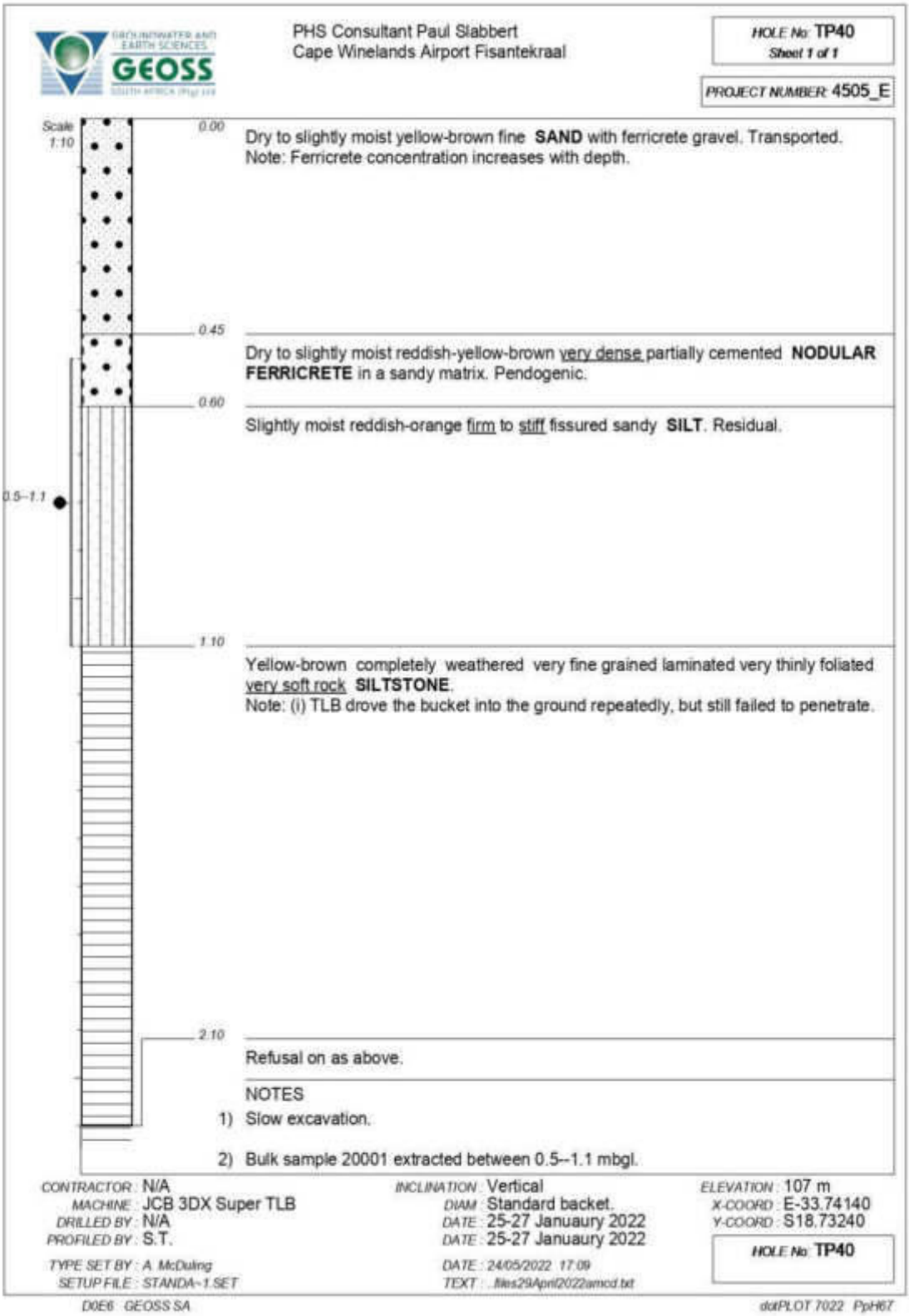

GEOSS
PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP35
Sheet 1 of 1
PROJECT NUMBER: 4505_E
Scale 1:10
0.00
Slightly moist yellow-brown medium dense intact fine & coarse SAND. Transported.
0.20
Matrix as above, but contains partially cemented abundant fine ferricrete gravel grading to NODULAR FERRICRETE. Pedogenic.
Note: (i) Ferricrete concentration increases with depth.
0.70
Dry to slightly moist red-orange-brown dense intact fissured slightly silty SAND. Residual.
1.60
Refusal on as above, but grey with orange blotching.
NOTES
1) Deeper penetration expected in unrestricted excavation.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 24/05/2022 17:09
TEXT : ..files29April2022amod.txt
ELEVATION : 94 m
X-COORD : E-33.74930
Y-COORD : S 18.73870
HOLE No: TP35
D0E6 GEOSS SA
dotPLOT 7022 PpH67

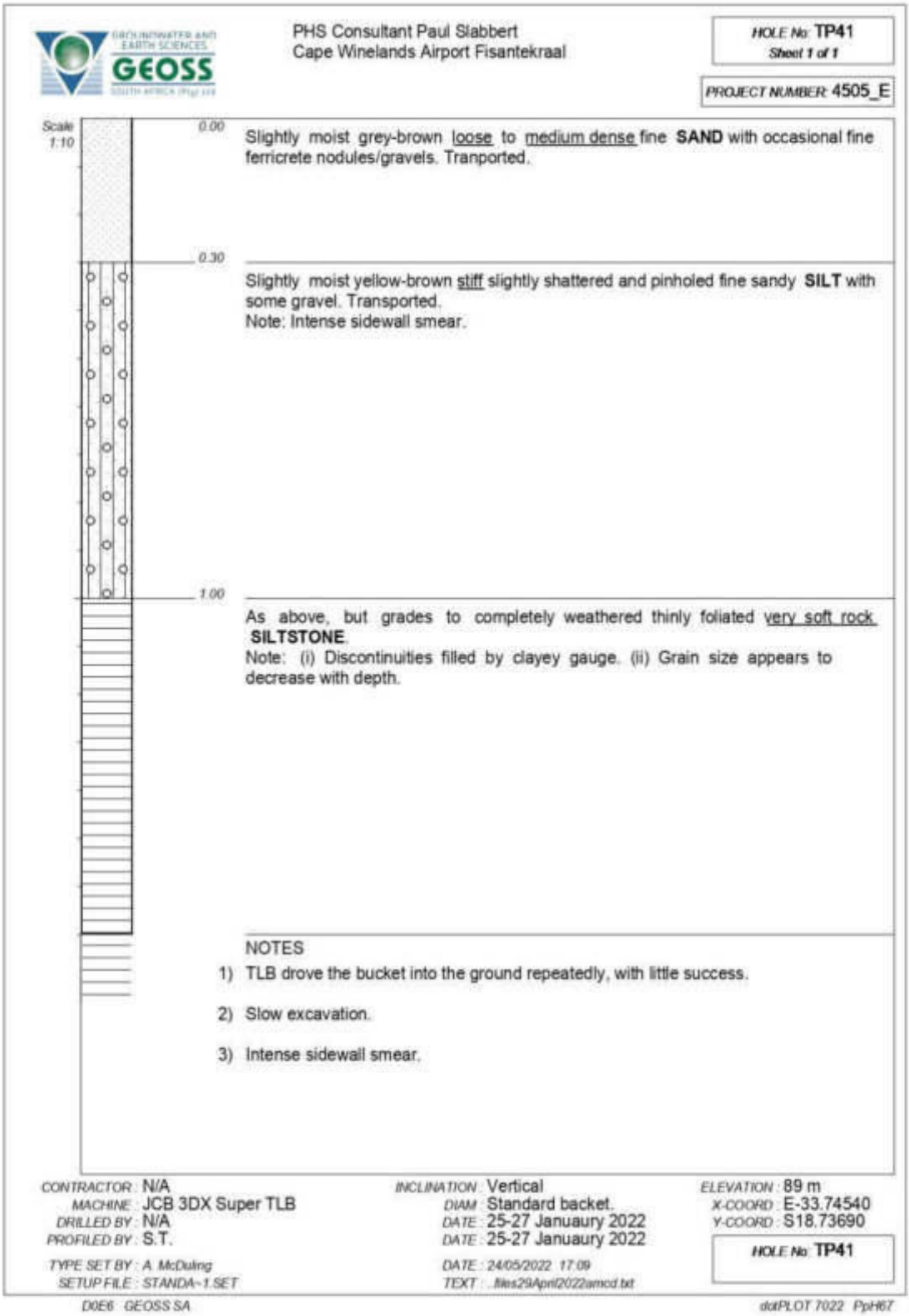

PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP36
Sheet 1 of 1
PROJECT NUMBER: 4505_E
Scale 1:10
0.00
Dry yellow-grey-brown loose to medium dense intact partially cemented pineholed fine SAND. Transported/ topsoil.
Note: (i) Contains some fine ferricrete gravel. (ii) Evidence of bioturbation (up to 5 mm in diameter).
0.20
Dry to very slightly moist reddish-yellow medium dense to dense intact silty SAND. Transported/pedogenic.
Note: (i) Contains abundant fine ferricrete nodules and clasts of quartz gravel.
0.50
Slightly moist brown blotched red-orange dense to very dense fisured silty SAND (cemented). Residual.
Note: (i) Contains some rounded quartzite clasts. (ii) Stained brown on fissure surfaces.
1.10
Slightly moist yellow-brown blotched off-white very dense fissured silty SAND. Residual.
1.50
Refusal in as above.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 24/05/2022 17:09
TEXT : ..files29April2022amod.txt
ELEVATION : 105 m
X-COORD : E-33.74870
Y-COORD : S18.73530
HOLE No: TP36
D0E6 GEOSS SA
dotPLOT 7022 PpH67

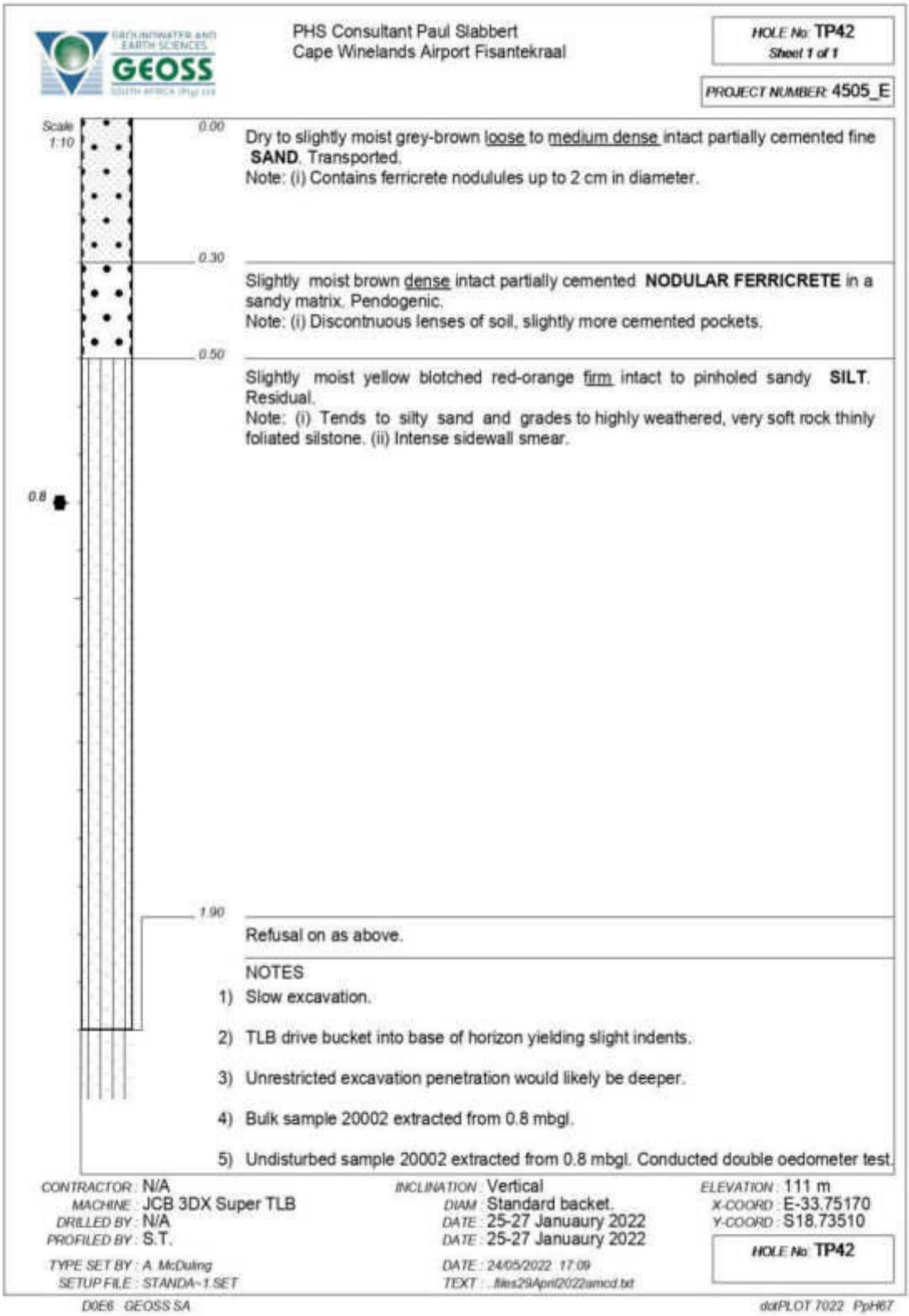

GEOSS
PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP37
Sheet 1 of 1
PROJECT NUMBER: 4505_E
Scale 1:10
0.00
Slightly moist grey to yellow occasionally blotched red-orange loose to dense pinholed partially cemented fine SAND. Transported / topsoil.
Note: (i) Contains occasional fine ferricrete gravel increase in concentration near base.
0.60
Dry to slighly moist orange-brown speckeled red stiff to very stiff fissured (stained brown) sandy SILT. Residual.
1.50
Refusal in as above.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 24/05/2022 17:09
TEXT : ..files29April2022amod.txt
ELEVATION : 99 m
X-COORD : E-33.74730
Y-COORD : S18.73190
HOLE No: TP37
D0E6 GEOSS SA
dotPLOT 7022 PpH67

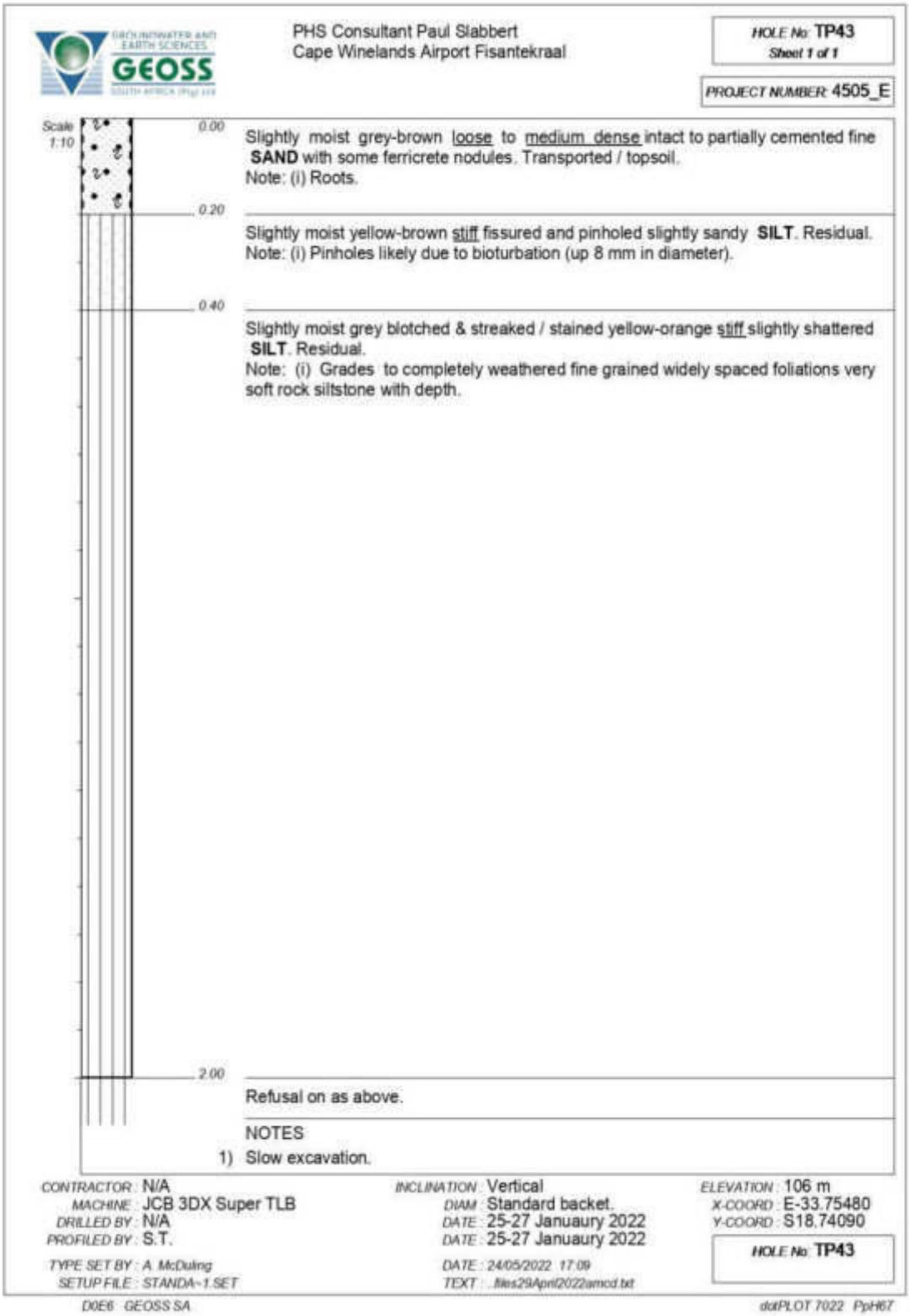

PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP38
Sheet 1 of 1
PROJECT NUMBER: 4505_E
Scale 1:10
0.00
Dry to slightly moist yellow-brown medium dense to dense pinholed gravelly fine SAND. Transported / topsoil.
Note: (i) Pinholes presumably due to bioturbation (up to 8 mm in diameter).
0.30
Dry to slightly moist grey-brown blotched orange firm to stiff slightly shattered to fissured with depth sandy clayey SILT. Residual.
Note: (i) Upper 0.2 m of horizon is dark brown and appears to be shattered. (ii) Grades to very thinly folisated very soft rock siltstone in places.
1.2
1.40
Refusal in as above.
NOTES
1) Bulk sample 20003 extracted from 1.2 mbgl.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 24/05/2022 17:09
TEXT : ..files29April2022amod.txt
ELEVATION : 100 m
X-COORD : E-33.74480
Y-COORD : S18.73250
HOLE No: TP38
D0E6 GEOSS SA
dotPLOT 7022 PpH67

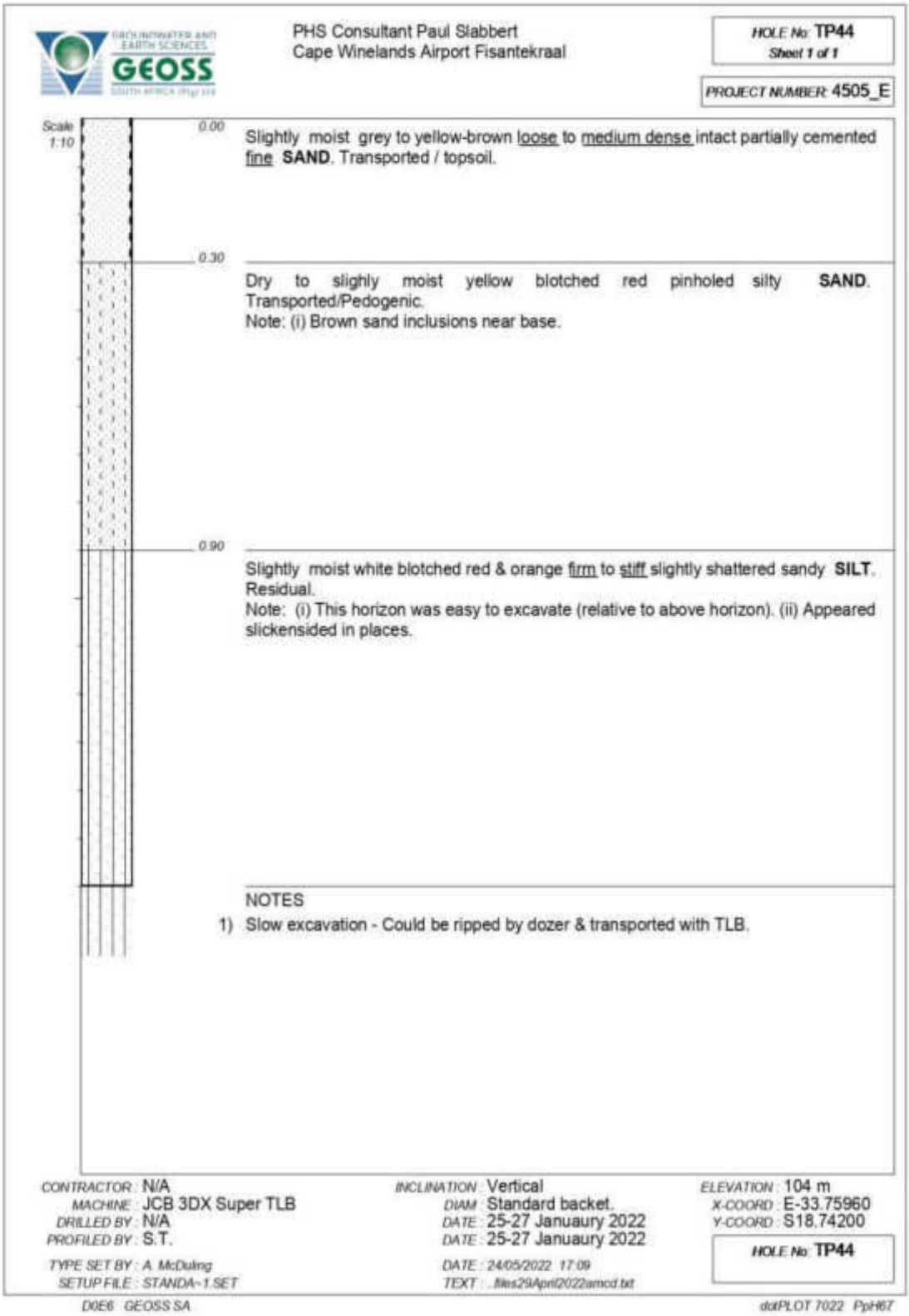

PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP39
Sheet 1 of 1
PROJECT NUMBER: 4505_E
Scale 1:10
0.00
Dry to slightly moist grey-brown medium dense intact to pinholed fine SAND. Transported / topsoil.
Note: (i) 0.1 m thick yellow-brown horizon as above and partially cemented containing ferricrete gravels.
0.50
Slightly moist red-brown-orange very dense partially cemented NODULAR FERRICRETE in a sandy matrix. Pedogenic.
0.60
Slightly moist yellow-brown blotched red stiff to very stiff slightly sandy SILT. Residual.
Note: (i) Inclusions of highly weathered very intensely laminated very soft rock siltstone. (ii) TLB drove the bucket into the ground repeatedly, but still failed to penetrate.
NOTES
1) Slow excavation.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 24/05/2022 17:09
TEXT : ..files29April2022amod.txt
ELEVATION : 97 m
X-COORD : E-33.7417
Y-COORD : S18.73560
HOLE No: TP39
D0E6 GEOSS SA
dotPLOT 7022 PpH67

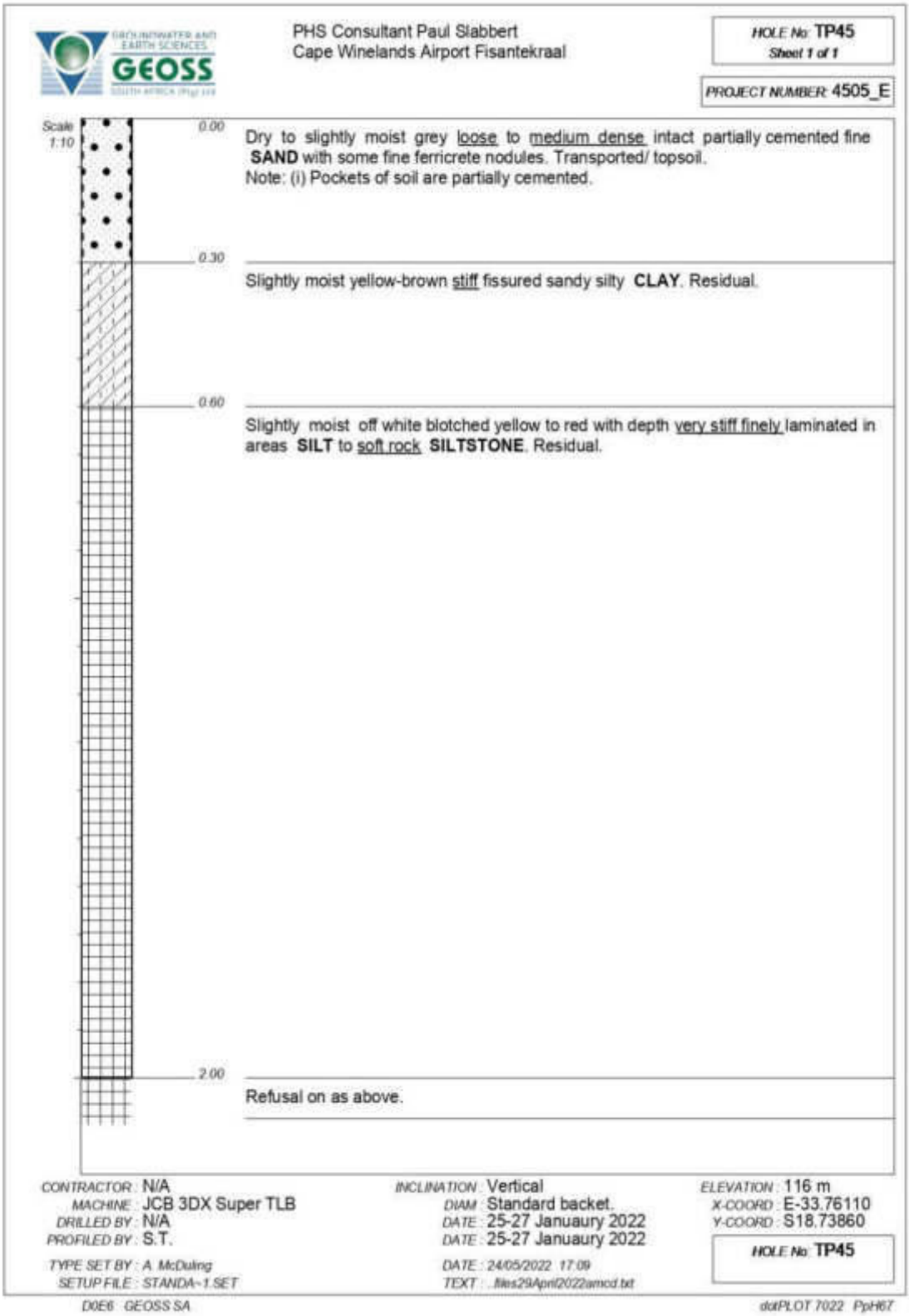

GEOSS
PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP40
Sheet 1 of 1
PROJECT NUMBER: 4505_E
Scale 1:10
0.00
Dry to slightly moist yellow-brown fine SAND with ferricrete gravel. Transported.
Note: Ferricrete concentration increases with depth.
0.45
Dry to slightly moist reddish-yellow-brown very dense partially cemented NODULAR FERRICRETE in a sandy matrix. Pendogenic.
0.60
Slightly moist reddish-orange firm to stiff fissured sandy SILT. Residual.
0.5--1.1
1.10
Yellow-brown completely weathered very fine grained laminated very thinly foliated very soft rock SILTSTONE.
Note: (i) TLB drove the bucket into the ground repeatedly, but still failed to penetrate.
2.10
Refusal on as above.
NOTES
1) Slow excavation.
2) Bulk sample 20001 extracted between 0.5--1.1 mbgl.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 24/05/2022 17:09
TEXT : ..files29April2022amod.txt
ELEVATION : 107 m
X-COORD : E-33.74140
Y-COORD : S18.73240
HOLE No: TP40
D0E6 GEOSS SA
dotPLOT 7022 PpH67

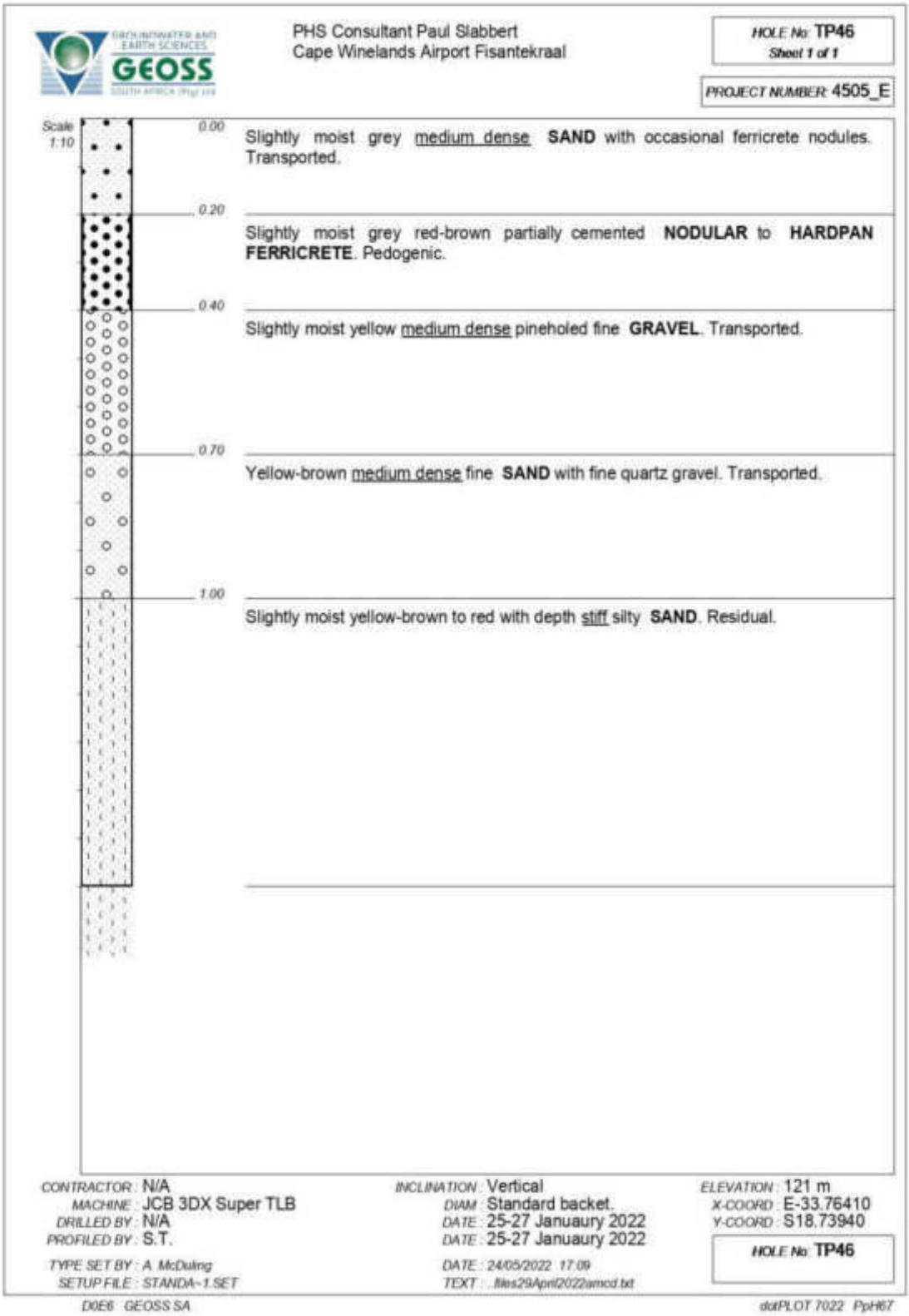

GEOSS
PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP41
Sheet 1 of 1
PROJECT NUMBER: 4505_E
Scale 1:10
0.00
Slightly moist grey-brown loose to medium dense fine SAND with occasional fine ferricrete nodules/gravels. Tranported.
0.30
Slightly moist yellow-brown stiff slightly shattered and pinholed fine sandy SILT with some gravel. Transported.
Note: Intense sidewall smear.
1.00
As above, but grades to completely weathered thinly foliated very soft rock SILTSTONE.
Note: (i) Discontinuities filled by clayey gauge. (ii) Grain size appears to decrease with depth.
NOTES
1) TLB drove the bucket into the ground repeatedly, with little success.
2) Slow excavation.
3) Intense sidewall smear.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 24/05/2022 17:09
TEXT : ..files29April2022amod.txt
ELEVATION : 89 m
X-COORD : E-33.74540
Y-COORD : S18.73690
HOLE No: TP41
D0E6 GEOSS SA
dotPLOT 7022 PpH67

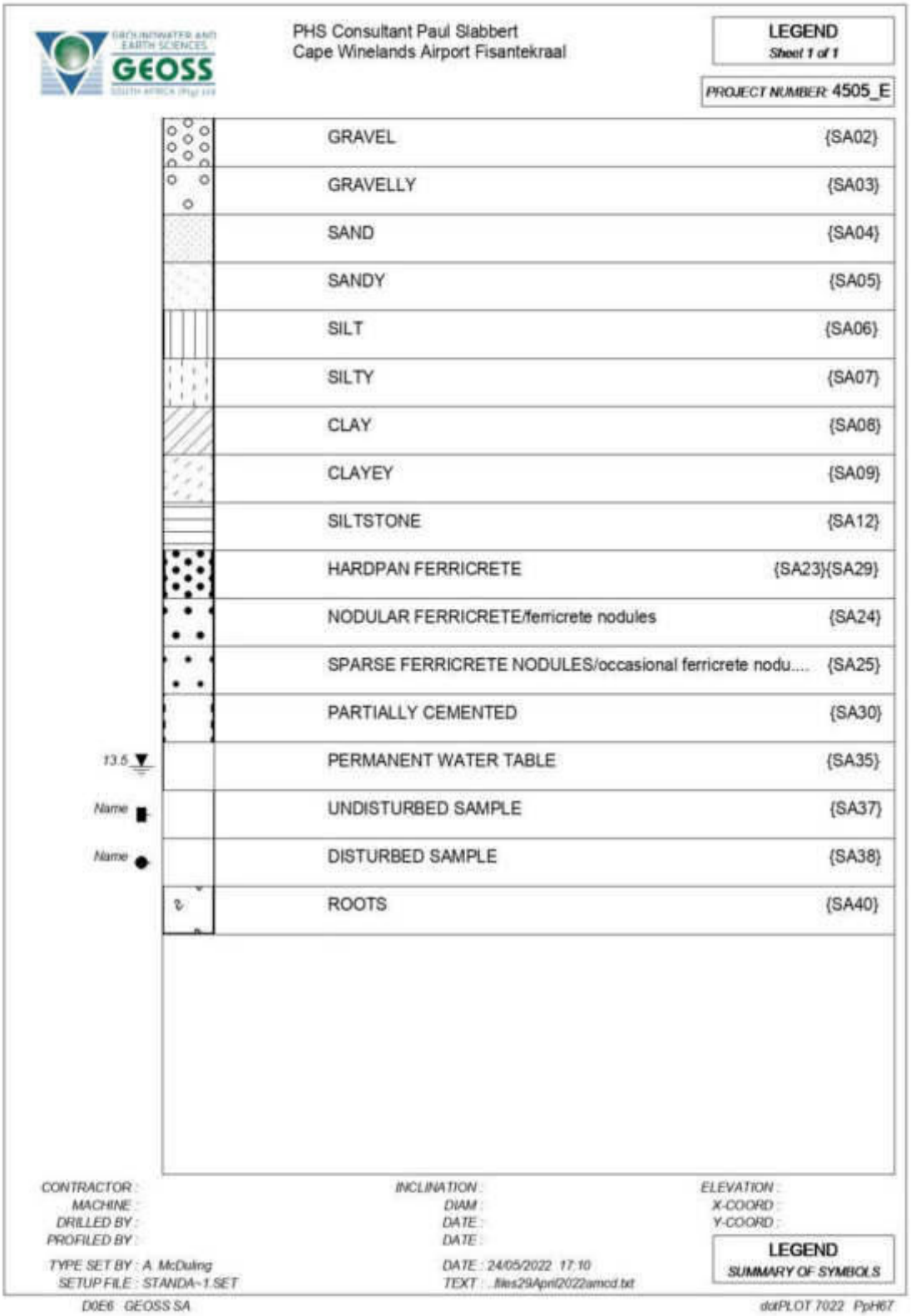

PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP42
Sheet 1 of 1
PROJECT NUMBER: 4505_E
Scale 1:10
0.00
Dry to slightly moist grey-brown loose to medium dense intact partially cemented fine SAND. Transported.
Note: (i) Contains ferricrete nodulules up to 2 cm in diameter.
0.30
Slightly moist brown dense intact partially cemented NODULAR FERRICRETE in a sandy matrix. Pendogenic.
Note: (i) Discontnuous lenses of soil, slightly more cemented pockets.
0.50
Slightly moist yellow blotched red-orange firm intact to pinholed sandy SILT. Residual.
Note: (i) Tends to silty sand and grades to highly weathered, very soft rock thinly foliated silstone. (ii) Intense sidewall smear.
0.8
1.90
Refusal on as above.
NOTES
1) Slow excavation.
2) TLB drive bucket into base of horizon yielding slight indents.
3) Unrestricted excavation penetration would likely be deeper.
4) Bulk sample 20002 extracted from 0.8 mbgl.
5) Undisturbed sample 20002 extracted from 0.8 mbgl. Conducted double oedometer test.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 24/05/2022 17:09
TEXT : ..files29April2022amod.txt
ELEVATION : 111 m
X-COORD : E-33.75170
Y-COORD : S18.73510
HOLE No: TP42
D0E6 GEOSS SA
dotPLOT 7022 PpH67


GEOSS
PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP43
Sheet 1 of 1
PROJECT NUMBER: 4505_E
Scale 1:10
0.00
Slightly moist grey-brown loose to medium dense intact to partially cemented fine SAND with some ferricrete nodules. Transported / topsoil.
Note: (i) Roots.
0.20
Slightly moist yellow-brown stiff fissured and pinholed slightly sandy SILT. Residual.
Note: (i) Pinholes likely due to bioturbation (up 8 mm in diameter).
0.40
Slightly moist grey blotched & streaked / stained yellow-orange stiff slightly shattered SILT. Residual.
Note: (i) Grades to completely weathered fine grained widely spaced foliations very soft rock siltstone with depth.
2.00
Refusal on as above.
NOTES
1) Slow excavation.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 24/05/2022 17:09
TEXT : ..files29April2022amod.txt
ELEVATION : 106 m
X-COORD : E-33.75480
Y-COORD : S18.74090
HOLE No: TP43
D0E6 GEOSS SA
dotPLOT 7022 PpH67


PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP44
Sheet 1 of 1
PROJECT NUMBER: 4505_E
Scale 1:10
0.00
Slightly moist grey to yellow-brown loose to medium dense intact partially cemented fine SAND. Transported / topsoil.
0.30
Dry to slighly moist yellow blotched red pinholed silty SAND. Transported/Pedogenic.
Note: (i) Brown sand inclusions near base.
0.90
Slightly moist white blotched red & orange firm to stiff slightly shattered sandy SILT. Residual.
Note: (i) This horizon was easy to excavate (relative to above horizon). (ii) Appeared slickensided in places.
NOTES
1) Slow excavation - Could be ripped by dozer & transported with TLB.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 24/05/2022 17:09
TEXT : ..files29April2022amod.txt
ELEVATION : 104 m
X-COORD : E-33.75960
Y-COORD : S18.74200
HOLE No: TP44
D0E6 GEOSS SA
dotPLOT 7022 PpH67


GEOSS
PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP45
Sheet 1 of 1
PROJECT NUMBER: 4505_E
Scale 1:10
0.00
Dry to slightly moist grey loose to medium dense intact partially cemented fine SAND with some fine ferricrete nodules. Transported/ topsoil.
Note: (i) Pockets of soil are partially cemented.
0.30
Slightly moist yellow-brown stiff fissured sandy silty CLAY. Residual.
0.60
Slightly moist off white blotched yellow to red with depth very stiff finely laminated in areas SILT to soft rock SILTSTONE. Residual.
2.00
Refusal on as above.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 24/05/2022 17:09
TEXT : ..files29April2022amod.txt
ELEVATION : 116 m
X-COORD : E-33.76110
Y-COORD : S18.73860
HOLE No: TP45
D0E6 GEOSS SA
dotPLOT 7022 PpH67


GEOSS
PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
HOLE No: TP46
Sheet 1 of 1
PROJECT NUMBER: 4505_E
Scale 1:10
0.00
Slightly moist grey medium dense SAND with occasional ferricrete nodules. Transported.
0.20
Slightly moist grey red-brown partially cemented NODULAR to HARDPAN FERRICRETE. Pedogenic.
0.40
Slightly moist yellow medium dense pineholed fine GRAVEL. Transported.
0.70
Yellow-brown medium dense fine SAND with fine quartz gravel. Transported.
1.00
Slightly moist yellow-brown to red with depth stiff silty SAND. Residual.
CONTRACTOR : N/A
MACHINE : JCB 3DX Super TLB
DRILLED BY : N/A
PROFILED BY : S.T.
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
INCLINATION : Vertical
DIAM : Standard backet.
DATE : 25-27 Januaury 2022
DATE : 25-27 Januaury 2022
DATE : 24/05/2022 17:09
TEXT : ..files29April2022amod.txt
ELEVATION : 121 m
X-COORD : E-33.76410
Y-COORD : S18.73940
HOLE No: TP46
D0E6 GEOSS SA
dotPLOT 7022 PpH67


GEOSS
PHS Consultant Paul Slabbert
Cape Winelands Airport Fisantekraal
LEGEND
Sheet 1 of 1
PROJECT NUMBER 4505_E
GRAVEL {SA02}
GRAVELLY {SA03}
SAND {SA04}
SANDY {SA05}
SILT {SA06}
SILTY {SA07}
CLAY {SA08}
CLAYEY {SA09}
SILTSTONE {SA12}
HARDPAN FERRICRETE {SA23}{SA29}
NODULAR FERRICRETE/ferricrete nodules {SA24}
SPARSE FERRICRETE NODULES/occasional ferricrete nodu.... {SA25}
PARTIALLY CEMENTED {SA30}
13.5
PERMANENT WATER TABLE {SA35}
Name
UNDISTURBED SAMPLE {SA37}
Name
DISTURBED SAMPLE {SA38}
ROOTS {SA40}
CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY :
INCLINATION :
DIAM :
DATE :
DATE :
ELEVATION :
X-COORD :
Y-COORD :
LEGEND
SUMMARY OF SYMBOLS
TYPE SET BY : A. McDuling
SETUP FILE : STANDA~1.SET
DATE : 24/05/2022 17:10
TEXT : ..files29April2022amod.txt
D0E6 GEOSS SA
dotPLOT 7022 PpH67

11. APPENDIX C: SUPPORTING PHOTOS

Figure 17: Close-up of TP01. Note cohesive nature of the material in the foreground, and the fine gravelly nature of material above refusal surface, i.e. next to hammer.

Figure 18: TP02 - Close-up of sidewall showing hardpan ferricrete refusal surface, note thin humified horizon on surface.

Figure 19: TP02 - Close-up of ferricrete nodules encountered near base of trial pit.

Figure 20: TP03 - Close up of sidewall; note nodular ferricrete grading to very dense hardpan ferricrete refusal surface.

Figure 21: TP04 – Nodular to hardpan ferricrete.

Figure 22: TP04: Close-up of trial pit sidewall. Note cemented nature of nodular ferricrete above hammer, and texture of sidewall 'smear' beneath hammer; sand- to clay- dominated with depth.

Figure 23: TP04 - Close-up of lower sandy clayey silt near base of trial pit.

Figure 24: TP04 – Close-up of sandy clayey silt spoil.

Figure 25: TP05 – Close-up of trial pit sidewall. Note pinch out of nodular ferricrete horizon, and pinholed nature of gravel horizon near base of hammer. Sidewall smear near base indicating high fines content.

Figure 26: TP05 – ferricrete nodules scattered on surface.

Figure 27: TP06 – Close-up of spoil excavated from lower-most sandy clayey silt horizon.

Figure 28: TP07 – Close-up of spoil excavated from residual horizon.

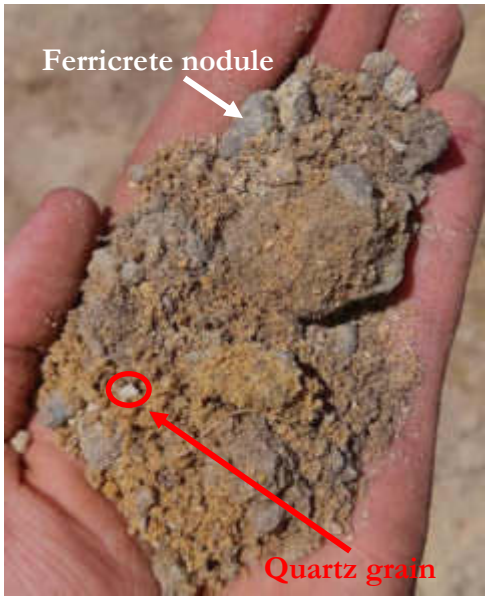


Figure 29: TP07 – Close-up of spoil from residual horizon; note angular nature of grains. Rounded grains are ferricrete.

Figure 30: TP08 – Close-up of upper transported sand horizon.

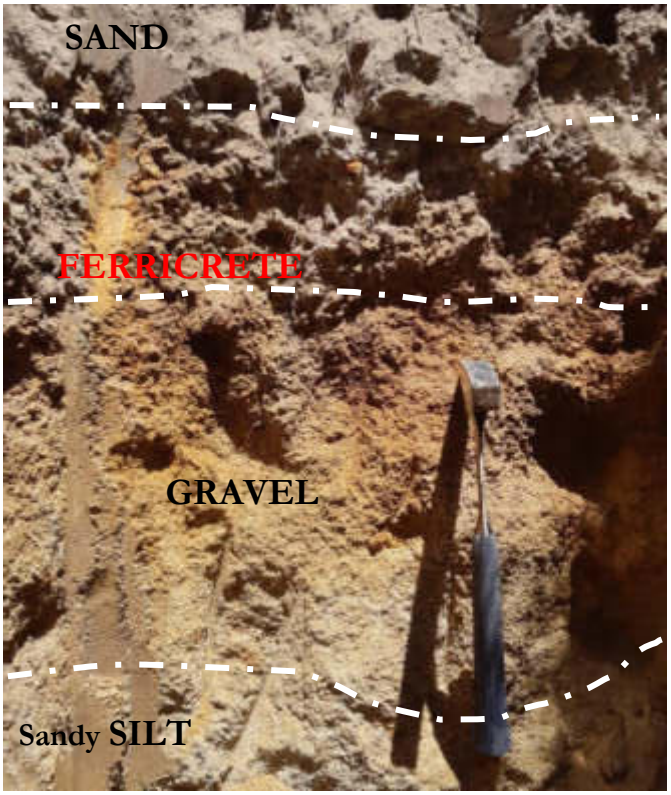


Figure 31: TP08 – Close-up of partially cemented pinholed sandy fine gravel horizon beneath nodular ferricrete. Note there is large variation in thickness of the ferricrete horizon (between 0.3 and 0.8 m thick).

Figure 32: TP10 – Close up of bottom of trial pit; note sidewall smear near base of trial pit.

Figure 33: TP10 – Close up of bottom of ferricrete nodules strewn across surface surrounding trial pit; exposed soil profile pictured on LHS of photograph.

Figure 34: TP11 – Close-up of spoil pile of ferricrete nodules excavated from trial pit.

Figure 35: TP11 – Close-up of ferricrete nodule; note angular nature of grains stuck to nodule.

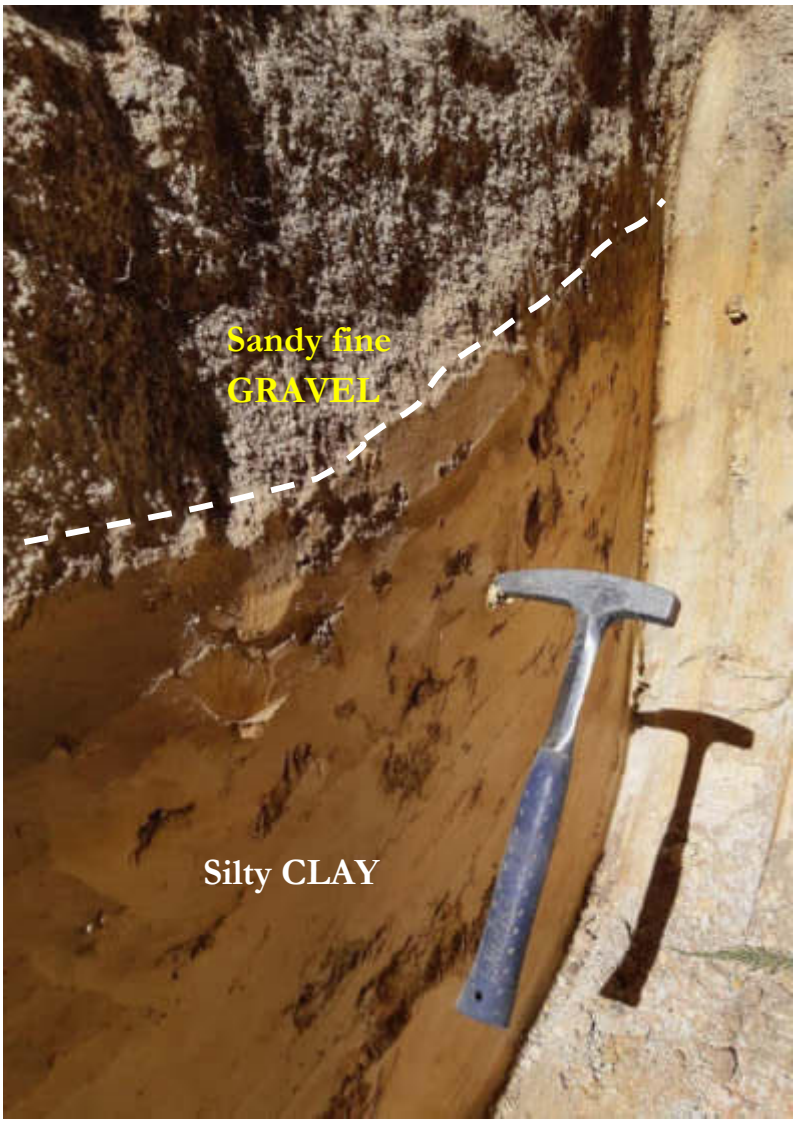


Figure 36: TP13 – Close-up of sidewall smear in silty clay residual horizon.

Figure 37: TP14 – Close-up of ferricrete boulders excavated from nodular ferricrete horizon.

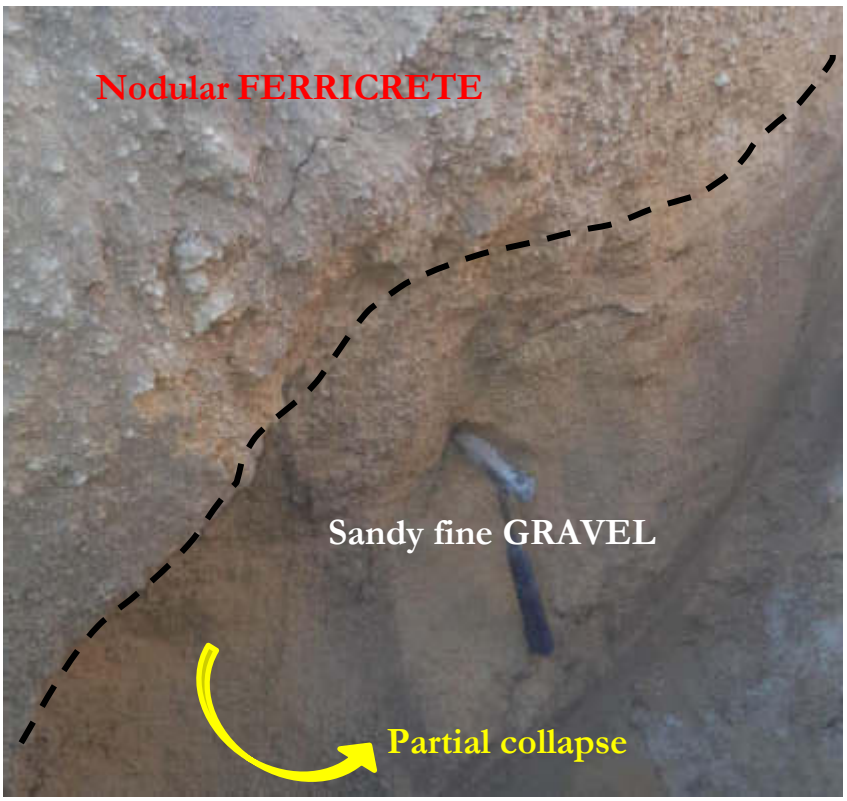


Figure 38: TP14 – Partial collapse of trial pit sidewall within the pinholed sandy fine gravel horizon; prior to water level rise.

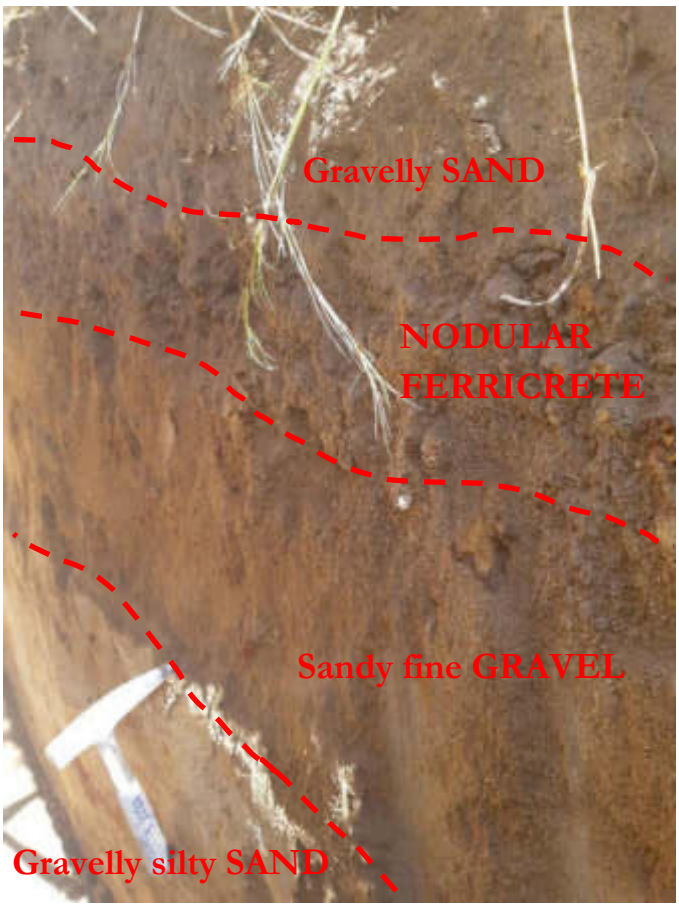


Figure 39: TP15 – Close-up of trial pit sidewall showing various horizons encountered.

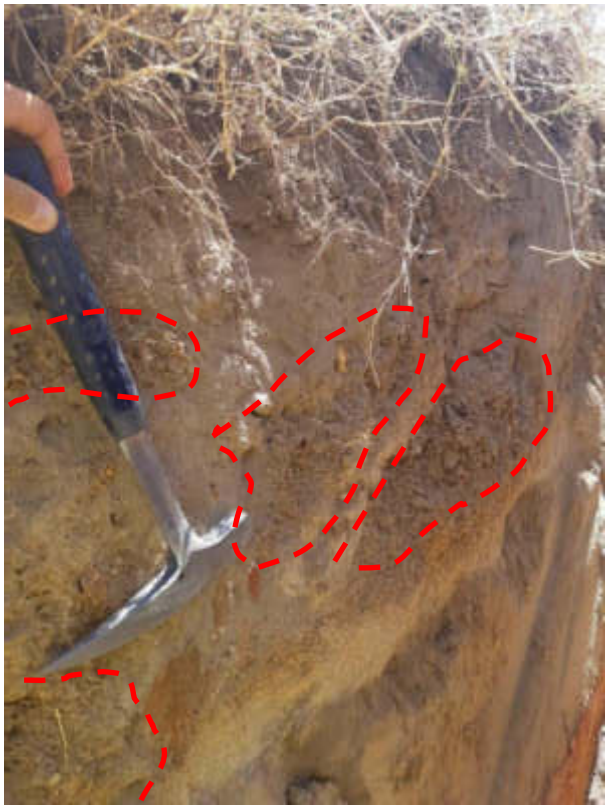


Figure 40: TP16 – Close-up of trial pit sidewall showing pockets of ferricrete nodules (annotated in red).

Figure 41: TP16 – Close-up of trial pit sidewall showing variation in 'smear' texture; material becomes less sandy toward base. Upon close inspection sandy grains are angular suggesting in-situ weathering.

Figure 42: TP18 – Close-up of trial pit upper surface of red-orange-brown nodular ferricrete horizon prior to excavation through to silty clay residual horizon.

Figure 43: TP19 – Close-up of trial pit floor; note metallic coating on base of trial pit.

Figure 44: TP21 – GEOSS team conducting DCP test beneath nodular ferricrete horizon. White clay-silt Corrobrick material pictured in the background.

Figure 45: TP22 – Close-up of transported gravelly sand horizon.

Figure 46: TP22 – Close-up of nodular ferricrete spoil pile; note this material excavated out in boulder-form occasionally. Excavation slow and time consuming.

Figure 47: TP22 – Close-up of spoil of silty clay material of the residual horizon; note blocky form of material in foreground - evidence of relict foliations.

Figure 48: TP27 – Close-up of soil profile; note the highly pinholed nature of fine gravel horizon near base of trial pit.

Figure 49: TP28 – Ferricrete boulders (approx. 300 mm in diameter) excavated from pedogenic hardpan ferricrete horizon.

Figure 50: TP29 – Close-up of trial pit sidewall; note occasional indurated ferricrete boulders in upper-most horizon. Intense sidewall 'smear' in residual clayey sandy silt horizon.

Figure 51: TP29 – Close-up of spoil of residual sandy silt horizon.

Figure 52: TP32 – Close-up of pin holed nature of transported material; likely due to bioturbation.

Figure 53: TP32 – Close-up of orange blotched red residual horizon.

Figure 54: TP43 – Close-up of voided/bioturbated residual material.

Figure 55: TP44 – Close-up of slightly smoothed/slickensided surface of residual material encountered in trial pit.

Figure 56: Corner down type crack possibly related to potentially expansive nature of subsoils; stable structure located between TP18 and TP15.

Figure 57: Vertical crack possibly related to potentially expansive nature of subsoils; storage structure located between TP18 and TP15.

Figure 58: Ferricrete outcrop exposed in northern portion of the site near TP36.

Figure 59: Fill dumped in drainage in northern portion of the site intended for future development.

Figure 60: View of JCB 3DX Super Tractor Loader Backhoe excavating a trial pit near the central portion of the site.

Figure 61: Close-up of TLB bucket tines used for conducting reconnaissance investigation.

12. APPENDIX D: DCP TESTING LOGS

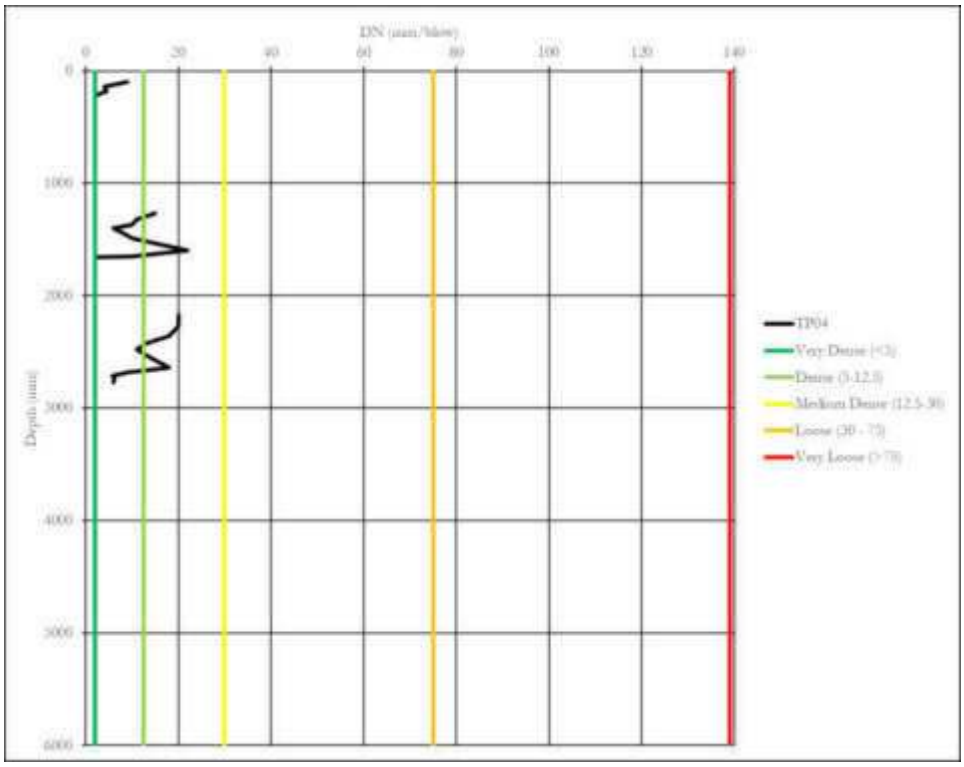


Figure 62: DCP04 Log.

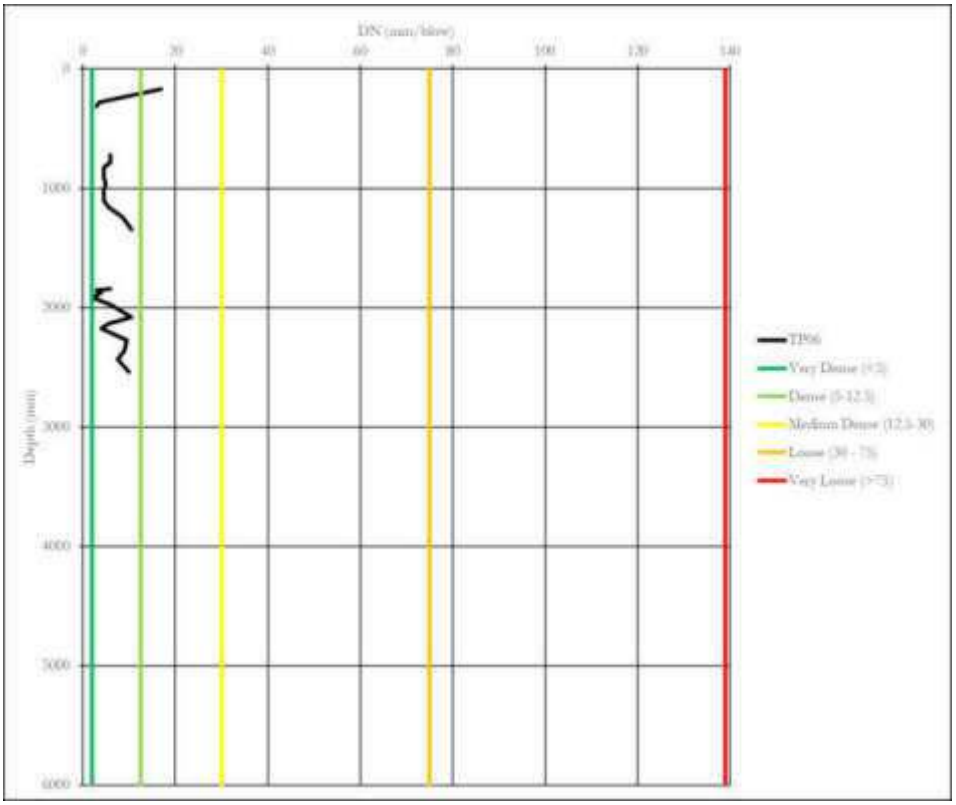


Figure 63: DCP06 Log.

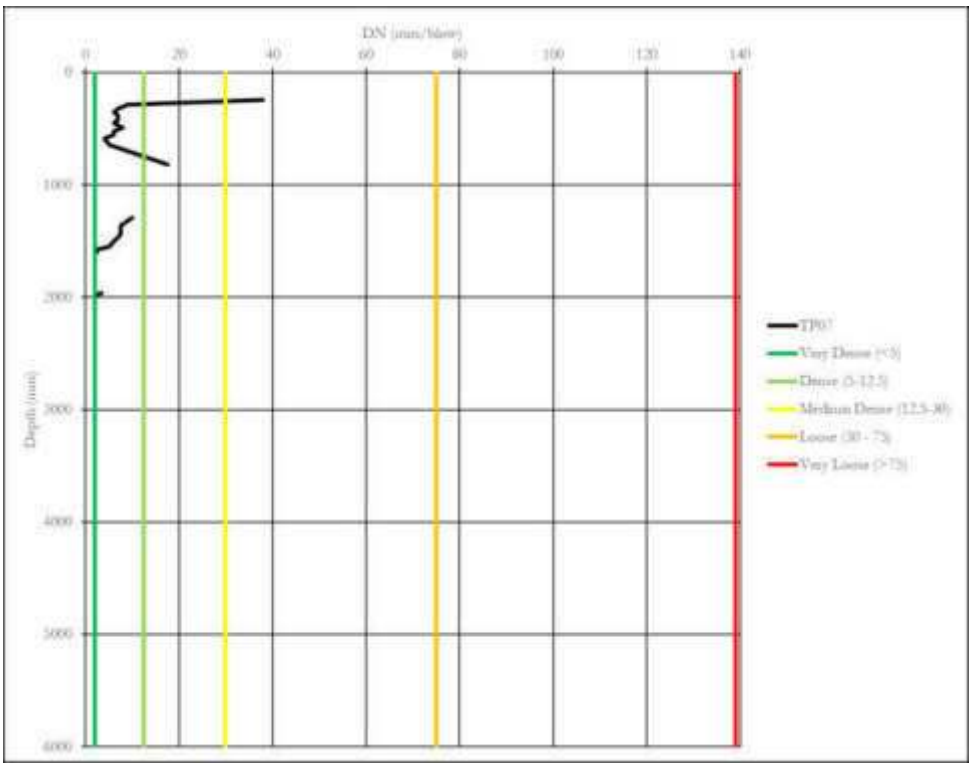


Figure 64: DCP07 Log.

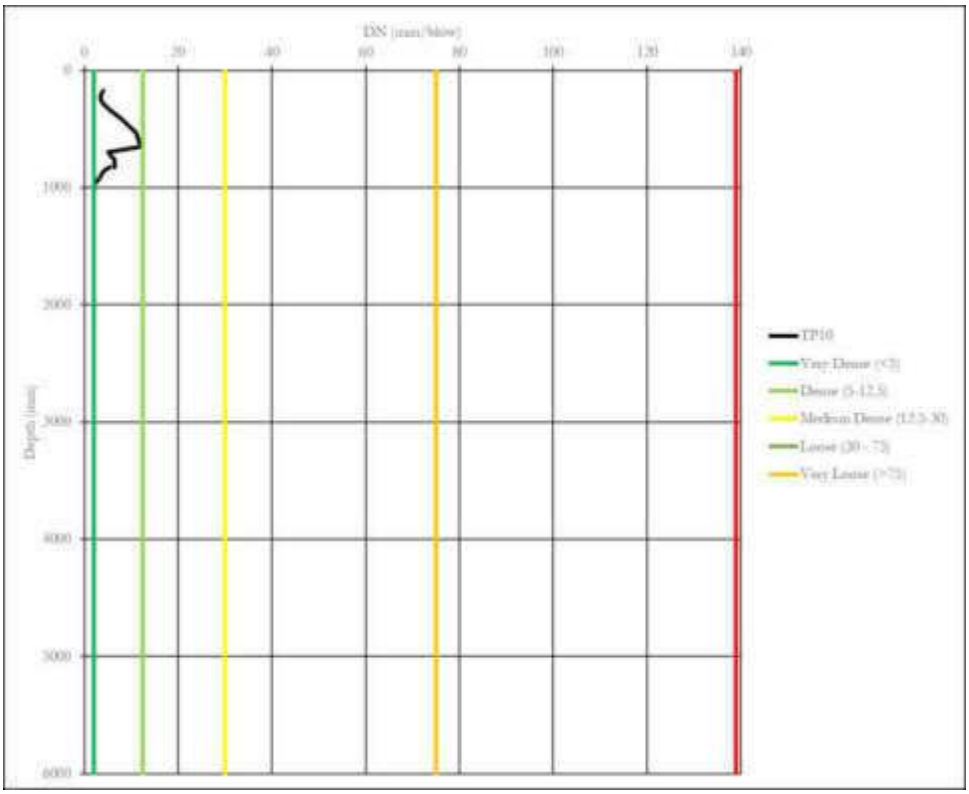


Figure 65: DCP10 Log.

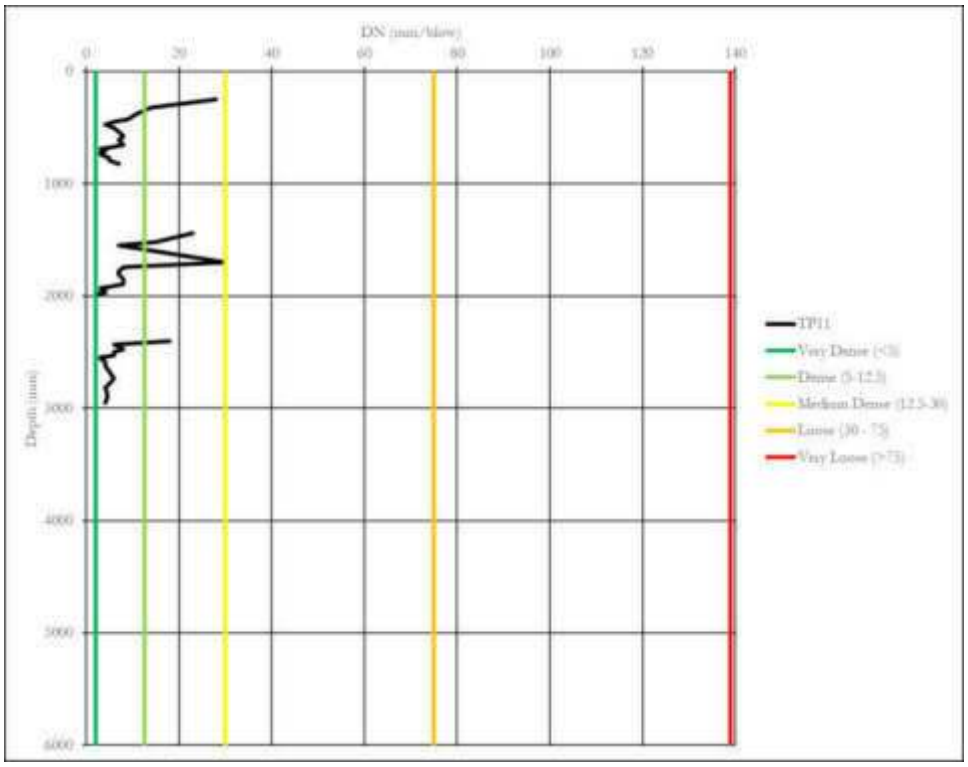


Figure 66: DCP11 Log.

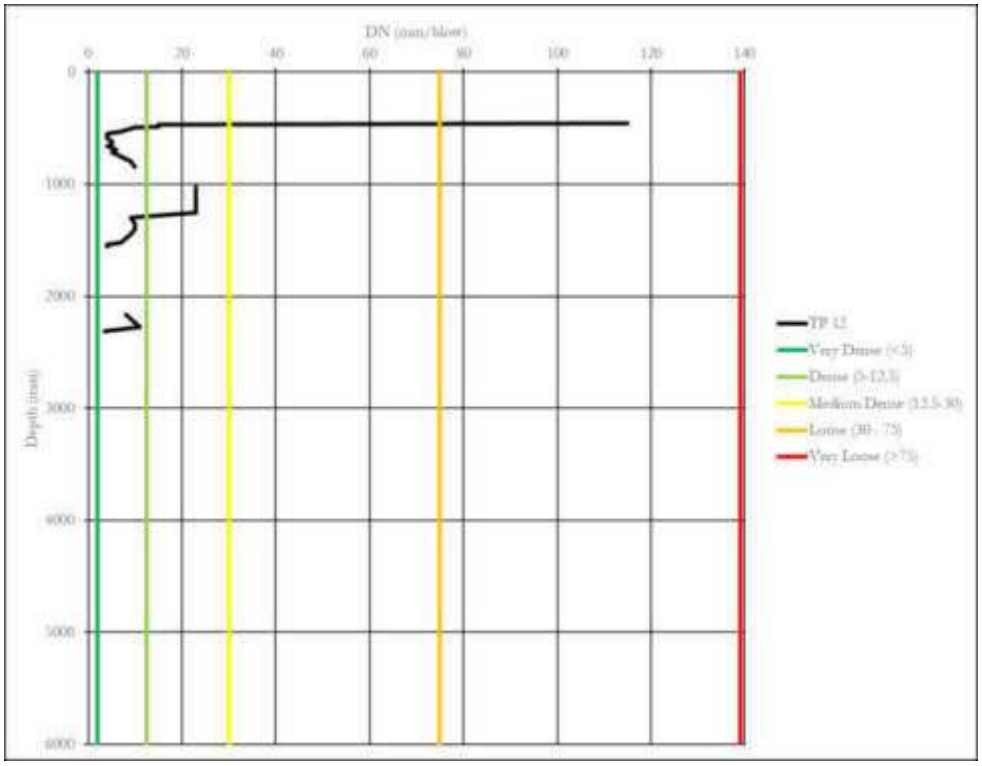


Figure 67: DCP12 Log.

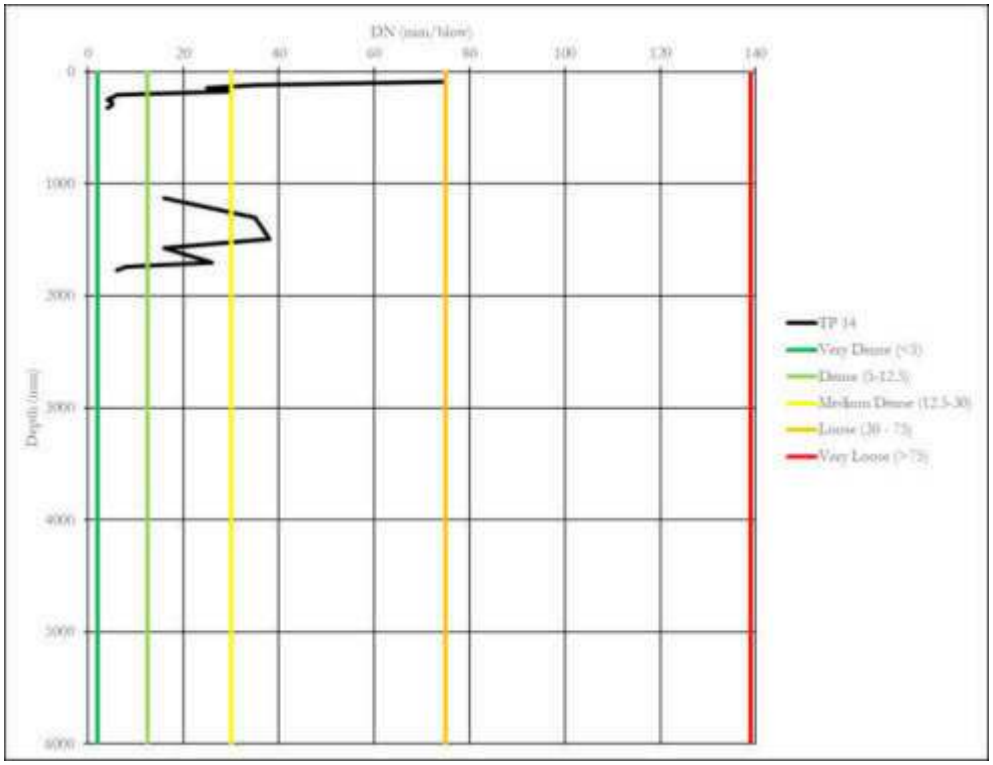


Figure 68: DCP14 Log.

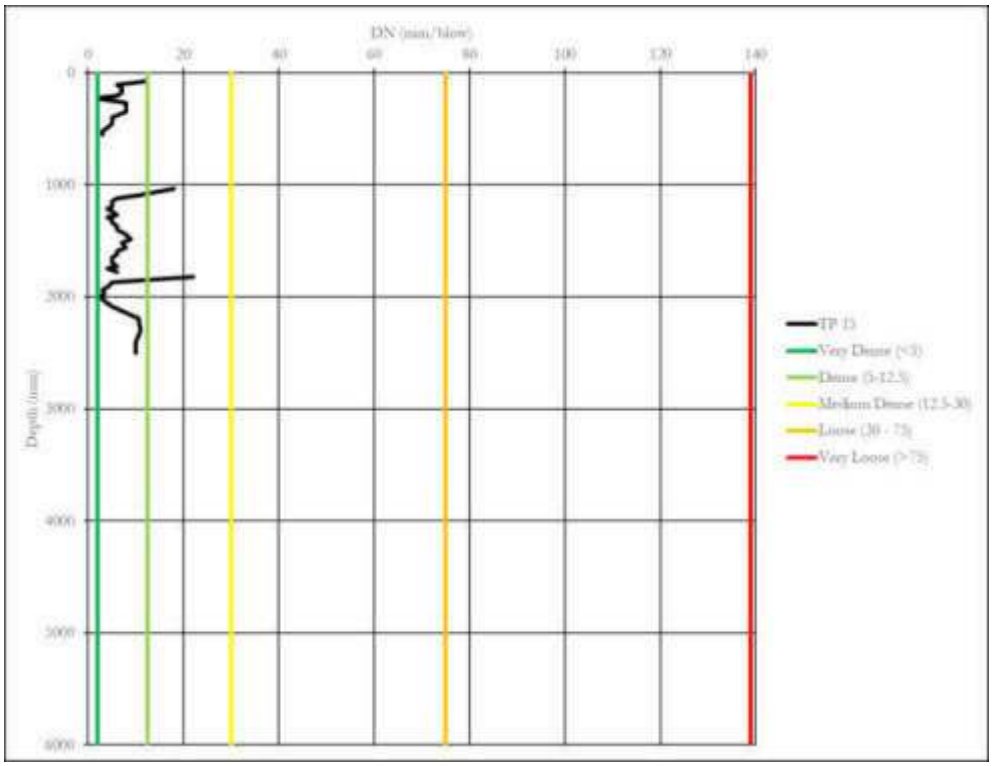


Figure 69: DCP15 Log.

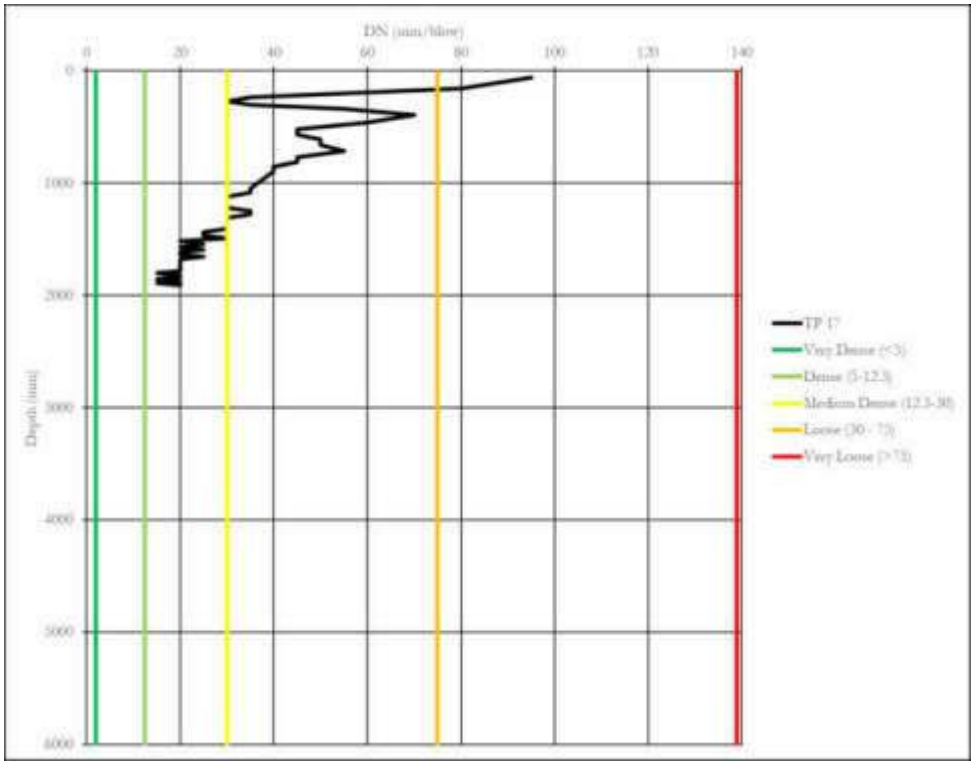


Figure 70: DCP17 Log.

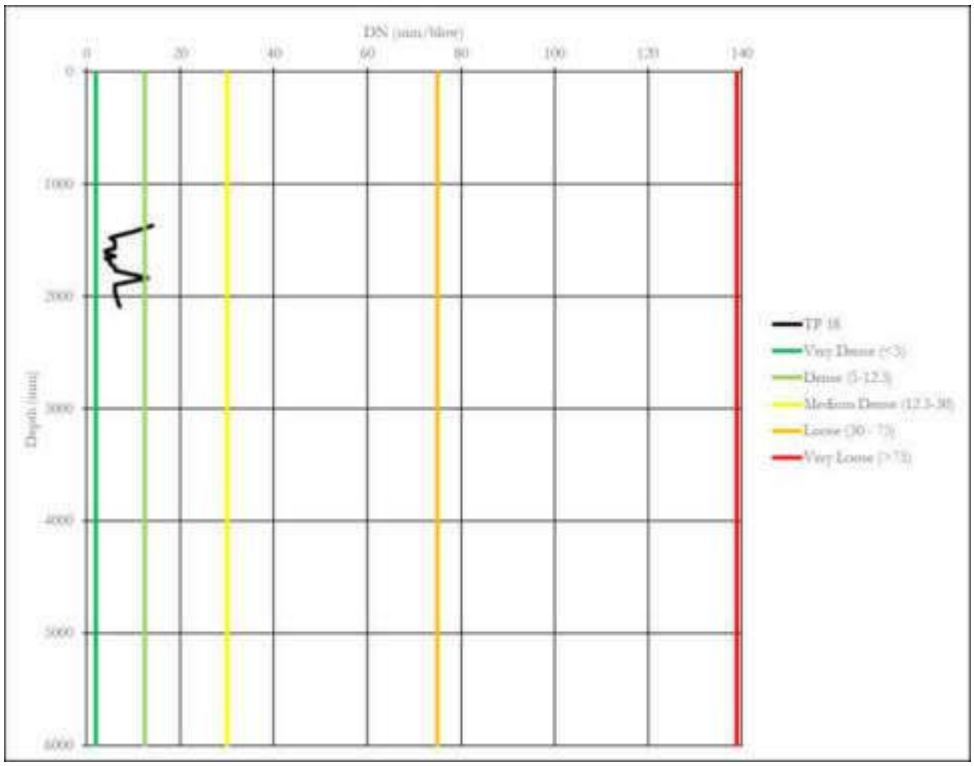


Figure 71: DCP18 Log.

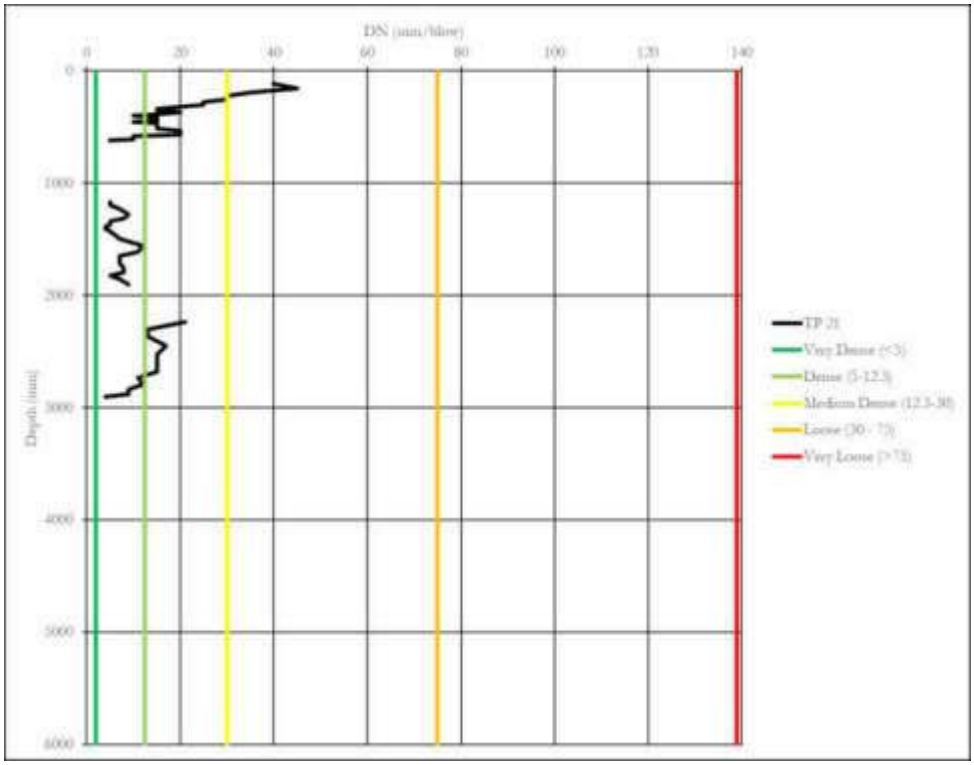


Figure 72: DCP21 Log.

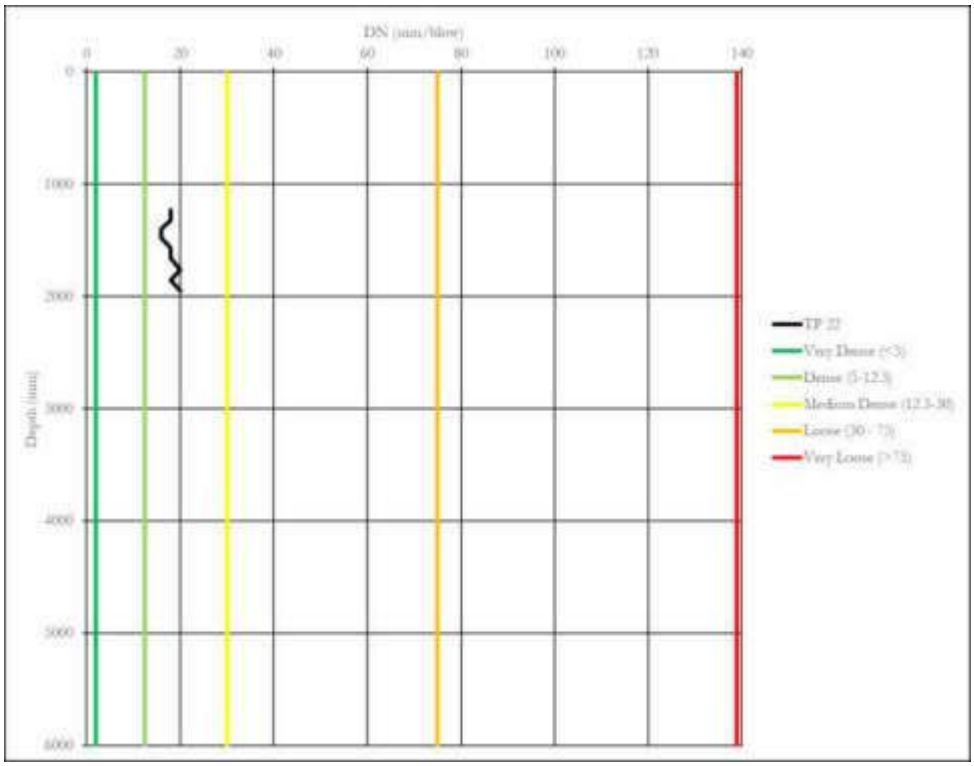


Figure 73: DCP22 Log.

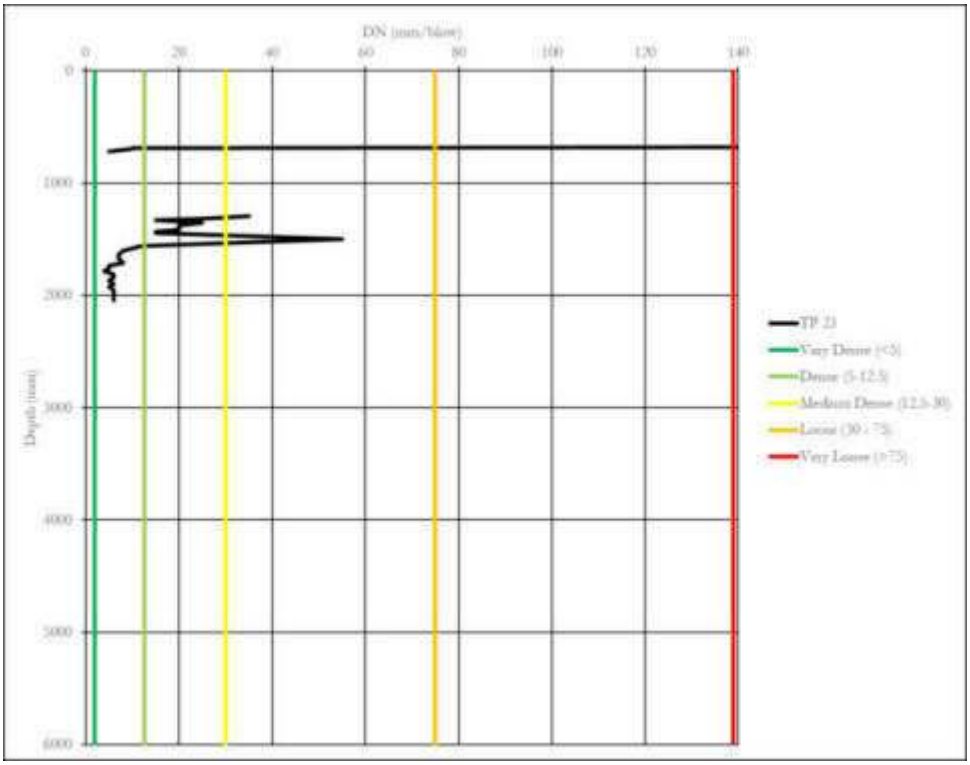


Figure 74: DCP23 Log.

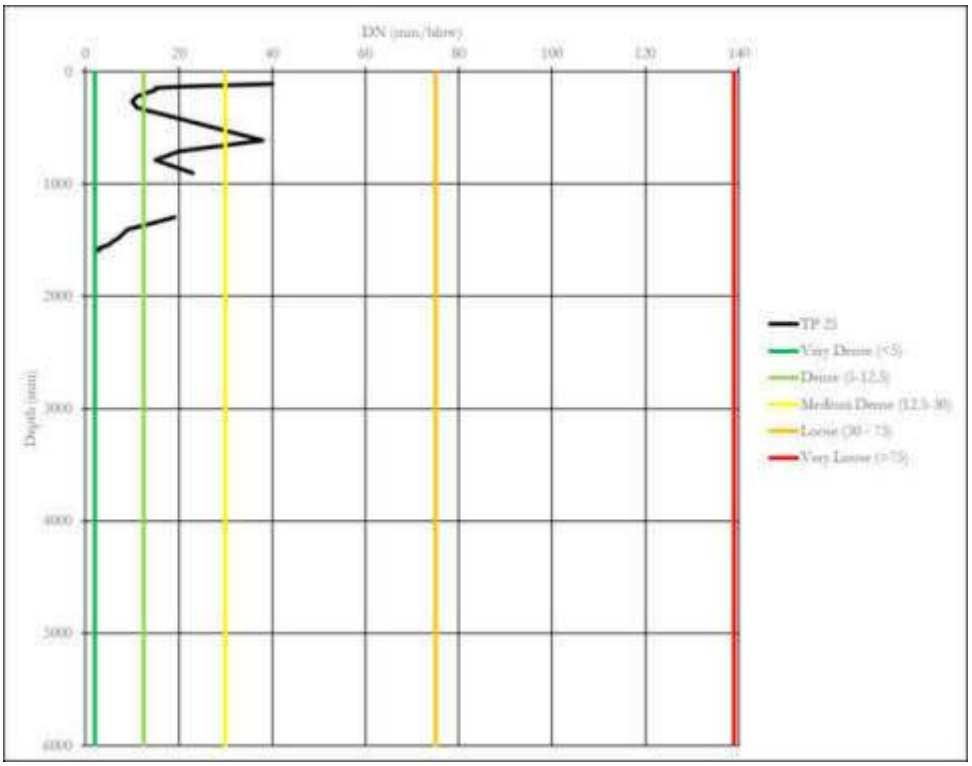


Figure 75: DCP25 Log.

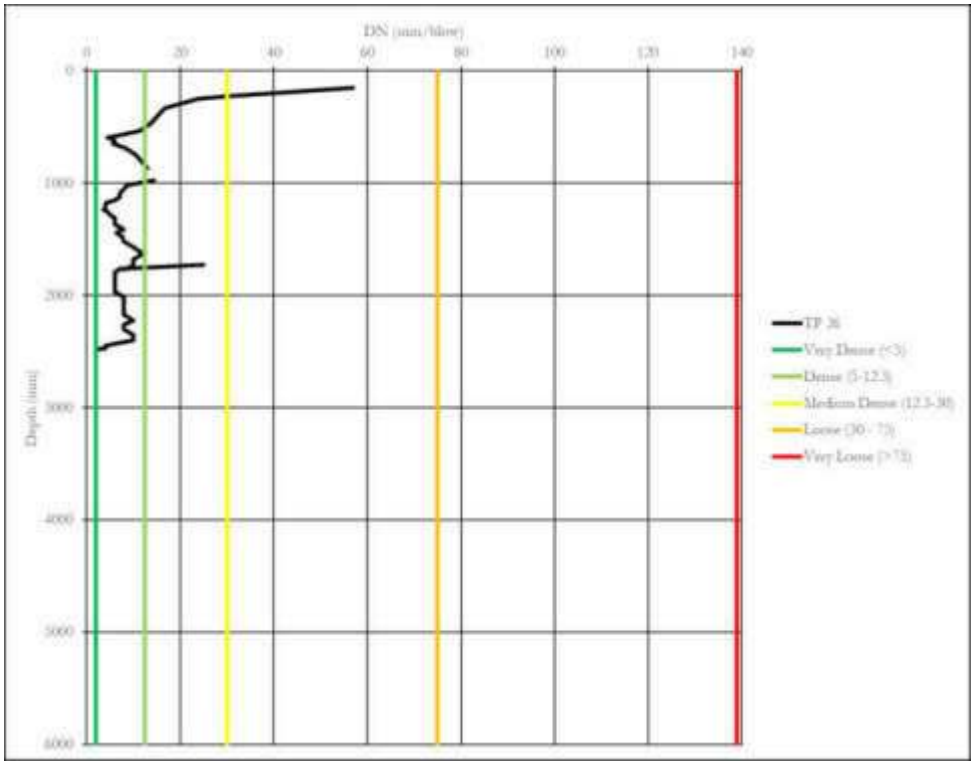


Figure 76: DCP26 Log.

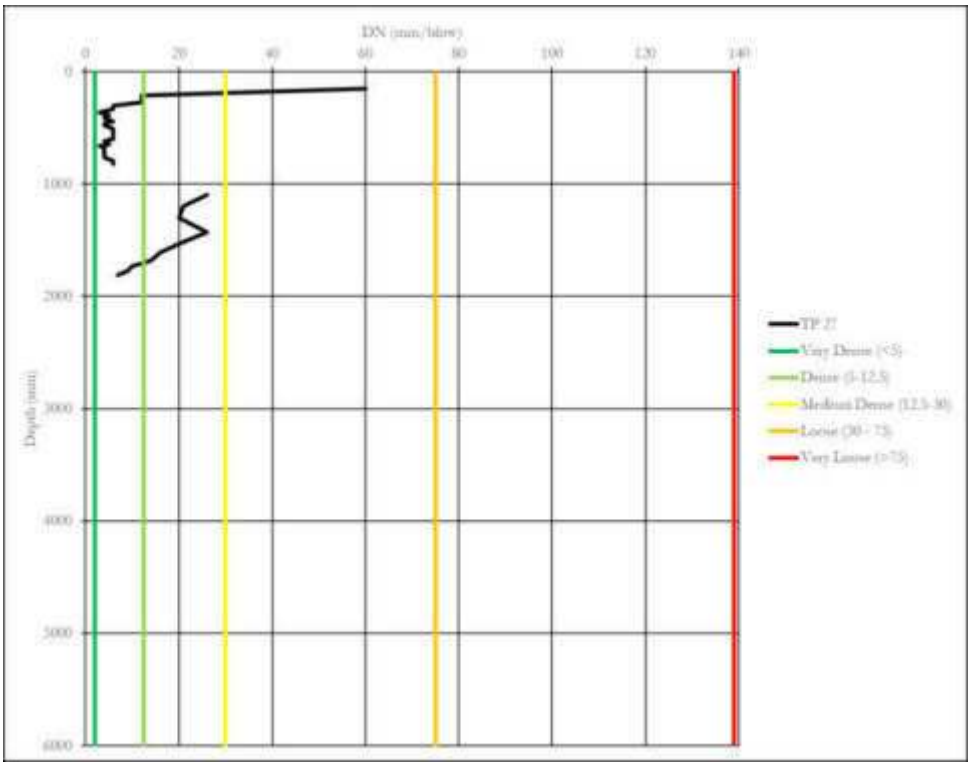


Figure 77: DCP27 Log.

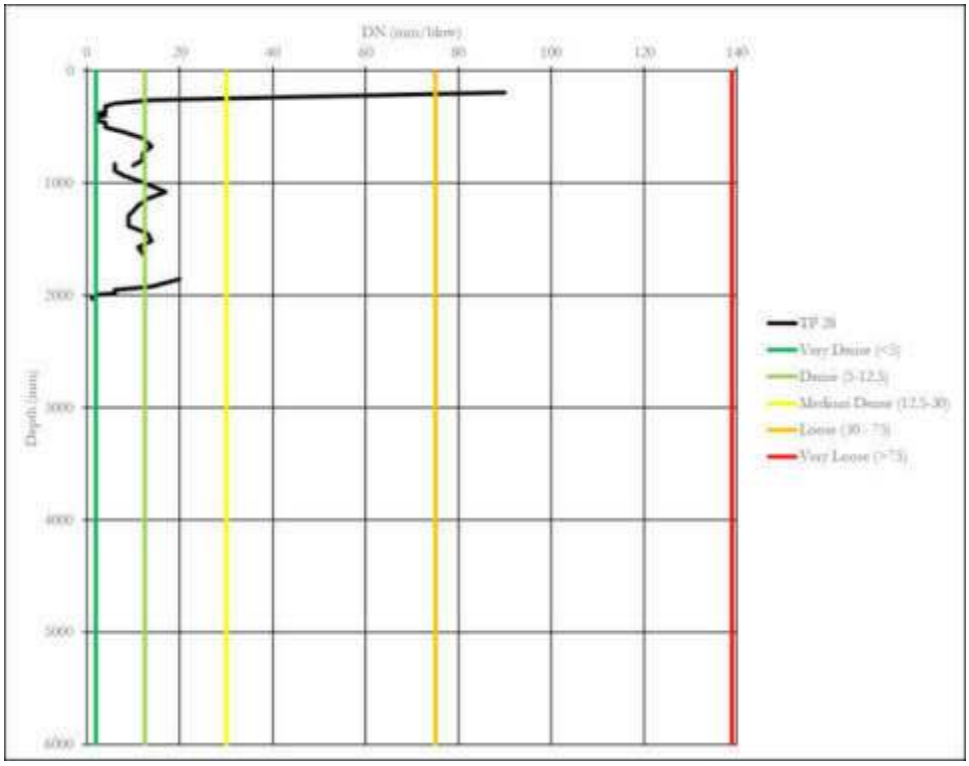


Figure 78: DCP28 Log.

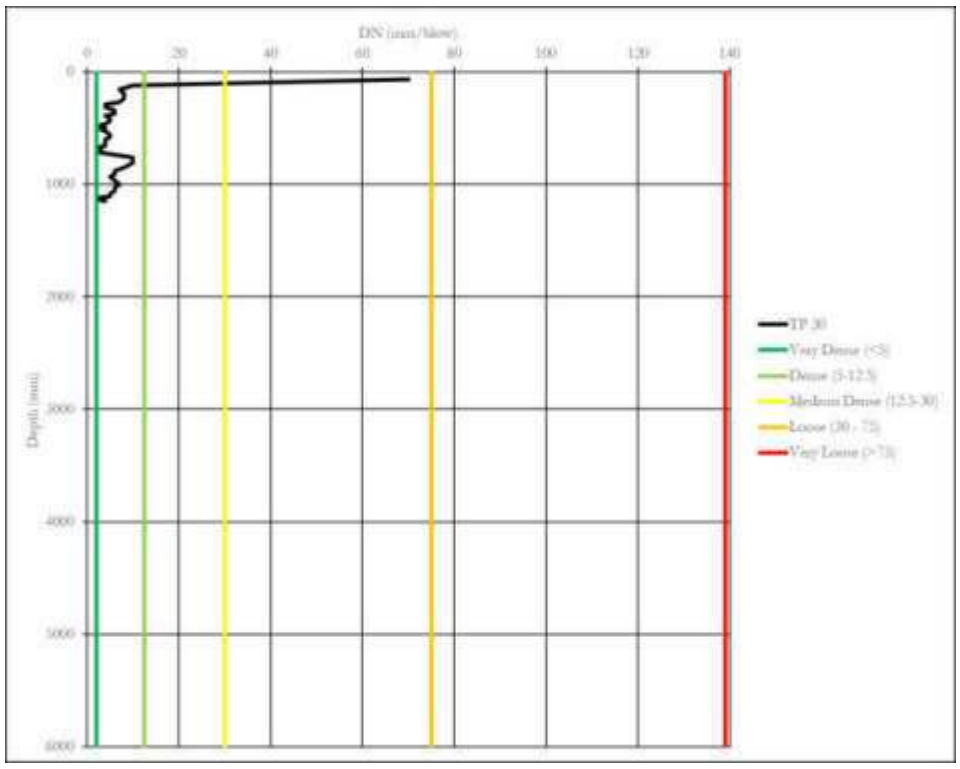


Figure 79: DCP30 Log.

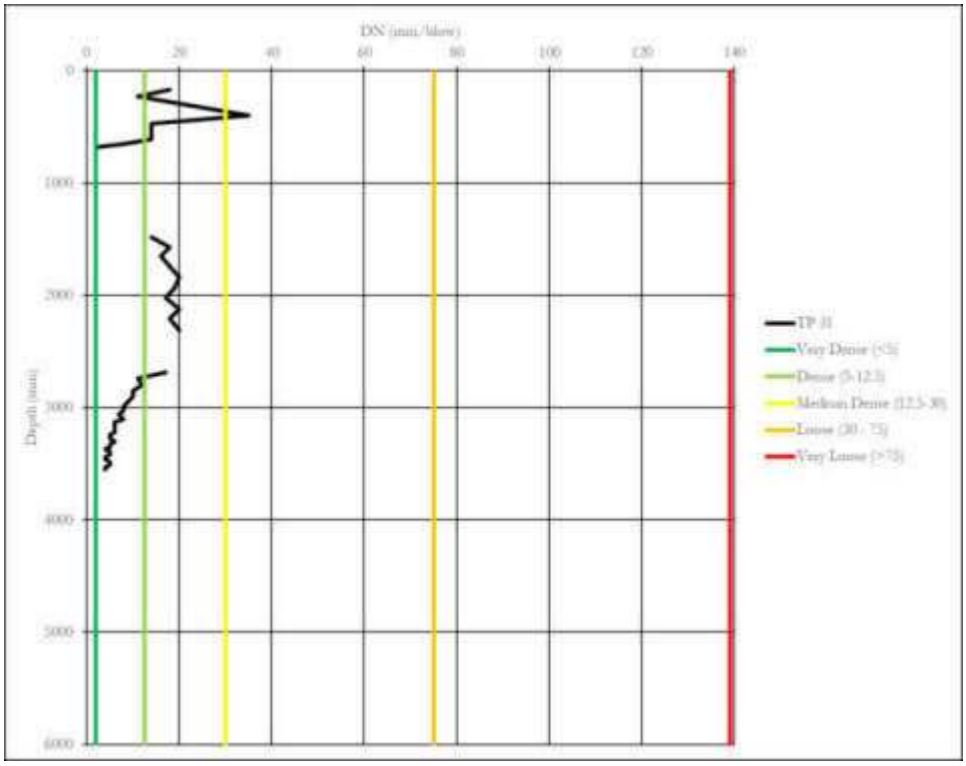


Figure 80: DCP31 Log.

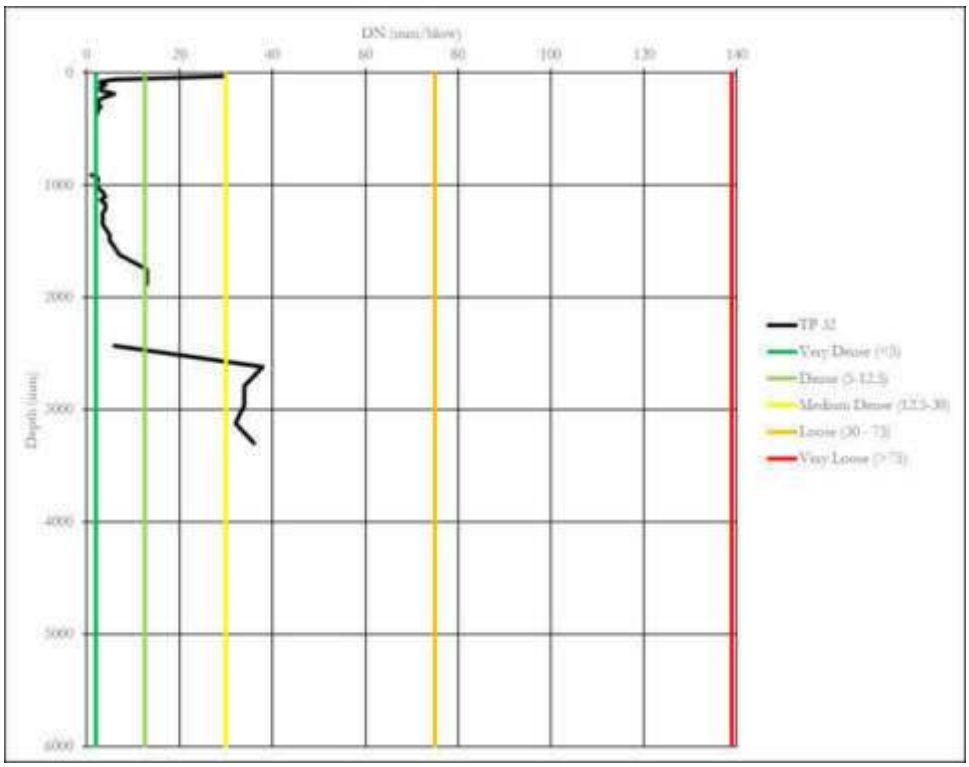


Figure 81: DCP32 Log.

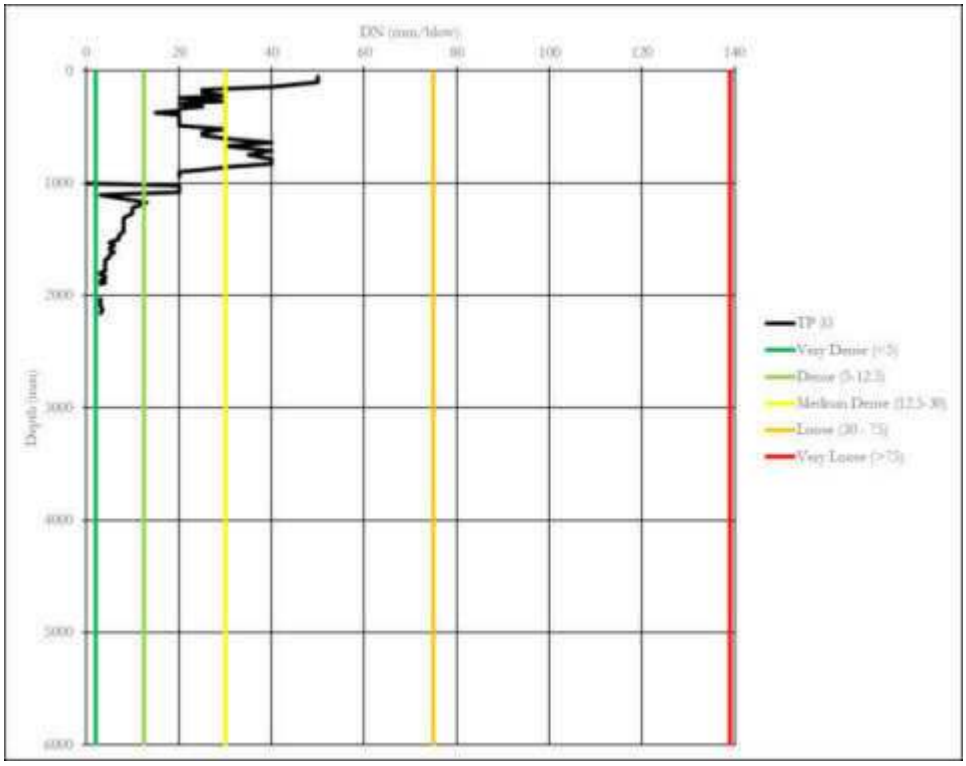


Figure 82: DCP33 Log.

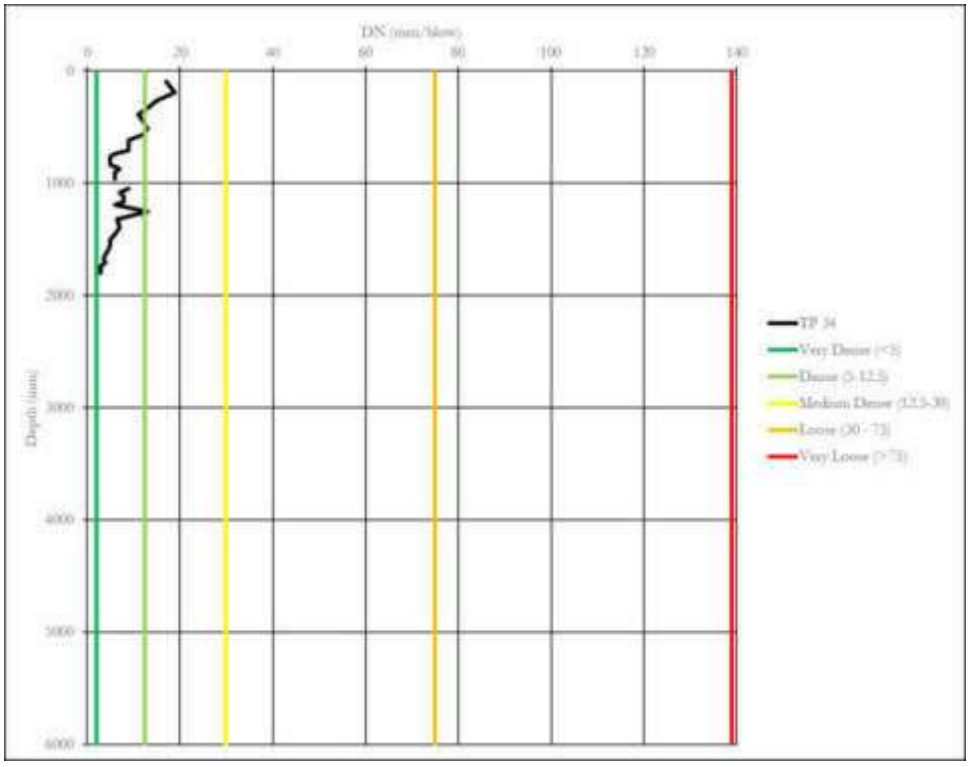


Figure 83: DCP34 Log.

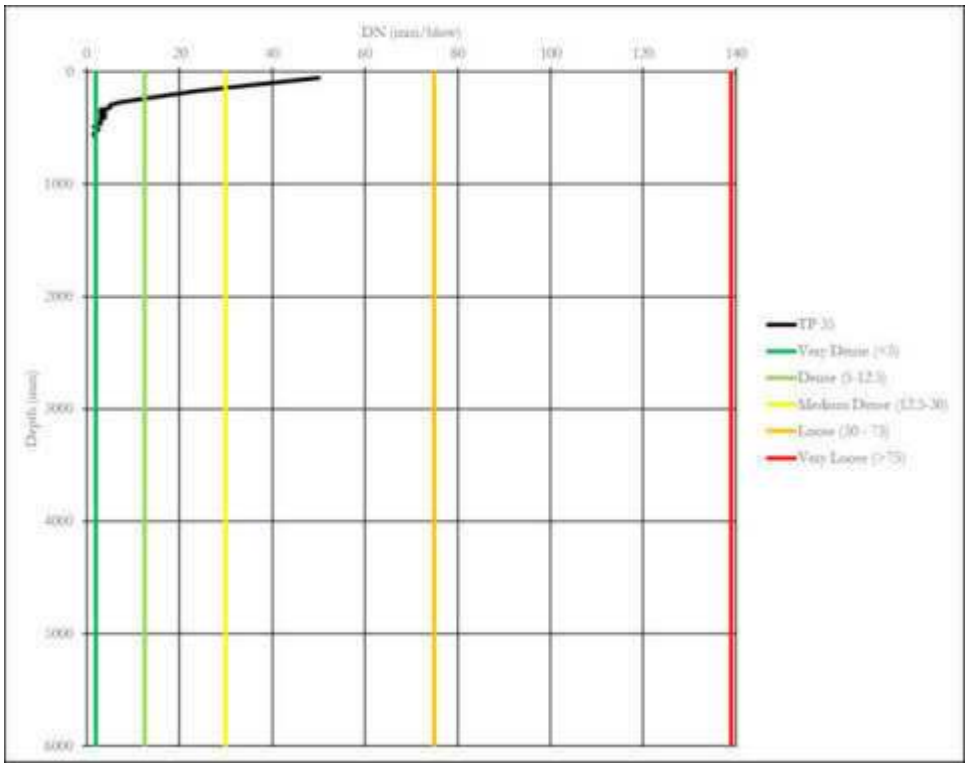


Figure 84: DCP35 Log.

Figure 85: DCP36 Log.

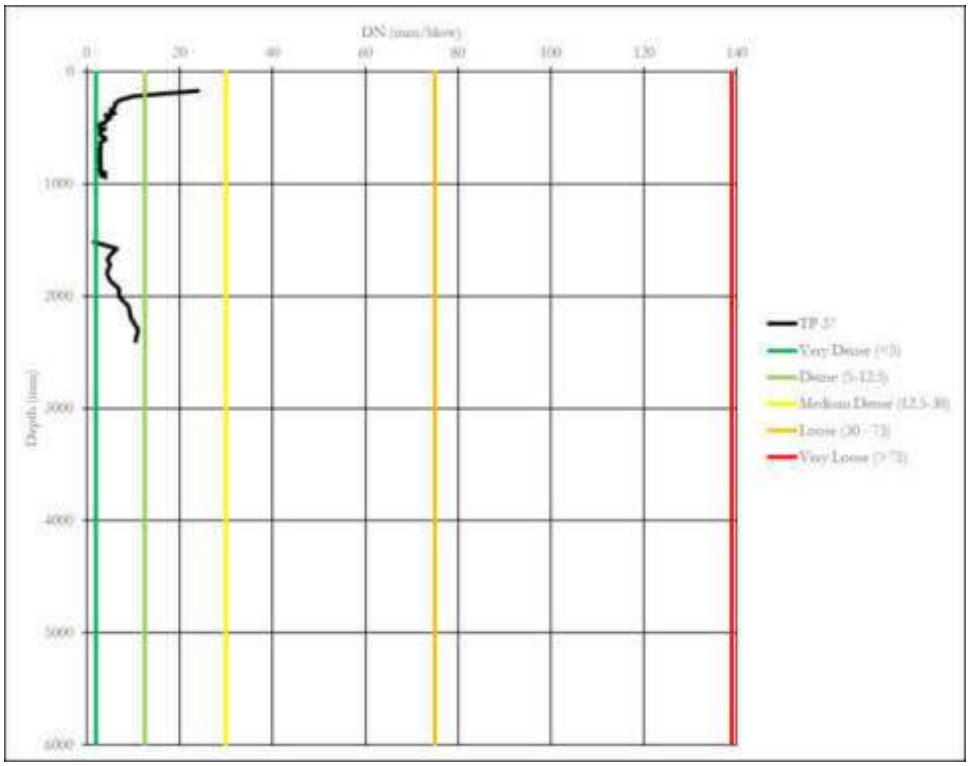


Figure 86: DCP37 Log.

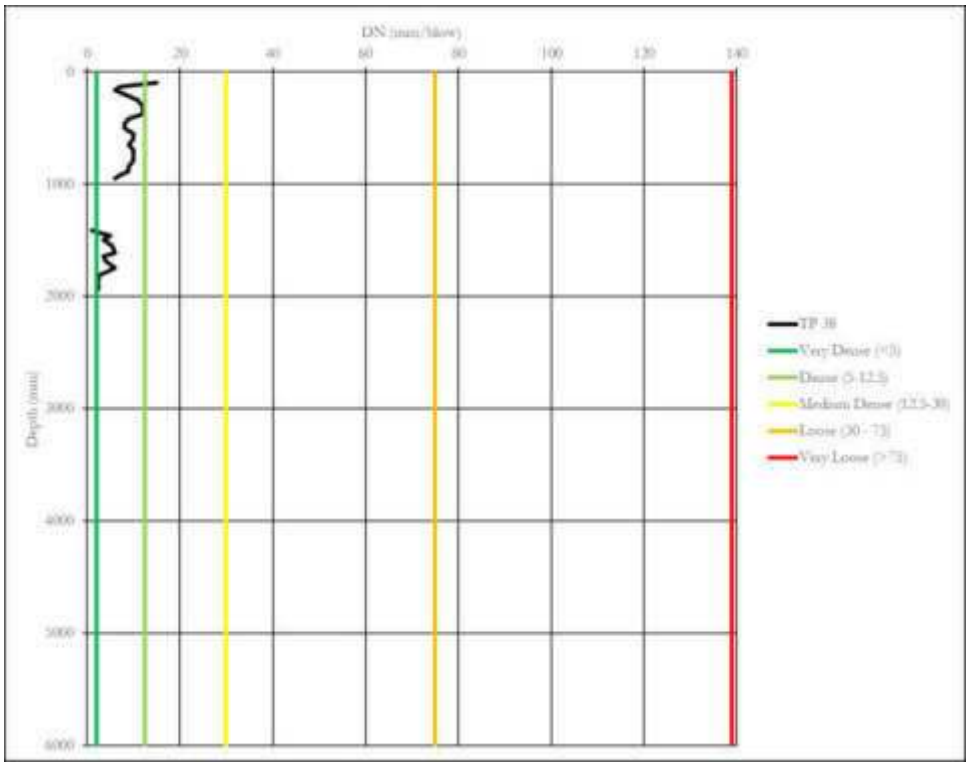


Figure 87: DCP38 Log.

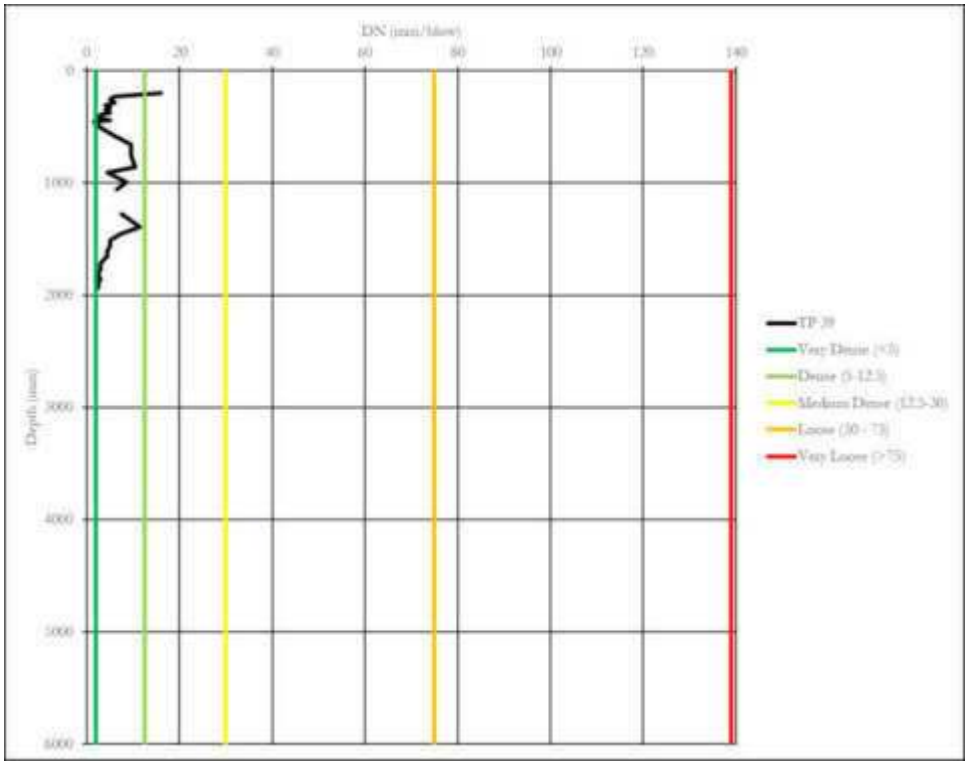


Figure 88: DCP39 Log.

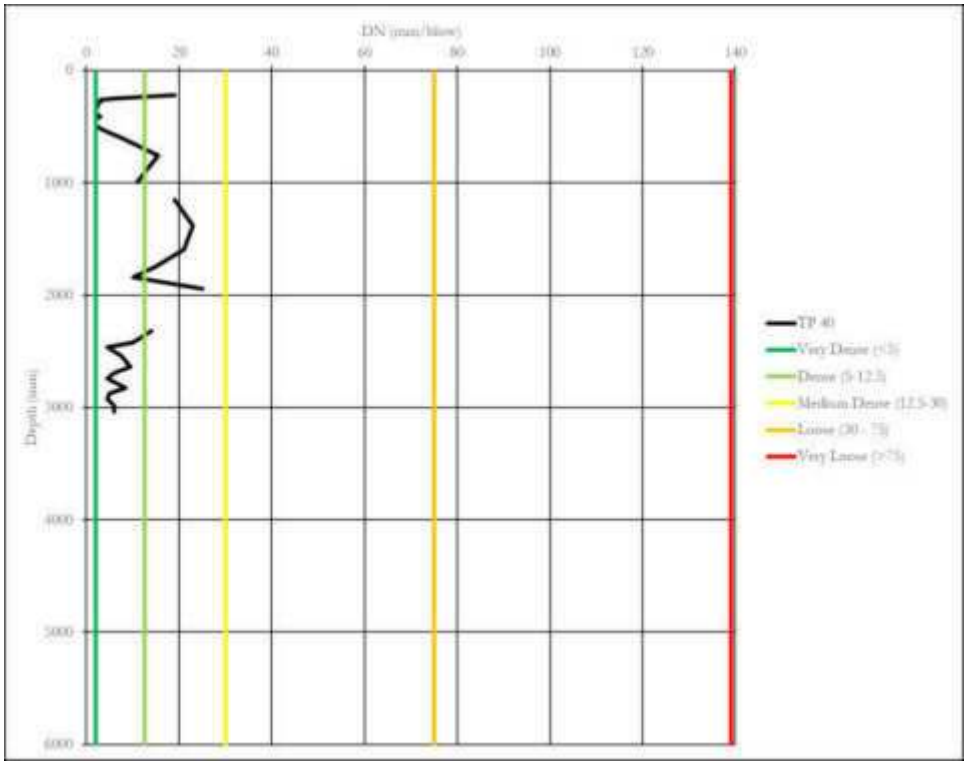


Figure 89: DCP40 Log.

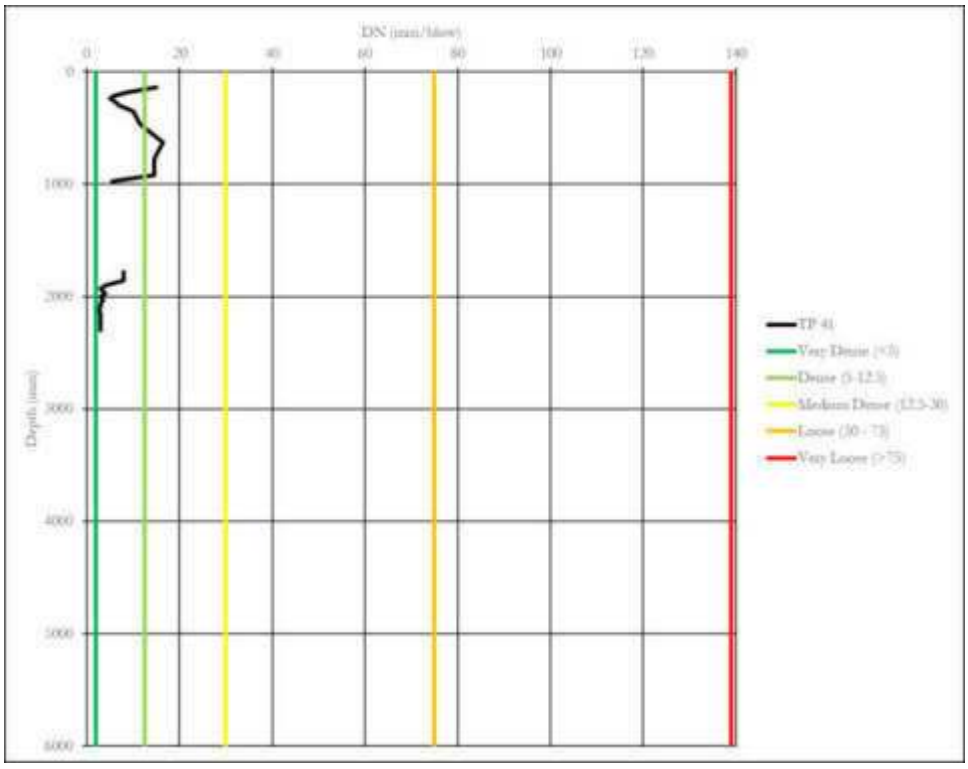


Figure 90: DCP41 Log.

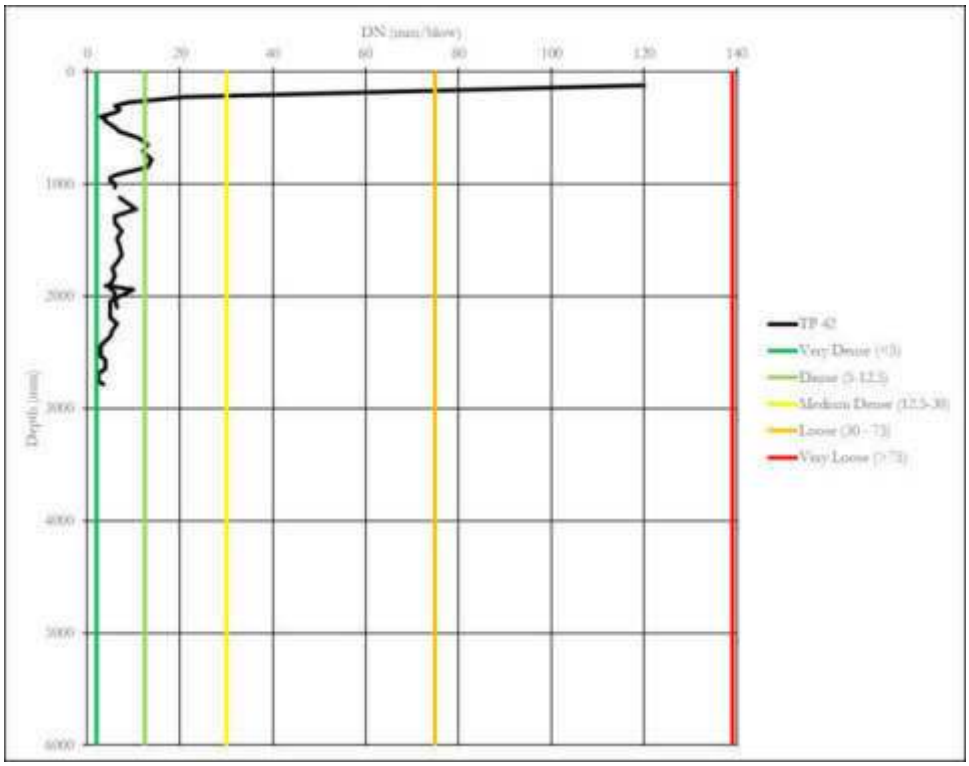


Figure 91: DCP42 Log.

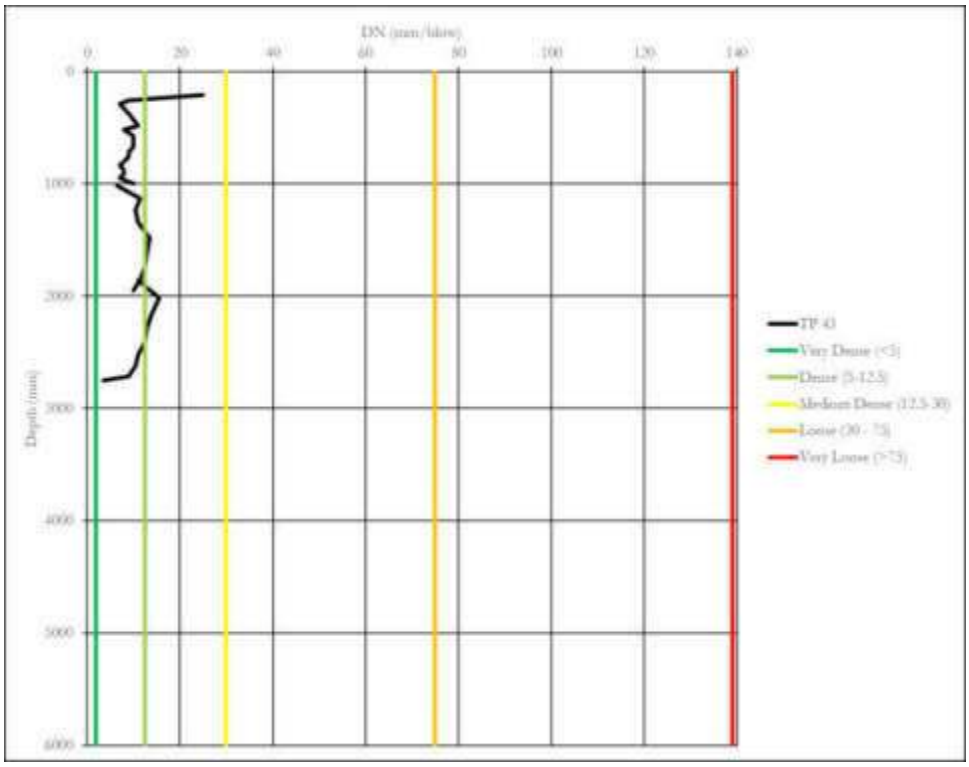


Figure 92: DCP43 Log.

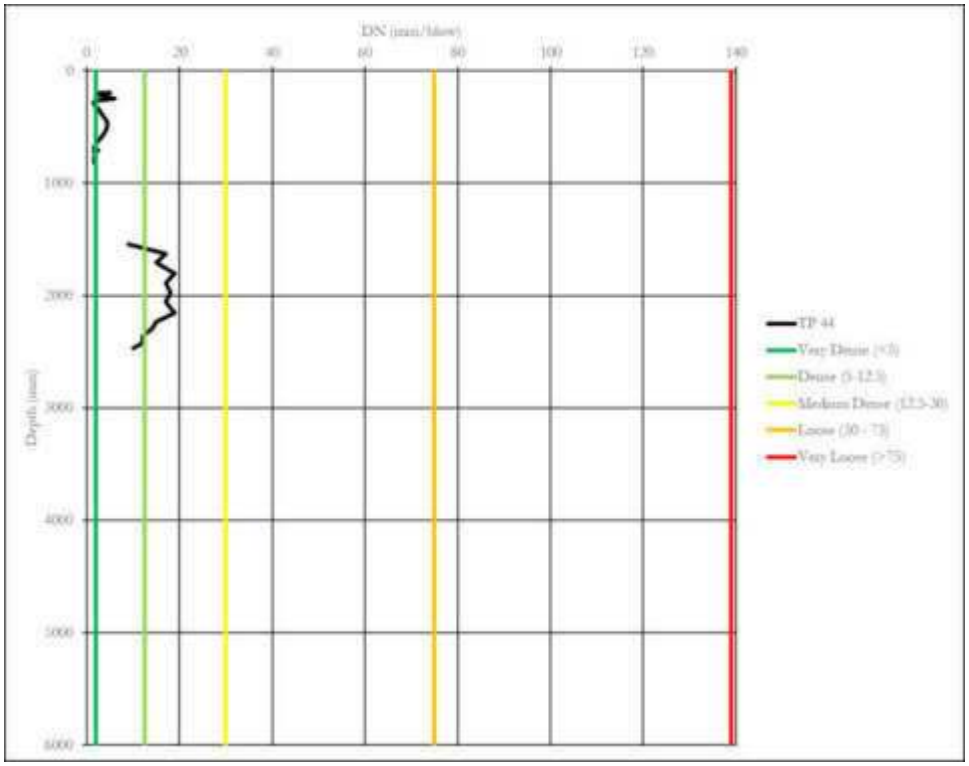


Figure 93: DCP44 Log.

13. APPENDIX E: LABORATORY ANALYSIS RESULTS

STEYN-WILSON LABORATORIES
CIVIL ENGINEERING TESTING LABORATORIES

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Fax: 086 499 9482
Email: admin@steynwilson.co.za
Web: www.steynwilson.co.za

Client:	**GEOSS South Africa**
Project:	Fisantekraal Airport
Attention:	Mr Shane Teek
Your Ref. No:	4505
Date Reported	16/02/22

TEST REPORT REFERENCE NUMBER / JOB NUMBER : SWL19674

Dear Sir / Madam

Herewith please find the original reports pertaining to the above mentioned project.

Test Requested

4 x MOD / CBR / FOUNDATION INDICATOR

Site Sampling and Materials Information

Sampling Method	*Specimens delivered to Steyn Wilson Laboratory.*
Environmental Condition	*Sunny & Hot*

● **FINAL REPORT**

We would like to take this opportunity to thank you for your valued support.
Should you have any further enquiries please don't hesitate to contact me.

Yours Faithfully
STEYN-WILSON LABORATORIES (PTY) LTD

Mr. R.Wilson
Technical Signatory

Remarks:

1. Information contained herein is confidential to STEYN-WILSON PTY LTD and the addressee
2. Opinions & Interpretations are not included in our schedule of Accreditation.
3. The samples where subjected and analysed according to ASTM.
4. The results reported relate only to the sample tested, Further use of the attached information is not the responsibility or liability of STEYN-WILSON LABORATORIES (PTY) LTD.
5. This document is the correct record of all measurements made, and may not be reproduced other than with full written approval from a director of STEYN-WILSON LABORATORIES (PTY) LTD.
6. Measuring equipment is traceable to national standards (Where applicable).
7. Should there be any deviation from the prescribed test method comments will be made thereof, pertaining to the test on the relevant materials report.

DIRECTORS: Mr. J. Steyn ND Civil (Managing) | Mr. R. Wilson B.Tech Civil (Operations)
FINANCIAL MANAGER: Mr. D. Erasmus (SAICA Reg No: 20052562)
LABORATORY MANAGER: Mr. K. Booysen

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Customer :	**GEOSS South Africa**	Project :	Fisantekraal Airport
	9 Quantum Street, Techno Park, Unit 12 Technodell Building	Date Received :	25/01/22
	Stellenbosch	Date Reported :	16/02/22
	7600	Req. Number :	4505
Attention :	Mr Shane Teek		

MOD / CBR / FOUNDATION INDICATOR – TMH1 A1* / ASTM D422 / SANS 3001 GR30 / SANS 3001 GR40

Material Description:	Light Reddish White Clayey SAND	Sample Number:	18589		
Position:	TP 4	Liquid Limit	33	Linear Shrinkage	8,1
Depth:	1.7m	Plasticity Index	15	Insitu M/C%	1,5

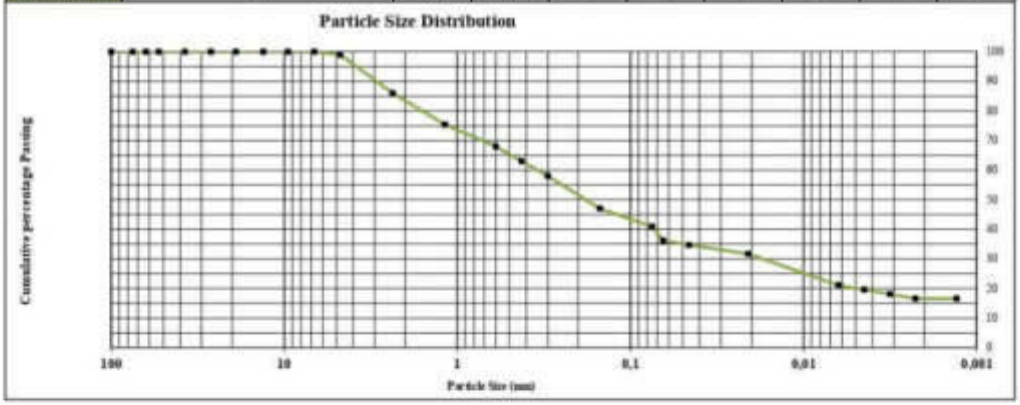
pH (TMH1 A20)*		Conductivity s/m* (TMH1 A21T)*		SG (TMH1 A12T)*	2,660

SIEVE ANALYSIS (TMH 1 A1a)* | **HYDROMETER ASTM D422**

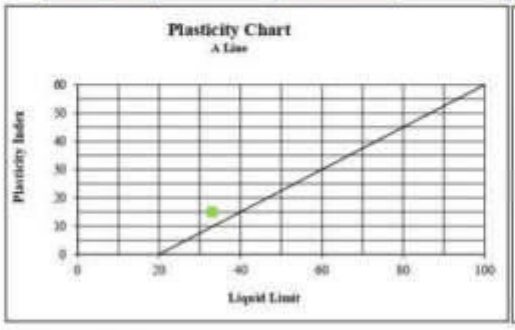
100	75	63	53	37,5	26,5	19,0	13,2	9,5	6,7	4,75	2,36	1,18	0,60	0,425	0,300	0,150	0,075	0,065	0,046	0,021	0,006	0,004	0,003	0,002	0,001
100	100	100	100	100	100	100	100	100	100	99	86	75,4	68	63	58	47	40,9	36,19	34,68	31,67	21,11	19,6	18,1	16,58	16,59

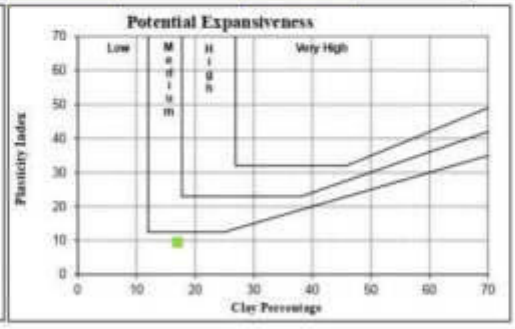
% Passing

MOD AASHTO SANS 3001 GR30		CBR SANS 3001 GR40							
OMC%	10,2	COMP MC	% SWELL	100%	98%	97%	95%	93%	90%
MDD(KG/M³)	2102	10,6	1,19	4	3	2	2	1	1



% Gravel	17	% Sand	47	% Silt	19	% Clay	17





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	Stellenbosch	Date Reported:	16/02/22
	7600	Req. Number:	4505
Attention:	Mr Shane Teek		

MOD / CBR / FOUNDATION INDICATOR – TMH1 A1* / ASTM D422 / SANS 3001 GR30 / SANS 3001 GR40

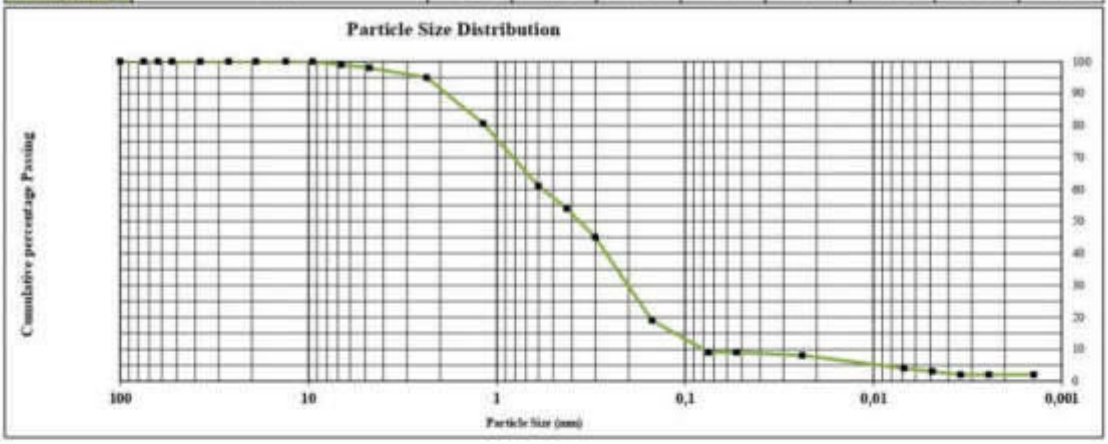
Material Description:	Light Brown Sand	Sample Number:	18590		
Position:	TH 12	Liquid Limit	NP	Linear Shrinkage	0,0
Depth:	0.0 - 0.6m	Plasticity Index	NP	Insitu M/C%	2,1

PH (TMH1 A20)*		(TMH1 A21T)* Conductivity s.m^{-1}		SG (TMH1 A12T)*	2,604

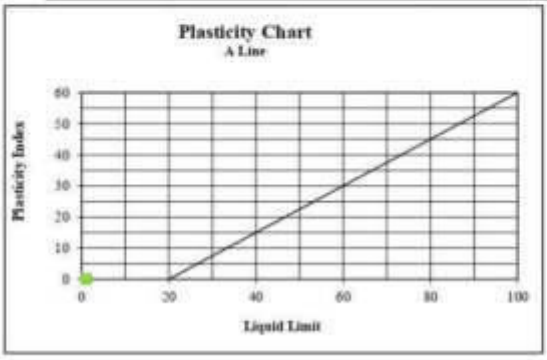
SIEVE ANALYSIS (TMH 1 A1a)*																	HYDROMETER ASTM D422							
100	75	63	53	37,5	26,5	19,0	13,2	9,5	6,7	4,75	2,36	1,18	0,60	0,425	0,300	0,150	0,075	0,075	0,053	0,024	0,007	0,005	0,003	0,002	0,001
100	100	100	100	100	100	100	100	100	99	98	95	80,6	61	54	45	19	9	9	9	8	4	3	2	2	2

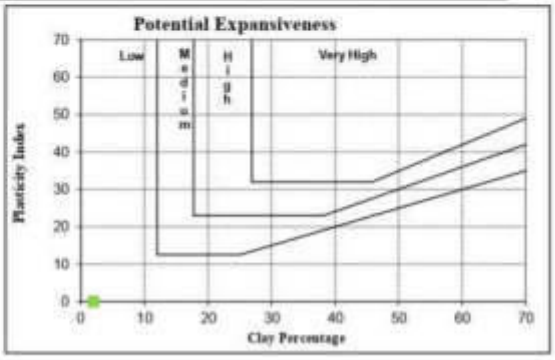
% Passing

MOD AASHTO SANS 3001 GR30		CBR SANS 3001 GR40							
OMC%	12,1	COMP MC	% SWELL	100%	98%	97%	95%	93%	90%
MDD(KG/M^3)	1909	12,4	0,0	17	14	12	10	8	5



% Gravel	9	% Sand	82	% Silt	7	% Clay	2





NOTE: All tests marked with (*) means that those test methods are not accredited.

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	Stellenbosch	Date Reported:	16/02/22
	7600	Req. Number:	4505
Attention:	Mr Shane Teek		

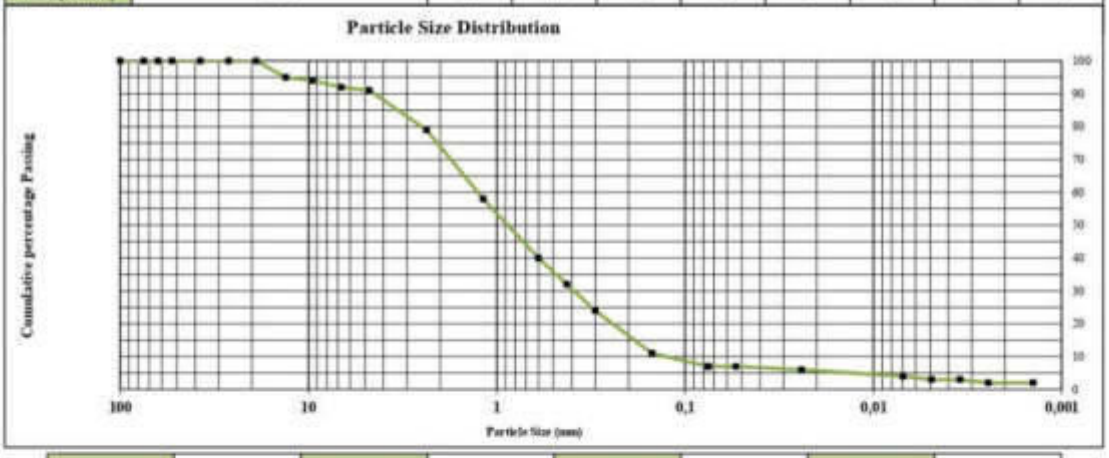
MOD / CBR / FOUNDATION INDICATOR – TMH1 A1* / ASTM D422 / SANS 3001 GR30 / SANS 3001 GR40

Material Description:	Light Brown Coarse Sand	Sample Number:	18591		
Position:	TP 12	Liquid Limit	NP	Linear Shrinkage	0,0
Depth:	0.75 - 1.2m	Plasticity Index	NP	Insitu M/C%	1,2

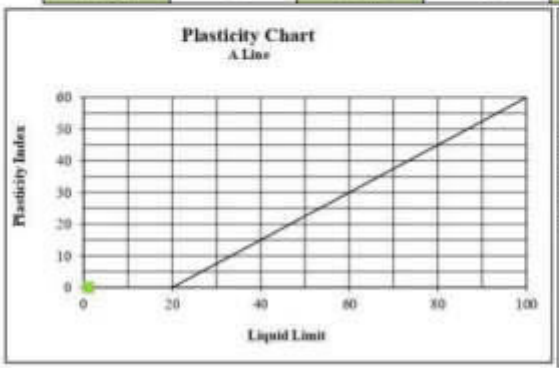
PH (TMH1 A20)*		(TMH1 A21T)* Conductivity s.m^{-1}		SG (TMH1 A12T)*	2,577

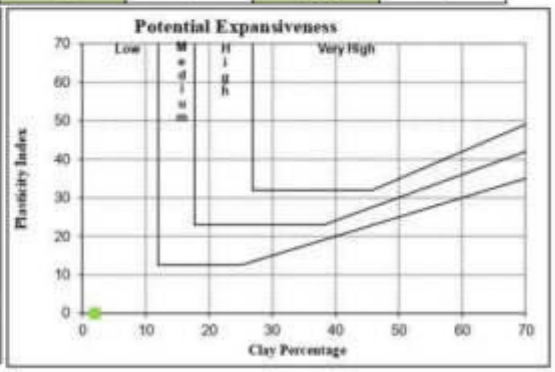
SIEVE ANALYSIS (TMH 1 A1a)*																	HYDROMETER ASTM D422							
100	75	63	53	37,5	26,5	19,0	13,2	9,5	6,7	4,75	2,36	1,18	0,60	0,425	0,300	0,150	0,075	0,076	0,054	0,024	0,007	0,005	0,003	0,002	0,001
100	100	100	100	100	100	100	95	94	92	91	79	58	40	32	24	11	7	7	7	6	4	3	3	2	2
% Passing																									

MOD AASHTO SANS 3001 GR30		CBR SANS 3001 GR40							
OMC%	9,2	COMP MC	% SWELL	100%	98%	97%	95%	93%	90%
MDD(KG/M^3)	2030	9,6	0,0	16	13	12	9	7	5



% Gravel	27	% Sand	66	% Silt	5	% Clay	2





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Stellenbosch
7600
Attention: Mr Shane Teek

Project: Fisantekraal Airport
Date Received: 25/01/22
Date Reported: 16/02/22
Req. Number: 4505

MOD / CBR / FOUNDATION INDICATOR – TMH1 A1* / ASTM D422 / SANS 3001 GR30 / SANS 3001 GR40

Material Description:	Light Brown Orange Soil with Femicrete	Sample Number:	18592		
Position:	TP 14	Liquid Limit	NP	Linear Shrinkage	0,0
Depth:	0.0 - 0.45m	Plasticity Index	NP	Insitu M/C%	1,2

PH (TMH1 A20)*		(TMH1 A21T)* Conductivity s.m^{-1}		SG (TMH1 A12T)*	2,604

SIEVE ANALYSIS (TMH 1 A1a)*

100	75	63	53	37,5	26,5	19,0	13,2	9,5	6,7	4,75	2,36	1,18	0,60	0,425	0,300	0,150	0,075
100	100	100	100	100	95	94	89	86	82	74	43	28,1	21	17	13	7	4,7

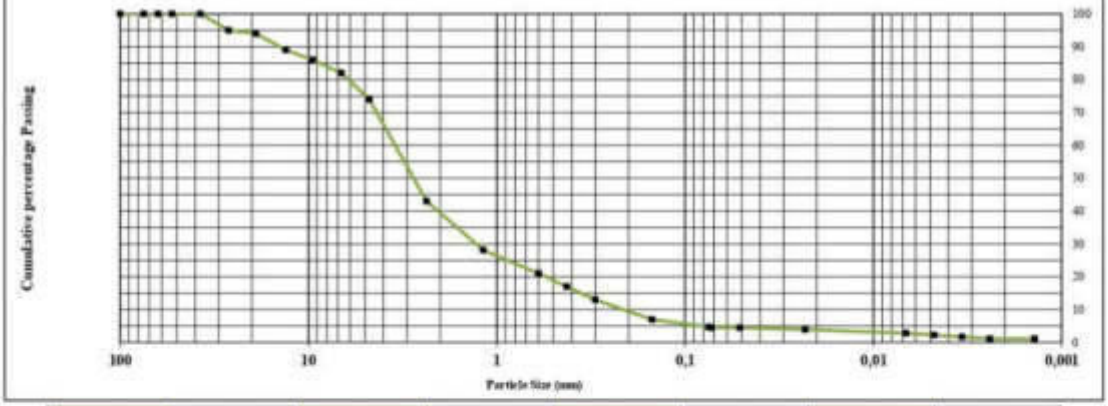
HYDROMETER ASTM D422

0,072	0,051	0,023	0,007	0,005	0,003	0,002	0,001
4,496	4,496	3,934	2,81	2,248	1,686	1,124	1,124

% Passing

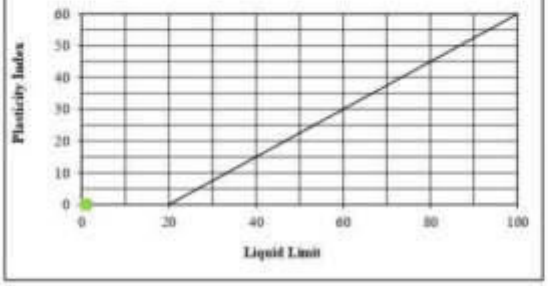
MOD AASHTO SANS 3001 GR30		CBR SANS 3001 GR40							
OMC%	8,3	COMP MC	% SWELL	100%	98%	97%	95%	93%	90%
MDD(KG/M^3)	2120	8,0	0,0	75	59	50	40	30	21

Particle Size Distribution

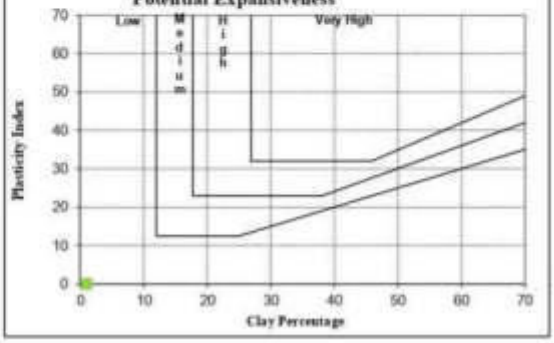


% Gravel	62	% Sand	34	% Silt	3	% Clay	1

Plasticity Chart
A Line



Potential Expansiveness



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Customer :	**GEOSS South Africa**	Project :	Fisantekraal Airport
	9 Quantum Steet, Techno Park, Unit 12 Technodell Building	Date Received :	25/01/22
	Stellenbosch	Date Reported :	16/02/22
	7600	Req. Number :	4505
Attention :	Mr Shane Teek		

MOD / CBR / FOUNDATION INDICATOR - TMH1 A1* / ASTM D422 / SANS 3001 GR30 / SANS 3001 GR40

Material Description:	Light Brown Whiteish Silty Clay Soil	Sample Number:	18593		
Position:	TP 14	Liquid Limit	32,2	Linear Shrinkage	7,9
Depth:	1.5-2.0m	Plasticity Index	15,7	Insitu M/C%	4,2

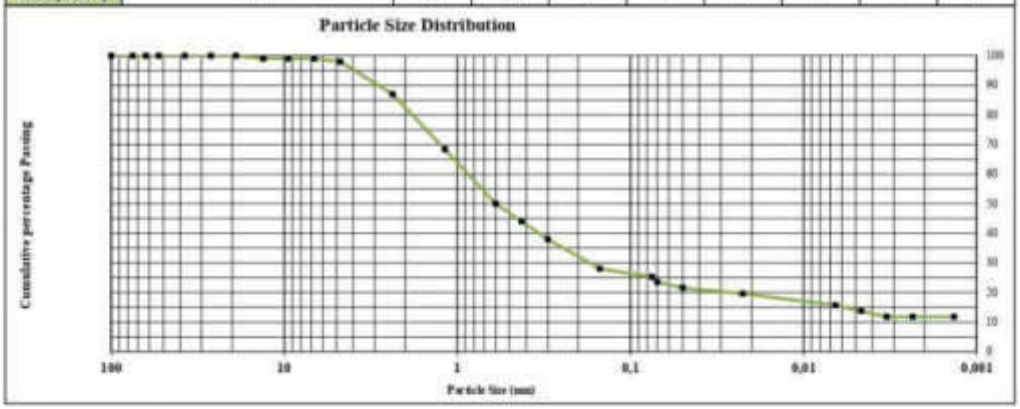
pH (TMH1 A20)*		Conductivity s/m* (TMH1 A21T)*		SG (TMH1 A12T)*	2,632

SIEVE ANALYSIS (TMH 1 A1a)* — **HYDROMETER ASTM D422**

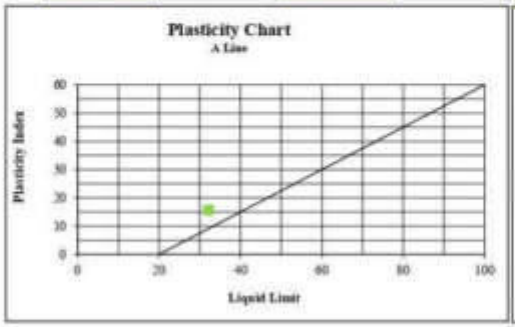
100	75	63	53	37,5	26,5	19,0	12,2	9,5	6,7	4,75	2,36	1,18	0,60	0,425	0,300	0,150	0,075	0,070	0,050	0,022	0,007	0,005	0,003	0,002	0,001
100	100	100	100	100	100	100	99	99	98	96	87	68,4	50	44	36	28	25,3	23,52	21,56	19,6	15,68	13,72	11,76	11,76	11,76

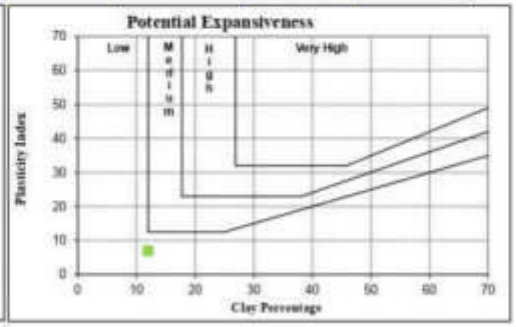
% Passing

MOD AASHTO SANS 3001 GR30		CBR SANS 3001 GR40							
OMC%	12,2	COMP MC	% SWELL	100%	98%	97%	95%	93%	90%
MDD(KG/M³)	2026	11,8	1,14	19	14	11	8	5	3



% Gravel	19	% Sand	58	% Silt	11	% Clay	12





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	Stellenbosch	Date Reported:	16/02/22
	7600	Req. Number:	4505
Attention:	Mr Shane Teek		

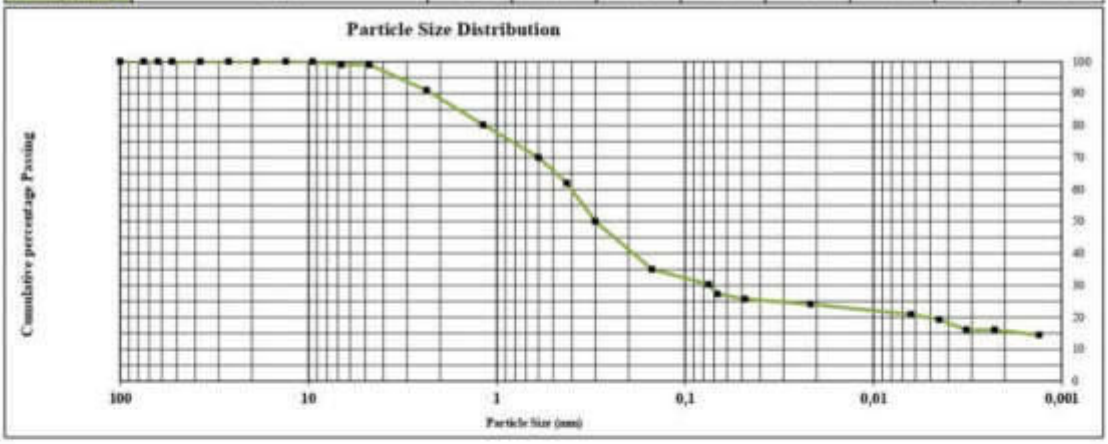
MOD / CBR / FOUNDATION INDICATOR – TMH1 A1* / ASTM D422 / SANS 3001 GR30 / SANS 3001 GR40

Material Description:	Light Brown Whitish Silty Soil with Sandstone	Sample Number:	18594		
Position:	TP 15	Liquid Limit	**27**	Linear Shrinkage	**6**
Depth:	0.9-1.7m	Plasticity Index	**9,8**	Insitu M/C%	**7,3**

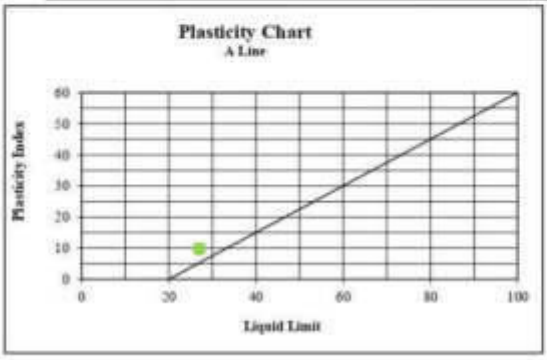
PH (TMH1 A20)*		(TMH1 A21T)* Conductivity s.m^{-1}		SG (TMH1 A12T)*	2,660

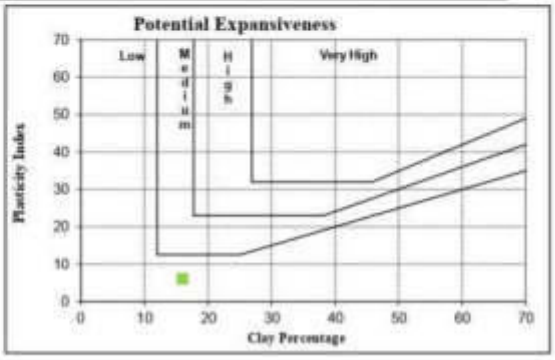
SIEVE ANALYSIS (TMH 1 A1a)*																	HYDROMETER ASTM D422							
100	75	63	53	37,5	26,5	19,0	13,2	9,5	6,7	4,75	2,36	1,18	0,60	0,425	0,300	0,150	0,075	0,067	0,048	0,022	0,006	0,004	0,003	0,002	0,001
100	100	100	100	100	100	100	100	100	99	99	91	80,2	70	62	50	35	30,3	27,27	25,68	24,06	20,85	19,25	16,04	16,04	14,44
% Passing																									

MOD AASHTO SANS 3001 GR30		CBR SANS 3001 GR40							
OMC%	12,5	COMP MC	% SWELL	100%	98%	97%	95%	93%	90%
MDD(KG/M^3)	2022	12,1	0,87	17	11	8	5	3	2



% Gravel	12	% Sand	61	% Silt	11	% Clay	16





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Stellenbosch
7600
Attention: Mr Shane Teek

Project: Fisantekraal Airport
Date Received: 25/01/22
Date Reported: 16/02/22
Req. Number: 4505

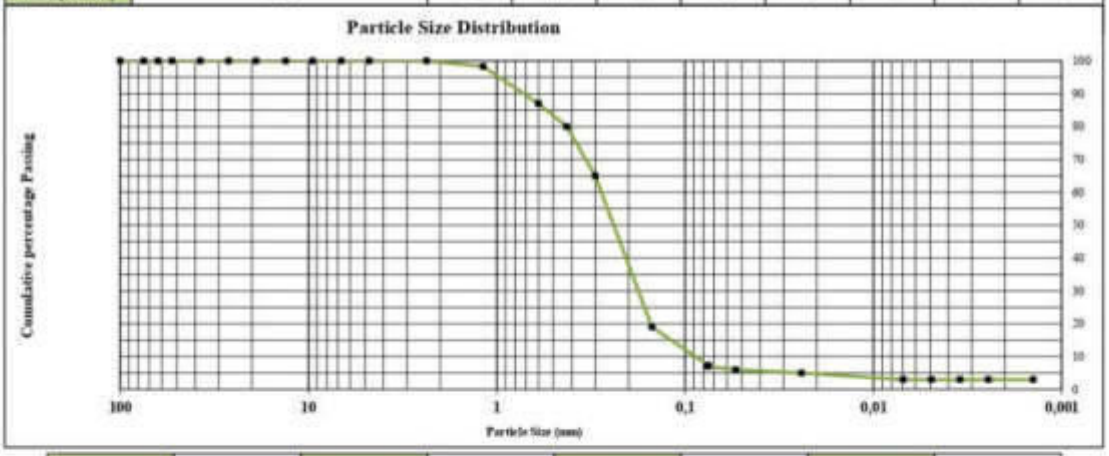
MOD / CBR / FOUNDATION INDICATOR – TMH1 A1* / ASTM D422 / SANS 3001 GR30 / SANS 3001 GR40

Material Description:	Light Brown Sand	Sample Number:	18595		
Position:	TP 17	Liquid Limit	NP	Linear Shrinkage	0,0
Depth:	0.0-1.9m	Plasticity Index	NP	Insitu M/C%	4,5

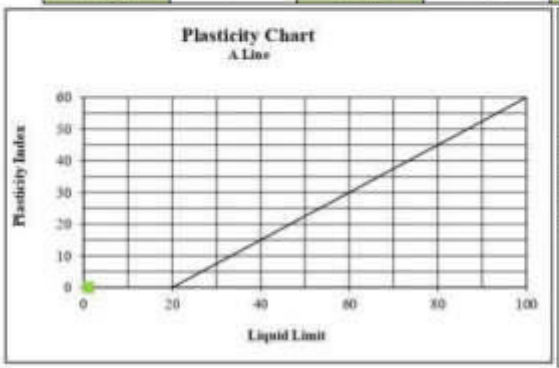
PH (TMH1 A20)*		(TMH1 A21T)* Conductivity s.m^{-1}		SG (TMH1 A12T)*	2,577

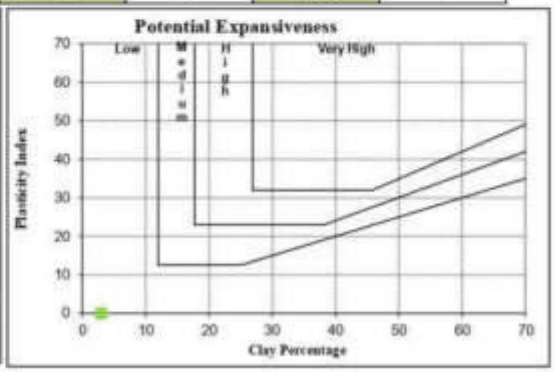
SIEVE ANALYSIS (TMH 1 A1a)*																	HYDROMETER ASTM D422							
100	75	63	53	37,5	26,5	19,0	13,2	9,5	6,7	4,75	2,36	1,18	0,60	0,425	0,300	0,150	0,075	0,076	0,054	0,024	0,007	0,005	0,003	0,002	0,001
100	100	100	100	100	100	100	100	100	100	100	100	98,3	87	80	65	19	7,3	7	6	5	3	3	3	3	3
% Passing																									

MOD AASHTO SANS 3001 GR30		CBR SANS 3001 GR40							
OMC%	12,3	COMP MC	% SWELL	100%	98%	97%	95%	93%	90%
MDD(KG/M^3)	1808	12,4	0,0	14	10	9	7	6	4



% Gravel	1	% Sand	93	% Silt	3	% Clay	3





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	7600	Req. Number:	4505
Attention:	Mr Shane Teek		

MOD / CBR / FOUNDATION INDICATOR – TMH1 A1* / ASTM D422 / SANS 3001 GR30 / SANS 3001 GR40

Material Description:	Dark Bown Sandy GRAVEL	Sample Number:	18596		
Position:	TP 18	Liquid Limit	NP	Linear Shrinkage	0,0
Depth:	0.2-0.6m	Plasticity Index	NP	Insitu M/C%	4,5

PH (TMH1 A20)*		(TMH1 A21T)* Conductivity s.m^{-1}		SG (TMH1 A12T)*	2,632

SIEVE ANALYSIS (TMH 1 A1a)*

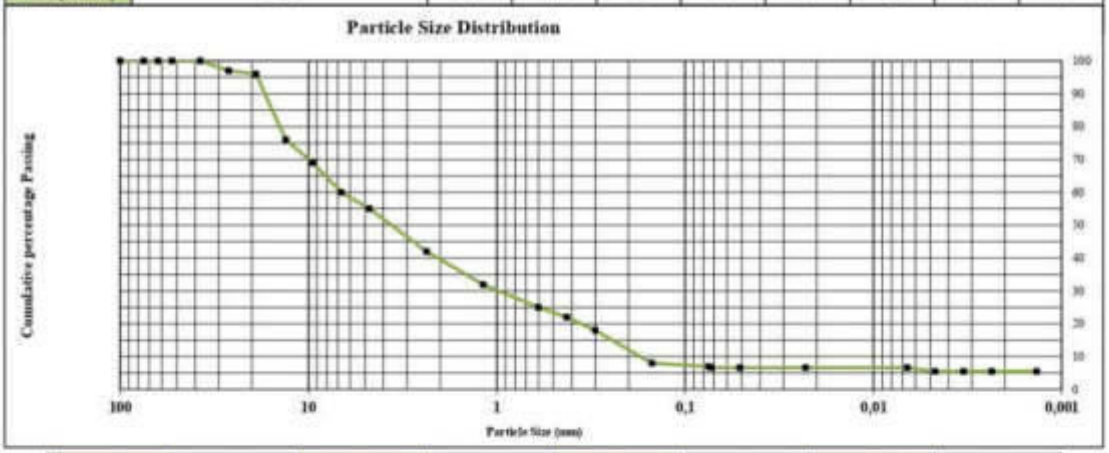
100	75	63	53	37,5	26,5	19,0	13,2	9,5	6,7	4,75	2,36	1,18	0,60	0,425	0,300	0,150	0,075
100	100	100	100	100	97	96	76	69	60	55	42	31,9	25	22	18	8	7

HYDROMETER ASTM D422

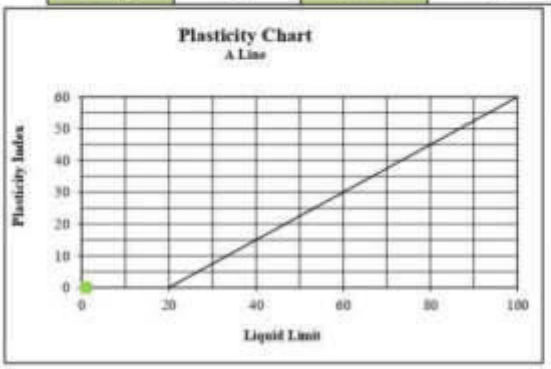
0,072	0,051	0,023	0,007	0,005	0,003	0,002	0,001
6,6	6,6	6,6	6,6	5,5	5,5	5,5	5,5

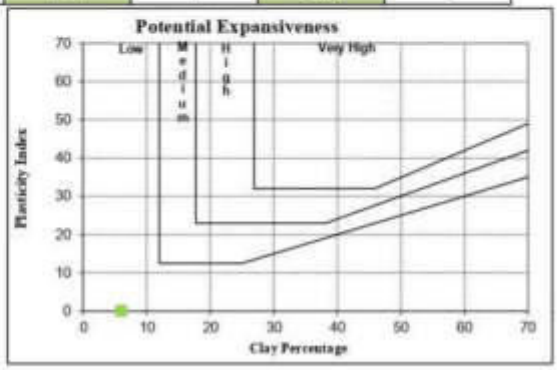
% Passing

MOD AASHTO SANS 3001 GR30		CBR SANS 3001 GR40							
OMC%	7,3	COMP MC	% SWELL	100%	98%	97%	95%	93%	90%
MDD(KG/M^3)	2240	7,0	0,0	50	39	33	26	20	13



% Gravel	61	% Sand	32	% Silt	1	% Clay	6





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	7600	Req. Number :	4505
Attention :	Mr S Teek		

MOD / CBR / FOUNDATION INDICATOR – TMH1 A1* / ASTM D422 / SANS 3001 GR30 / SANS 3001 GR40

Material Description:	Reddish Brown CLAY	Sample Number:	18597		
Position:	TP 18	Liquid Limit	77,9	Linear Shrinkage	18,9
Depth:	0.6-1.0m	Plasticity Index	41,8	Insitu M/C%	15,8

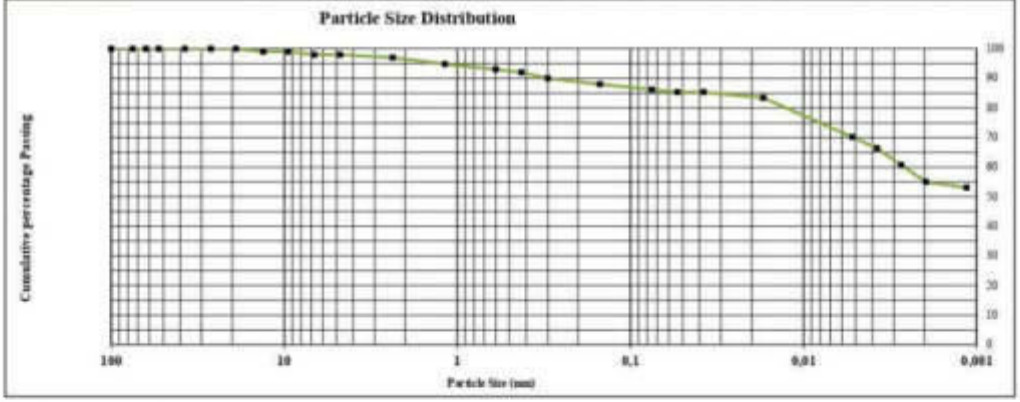
pH (TMH1 A20)*		Conductivity s/m* (TMH1 A21T)*		SG (TMH1 A12T)*	2,747

SIEVE ANALYSIS (TMH 1 A1a)* — **HYDROMETER ASTM D422**

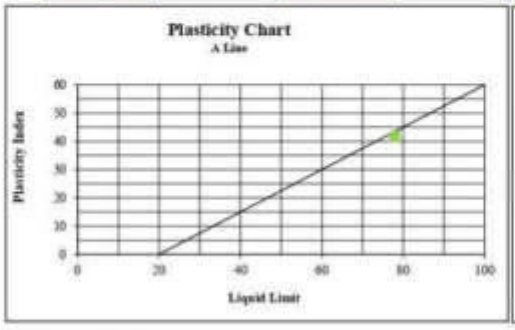
100	75	63	53	37,5	26,5	19,0	13,2	9,5	6,7	4,75	2,36	1,18	0,60	0,425	0,300	0,150	0,075	0,053	0,038	0,027	0,005	0,004	0,003	0,002	0,001
100	100	100	100	100	100	100	99	99	98	98	97	94,8	93	92	90	88	86,2	85,32	83,32	83,42	70,15	60,36	60,67	54,98	53,09

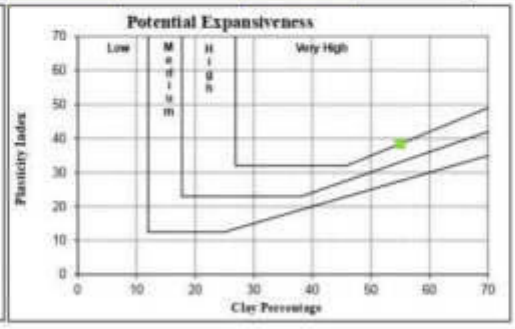
% Passing

MOD AASHTO SANS 3001 GR30		CBR SANS 3001 GR40							
OMC%	14,3	COMP MC	% SWELL	100%	98%	97%	95%	93%	90%
MDD(KG/M³)	1788	14,0	1,87	1	1	1	1	1	1



% Gravel	4	% Sand	11	% Silt	30	% Clay	55





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MOD / CBR / FOUNDATION INDICATOR – TMH1 A1* / ASTM D422 / SANS 3001 GR30 / SANS 3001 GR40

Material Description:	White Clayey SILT	Sample Number:	18598		
Position:	TP 22	Liquid Limit	48	Linear Shrinkage	6,2
Depth:	0.5-2.0m	Plasticity Index	16,8	Insitu M/C%	15,6

PH (TMH1 A20)*		(TMH1 A21T)* Conductivity s.m^{-1}		SG (TMH1 A12T)*	2,747

SIEVE ANALYSIS (TMH 1 A1a)*

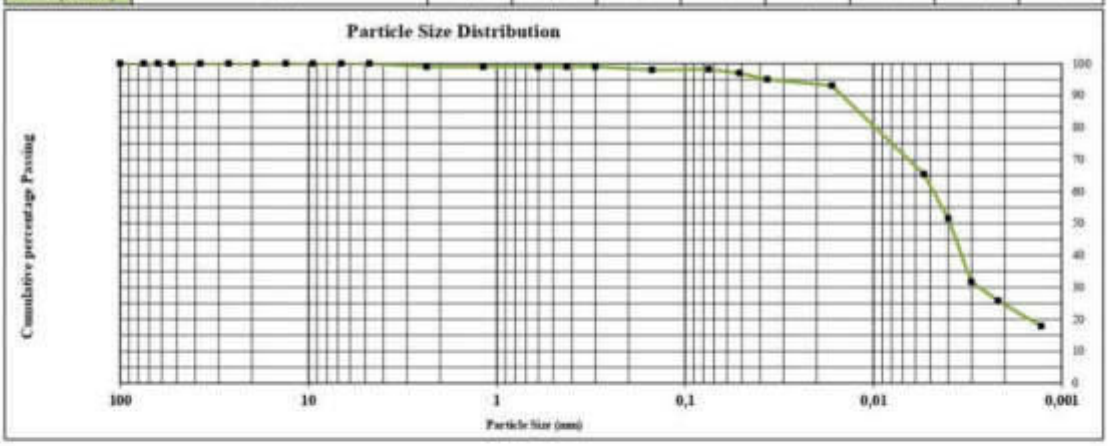
100	75	63	53	37,5	26,5	19,0	13,2	9,5	6,7	4,75	2,36	1,18	0,60	0,425	0,300	0,150	0,075
100	100	100	100	100	100	100	100	100	100	100	99	99	99	99	99	98	98,2

HYDROMETER ASTM D422

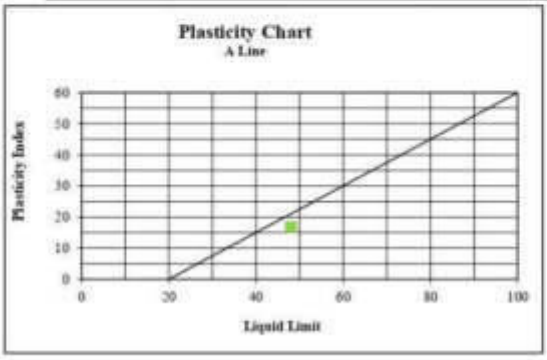
0,052	0,037	0,017	0,005	0,004	0,003	0,002	0,001
97,02	95,04	93,06	65,34	51,48	31,68	25,74	17,82

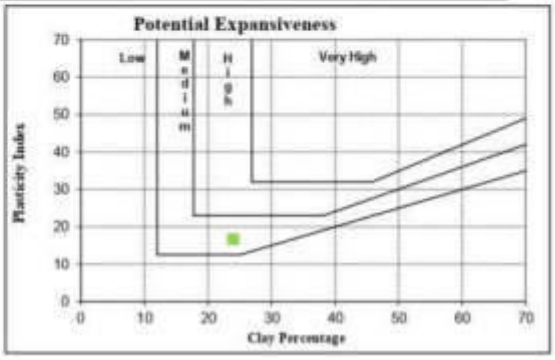
% Passing

MOD AASHTO SANS 3001 GR30		CBR SANS 3001 GR40							
OMC%	13,4	COMP MC	% SWELL	100%	98%	97%	95%	93%	90%
MDD(KG/M^3)	1745	13,1	0,94	1	1	1	1	1	1



% Gravel	1	% Sand	1	% Silt	74	% Clay	24





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Project: Fisantekraal Airport
Date Received: 25/01/22
Date Reported: 16/02/22
Req. Number: 4505

MOD / CBR / FOUNDATION INDICATOR – TMH1 A1* / ASTM D422 / SANS 3001 GR30 / SANS 3001 GR40

Material Description:	Dark Brown Soil with Reddish Orange Ferricrete	Sample Number:	18599		
Position:	TP 25	Liquid Limit	NP	Linear Shrinkage	0,0
Depth:	0.0-0.7m	Plasticity Index	NP	Insitu M/C%	4,4

PH (TMH1 A20)*		(TMH1 A21T)* Conductivity s.m^{-1}		SG (TMH1 A12T)*	2,577

SIEVE ANALYSIS (TMH 1 A1a)*

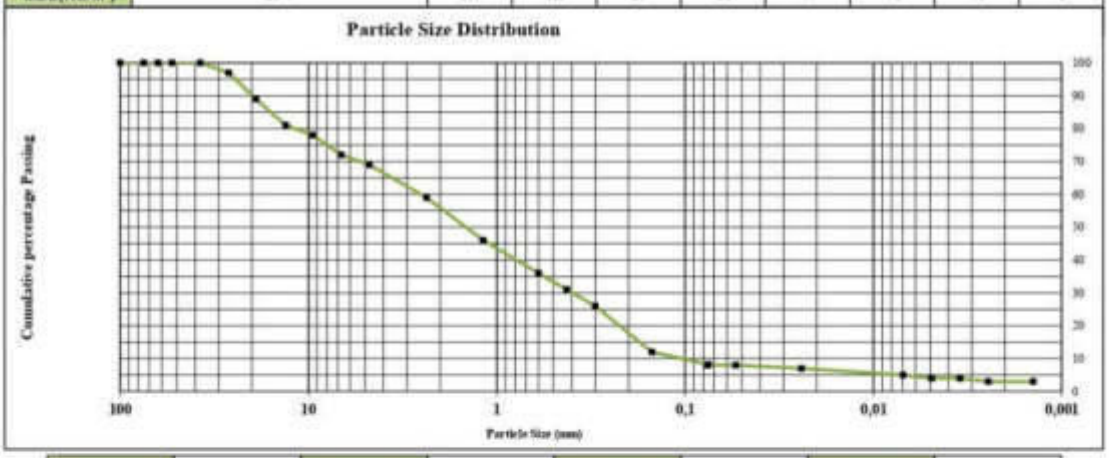
100	75	63	53	37,5	26,5	19,0	13,2	9,5	6,7	4,75	2,36	1,18	0,60	0,425	0,300	0,150	0,075
100	100	100	100	100	97	89	81	78	72	69	59	46	36	31	26	12	8,2

HYDROMETER ASTM D422

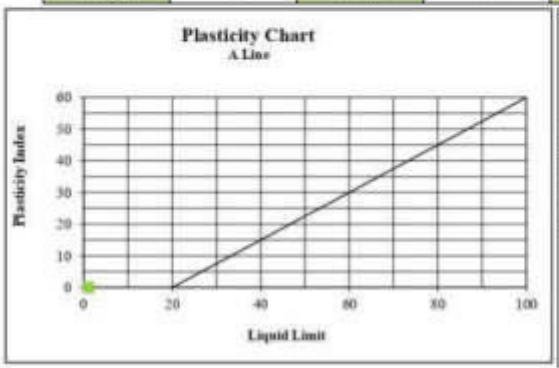
0,076	0,054	0,024	0,007	0,005	0,003	0,002	0,001
8	8	7	5	4	4	3	3

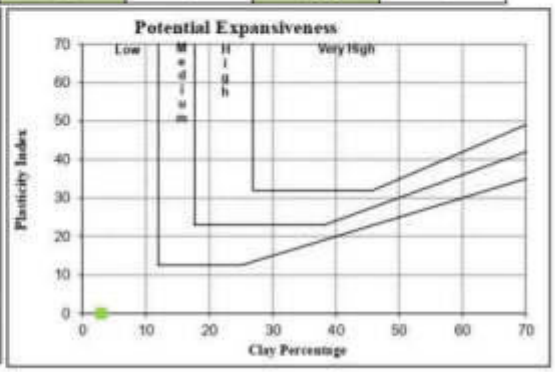
% Passing

MOD AASHTO SANS 3001 GR30		CBR SANS 3001 GR40							
OMC%	9,2	COMP MC	% SWELL	100%	98%	97%	95%	93%	90%
MDD(KG/M^3)	2047	9,0	0,0	27	20	17	13	10	6



% Gravel	45	% Sand	47	% Silt	8	% Clay	3





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Compiled by: M Steyn Approved By: J Steyn

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CIVIL ENGINEERING TESTING LABORATORIES

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Fax: 086 499 9482
Email: admin@steynwilson.co.za
Web: www.steynwilson.co.za

Customer:	**GEOSS South Africa**	Project:	Fisantekraal Airport
	9 Quantum Street, Techno Park, Unit 12 Technostell Building	Date Received:	25/01/22
	Stellenbosch	Date Reported:	16/02/22
	7600	Req. Number:	4505
Attention:	Mr S Teek		

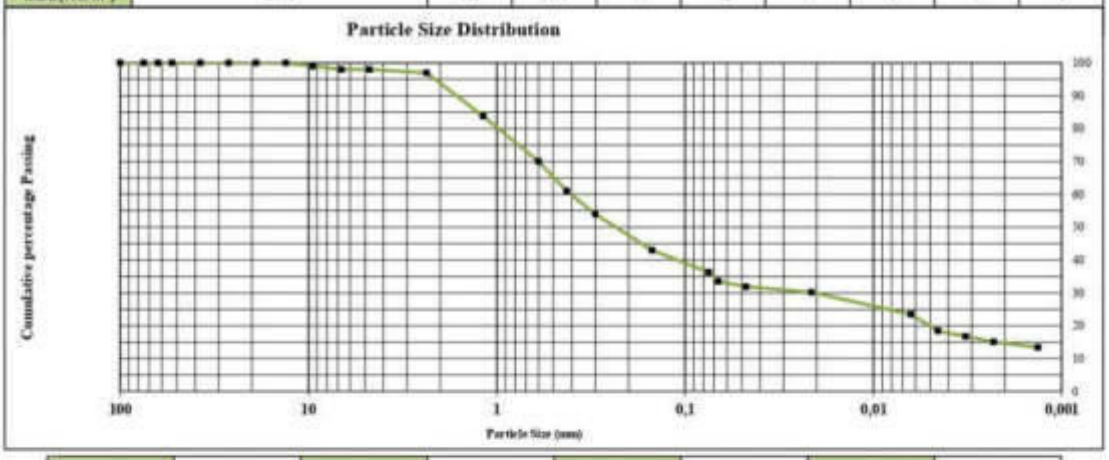
MOD / CBR / FOUNDATION INDICATOR – TMH1 A1* / ASTM D422 / SANS 3001 GR30 / SANS 3001 GR40

Material Description:	Light Brown Whitish Silty Sand	Sample Number:	18600		
Position:	TP 25	Liquid Limit	**24**	Linear Shrinkage	**4,5**
Depth:	0.9-1.4m	Plasticity Index	**8,6**	Insitu M/C%	**4,4**

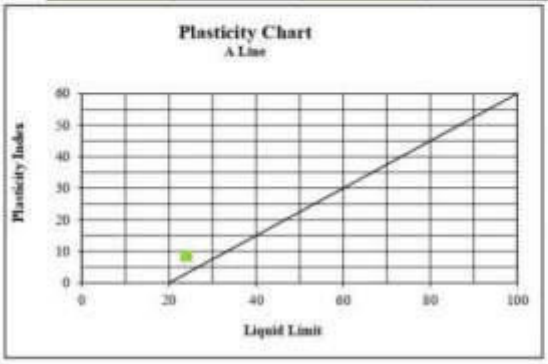
PH (TMH1 A20)*		(TMH1 A21T)* Conductivity s.m^{-1}		SG (TMH1 A12T)*	2,632

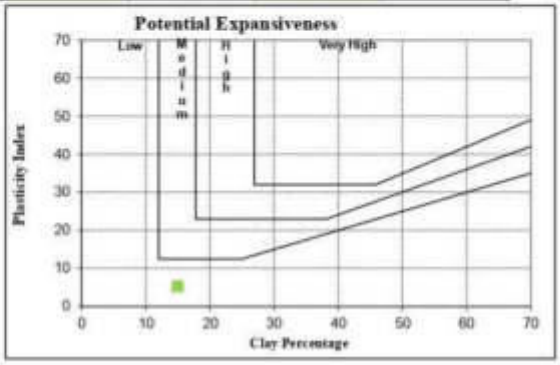
SIEVE ANALYSIS (TMH 1 A1a)*																	HYDROMETER ASTM D422							
100	75	63	53	37,5	26,5	19,0	13,2	9,5	6,7	4,75	2,36	1,18	0,60	0,425	0,300	0,150	0,075	0,067	0,048	0,021	0,006	0,005	0,003	0,002	0,001
100	100	100	100	100	100	100	100	99	98	98	97	83,8	70	61	54	43	36,3	33,52	31,84	30,17	23,46	18,44	16,76	15,08	13,41
% Passing																									

MOD AASHTO SANS 3001 GR30		CBR SANS 3001 GR40							
OMC%	8,2	COMP MC	% SWELL	100%	98%	97%	95%	93%	90%
MDD(KG/M^3)	2143	7,8	0,58	14	12	11	9	7	5



% Gravel	7	% Sand	60	% Silt	18	% Clay	15





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Customer :	**GEOSS South Africa**	Project :	Fisantekraal Airport
	9 Quantum Street, Techno Park, Unit 12 Technodell Building	Date Received :	25/01/22
	Stellenbosch	Date Reported :	16/02/22
	7600	Req. Number :	4505
Attention :	Mr Shane Teek		

MOD / CBR / FOUNDATION INDICATOR – TMH1 A1* / ASTM D422 / SANS 3001 GR30 / SANS 3001 GR40

Material Description:	Light Brown Orange Silty Soil with Sandstone	Sample Number:	18601		
Position:	TP 26	Liquid Limit	36,9	Linear Shrinkage	7,3
Depth:	1.0-1.7m	Plasticity Index	13	Insitu M/C%	5,9

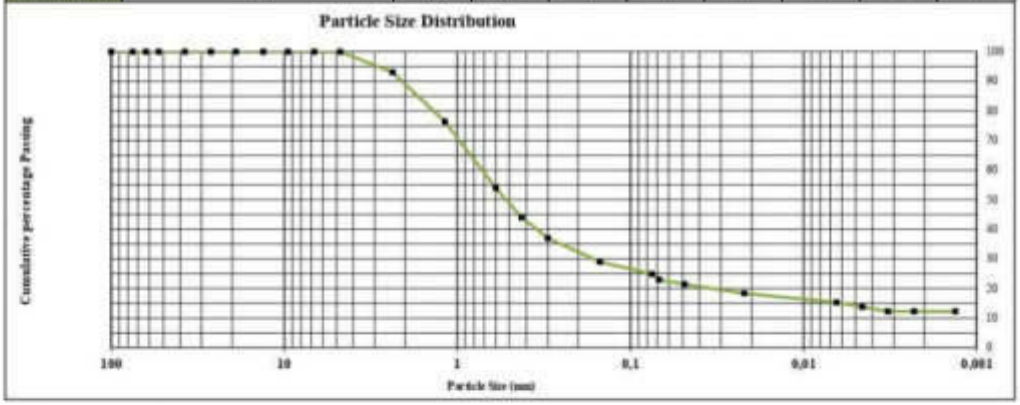
pH (TMH1 A20)*		Conductivity s/m* (TMH1 A21T)*		SG (TMH1 A12T)*	2,632

SIEVE ANALYSIS (TMH 1 A1a)* | **HYDROMETER ASTM D422**

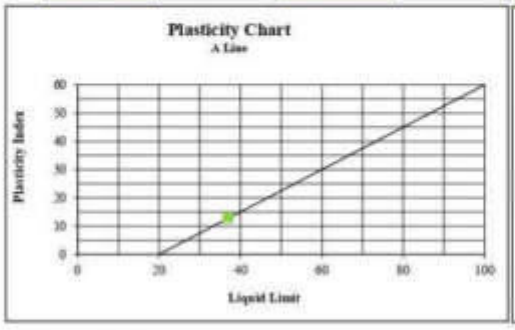
100	75	63	53	37,5	26,5	19,0	13,2	9,5	6,7	4,75	2,36	1,18	0,60	0,425	0,300	0,150	0,075	0,068	0,049	0,022	0,006	0,005	0,003	0,002	0,001
100	100	100	100	100	100	100	100	100	100	100	93	76,4	54	44	37	29	24,9	22,92	21,39	16,34	15,29	13,75	13,22	12,23	12,22

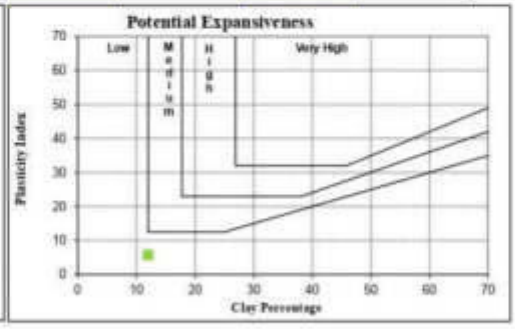
% Passing

MOD AASHTO SANS 3001 GR30		CBR SANS 3001 GR40							
OMC%	12,4	COMP MC	% SWELL	100%	98%	97%	95%	93%	90%
MDD(KG/M³)	2008	12,1	0,95	15	11	10	8	6	4



% Gravel	12	% Sand	66	% Silt	10	% Clay	12





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Web: www.steynwilson.co.za

Client:	**GEOSS South Africa**
Project:	4505
Attention:	Mr S Teek
Your Ref. No:	4505
Date Reported	11/05/22

TEST REPORT REFERENCE NUMBER / JOB NUMBER : SWL21614

Dear Sir / Madam

Herewith please find the original reports pertaining to the above mentioned project.

Test Requested

3 x *FOUNDATION INDICATOR*

Site Sampling and Materials Information

Sampling Method	*Specimens delivered to Steyn Wilson Laboratory*
Environmental Condition	*Sunny*
Deviation from the prescribed test method	
Responsibility of information disclaimer	*The sample information was received from the customer. Results apply to the sample as received from the Customer.*

FINAL REPORT

We would like to take this opportunity to thank you for your valued support.
Should you have any further enquiries please don't hesitate to contact me.

Yours Faithfully
STEYN-WILSON LABORATORIES (PTY) LTD

Remarks:

1. Information contained herein is confidential to STEYN-WILSON PTY LTD and the addressee
2. Opinions & Interpretations are not included in our schedule of Accreditation.
3. The samples where subjected and analysed according to ASTM.
4. The results reported relate only to the sample tested, Further use of the attached information is not the responsibility or liability of STEYN-WILSON LABORATORIES (PTY) LTD.
5. This document is the correct record of all measurements made, and may not be reproduced other than with full written approval from a director of STEYN-WILSON LABORATORIES (PTY) LTD.
6. Measuring equipment is traceable to national standards (Where applicable).
7. Should there be any deviation from the prescribed test method comments will be made thereof, pertaining to the test on the relevant materials report.
8. Uncertainty of measurement is calculated and corresponds to a coverage probability of approximately 95%. Available on request.
9. The decision rule states that the measurement of uncertainty can be applied by the customer to the test results, on request, It is not the responsibility or liability of STEYN-WILSON LABORATORIES (PTY) LTD.

Mr. J.Steyn
Technical Signatory

DIRECTORS: **Mr. J. Steyn ND-Civil (Managing) | Mr. R. Wilson B-Tech Civil (Operations)**

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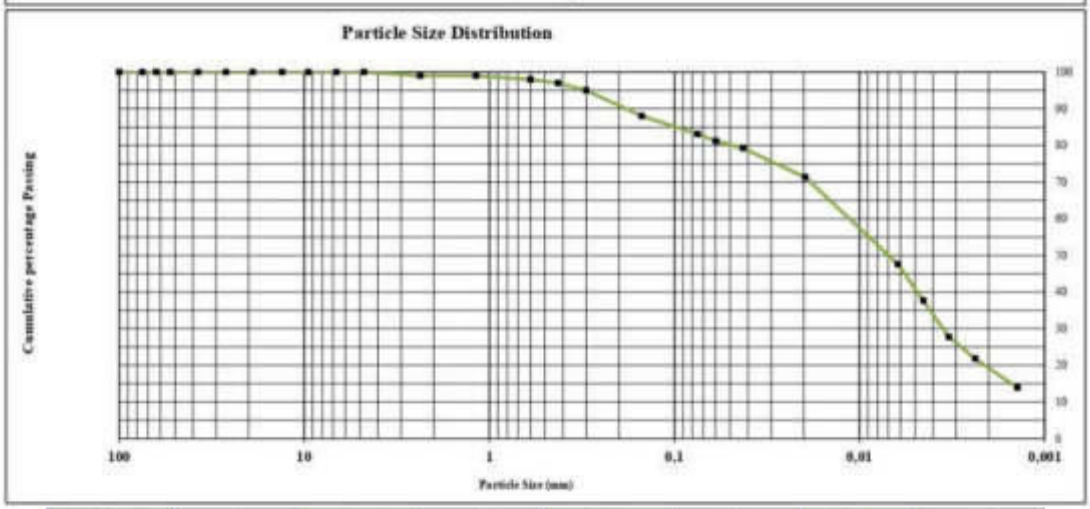
Customer:	GEOSS South Africa	Project:	4505
	9 Quantum Street, Techno Park, Unit 12 Technostell Building	Date Received:	19/04/22
	Stellenbosch	Date Reported:	11/05/22
	7600	Req. Number:	4505
Attention:	Mr S Teek	Date Sampled:	19/04/22

FOUNDATION INDICATOR ASTM D422

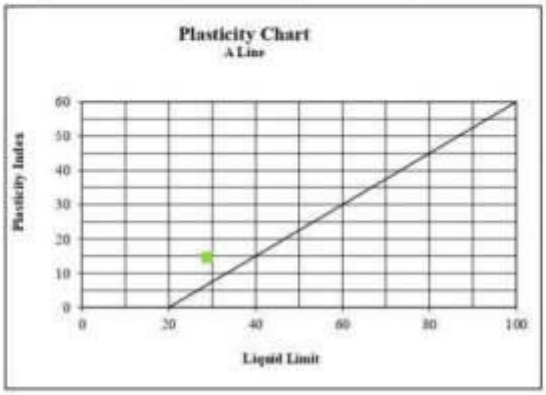
Material Description:	Light Orange Clay	Sample Number:	20001		
Position:	TP 40	Liquid Limit (Casagrande SANS 3001 GR12)	28,8	Linear Shrinkage	7,8
Depth:	0.5 - 1.1m	Plasticity Index	14,6	Insitu M/C%	15,7

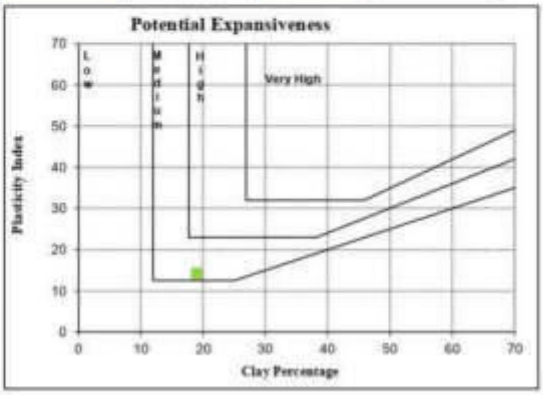
PH (TMH1 A20)		(TMH1 A21T) Conductivity s.m^{-1}		SG (TMH1 A12T)*	2,660

SIEVE ANALYSIS (TMH 1 A1a)*																	HYDROMETER ASTM D422							
100	75	63	53	37,5	26,5	19,0	13,2	9,5	6,7	4,75	2,36	1,18	0,60	0,425	0,300	0,150	0,075	0,060	0,042	0,020	0,006	0,005	0,003	0,002	0,001
100	100	100	100	100	100	100	100	100	100	100	99	99	98	97	95	88	83,1	81,18	79,2	71,28	47,52	37,62	27,72	21,78	13,86
% Passing																									



% Gravel	1	% Sand	18	% Silt	62	% Clay	19





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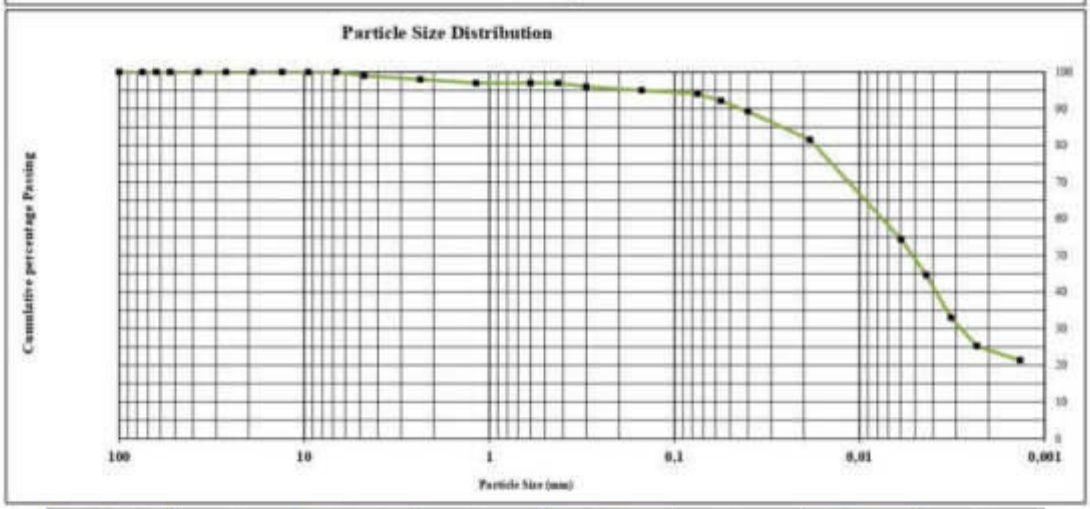
Customer:	GEOSS South Africa	Project:	4505
	9 Quantum Street, Techno Park, Unit 12 Technostell Building	Date Received:	19/04/22
	Stellenbosch	Date Reported:	11/05/22
	7600	Req. Number:	4505
Attention:	Mr S Teek		

FOUNDATION INDICATOR ASTM D422

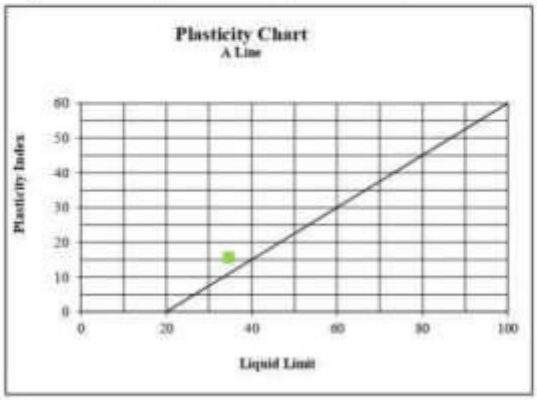
Material Description:	Light Orange Clay	Sample Number:	20002		
Position:	TP 42	Liquid Limit (Casagrande SANS 3001 GR12)	34,6	Linear Shrinkage	7,6
Depth:	0.8m	Plasticity Index	15,6	Insitu M/C%	11,4

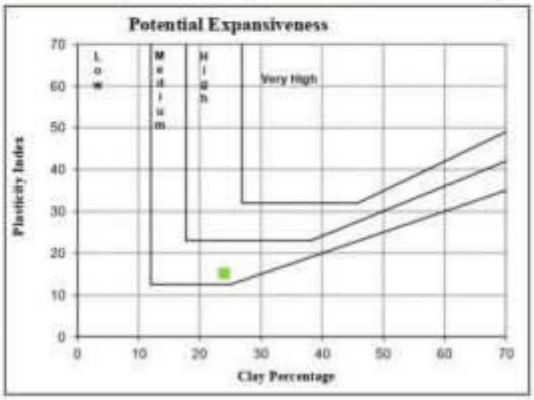
PH (TMH1 A20)*		(TMH1 A21T)* Conductivity s.m^{-1}		SG (TMH1 A12T)*	2,688

SIEVE ANALYSIS (TMH 1 A1a)*																HYDROMETER ASTM D422							
100	75	63	53	37,5	26,5	19,0	13,2	9,5	6,7	4,75	2,36	1,18	0,60	0,425	0,300	0,150	0,075	0,056	0,040	0,019	0,006	0,004	0,003	0,002	0,001
100	100	100	100	100	100	100	100	100	100	99	98	97	97	97	96	95	94,1	92,15	89,24	81,48	54,32	44,82	32,98	25,22	21,34
% Passing																									



% Gravel	2	% Sand	5	% Silt	69	% Clay	24





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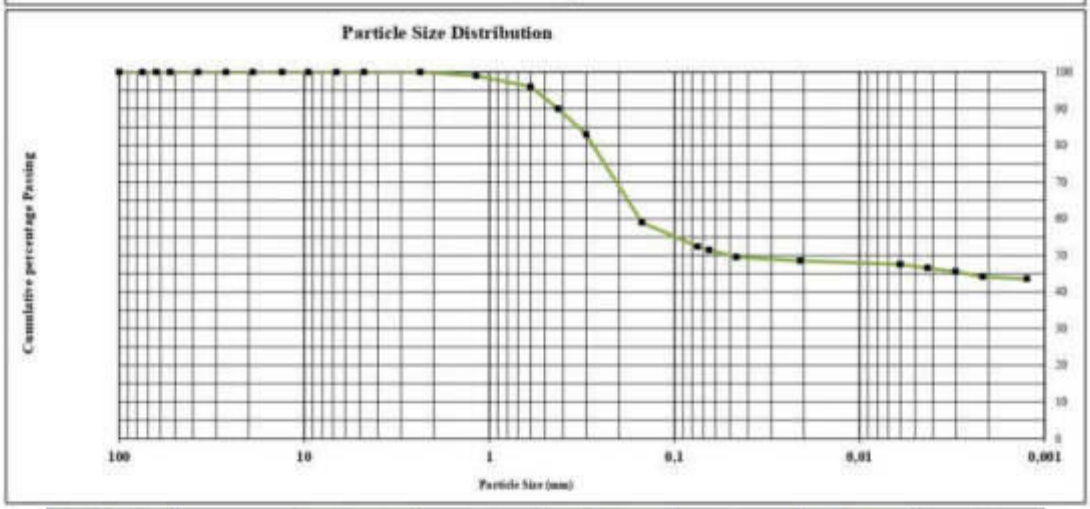
Customer:	GEOSS South Africa	Project:	4505
	9 Quantum Street, Techno Park, Unit 12 Technostell Building	Date Received:	19/04/22
	Stellenbosch	Date Reported:	11/05/22
	7600	Req. Number:	4505
Attention:	Mr S Teek		

FOUNDATION INDICATOR ASTM D422

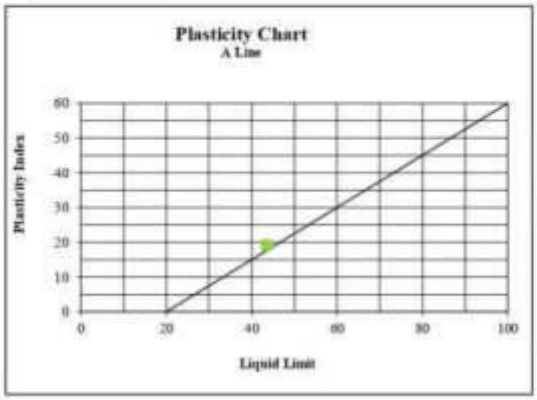
Material Description:	Light Brown Silty Clay	Sample Number:	20003		
Position:	TP 34	Liquid Limit (Casagrande SANS 3001 GR12)	43,5	Linear Shrinkage	9,2
Depth:	1,2m	Plasticity Index	19,2	Insitu M/C%	13,5

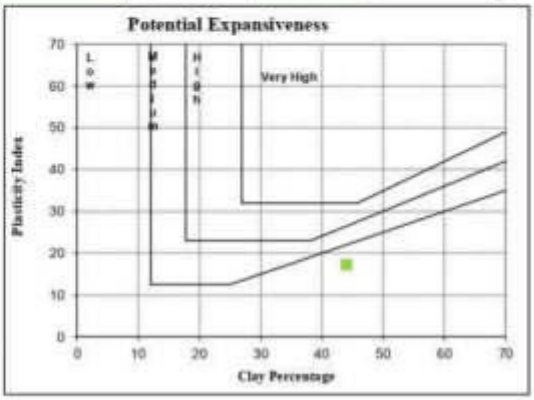
PH (TMH1 A20)*		(TMH1 A21T)* Conductivity s.m^{-1}		SG (TMH1 A12T)*	2,747

SIEVE ANALYSIS (TMH 1 A1a)*																	HYDROMETER ASTM D422							
100	75	63	53	37,5	26,5	19,0	13,2	9,5	6,7	4,75	2,36	1,18	0,60	0,425	0,300	0,150	0,075	0,065	0,046	0,021	0,006	0,004	0,003	0,002	0,001
100	100	100	100	100	100	100	100	100	100	100	100	99	96	90	83	59	52,4	51,5	49,5	48,5	47,5	46,5	45,5	44,2	43,6
% Passing																									



% Gravel		% Sand	49	% Silt	7	% Clay	44





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Compiled by: M.Steyn Approved By: J.Steyn / R. Wilson

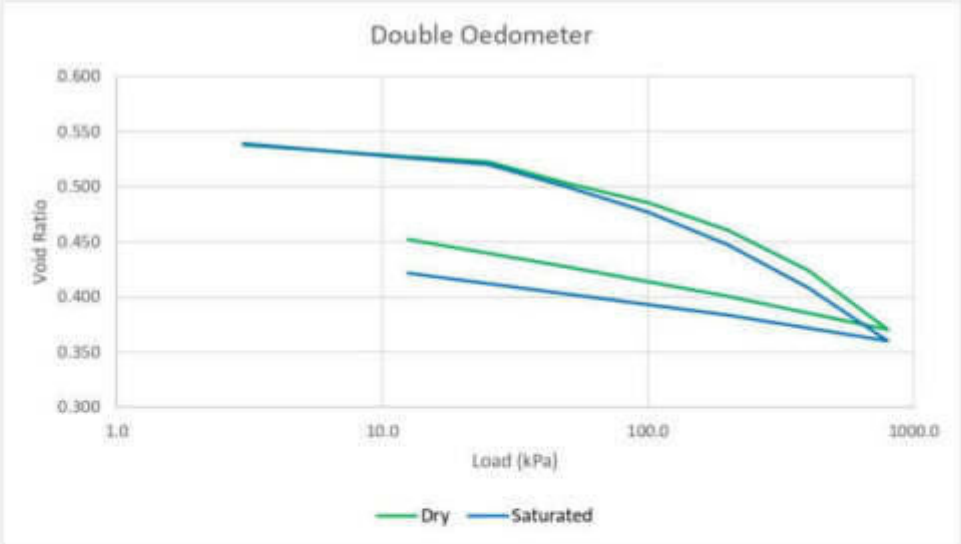
Double Oedometer Test

Dry Sample Detail		Initial	Final
Height	(mm)	20.3	19.2
Diameter	(mm)	63.5	63.5
Weight	(g)	125.7	130.5
Moisture	(%)	13.5	13.9
Dry Density	(Mg/m^3)	1.72	1.89
Bulk Density	(Mg/m^3)	1.96	2.15
Void Ratio		0.538	0.452
Particle Density	(Mg/m^3)	2.65	
Disturbed/Undisturbed		Undisturbed	
Remoulded Density	(Mg/m^3)	-	

Saturated Sample Detail		Initial	Final
Height	(mm)	20.3	18.8
Diameter	(mm)	63.5	63.5
Weight	(g)	125.6	120.2
Moisture	(%)	13.5	28.1
Dry Density	(Mg/m^3)	1.72	1.58
Bulk Density	(Mg/m^3)	1.95	2.02
Void Ratio		0.539	0.421
Particle Density	(Mg/m^3)	2.65	
Disturbed/Undisturbed		Undisturbed	
Remoulded Density	(Mg/m^3)	-	

Dry Sample		
Load (kPa)	Height (mm)	Void Ratio
3.0	20.300	0.538
12.5	20.160	0.527
25.0	20.100	0.523
50.0	19.840	0.503
100.0	19.610	0.486
200.0	19.280	0.461
400.0	18.800	0.424
800.0	18.090	0.370
200.0	18.490	0.401
50.0	18.840	0.427
12.5	19.170	0.452

Saturated Sample		
Load (kPa)	Height (mm)	Void Ratio
3.0	20.300	0.539
12.5	20.130	0.526
25.0	20.050	0.520
50.0	19.780	0.500
100.0	19.480	0.477
200.0	19.090	0.447
400.0	18.580	0.409
800.0	17.940	0.360
200.0	18.250	0.384
50.0	18.500	0.403
12.5	18.750	0.421



STEYN-WILSON GEOTECHNICAL

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Project	Fisantekraal		
Sample	TP42_0.8m		
Client	Geoss	Test Method	BS1377 - 5: 1990
Jobfile	SWG0036	Test Date	16/05/2022

01/02/2021 Rev2 TR\GEO-SW0011 Compiled: M. Steyn Approved: R. Wilson

WATERLAB (Pty) Ltd
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Tel: +2712 – 349 – 1066
Fax: +2712 – 349 – 2064
e-mail: admin@waterlab.co.za
T0391

CERTIFICATE OF ANALYSES
GENERAL WATER QUALITY PARAMETERS

Date received: 2022 - 02 - 16 **Date completed:** 2022 - 03 - 25
Project number: 1000 **Report number:** 107382 **Order number:**
Client name: Geoss South Africa Pty Ltd **Contact person:** Ms. A. Mcduling
Address: P.O Box 12412 Die Boord Stellenbosch **e-mail:** amcduling@geoss.co.za
Telephone: 021 880 1079 **Facsimile:** **Mobile:**

Analyses in mg/ℓ (Unless specified otherwise)	Method Identification	Sample Identification: 4505_C_TP25_27 Jan 2022	[redacted]
Sample Number		153126	
pH Value at 25°C	WLAB001	6.7	
Electrical Conductivity in mS/m at 25°C	WLAB002	31.8	
Total Dissolved Solids at 180°C	WLAB003	284	
Total Alkalinity as $CaCO_3$	WLAB007	32	
Total Hardness as $CaCO_3$	WLAB051	86	
Calcium Hardness as $CaCO_3$	WLAB051	65	
pH Saturation (pHs) at 20°C	WLAB053	8.6	
Chloride as Cl	WLAB046	31	
Sulphate as SO_4	WLAB046	34	
Free & Saline Ammonia as N	WLAB046	0.1	
Ammonium as NH_4	WLAB046	0.1	
Calcium as Ca	WLAB015	26	
Magnesium as Mg	WLAB015	5	
Langelier Index at 20°C (calc)	---	-2.0	
Ryznar Index at 20°C (calc)	---	10.7	
Corrosivity Ratio (calc)	---	2.5	
Leaching Index [LCSI] *	---	1 772	
Spalling Index [SCSI] *	---	5	
Aggressiveness Index [N] *	---	1 777	

*** = Not SANAS Accredited**
Tests marked "Not SANAS Accredited" in this report are not included in the SANAS Schedule of Accreditation for this Laboratory.

Important notes:

1. The above aggressiveness index is only applicable for conditions of laminar flow at a mean annual temperature of 20°C.
2. For stagnant/turbulent conditions the aggressiveness index must be corrected.
3. For wet/dry cycling conditions (for example in tidal zones) the aggressiveness index must be corrected.
4. For mean annual temperatures lower/higher than 20°C the aggressiveness index must be corrected.

J. Ngobeza
Technical Signatory:

The information contained in this report is relevant only to the sample/samples supplied to **WATERLAB (Pty) Ltd**. Any further use of the above information is not the responsibility of **WATERLAB (Pty) Ltd**. Except for the full report, part of this report may not be reproduced without written approval of **WATERLAB (Pty) Ltd**. Details of sample conducted by Waterlab (PTY) Ltd according to WLAB/Sampling Plan and Procedures/SOP are available on request.

WATERLAB

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sanas
T0391

CERTIFICATE OF ANALYSES
GENERAL WATER QUALITY PARAMETERS

Date received: 2022 - 02 - 16 **Date completed:** 2022 - 03 - 25
Project number: 1000 **Report number: 107382** **Order number:**
Client name: Geoss South Africa Pty Ltd **Contact person: Ms. A. Mcduling**
Address: P.O Box 12412 Die Boord Stellenbosch **e-mail: amcduling@geoss.co.za**
Telephone: 021 880 1079 **Facsimile:** **Mobile:**

Guidelines for assessing overall aggressiveness (N_c):

N_c	Aggressiveness
Not greater than 300	None to mild
400-700	Mild to moderate
800-1000	High
= or > 1 100	Very high

Aggressiveness Towards *Concrete and Fibre Cement Pipes*			
Index	Aggressive	Neutral	Non- Aggressive
a) Stability pH (pHs)	> pH	= pH	<pH
b) Langelier Index	Neg. Value	Zero	Pos. Value
c) Ryznar Index	>7.5	6-7	<6

Corrosiveness Towards metals	
Corrosivity	>0.2

J. Ngobeza

Technical Signatory:

The information contained in this report is relevant only to the sample/samples supplied to **WATERLAB (Pty) Ltd**. Any further use of the above information is not the responsibility of **WATERLAB (Pty) Ltd**. Except for the full report, part of this report may not be reproduced without written approval of **WATERLAB (Pty) Ltd**. Details of sample conducted by Waterlab (PTY) Ltd according to WLAB/Sampling Plan and Procedures/SOP are available on request.

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Telephone: 021 880 1079 **Facsimile:** **Mobile:**

To correct for:	Multiply	By: (see Notes 2 to 5 below)
Turbulence	LCSI	1.75
Stagnance	LCSI	0.5
Temperature	LCSI, SCSI, N7 Where N7=0.2 x Cl in mg/l	(1+ [0.05 x (T-20)])
Wet-dry cycles	SCSI	0.23×10^{-6} x TDS x DTF x CPA Where: DTF = Dry Time Fraction CPA = wet-dry cycles per annum

Note 1: Only if the concrete contains embedded steel.
Note 2: To preserve the correct logical relationships when dealing with the negative sub-indices (i.e. LCSI or SCSI having minus values) they should be multiplied by the reciprocal of the relevant factor indicated in this column
Note 3: If more than one correction is required, multiply by the product of the individual correction factors
Note 4: Use subscript c to indicate that the index has been corrected, e.g. for turbulent conditions $LCSI_C$ = LCSI x 1.75
Note 5: Round off corrected indices to the nearest 100.

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Technical Signatory:

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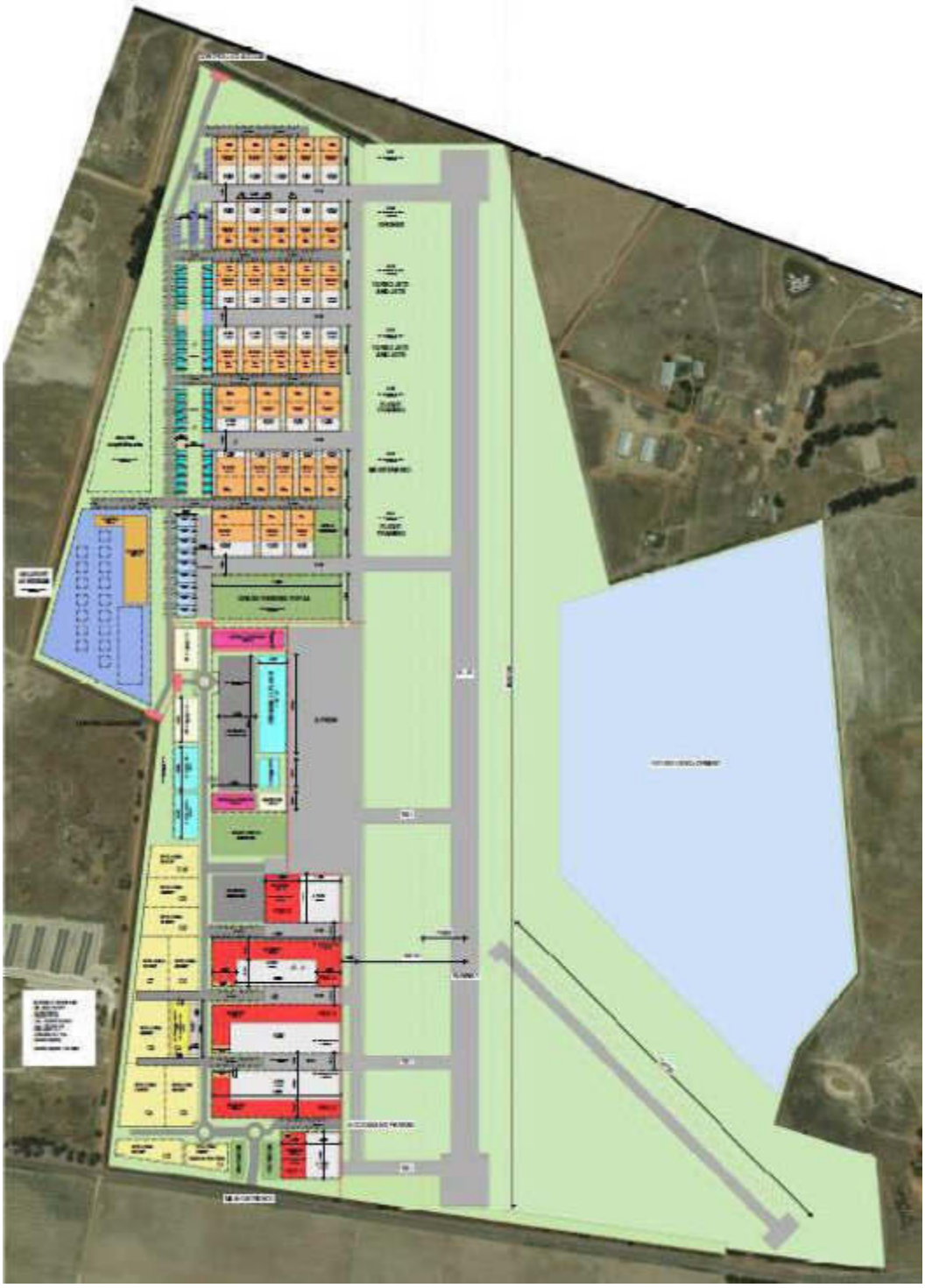
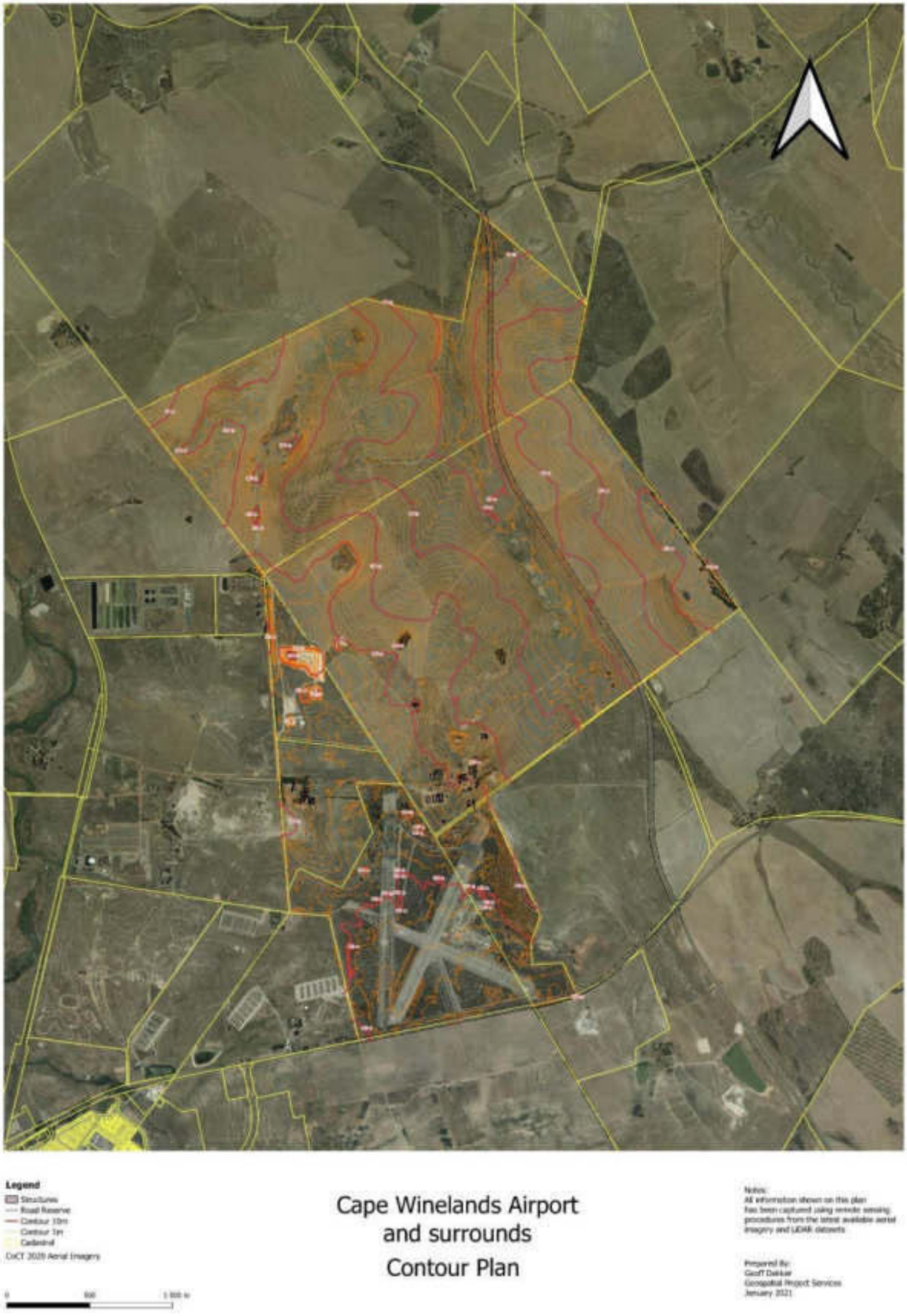
14. APPENDIX F: AVAILABLE PLANS AND SKETCHES



Map 8: Site development plan (Ver. 21D).



Map 9: LiDAR Data.

15. APPENDIX G: OTHER SUPPORTING INFORMATION

Table 14: Laboratory results for the region surrounding the site (after Stapelberg (2009).

Profile number and depth (m)	Origin	Landform	Indicator tests						Clay minerals (%)	Heave potential	Collapse potential	Dispersiveness	pH/ cond. (mS/m)	Lab.	Permeability (cm/s)	Unifi ed class	PRA Class	Fm	Gm
			LL CC	PI		LS	Clay	Act %											
				<425 µm total	Total														
5/8 (0,4)	Colluvium (granite)	Plain	-	-	-	-	-	-	N.T.	Low	No	-	-	Geos. Lab.	3.6×10^{-3}	SM	A.2.4	2.0	1.49
5/3 (3,0)	Residual shale	Plain	30 0,18	7	6,9	3	2	3.5	Ka/Cl(34) Il/Sm(2)	Low	No	ND3,CT2 SCS 19%	6.79 2232	Geos. Lab.	7.8×10^{-6}	ML	A.2.6 (4)	0.09	0.28
5/10 (0,5)	Residual sh. (slight ferr.)	Convex slope	42 0,29	12	11.9	4	40.5	0.3	N.T.	Low	No	-	-	Geos. Lab.	$<4 \times 10^{-6}$	ML	A.7.5 (9)	0.04	0.05

Table 15: General limits for assessment of aggressiveness (Basson, 1989).

Property of water	Degree of aggressiveness of water			
	Moderate	High	Very high	Excessive
pH	6,0 to 8,0	5,0 to 6,0	4,5 to 5,0	less than 4,5
pH minus $CaCO_3$-saturated pH	–0,2 to –0,3	–0,3 to –0,4	–0,4 to –0,5	less than –0,5
Calcium hardness as mg $CaCO_3$/ℓ	200 to 300	100 to 200	50 to 100	less than 50
Total ammonium ion as mg NH_4/ℓ	30 to 50	50 to 80	80 to 100	greater than 100
Magnesium ion as mg Mg/ℓ	100 to 500	500 to 1 000	1 000 to 1 500	greater than 1 500
Total sulphate ion as mg SO_4/ℓ	150 to 1 000	1 000 to 2 000	2 000 to 3 000	greater than 3 000
Chloride ion as mg Cl/ℓ	500 to 1 000	1 000 to 2 500	2 500 to 5 000	greater than 5 000
Other (see Note (b) under *Analytical tests required and methods of analysis* pp. 5–6)				

Table 16: Guide for assessing Final Basson Index (Basson, 1989).

Final index	Aggressiveness	Recommendation
Under 350	Non- to mildly aggressive	Use concrete class as required for structural design, but see *Remarks* in Table 9.
350 to 750	Mildly to fairly aggressive	Good concrete design and construction essential. Read *Remarks* in Table 9.
750 to 1 000	Highly aggressive	Identify dominant corrosion sub-index and follow applicable recommendations.
Over 1 000	Very highly aggressive	Do not use in contact with unprotected concrete unless recommended anti-corrosive measures can be carried out in full.

Appendix D

Bella Riva Stormwater Management Plan

ZUTARI
IMPACT. ENGINEERED.

Concept Stormwater Master Plan

Bella Riva SW Investigation

Sagewise 67 (Pty) Ltd

Submission date: 2024/01/31

Document number: 504584-0000-REP-CC-0001
Revision: B

Appendix E

PCSWMM Simulation Model Output Results

CAPE WINELANDS AIRPORT (CWA) CONCEPT STORMWATER MANAGEMENT PLAN -
EPA STORM WATER MANAGEMENT MODEL - VERSION 5.2 (Build 5.2.4)

****

Element Count

****

Number of rain gages 9

Number of subcatchments ... 559

Number of nodes 276

Number of links 287

Number of pollutants 0

Number of land uses 0

****

Raingage Summary

****

Name	Data Source	Data Type	Recording Interval
(1)_6month_RI_SCS_Type_II_(20.1mm)	(1)_6month_RI_SCS_Type_II_(20.1mm)	INTENSITY	6 min.
(2)_1year_RI_SCS_Type_II_(32.9mm)	(2)_1year_RI_SCS_Type_II_(32.9mm)	INTENSITY	6 min.
(3)_2year_RI_SCS_Type_II_(44.9mm)	(3)_2year_RI_SCS_Type_II_(44.9mm)	INTENSITY	6 min.
(4)_5year_RI_SCS_Type_II_(60.3mm)	(4)_5year_RI_SCS_Type_II_(60.3mm)	INTENSITY	6 min.
(5)_10year_RI_SCS_Type_II_(71.4mm)	(5)_10year_RI_SCS_Type_II_(71.4mm)	INTENSITY	6 min.
(6)_20year_RI_SCS_Type_II_(83mm)	(6)_20year_RI_SCS_Type_II_(83mm)	INTENSITY	6 min.
(7)_50year_RI_SCS_Type_II_(99.4mm)	(7)_50year_RI_SCS_Type_II_(99.4mm)	INTENSITY	6 min.
(8)_100year_RI_SCS_Type_II_(112.7mm)	(8)_100year_RI_SCS_Type_II_(112.7mm)	INTENSITY	6 min.
(9)_200year_RI_SCS_Type_II_(127mm)	(9)_200year_RI_SCS_Type_II_(127mm)	INTENSITY	6 min.

****

Subcatchment Summary

****

Name	Area	Width	%Imperv	%Slope	Rain Gage	Outlet
S_Pond1	0.21	41.96	0.00	0.5000	(4)_5year_RI_SCS_Type_II_(60.3mm)	SU1_Pond1
S_Pond2	3.29	411.29	0.00	0.5000	(4)_5year_RI_SCS_Type_II_(60.3mm)	SU2_Pond2
S_Pond3	0.61	76.19	0.00	0.5000	(4)_5year_RI_SCS_Type_II_(60.3mm)	SU3_Pond3
S_Pond4	0.13	31.32	0.00	0.5000	(4)_5year_RI_SCS_Type_II_(60.3mm)	SU4_Pond4
S_Pond5	0.45	64.07	0.00	0.5000	(4)_5year_RI_SCS_Type_II_(60.3mm)	SU5_Pond5
S_Pond6	0.09	45.90	0.00	0.5000	(4)_5year_RI_SCS_Type_II_(60.3mm)	SU6_Pond6

S_Pond7	0.27	90.10	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm)	SU7_Pond7
S_Pond8	0.20	102.25	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm)	SU8_Pond8
S1	0.29	29.34	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm)	J327
S1_4	0.33	66.14	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm)	J231
S1_8	1.24	35.42	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm)	S7_46
S10	0.03	13.70	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm)	OF_Pond4
S11	0.01	7.20	100.00	1.0000 (4)_5year_RI_SCS_Type_II_(60.3mm)	S45_27
S11_1	0.11	10.71	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm)	J17
S11_10	0.09	8.81	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm)	J179
S11_11	0.07	7.48	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm)	J168
S11_12	0.12	11.93	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm)	J218
S11_2	0.08	8.42	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm)	S39_2
S11_4	0.17	16.61	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm)	J186
S11_5	0.11	11.33	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm)	J26
S11_6	0.14	13.50	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm)	J174
S11_7	0.12	12.12	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm)	J190
S11_8	0.13	12.91	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm)	J230
S11_9	0.10	9.93	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm)	J168
S12	0.08	8.15	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm)	J35
S12_1	0.46	30.87	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm)	J17
S12_2	0.33	33.07	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm)	S39_2
S12_3	0.81	36.74	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm)	J186
S12_5	0.49	32.55	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm)	J163
S12_6	0.44	31.64	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm)	J179
S12_7	0.64	32.00	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm)	OF_Pond7
S12_8	0.38	34.23	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm)	OF_Pond7
S13	4.46	222.99	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm)	J231
S13_11	3.30	194.01	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm)	J72
S13_12	2.86	143.16	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm)	J267
S13_14	2.18	128.41	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm)	J270
S13_2	3.71	217.98	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm)	J143
S13_8	2.29	134.74	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm)	J72
S136_1	0.87	87.16	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm)	J351
S136_3	0.59	58.61	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm)	J351
S136_4	1.14	114.21	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm)	J244
S136_5	1.77	176.65	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm)	J13
S139_1	0.19	19.00	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm)	J351
S139_2	0.25	17.86	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm)	J13
S14	0.43	43.24	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm)	J351
S140_1	0.25	20.46	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm)	J69

S140_2	0.20	15.14	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J244
S141_1	0.20	19.78	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J145
S141_2	0.16	16.38	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J260
S141_4	0.27	27.05	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J359
S141_5	0.10	10.37	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J145
S143_1	0.12	12.35	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J34
S143_2	0.20	15.03	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J18
S143_3	0.15	15.26	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J242
S144_1	0.18	23.11	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J257
S144_3	0.31	14.16	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J277
S144_4	0.13	13.35	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J141
S144_5	0.15	10.13	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J144
S145_2	0.11	10.74	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J131
S147	0.42	28.26	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J305
S148_1	0.20	10.98	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J140
S15	0.21	10.36	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J150
S15_3	0.61	30.66	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J230
S15_4	0.61	30.36	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J218
S150	0.36	12.75	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J124
S152	0.02	9.90	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J24
S153	1.29	129.38	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J143
S155	0.11	11.33	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J92
S156_1	0.17	17.18	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J43
S157	0.08	8.07	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J96
S158_1	0.09	8.81	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J89
S158_2	0.15	10.09	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J37
S16	0.23	28.50	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J91
S160_2	0.15	10.54	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J98
S161_1	0.04	4.18	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J93
S161_2	0.10	10.13	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J77
S161_3	0.14	9.40	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J77
S161_5	0.09	9.40	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J54
S161_6	0.16	10.48	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J321
S163	0.17	13.23	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J65
S164_1	0.15	9.62	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J160
S164_3	0.11	8.96	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J61
S164_4	0.10	9.38	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J88
S164_5	0.05	6.80	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J103
S165	0.10	10.17	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J70
S166_1	0.11	9.91	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J44

S166_3	0.12	9.62	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J42
S166_4	0.19	9.56	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J111
S167_1	0.13	5.47	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J74
S167_2	0.26	10.89	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J51
S168_1	0.08	8.82	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J116
S168_2	0.12	9.67	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J9
S168_3	0.08	8.71	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J112
S168_4	0.12	9.36	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J49
S17	0.10	10.38	100.00	0.5420 (4)_5year_RI_SCS_Type_II_(60.3mm) J32
S170_1	0.27	27.26	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J349
S170_2	0.09	9.20	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J302
S170_3	0.27	13.28	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J95
S170_4	0.60	29.79	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J154
S170_5	0.09	9.17	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J154
S170_7	0.17	9.11	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J23
S170_8	0.24	23.87	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J101
S171_1	0.12	12.44	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J79
S171_10	0.12	12.48	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J358
S171_13	0.17	17.41	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J223
S171_14	0.14	13.70	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J230
S171_16	0.20	19.52	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J161
S171_17	0.13	12.92	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J17
S171_18	0.15	14.67	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) S39_2
S171_19	0.13	12.90	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J25
S171_2	0.21	21.01	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J164
S171_3	0.10	10.36	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J73
S171_4	0.11	11.19	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J239
S171_5	0.18	17.79	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J237
S171_7	0.10	9.81	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J223
S171_8	0.14	14.16	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J237
S173_1	0.13	12.63	75.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J74
S173_2	0.28	27.99	75.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J78
S173_3	0.27	27.05	75.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J46
S173_5	0.31	31.34	75.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J156
S173_6	0.39	38.54	75.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J113
S173_7	0.65	65.22	75.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J108
S174_1	0.30	30.36	75.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J44
S174_2	0.12	12.25	75.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J42
S175_1	0.65	64.58	75.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J67
S175_3	0.42	41.75	75.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J83

S175_4	0.55	54.60	75.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J157
S176_1	0.65	65.18	75.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J63
S176_3	0.41	41.28	75.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J86
S176_4	0.55	54.68	75.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J158
S177_1	0.97	96.74	75.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J97
S177_2	1.36	136.16	75.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J98
S178_1	0.97	97.46	75.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J89
S178_2	1.36	135.80	75.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J37
S179_1	0.77	77.30	75.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J60
S179_2	0.32	31.55	75.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J37
S179_3	0.23	22.67	75.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J321
S18	2.14	107.15	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J17
S18_3	0.19	6.18	100.00	1.0000 (4)_5year_RI_SCS_Type_II_(60.3mm) J76
S18_6	3.24	323.86	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J110
S180	0.14	14.34	75.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J37
S181	0.37	36.93	75.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J77
S182_2	0.27	27.30	75.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J160
S182_3	0.90	89.96	75.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J97
S182_4	0.70	69.64	75.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J98
S183	0.55	55.14	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J265
S184_1	0.08	8.08	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J42
S184_3	0.08	8.04	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J42
S184_4	0.64	63.83	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J107
S185	0.17	16.87	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J25
S186	0.29	28.72	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J70
S187	0.40	39.72	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J76
S188_1	0.12	11.64	75.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J74
S188_2	0.19	19.18	75.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J80
S189	0.09	9.03	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J65
S19	0.05	5.43	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J31
S190	0.79	79.08	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J94
S191	0.38	38.45	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J93
S192	0.01	0.78	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J109
S193_2	0.42	70.50	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J105
S193_3	0.76	75.55	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J106
S193_4	0.70	87.34	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J103
S193_5	0.21	34.60	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J106
S193_6	0.52	74.07	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J112
S193_7	0.74	92.06	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J106
S194_1	0.18	18.45	75.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J61

S194_3	0.11	11.37	75.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J88
S194_4	0.15	14.85	75.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J160
S195_1	0.55	54.57	0.00	0.7500 (4)_5year_RI_SCS_Type_II_(60.3mm) J112
S195_2	0.91	91.04	0.00	0.7500 (4)_5year_RI_SCS_Type_II_(60.3mm) J109
S196_1	0.11	9.31	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J99
S196_2	0.07	8.60	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J84
S196_3	0.06	8.11	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J102
S197_1	0.55	55.32	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J31
S197_3	0.36	36.29	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J34
S197_4	0.20	20.28	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J240
S197_5	0.12	11.60	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J68
S197_6	0.31	30.71	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J91
S198_1	0.34	33.80	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J34
S198_10	0.07	7.43	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J33
S198_2	0.36	36.01	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J68
S198_3	0.32	31.97	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J146
S198_4	0.12	12.22	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J119
S198_5	0.15	14.67	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J132
S198_6	0.33	33.09	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J146
S198_7	0.19	19.41	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J242
S198_8	0.13	13.24	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J68
S199	0.31	30.90	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) S198_10
S2	1.27	36.36	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J327
S2_1	1.08	28.50	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J231
S2_11	2.26	59.53	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J334
S2_12	0.54	14.32	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J348
S2_2	0.32	8.31	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) S3_122
S2_21	0.90	23.64	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J351
S2_22	1.09	28.76	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J258
S2_23	0.38	9.89	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J273
S2_24	0.93	24.57	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J317
S2_25	0.57	15.03	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J319
S2_26	1.48	39.03	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) S4
S2_27	0.86	22.75	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J265
S2_28	0.23	6.11	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J359
S2_3	2.66	70.10	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J331
S2_4	0.58	15.13	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) S3_127
S2_5	1.48	38.87	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J348
S2_6	2.61	68.60	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J299
S2_7	0.72	19.06	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) S3_32

S2_8	0.76	20.05	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J338
S20	5.36	536.01	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J59
S200_1	0.35	34.74	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J33
S200_2	0.47	46.85	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J207
S201	0.27	24.55	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J310
S202	0.54	54.47	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J75
S203	0.15	15.18	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J75
S204	0.17	15.20	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J75
S205	0.16	16.20	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J140
S206_1	0.29	23.76	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J306
S206_2	0.41	34.50	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J140
S206_3	0.21	21.17	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J310
S207	0.45	45.30	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J310
S208_1	0.56	70.54	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J95
S208_2	0.13	12.72	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J36
S208_3	0.31	31.20	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J101
S208_4	0.24	23.59	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J57
S209	0.68	67.81	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J56
S21	3.49	348.82	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J13
S210_1	0.22	21.53	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J55
S210_3	0.28	28.28	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J152
S210_4	0.11	10.65	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J95
S210_5	0.23	22.99	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J24
S211_1	0.96	95.71	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J100
S211_2	2.11	210.91	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J99
S212_1	0.24	23.61	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J100
S212_2	1.57	156.63	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J102
S213_1	0.47	47.12	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J48
S213_2	0.14	14.44	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J316
S213_3	1.45	90.76	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J54
S214	0.14	13.55	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J48
S215	0.34	33.75	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J316
S216	1.20	66.57	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J141
S217_1	0.39	39.00	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J41
S217_2	0.53	44.37	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J77
S217_3	0.89	88.50	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J58
S218	0.20	20.00	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J36
S219	0.19	19.02	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J40
S22	4.49	448.70	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J79
S220	0.03	2.74	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J36

S221	0.30	30.31	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J39
S222	0.12	12.32	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J120
S223_1	0.15	18.94	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J134
S223_2	1.27	79.34	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J127
S224	0.05	4.99	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) S223_2
S225	0.03	2.97	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J120
S226	0.40	39.87	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J154
S227	0.48	47.56	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J47
S228	0.05	5.37	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J121
S229_1	0.13	13.44	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J150
S229_2	0.11	10.93	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J123
S229_3	0.27	26.84	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J194
S229_4	0.07	6.90	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J124
S23	0.19	18.72	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J253
S23_2	1.87	58.30	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J243
S23_3	0.35	11.05	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) S29
S23_4	0.09	2.78	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J22
S230_1	0.34	33.60	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J87
S230_2	0.29	29.26	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J121
S231	0.16	15.66	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J302
S232	0.03	2.52	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J302
S233	0.05	4.76	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) S232
S234	0.06	5.72	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J124
S235	0.30	30.20	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J136
S236	0.02	1.57	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J127
S237	0.17	16.74	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J267
S238	0.09	8.74	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) S237
S239	0.47	47.24	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J130
S24	0.17	16.88	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J234
S24_2	0.39	32.58	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J156
S24_3	0.52	34.85	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J113
S24_4	0.45	34.97	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J46
S240_1	0.23	25.36	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J139
S240_2	0.38	42.42	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J134
S241	0.23	29.30	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J280
S242	0.89	52.55	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J130
S25	0.07	6.88	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J81
S26	0.32	31.61	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J133
S27	0.08	8.32	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J137
S28	0.61	61.37	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J230

S29	2.33	116.53	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J243
S3	4.46	446.30	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J73
S3_1	0.63	41.69	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J67
S3_11	0.11	10.77	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J258
S3_119	1.53	85.18	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J281
S3_122	1.92	80.04	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J357
S3_124	3.59	94.58	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J357
S3_126	2.98	149.24	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J327
S3_127	3.10	154.93	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J330
S3_17	2.93	101.08	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J299
S3_18	1.17	65.24	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J273
S3_19	0.92	45.94	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J331
S3_20	2.93	146.39	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J338
S3_21	1.66	83.10	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J348
S3_23	1.65	91.86	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J308
S3_24	1.22	121.64	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J319
S3_27	2.99	90.52	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J281
S3_3	0.18	18.39	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J243
S3_32	1.33	74.02	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J282
S3_4	0.40	39.78	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J86
S3_42	0.44	43.77	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J203
S3_5	0.66	43.79	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J157
S3_69	1.38	138.00	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J359
S3_7	0.26	26.14	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J257
S3_8	1.66	83.09	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J311
S30	0.33	32.77	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J36
S31	0.09	9.34	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J40
S32	0.10	10.18	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J31
S32_1	0.21	21.38	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J164
S32_10	1.02	40.68	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J163
S32_11	0.66	32.94	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J17
S32_12	0.55	39.14	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) S39_2
S32_13	0.08	7.56	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J25
S32_3	0.53	29.28	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J27
S32_4	0.80	106.81	75.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J50
S32_6	0.59	32.54	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) OF_Pond6
S32_8	0.65	32.62	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J358
S33	0.16	16.20	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J48
S34	0.22	22.28	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J56
S35	0.09	9.36	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J97

S36	3.22	161.22	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J223
S37	0.74	30.91	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J162
S38	6.00	300.09	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J162
S39	0.13	43.20	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J10
S39_1	0.10	5.89	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J10
S39_2	3.20	188.19	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J10
S39_4	0.09	5.32	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J10
S4	1.18	65.35	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J275
S40	0.04	18.60	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) S39_2
S43	0.26	25.85	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J325
S45_1	0.26	8.58	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J14
S45_10	0.20	9.24	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J29
S45_11	0.17	16.60	0.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J16
S45_12	0.15	15.15	0.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J16
S45_13	0.21	11.66	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J20
S45_14	0.12	9.62	0.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J207
S45_15	0.16	8.86	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J207
S45_16	0.10	5.71	0.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J15
S45_17	0.10	5.58	0.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J203
S45_18	0.14	7.58	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J15
S45_19	0.10	9.96	0.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J115
S45_2	0.07	8.82	0.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J118
S45_20	0.10	9.68	0.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J115
S45_21	0.13	7.37	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J115
S45_22	0.13	7.83	0.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J85
S45_23	0.06	11.20	0.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J205
S45_24	0.16	8.56	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J85
S45_25	0.12	7.79	0.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J47
S45_26	0.12	7.66	0.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J203
S45_27	0.15	7.90	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J47
S45_28	0.12	8.01	0.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J115
S45_29	0.11	7.36	0.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J115
S45_3	0.07	10.10	0.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J33
S45_30	0.15	8.60	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J115
S45_31	0.16	9.90	0.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J147
S45_32	0.03	6.47	0.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J85
S45_33	0.21	9.42	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J203
S45_34	0.11	8.62	0.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J206
S45_36	0.15	9.93	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J205
S45_37	0.10	10.57	0.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J30

S45_38	0.07	8.24	0.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J30
S45_39	0.12	10.11	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J30
S45_4	0.09	9.26	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J33
S45_40	0.07	8.18	0.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J119
S45_41	0.09	9.74	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J119
S45_42	0.29	16.21	0.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J31
S45_43	0.03	6.70	0.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J194
S45_44	0.37	18.39	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J31
S45_45	0.08	9.62	0.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J47
S45_46	0.03	6.53	0.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J35
S45_47	0.09	9.59	0.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J194
S45_48	0.05	9.56	0.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J7
S45_49	0.09	4.60	0.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J32
S45_5	0.16	10.96	0.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J29
S45_6	0.12	8.59	0.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J208
S45_7	0.07	8.65	0.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J119
S45_8	0.13	10.97	0.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J29
S48_1	0.73	40.64	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J97
S48_2	1.27	48.67	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J98
S49	0.37	11.69	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J338
S5	1.68	167.90	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J243
S50	0.90	89.50	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J325
S51_1	0.31	20.56	0.00	0.8680 (4)_5year_RI_SCS_Type_II_(60.3mm) J14
S51_2	0.29	19.33	0.00	0.8680 (4)_5year_RI_SCS_Type_II_(60.3mm) J149
S52	0.27	26.88	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) S18
S52_1	0.98	39.20	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) S7_48
S52_11	1.33	41.48	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J189
S52_12	0.38	11.79	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J209
S52_13	1.54	48.21	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) S7_53
S52_14	0.84	26.35	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) S7_41
S52_15	1.34	41.79	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J282
S52_17	1.46	45.73	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J22
S52_18	0.83	25.91	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) S3_21
S52_19	1.71	53.56	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) S3_20
S52_2	1.72	53.71	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J353
S52_20	0.61	18.98	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J357
S52_21	1.52	47.54	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J333
S52_22	1.09	33.93	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J169
S52_23	1.10	34.50	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) S3_17
S52_3	0.61	18.98	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J176

S52_4	1.51	47.05	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) S7_45
S52_5	1.24	38.69	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J170
S52_8	1.00	39.87	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) S3_127
S52_9	1.24	38.77	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) S3_124
S54	7.40	369.75	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J26
S55	0.70	18.45	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J327
S56	1.05	27.59	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J19
S6	3.82	212.40	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J25
S66_3	7.97	796.83	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J237
S66_4	5.66	566.38	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J79
S66_5	2.44	244.06	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J237
S67	6.20	310.09	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J7
S7	1.37	42.89	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) S38
S7_1	0.54	66.92	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J237
S7_11	1.65	82.71	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J190
S7_12	0.48	23.80	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J223
S7_2	0.21	6.89	100.00	1.0000 (4)_5year_RI_SCS_Type_II_(60.3mm) J110
S7_3	3.85	192.47	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J173
S7_39	0.45	22.62	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J235
S7_4	1.22	121.87	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J125
S7_41	4.35	217.65	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J218
S7_44	3.27	163.38	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J179
S7_45	8.10	404.81	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J169
S7_46	6.31	315.46	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J17
S7_48	5.24	262.05	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J358
S7_5	1.30	130.15	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J110
S7_50	6.91	345.61	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J185
S7_51	2.02	101.13	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J27
S7_53	7.99	399.62	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J230
S7_6	0.37	45.70	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J239
S7_7	0.58	72.56	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J235
S7_8	8.45	422.47	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J169
S70	1.24	69.05	100.00	1.0000 (4)_5year_RI_SCS_Type_II_(60.3mm) J13
S70_1	0.06	6.29	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J255
S70_3	0.10	24.95	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J243
S70_4	2.16	179.96	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J360
S71_1	0.17	16.97	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J69
S71_10	0.21	20.56	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J258
S71_11	0.50	50.37	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J359
S71_3	0.23	22.87	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J260

S71_5	0.50	50.07	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J253
S71_6	0.91	90.87	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J361
S71_7	0.46	45.84	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J260
S71_8	2.06	206.17	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J244
S71_9	1.20	120.04	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J31
S72	0.16	32.44	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J317
S8	2.49	177.85	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J164
S8_1	0.34	34.46	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J351
S8_2	0.04	3.85	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J351
S8_4	0.44	44.17	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J142
S8_6	0.06	15.70	100.00	1.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J351
S824_1	0.54	54.28	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J74
S824_2	1.32	132.02	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J156
S825	1.23	123.28	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J54
S826	1.96	122.44	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J92
S827	0.04	4.40	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J141
S828	1.83	131.06	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J137
S829	0.18	30.45	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J134
S830	0.33	46.43	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J136
S831_1	0.97	96.70	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J136
S831_2	0.98	98.44	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J134
S832_1	0.73	72.94	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J310
S832_2	1.52	152.50	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J140
S833	3.32	332.16	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J81
S834	0.05	4.60	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J141
S835_1	0.23	23.46	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J139
S835_2	0.53	53.13	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J137
S836_1	0.54	53.95	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J150
S836_2	0.58	57.75	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J123
S837_1	0.49	49.18	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J87
S837_2	0.42	42.26	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J121
S838_1	0.42	41.54	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J123
S838_2	0.49	49.21	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J121
S839	1.74	174.35	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J306
S840	1.40	140.43	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J133
S841	0.35	35.00	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J144
S842	0.26	43.72	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J302
S843	0.75	94.30	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J302
S844	1.65	165.38	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J154
S845	0.20	24.99	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J302

S846	1.17	58.33	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J136
S847	0.17	34.50	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J127
S848	0.18	36.86	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J129
S849	0.45	44.68	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J129
S850	0.76	63.65	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J267
S851	0.41	41.26	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J267
S852_1	1.27	63.56	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J129
S852_2	1.15	57.44	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J316
S853	0.06	30.00	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J130
S854	0.94	94.10	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J39
S855	0.26	43.72	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J120
S856	0.20	24.99	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J120
S857_1	0.59	59.44	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J75
S857_2	0.49	49.31	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J75
S858_1	0.75	74.58	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J131
S858_2	0.71	70.87	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J265
S859	0.84	84.32	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J132
S860_1	2.20	219.68	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J240
S860_2	0.89	89.11	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J146
S861	1.10	109.92	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J242
S862	0.10	10.00	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J33
S863	0.10	10.00	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J33
S864	0.12	12.50	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J68
S865	0.12	12.50	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J34
S866	0.12	12.50	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J34
S867	0.25	25.00	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J34
S868_1	0.48	48.10	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J31
S868_2	0.43	42.84	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J34
S869_1	0.24	23.81	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J253
S869_2	0.24	24.38	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J34
S870_1	0.57	56.59	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J253
S870_3	0.52	52.13	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J69
S870_4	0.59	59.05	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J244
S870_5	0.62	61.83	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J253
S871_1	0.22	21.74	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J260
S871_2	0.50	50.41	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J260
S872	1.00	100.41	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J68
S873	0.64	64.00	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J359
S874	1.00	99.96	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J359
S875	1.36	135.94	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J18

S876_1	0.85	84.86	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J36
S876_2	0.62	61.90	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J57
S876_3	0.49	48.86	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J36
S877_1	0.49	48.82	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J95
S877_2	0.86	85.87	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J57
S878	0.59	59.28	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J40
S879	0.56	69.61	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J120
S880	0.93	46.45	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J92
S881	0.63	31.54	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J316
S882	0.59	29.55	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J259
S883_1	1.34	133.83	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J41
S883_2	1.37	136.98	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J217
S884	0.79	79.19	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J53
S885	0.62	62.20	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J77
S886	0.70	70.17	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J37
S887	0.70	70.17	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J89
S888	0.62	62.20	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J160
S889	0.70	70.17	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J98
S890	0.70	70.17	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J97
S891_1	1.13	113.07	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J63
S891_3	0.70	70.50	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J86
S891_4	0.94	94.08	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J158
S892_1	1.11	111.03	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J67
S892_3	0.73	72.57	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J83
S892_4	0.94	93.89	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J157
S893	0.63	50.52	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J49
S894_1	0.75	75.28	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J78
S894_2	1.11	111.02	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J156
S895	0.46	46.36	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J113
S896	0.85	85.12	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J46
S897	0.52	52.04	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J25
S898	0.30	24.89	100.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) J107
S9	0.12	57.50	0.00	0.5000 (4)_5year_RI_SCS_Type_II_(60.3mm) OF_Pond4

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LID Control Summary

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Subcatchment	LID Control	No. of Units	Unit Area	Unit Width	% Area Covered	% Imperv Treated	% Perv Treated

S_Pond1	Pond1	1	2098.00	0.00	100.00	0.00	0.00
S_Pond4	Pond4	1	1253.00	0.00	100.00	0.00	0.00
S_Pond5	Pond5	1	4485.00	0.00	100.00	0.00	0.00
S_Pond6	Pond6	1	918.00	0.00	100.00	0.00	0.00
S_Pond7	Pond7	1	2703.00	0.00	100.00	0.00	0.00
S_Pond8	Pond8	1	2045.00	0.00	100.00	0.00	0.00

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Node Summary

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Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
J1	JUNCTION	98.89	2.50	0.0	
J10	JUNCTION	122.20	2.77	0.0	
J100	JUNCTION	116.42	2.50	0.0	
J101	JUNCTION	112.90	2.50	0.0	
J102	JUNCTION	117.71	2.50	0.0	
J103	JUNCTION	117.52	2.50	0.0	
J104	JUNCTION	117.90	2.56	0.0	
J105	JUNCTION	117.30	2.46	0.0	
J106	JUNCTION	118.40	2.50	0.0	
J107	JUNCTION	119.57	2.50	0.0	
J108	JUNCTION	120.56	2.14	0.0	
J109	JUNCTION	118.54	2.50	0.0	
J11	JUNCTION	119.20	3.30	0.0	
J110	JUNCTION	119.36	2.50	0.0	
J111	JUNCTION	120.20	2.46	0.0	
J112	JUNCTION	117.70	2.50	0.0	
J113	JUNCTION	120.59	2.41	0.0	
J114	JUNCTION	120.66	2.39	0.0	
J115	JUNCTION	110.23	3.82	0.0	
J116	JUNCTION	118.34	2.50	0.0	
J117	JUNCTION	118.19	2.50	0.0	
J118	JUNCTION	109.94	2.50	0.0	
J119	JUNCTION	109.78	2.24	0.0	
J12	JUNCTION	110.41	2.50	0.0	
J120	JUNCTION	116.65	2.50	0.0	
J121	JUNCTION	114.66	2.50	0.0	
J122	JUNCTION	114.64	2.50	0.0	

J123	JUNCTION	113.89	2.74	0.0
J124	JUNCTION	113.28	2.72	0.0
J125	JUNCTION	117.58	2.74	0.0
J127	JUNCTION	115.39	2.50	0.0
J128	JUNCTION	109.18	3.19	0.0
J129	JUNCTION	115.58	2.50	0.0
J13	JUNCTION	96.15	3.97	0.0
J130	JUNCTION	113.51	1.97	0.0
J131	JUNCTION	109.89	2.50	0.0
J132	JUNCTION	109.71	2.63	0.0
J133	JUNCTION	113.23	2.50	0.0
J134	JUNCTION	113.79	1.87	0.0
J136	JUNCTION	113.71	2.65	0.0
J137	JUNCTION	114.05	2.50	0.0
J139	JUNCTION	113.68	2.84	0.0
J14	JUNCTION	115.50	2.54	0.0
J140	JUNCTION	112.85	2.70	0.0
J141	JUNCTION	110.75	2.34	0.0
J142	JUNCTION	101.10	2.50	0.0
J143	JUNCTION	112.21	2.50	0.0
J144	JUNCTION	111.17	2.72	0.0
J145	JUNCTION	105.44	2.50	0.0
J146	JUNCTION	111.09	2.50	0.0
J147	JUNCTION	109.73	3.77	0.0
J148	JUNCTION	116.65	2.50	0.0
J149	JUNCTION	116.22	2.50	0.0
J15	JUNCTION	109.08	3.65	0.0
J150	JUNCTION	111.47	2.48	0.0
J151	JUNCTION	115.81	2.50	0.0
J152	JUNCTION	115.17	2.50	0.0
J153	JUNCTION	114.04	2.50	0.0
J154	JUNCTION	116.13	2.24	0.0
J155	JUNCTION	121.42	2.50	0.0
J156	JUNCTION	120.89	1.96	0.0
J157	JUNCTION	119.71	2.50	0.0
J158	JUNCTION	119.57	2.50	0.0
J159	JUNCTION	120.65	2.50	0.0
J16	JUNCTION	93.44	2.50	0.0
J160	JUNCTION	119.66	2.50	0.0
J161	JUNCTION	109.39	3.86	0.0

J162	JUNCTION	97.86	2.73	0.0
J163	JUNCTION	107.19	2.62	0.0
J164	JUNCTION	122.13	2.80	0.0
J165	JUNCTION	105.81	7.31	0.0
J168	JUNCTION	104.75	2.53	0.0
J169	JUNCTION	111.10	2.50	0.0
J17	JUNCTION	114.34	2.50	0.0
J170	JUNCTION	102.64	8.91	0.0
J171	JUNCTION	101.76	2.42	0.0
J172	JUNCTION	108.92	2.50	0.0
J173	JUNCTION	106.00	4.76	0.0
J174	JUNCTION	105.24	2.50	0.0
J176	JUNCTION	108.15	2.50	0.0
J179	JUNCTION	104.37	2.56	0.0
J18	JUNCTION	110.59	2.50	0.0
J182	JUNCTION	104.25	3.06	0.0
J183	JUNCTION	105.03	3.97	0.0
J185	JUNCTION	98.91	2.29	0.0
J186	JUNCTION	103.50	3.84	0.0
J189	JUNCTION	106.08	2.50	0.0
J19	JUNCTION	119.01	2.79	0.0
J190	JUNCTION	95.51	2.92	0.0
J194	JUNCTION	111.63	2.50	0.0
J2	JUNCTION	92.20	2.80	0.0
J20	JUNCTION	85.14	2.50	0.0
J203	JUNCTION	109.37	3.37	0.0
J205	JUNCTION	109.59	2.74	0.0
J206	JUNCTION	109.33	2.67	0.0
J207	JUNCTION	109.48	2.40	0.0
J208	JUNCTION	109.65	2.00	0.0
J209	JUNCTION	101.20	3.33	0.0
J21	JUNCTION	94.80	2.50	0.0
J212	JUNCTION	119.57	2.33	0.0
J217	JUNCTION	115.32	2.50	0.0
J218	JUNCTION	99.25	3.06	0.0
J22	JUNCTION	99.92	2.70	0.0
J223	JUNCTION	101.98	2.50	0.0
J23	JUNCTION	115.08	2.50	0.0
J230	JUNCTION	96.20	2.30	0.0
J231	JUNCTION	98.31	3.62	0.0

J233	JUNCTION	107.68	2.50	0.0
J234	JUNCTION	101.30	2.50	0.0
J235	JUNCTION	99.66	2.50	0.0
J237	JUNCTION	96.61	2.72	0.0
J239	JUNCTION	93.36	2.50	0.0
J24	JUNCTION	113.90	2.50	0.0
J240	JUNCTION	107.22	2.50	0.0
J242	JUNCTION	105.27	2.50	0.0
J243	JUNCTION	102.01	2.50	0.0
J244	JUNCTION	98.75	3.33	0.0
J25	JUNCTION	122.32	2.28	0.0
J253	JUNCTION	101.61	2.50	0.0
J255	JUNCTION	101.87	2.50	0.0
J256	JUNCTION	101.44	2.50	0.0
J257	JUNCTION	106.75	2.50	0.0
J258	JUNCTION	106.34	2.50	0.0
J259	JUNCTION	115.66	2.50	0.0
J26	JUNCTION	100.82	1.77	0.0
J260	JUNCTION	101.88	2.50	0.0
J263	JUNCTION	108.87	3.78	0.0
J265	JUNCTION	109.49	2.30	0.0
J267	JUNCTION	113.97	2.50	0.0
J27	JUNCTION	100.46	2.84	0.0
J270	JUNCTION	115.40	2.50	0.0
J273	JUNCTION	110.09	2.58	0.0
J274	JUNCTION	111.23	2.50	0.0
J275	JUNCTION	111.54	2.50	0.0
J277	JUNCTION	108.72	2.56	0.0
J279	JUNCTION	108.91	2.28	0.0
J28	JUNCTION	104.67	2.50	0.0
J280	JUNCTION	112.89	2.71	0.0
J281	JUNCTION	105.38	3.24	0.0
J282	JUNCTION	109.07	2.20	0.0
J285	JUNCTION	110.31	2.16	0.0
J289	JUNCTION	114.60	2.50	0.0
J29	JUNCTION	93.75	3.44	0.0
J299	JUNCTION	110.83	2.34	0.0
J30	JUNCTION	94.07	3.50	0.0
J301	JUNCTION	112.68	2.55	0.0
J302	JUNCTION	115.01	2.50	0.0

J305	JUNCTION	111.05	2.21	0.0
J306	JUNCTION	112.03	2.24	0.0
J308	JUNCTION	113.04	2.48	0.0
J309	JUNCTION	111.84	2.50	0.0
J31	JUNCTION	99.77	2.49	0.0
J310	JUNCTION	110.66	2.10	0.0
J311	JUNCTION	112.49	2.76	0.0
J312	JUNCTION	114.21	2.50	0.0
J316	JUNCTION	116.50	2.50	0.0
J317	JUNCTION	114.58	2.49	0.0
J319	JUNCTION	116.19	2.50	0.0
J32	JUNCTION	101.04	4.33	0.0
J321	JUNCTION	117.23	4.02	0.0
J325	JUNCTION	117.25	2.76	0.0
J327	JUNCTION	118.67	2.50	0.0
J33	JUNCTION	108.18	2.50	0.0
J330	JUNCTION	116.64	2.23	0.0
J331	JUNCTION	114.36	2.50	0.0
J333	JUNCTION	113.38	2.50	0.0
J334	JUNCTION	104.28	2.78	0.0
J336	JUNCTION	103.29	2.62	0.0
J338	JUNCTION	102.00	2.88	0.0
J34	JUNCTION	102.82	2.49	0.0
J345	JUNCTION	101.31	3.02	0.0
J348	JUNCTION	100.32	2.48	0.0
J349	JUNCTION	113.69	2.78	0.0
J35	JUNCTION	109.78	3.71	0.0
J350	JUNCTION	99.16	2.87	0.0
J351	JUNCTION	101.61	2.50	0.0
J353	JUNCTION	103.92	2.82	0.0
J357	JUNCTION	109.62	2.09	0.0
J358	JUNCTION	112.52	4.81	0.0
J359	JUNCTION	103.85	2.50	0.0
J36	JUNCTION	115.40	2.18	0.0
J360	JUNCTION	83.89	2.25	0.0
J361	JUNCTION	93.63	3.56	0.0
J37	JUNCTION	118.62	2.50	0.0
J38	JUNCTION	120.01	2.86	0.0
J39	JUNCTION	116.08	2.50	0.0
J4	JUNCTION	88.00	4.00	0.0

J40	JUNCTION	116.27	2.50	0.0
J41	JUNCTION	115.90	3.16	0.0
J42	JUNCTION	122.57	2.50	0.0
J43	JUNCTION	118.55	2.50	0.0
J44	JUNCTION	122.39	2.67	0.0
J45	JUNCTION	119.22	2.50	0.0
J46	JUNCTION	120.98	2.50	0.0
J47	JUNCTION	112.53	2.50	0.0
J48	JUNCTION	118.56	2.50	0.0
J49	JUNCTION	119.08	2.50	0.0
J5	JUNCTION	80.00	6.02	0.0
J50	JUNCTION	118.66	2.50	0.0
J51	JUNCTION	118.90	2.31	0.0
J52	JUNCTION	109.02	3.71	0.0
J53	JUNCTION	116.97	2.50	0.0
J54	JUNCTION	117.45	2.50	0.0
J55	JUNCTION	114.20	2.50	0.0
J56	JUNCTION	115.01	2.44	0.0
J57	JUNCTION	115.30	2.02	0.0
J58	JUNCTION	114.69	2.50	0.0
J59	JUNCTION	117.72	2.20	0.0
J6	JUNCTION	90.11	2.50	0.0
J60	JUNCTION	117.47	2.76	0.0
J61	JUNCTION	122.62	1.56	0.0
J62	JUNCTION	122.56	1.60	0.0
J63	JUNCTION	122.66	1.32	0.0
J64	JUNCTION	110.83	2.50	0.0
J65	JUNCTION	122.53	1.62	0.0
J66	JUNCTION	110.15	2.50	0.0
J67	JUNCTION	122.53	1.47	0.0
J68	JUNCTION	104.52	2.50	0.0
J69	JUNCTION	101.87	2.50	0.0
J7	JUNCTION	107.73	2.50	0.0
J70	JUNCTION	122.47	1.65	0.0
J71	JUNCTION	102.23	2.50	0.0
J72	JUNCTION	113.01	2.50	0.0
J73	JUNCTION	95.71	3.72	0.0
J74	JUNCTION	122.52	1.39	0.0
J75	JUNCTION	109.65	2.72	0.0
J76	JUNCTION	122.42	1.67	0.0

J77	JUNCTION	116.77	3.31	0.0
J78	JUNCTION	121.25	2.23	0.0
J79	JUNCTION	93.49	2.50	0.0
J8	JUNCTION	118.02	2.50	0.0
J80	JUNCTION	121.66	2.50	0.0
J81	JUNCTION	110.20	2.03	0.0
J82	JUNCTION	112.40	2.60	0.0
J83	JUNCTION	120.48	2.50	0.0
J84	JUNCTION	116.14	2.50	0.0
J85	JUNCTION	111.05	2.40	0.0
J86	JUNCTION	120.49	2.50	0.0
J87	JUNCTION	113.74	3.25	0.0
J88	JUNCTION	120.74	2.50	0.0
J89	JUNCTION	118.70	2.50	0.0
J9	JUNCTION	117.27	2.50	0.0
J90	JUNCTION	117.68	2.57	0.0
J91	JUNCTION	111.01	2.50	0.0
J92	JUNCTION	117.36	2.50	0.0
J93	JUNCTION	118.03	2.36	0.0
J94	JUNCTION	118.31	2.76	0.0
J95	JUNCTION	113.36	2.50	0.0
J96	JUNCTION	116.73	3.88	0.0
J97	JUNCTION	118.66	2.50	0.0
J98	JUNCTION	118.38	2.80	0.0
J99	JUNCTION	117.02	2.74	0.0
OF1	JUNCTION	115.95	3.70	0.0
OF_Pond1	OUTFALL	116.05	1.35	0.0
OF_Pond2	OUTFALL	108.25	2.00	0.0
OF_Pond3	OUTFALL	93.00	1.00	0.0
OF_Pond4	OUTFALL	83.50	1.00	0.0
OF_Pond5	OUTFALL	96.00	1.05	0.0
OF_Pond6	OUTFALL	94.00	1.00	0.0
OF_Pond7	OUTFALL	100.50	1.00	0.0
OF_Pond8	OUTFALL	122.00	1.00	0.0
OF2	OUTFALL	106.50	1.00	0.0
OF3	OUTFALL	87.00	1.00	0.0
OF4	OUTFALL	78.00	1.00	0.0
OF5	OUTFALL	87.00	1.00	0.0
OF6	OUTFALL	92.00	1.00	0.0
OF7	OUTFALL	98.00	1.00	0.0

OF8	OUTFALL	115.00	2.00	0.0
SU1_Pond1	STORAGE	116.00	2.50	0.0
SU2_Pond2	STORAGE	105.00	5.30	0.0
SU3_Pond3	STORAGE	93.00	2.00	0.0
SU4_Pond4	STORAGE	83.50	1.50	0.0
SU5_Pond5	STORAGE	96.00	2.50	0.0
SU6_Pond6	STORAGE	94.00	1.00	0.0
SU7_Pond7	STORAGE	100.50	2.50	0.0
SU8_Pond8	STORAGE	122.00	2.00	0.0

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Link Summary

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Name	From Node	To Node	Type	Length	%Slope	Roughness
C1	J44	J25	CONDUIT	127.2	0.0582	0.0120
C10	J171	OF_Pond7	CONDUIT	107.6	1.1679	0.0120
C100	J51	J50	CONDUIT	25.7	0.9217	0.0120
C101	J139	J140	CONDUIT	91.4	0.9141	0.0120
C102	J101	J47	CONDUIT	38.5	0.9439	0.0120
C103_1	J78	J156	CONDUIT	168.2	0.2194	0.0120
C103_2	J156	J108	CONDUIT	134.2	0.2415	0.0120
C104	J150	J85	CONDUIT	30.4	1.3771	0.0120
C105	J360	OF_Pond4	CONDUIT	23.3	1.6663	0.0120
C106	J140	J306	CONDUIT	166.7	0.4884	0.0120
C107	J130	J133	CONDUIT	70.1	0.4080	0.0120
C108	J263	OF_Pond2	CONDUIT	28.1	2.2257	0.0120
C109	SU5_Pond5	J4	CONDUIT	28.7	38.4931	0.0120
C11	J244	J13	CONDUIT	195.0	1.3337	0.0120
C110	SU6_Pond6	J2	CONDUIT	32.1	7.8058	0.0120
C111	SU8_Pond8	J11	CONDUIT	68.2	6.9081	0.0120
C112	SU7_Pond7	J1	CONDUIT	40.5	6.8374	0.0120
C113	J1	OF7	CONDUIT	21.4	4.1331	0.0120
C114	J2	OF6	CONDUIT	12.4	1.6178	0.0120
C115	J4	OF5	CONDUIT	8.8	11.4774	0.0120
C116	J5	OF4	CONDUIT	35.0	5.7297	0.0120
C117	J6	OF3	CONDUIT	34.4	9.0774	0.0120
C118	J7	OF2	CONDUIT	35.7	3.4323	0.0120
C119_1	J83	J157	CONDUIT	132.7	0.5810	0.0120

C119_2	J157	J106	CONDUIT	225.7	0.5805	0.0120
C12	J84	OF_Pond1	CONDUIT	8.5	1.1127	0.0120
C12_1	J25	J164	CONDUIT	399.1	0.0476	0.0120
C12_2	J164	J10	CONDUIT	113.0	-0.0611	0.0120
C120	J106	J104	CONDUIT	93.0	0.5353	0.0120
C121	J104	J103	CONDUIT	73.9	0.5158	0.0120
C122	J9	J148	CONDUIT	130.2	0.4739	0.0120
C122_1	J103	J105	CONDUIT	46.7	0.4860	0.0120
C122_2	J105	J9	CONDUIT	5.7	0.5410	0.0120
C123	J116	J117	CONDUIT	36.0	0.4278	0.0120
C124	J117	J8	CONDUIT	35.8	0.4783	0.0120
C125	J8	J112	CONDUIT	64.9	0.4980	0.0120
C126	J112	J9	CONDUIT	89.1	0.4835	0.0120
C127	J102	J99	CONDUIT	80.9	0.8613	0.0120
C128	J97	J94	CONDUIT	117.4	0.3007	0.0120
C129	J98	J99	CONDUIT	313.1	0.4366	0.0120
C13	J68	J34	CONDUIT	147.2	1.1537	0.0120
C130	J99	J100	CONDUIT	154.2	0.3885	0.0120
C131	J100	J84	CONDUIT	102.9	0.2654	0.0120
C132	J37	J100	CONDUIT	314.5	0.6995	0.0120
C133	J89	J93	CONDUIT	127.9	0.5271	0.0120
C134	J94	J93	CONDUIT	155.0	0.1807	0.0120
C135	J93	J90	CONDUIT	100.9	0.3468	0.0120
C136	J90	J60	CONDUIT	58.2	0.3560	0.0120
C137	J23	J58	CONDUIT	79.9	0.4842	0.0120
C138	J58	J55	CONDUIT	101.2	0.4790	0.0120
C139	J57	J56	CONDUIT	38.9	0.7450	0.0120
C14	J34	J32	CONDUIT	169.4	1.0555	0.0120
C140	J56	J58	CONDUIT	59.8	0.5370	0.0120
C141	J95	J47	CONDUIT	173.3	0.4777	0.0120
C142	J40	J41	CONDUIT	97.6	0.3790	0.0120
C143	J41	J56	CONDUIT	167.9	0.5278	0.0120
C144	J302	J87	CONDUIT	68.7	1.8590	0.0120
C145	J43	J96	CONDUIT	50.9	3.5825	0.0120
C146	J96	J41	CONDUIT	168.7	0.4926	0.0120
C147	J82	J150	CONDUIT	75.1	1.2430	0.0120
C148	J47	J194	CONDUIT	191.1	0.4742	0.0120
C149	J194	J85	CONDUIT	139.1	0.4133	0.0120
C15	J33	J32	CONDUIT	173.5	4.1236	0.0120
C150	J92	J96	CONDUIT	146.5	0.4286	0.0120

C151	J48	J316	CONDUIT	212.0	0.9719	0.0120
C152	J147	J203	CONDUIT	212.4	0.1718	0.0120
C153	J203	J15	CONDUIT	164.2	0.1754	0.0120
C154	J205	J15	CONDUIT	103.1	0.4906	0.0120
C155	J15	J52	CONDUIT	44.8	0.1249	0.0120
C156	J316	J259	CONDUIT	83.2	1.0019	0.0120
C157	J53	J259	CONDUIT	237.5	0.5500	0.0120
C158	J39	J36	CONDUIT	77.9	0.8720	0.0120
C159	J36	J349	CONDUIT	194.6	0.8776	0.0120
C16_1	J79	J73	CONDUIT	300.8	-0.7387	0.0120
C160	J289	J349	CONDUIT	55.6	1.6383	0.0120
C161	J133	J280	CONDUIT	63.3	0.5370	0.0120
C162	J129	J133	CONDUIT	325.0	0.7252	0.0120
C163	J127	J136	CONDUIT	163.1	1.0293	0.0120
C164	J136	J280	CONDUIT	82.4	0.9951	0.0120
C165	J137	J82	CONDUIT	99.1	1.6618	0.0120
C166	J122	J123	CONDUIT	87.1	0.8656	0.0120
C167	J123	J124	CONDUIT	79.9	0.7593	0.0120
C168	J124	J82	CONDUIT	132.3	0.6614	0.0120
C169	J134	J136	CONDUIT	139.4	0.0588	0.0120
C17	J71	J13	CONDUIT	245.4	2.4762	0.0120
C170	J120	J154	CONDUIT	66.7	0.7786	0.0120
C171	J154	J87	CONDUIT	297.8	0.8026	0.0120
C172	J87	J124	CONDUIT	52.3	0.8750	0.0120
C173	J121	J349	CONDUIT	87.2	1.1122	0.0120
C174_1	J86	J158	CONDUIT	129.8	0.7101	0.0120
C174_2	J158	J104	CONDUIT	226.7	0.7350	0.0120
C175_1	J88	J160	CONDUIT	117.8	0.9151	0.0120
C175_2	J160	J103	CONDUIT	234.1	0.9152	0.0120
C176_1	J18	J240	CONDUIT	263.1	1.2805	0.0120
C177	J148	J149	CONDUIT	89.8	0.4797	0.0120
C178	J149	J151	CONDUIT	90.0	0.4567	0.0120
C179	J151	J14	CONDUIT	53.5	0.5724	0.0120
C18	J125	J325	CONDUIT	54.0	0.6115	0.0120
C18_2	J243	J22	CONDUIT	234.5	0.8932	0.0200
C182	J118	J119	CONDUIT	76.7	0.2165	0.0120
C183	J119	J208	CONDUIT	72.0	0.1806	0.0120
C184	J208	J207	CONDUIT	90.1	0.1787	0.0120
C185	J207	J206	CONDUIT	90.0	0.1744	0.0120
C186	J206	J205	CONDUIT	89.9	-0.2871	0.0120

C19	J327	J330	CONDUIT	237.8	0.8554	0.0200
C2	SU1_Pond1	OF1	CONDUIT	8.5	24.9917	0.0120
C20	J240	J242	CONDUIT	153.2	1.2693	0.0120
C21	J14	J217	CONDUIT	46.6	0.3781	0.0120
C21_1	J12	J66	CONDUIT	28.4	0.9267	0.0120
C21_2	J66	J263	CONDUIT	116.3	1.0928	0.0120
C217	J349	J101	CONDUIT	98.7	0.8044	0.0120
C22	J310	J35	CONDUIT	120.0	0.7360	0.0120
C227	J17	J358	CONDUIT	220.0	0.8254	0.0120
C23	J79	J360	CONDUIT	204.3	4.7017	0.0120
C235	J330	J331	CONDUIT	291.7	0.7817	0.0200
C236	J331	J333	CONDUIT	140.7	0.6945	0.0120
C237	J333	J311	CONDUIT	121.0	0.7423	0.0200
C238	J311	J309	CONDUIT	101.1	0.6412	0.0120
C239	J309	J299	CONDUIT	170.3	0.5890	0.0200
C24	J64	J12	CONDUIT	59.0	0.7064	0.0120
C240	J299	J285	CONDUIT	148.4	0.3524	0.0120
C241	J285	J357	CONDUIT	295.2	0.2327	0.0200
C242	J357	J282	CONDUIT	282.1	0.1953	0.0200
C243	J282	J279	CONDUIT	95.4	0.1730	0.0120
C244	J279	J277	CONDUIT	127.9	0.1501	0.0120
C245	J277	J263	CONDUIT	142.0	-0.1112	0.0120
C246	J281	J334	CONDUIT	192.9	0.5706	0.0200
C247	J334	J336	CONDUIT	145.7	0.6793	0.0120
C248	J336	J338	CONDUIT	180.8	0.7150	0.0200
C249	J338	J345	CONDUIT	88.9	0.7740	0.0120
C25	J35	J147	CONDUIT	4.8	0.9099	0.0120
C250	J345	J348	CONDUIT	124.1	0.7987	0.0200
C251	J348	J350	CONDUIT	148.9	0.7759	0.0120
C252	J350	J231	CONDUIT	96.3	0.8859	0.0200
C256	J231	J230	CONDUIT	364.8	0.5790	0.0120
C257	J255	J351	CONDUIT	197.8	0.1294	0.0120
C258	J351	J256	CONDUIT	132.4	0.1284	0.0120
C259	J256	J234	CONDUIT	123.4	0.1183	0.0120
C26	J61	J62	CONDUIT	115.0	0.0591	0.0120
C260_1	J234	J142	CONDUIT	13.1	1.4619	0.0120
C260_2	J142	J231	CONDUIT	113.6	2.4575	0.0120
C261	J325	J319	CONDUIT	168.9	0.6224	0.0200
C262	J319	J317	CONDUIT	253.3	0.6389	0.0200
C263	J317	J312	CONDUIT	64.2	0.5729	0.0120

C264	J312	J308	CONDUIT	238.9	0.4910	0.0200
C265	J308	J301	CONDUIT	68.4	0.5223	0.0120
C266	J301	J275	CONDUIT	239.5	0.4752	0.0200
C267	J275	J274	CONDUIT	61.4	0.5114	0.0120
C268	J274	J273	CONDUIT	245.0	0.4632	0.0120
C269	J273	J265	CONDUIT	137.6	0.4396	0.0120
C27	J259	J270	CONDUIT	47.3	0.5514	0.0120
C270	J265	J277	CONDUIT	184.5	0.4173	0.0120
C271	J233	J257	CONDUIT	110.2	0.8461	0.0120
C272	J257	J258	CONDUIT	56.8	0.7178	0.0120
C273_1	J258	J145	CONDUIT	102.1	0.8826	0.0120
C273_2	J145	J359	CONDUIT	204.7	0.7800	0.0120
C274	J359	J260	CONDUIT	278.6	0.7067	0.0120
C275	J260	J234	CONDUIT	169.4	0.3435	0.0120
C276	J163	J165	CONDUIT	152.9	0.9001	0.0120
C277	J165	J168	CONDUIT	115.6	0.9224	0.0120
C278	J168	J171	CONDUIT	261.6	1.1439	0.0120
C28	J62	J65	CONDUIT	75.0	0.0333	0.0120
C283	J169	J170	CONDUIT	390.9	2.1635	0.0120
C284	J170	J171	CONDUIT	40.1	2.2101	0.0120
C285	J172	J173	CONDUIT	165.7	1.7667	0.0120
C286	J173	J174	CONDUIT	40.6	1.8669	0.0120
C287	J174	J171	CONDUIT	193.3	1.8013	0.0120
C288	J176	J183	CONDUIT	337.2	0.9232	0.0120
C29	J270	J267	CONDUIT	256.2	0.5569	0.0120
C293	J183	J185	CONDUIT	142.5	4.3002	0.0120
C294	J186	J185	CONDUIT	89.0	5.1656	0.0120
C295	J185	J190	CONDUIT	187.5	1.8163	0.0120
C296	J189	J353	CONDUIT	228.7	0.9426	0.0120
C297	J353	J209	CONDUIT	265.3	1.0266	0.0120
C3	J11	OF8	CONDUIT	60.5	6.9635	0.0120
C30	J267	J72	CONDUIT	177.8	0.5432	0.0120
C302	J218	J230	CONDUIT	414.4	0.7354	0.0120
C306	J13	J361	CONDUIT	52.2	4.8262	0.0120
C31	J32	J31	CONDUIT	104.1	1.2162	0.0120
C310	J235	J237	CONDUIT	240.2	1.2672	0.0120
C311	J237	J239	CONDUIT	279.4	1.1644	0.0120
C32	J253	J31	CONDUIT	270.0	0.6810	0.0120
C33	J69	J244	CONDUIT	245.2	1.2713	0.0120
C34	J29	J361	CONDUIT	20.0	0.6000	0.0120

C35	J65	J70	CONDUIT	93.0	0.0645	0.0120
C36	J242	J68	CONDUIT	60.8	1.2334	0.0120
C37	J72	J143	CONDUIT	180.3	0.4410	0.0120
C38	J143	J144	CONDUIT	203.6	0.5142	0.0120
C39	J31	J30	CONDUIT	286.5	1.9882	0.0120
C4	OF1	J14	CONDUIT	6.7	0.7481	0.0120
C41	J21	J29	CONDUIT	203.5	0.5151	0.0120
C42	J46	J114	CONDUIT	152.5	0.2098	0.0120
C43	J114	J113	CONDUIT	14.0	0.4650	0.0120
C44	J113	J111	CONDUIT	150.0	0.2587	0.0120
C45	J107	J108	CONDUIT	38.0	-2.6140	0.0120
C46	J108	J111	CONDUIT	48.3	0.7390	0.0120
C47	J111	J38	CONDUIT	29.6	0.6689	0.0120
C48	J54	J321	CONDUIT	137.8	0.1604	0.0120
C49	J59	J60	CONDUIT	147.4	0.1675	0.0120
C5	SU2_Pond2	J7	CONDUIT	108.8	2.0910	0.0120
C50_1	J42	J155	CONDUIT	155.7	0.7378	0.0120
C50_2	J155	J38	CONDUIT	142.5	0.9903	0.0120
C51	J60	J321	CONDUIT	109.8	0.2205	0.0120
C52	J38	J212	CONDUIT	43.1	1.0065	0.0120
C53_1	J321	J77	CONDUIT	161.9	0.2817	0.0120
C53_2	J77	J84	CONDUIT	200.4	0.3144	0.0120
C54	J212	J45	CONDUIT	24.9	1.4053	0.0120
C55	J70	J76	CONDUIT	78.4	0.0638	0.0120
C56	J76	J25	CONDUIT	214.7	0.0461	0.0120
C57	J110	J19	CONDUIT	50.7	0.6879	0.0120
C58	J19	J125	CONDUIT	237.1	0.6036	0.0120
C6	SU3_Pond3	J6	CONDUIT	34.8	13.2939	0.0120
C62	J358	J161	CONDUIT	382.7	0.8180	0.0120
C63	J239	J360	CONDUIT	383.1	2.4736	0.0120
C64	J28	J179	CONDUIT	117.0	0.2598	0.0120
C65	J131	J75	CONDUIT	78.5	0.2981	0.0120
C66	J146	J132	CONDUIT	191.7	0.7206	0.0120
C67	J132	J205	CONDUIT	20.2	0.6296	0.0120
C68	J22	J231	CONDUIT	185.9	0.8632	0.0200
C69	J30	J361	CONDUIT	20.0	2.2005	0.0120
C69_1	J217	J152	CONDUIT	20.1	0.7569	0.0120
C69_2	J152	J23	CONDUIT	20.0	0.4810	0.0120
C7	SU4_Pond4	J5	CONDUIT	61.8	7.2195	0.0120
C70	J74	J76	CONDUIT	110.7	0.0940	0.0120

C71	J20	J360	CONDUIT	30.0	4.1803	0.0120
C71_1	J55	J153	CONDUIT	34.7	0.4646	0.0120
C71_2	J153	J24	CONDUIT	34.6	0.4072	0.0120
C72	J24	J95	CONDUIT	129.0	0.4193	0.0120
C73	J161	J163	CONDUIT	253.5	0.8681	0.0120
C74_1	J223	J162	CONDUIT	362.7	1.1360	0.0120
C74_2	J162	J230	CONDUIT	248.8	0.6672	0.0120
C75	J26	J27	CONDUIT	192.3	0.1862	0.0120
C76	J182	J186	CONDUIT	209.3	0.3550	0.0120
C77	J45	J49	CONDUIT	27.2	0.5363	0.0120
C78	J67	J70	CONDUIT	113.1	0.0540	0.0120
C79	J209	J27	CONDUIT	62.6	1.1871	0.0120
C8	J230	OF_Pond5	CONDUIT	16.1	1.2393	0.0120
C80	J27	J218	CONDUIT	115.6	1.0477	0.0120
C81	J179	J182	CONDUIT	35.8	0.3465	0.0120
C82	J16	J20	CONDUIT	179.9	4.6174	0.0120
C83	J91	J64	CONDUIT	69.7	0.2697	0.0120
C83_1	J75	J128	CONDUIT	61.7	0.7586	0.0120
C83_2	J128	J263	CONDUIT	113.5	0.2721	0.0120
C84	J52	J263	CONDUIT	251.3	0.0593	0.0120
C85	J10	OF_Pond8	CONDUIT	36.5	0.5479	0.0120
C86	J63	J65	CONDUIT	112.4	0.1157	0.0120
C87	J361	OF_Pond3	CONDUIT	24.1	2.6279	0.0120
C88	J85	J115	CONDUIT	258.2	0.3164	0.0120
C89	J115	J147	CONDUIT	198.8	0.2526	0.0120
C9	J190	OF_Pond6	CONDUIT	94.8	1.5882	0.0120
C90	J305	J141	CONDUIT	79.2	0.3786	0.0120
C91	J141	J81	CONDUIT	107.2	0.5141	0.0120
C92	J49	J50	CONDUIT	92.3	0.4516	0.0120
C93	J50	J109	CONDUIT	30.2	0.4110	0.0120
C94	J280	J306	CONDUIT	143.5	0.5958	0.0120
C95	J306	J305	CONDUIT	216.8	0.4510	0.0120
C96	J144	J141	CONDUIT	74.3	0.5542	0.0120
C97	J81	J75	CONDUIT	85.0	0.6474	0.0120
C98	J109	J116	CONDUIT	39.2	0.4900	0.0120
C99_1	J80	J159	CONDUIT	119.5	0.8484	0.0120
C99_2	J159	J51	CONDUIT	229.4	0.7643	0.0120
OR1	SU1_Pond1	OF1	ORIFICE			
OR10	SU6_Pond6	J2	ORIFICE			
OR11	SU2_Pond2	J7	ORIFICE			

OR12	SU6_Pond6	J2	ORIFICE
OR13	SU5_Pond5	J4	ORIFICE
OR14	SU5_Pond5	J4	ORIFICE
OR15	SU5_Pond5	J4	ORIFICE
OR16	SU4_Pond4	J5	ORIFICE
OR17	SU4_Pond4	J5	ORIFICE
OR18	SU4_Pond4	J5	ORIFICE
OR19	SU3_Pond3	J6	ORIFICE
OR2	SU1_Pond1	OF1	ORIFICE
OR20	SU3_Pond3	J6	ORIFICE
OR21	SU3_Pond3	J6	ORIFICE
OR22	SU2_Pond2	J7	ORIFICE
OR23	SU2_Pond2	J7	ORIFICE
OR24	SU2_Pond2	J7	ORIFICE
OR25	SU1_Pond1	OF1	ORIFICE
OR26	SU8_Pond8	J11	ORIFICE
OR3	SU1_Pond1	OF1	ORIFICE
OR4	SU8_Pond8	J11	ORIFICE
OR5	SU3_Pond3	J6	ORIFICE
OR6	SU8_Pond8	J11	ORIFICE
OR7	SU7_Pond7	J1	ORIFICE
OR8	SU7_Pond7	J1	ORIFICE
OR9	SU7_Pond7	J1	ORIFICE

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Cross Section Summary

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Conduit	Shape	Full Depth	Full Area	Hyd. Rad.	Max. Width	No. of Barrels	Full Flow
C1	CIRCULAR	1.00	0.79	0.25	1.00	1	0.63
C10	TRAPEZOIDAL	1.00	8.00	0.71	11.00	1	57.16
C100	CIRCULAR	1.05	0.87	0.26	1.05	1	2.84
C101	CIRCULAR	1.00	0.79	0.25	1.00	1	2.48
C102	CIRCULAR	1.65	2.14	0.41	1.65	1	9.59
C103_1	CIRCULAR	1.05	0.87	0.26	1.05	1	1.39
C103_2	CIRCULAR	1.05	0.87	0.26	1.05	1	1.45
C104	CIRCULAR	2.00	3.14	0.50	2.00	1	19.36
C105	TRAPEZOIDAL	1.00	6.00	0.64	9.00	1	48.11
C106	CIRCULAR	1.35	1.43	0.34	1.35	1	4.04

C107	CIRCULAR	1.05	0.87	0.26	1.05	1	1.89
C108	TRAPEZOIDAL	2.00	18.00	1.15	15.00	1	245.71
C109	TRAPEZOIDAL	1.00	6.00	0.64	9.00	1	231.25
C11	CIRCULAR	1.05	0.87	0.26	1.05	1	3.42
C110	TRAPEZOIDAL	1.00	6.00	0.64	9.00	1	104.14
C111	TRAPEZOIDAL	1.00	6.00	0.64	9.00	1	97.96
C112	TRAPEZOIDAL	1.00	6.00	0.64	9.00	1	97.46
C113	TRAPEZOIDAL	1.00	6.00	0.64	9.00	1	75.78
C114	TRAPEZOIDAL	1.00	6.00	0.64	9.00	1	47.41
C115	TRAPEZOIDAL	1.00	6.00	0.64	9.00	1	126.27
C116	TRAPEZOIDAL	1.00	6.00	0.64	9.00	1	89.22
C117	TRAPEZOIDAL	1.00	6.00	0.64	9.00	1	112.30
C118	TRAPEZOIDAL	1.00	6.00	0.64	9.00	1	69.05
C119_1	CIRCULAR	1.05	0.87	0.26	1.05	1	2.26
C119_2	CIRCULAR	1.05	0.87	0.26	1.05	1	2.25
C12	CIRCULAR	1.35	1.43	0.34	1.35	1	6.10
C12_1	TRAPEZOIDAL	1.35	5.87	0.86	5.70	1	9.67
C12_2	TRAPEZOIDAL	1.35	5.87	0.86	5.70	1	10.95
C120	CIRCULAR	1.05	0.87	0.26	1.05	1	2.16
C121	CIRCULAR	1.05	0.87	0.26	1.05	1	2.13
C122	CIRCULAR	1.65	2.14	0.41	1.65	1	6.80
C122_1	CIRCULAR	1.65	2.14	0.41	1.65	1	6.88
C122_2	CIRCULAR	1.65	2.14	0.41	1.65	1	7.26
C123	CIRCULAR	1.20	1.13	0.30	1.20	1	2.76
C124	CIRCULAR	1.20	1.13	0.30	1.20	1	2.92
C125	CIRCULAR	1.20	1.13	0.30	1.20	1	2.98
C126	CIRCULAR	1.20	1.13	0.30	1.20	1	2.94
C127	CIRCULAR	1.05	0.87	0.26	1.05	1	2.75
C128	CIRCULAR	1.05	0.87	0.26	1.05	1	1.62
C129	CIRCULAR	1.05	0.87	0.26	1.05	1	1.96
C13	CIRCULAR	1.05	0.87	0.26	1.05	1	3.18
C130	CIRCULAR	1.20	1.13	0.30	1.20	1	2.63
C131	CIRCULAR	1.20	1.13	0.30	1.20	1	2.18
C132	CIRCULAR	1.05	0.87	0.26	1.05	1	2.47
C133	CIRCULAR	1.05	0.87	0.26	1.05	1	2.15
C134	CIRCULAR	1.05	0.87	0.26	1.05	1	1.26
C135	CIRCULAR	1.20	1.13	0.30	1.20	1	2.49
C136	CIRCULAR	1.20	1.13	0.30	1.20	1	2.52
C137	CIRCULAR	1.65	2.14	0.41	1.65	1	6.87
C138	CIRCULAR	1.85	2.69	0.46	1.85	1	9.27

C139	CIRCULAR	1.05	0.87	0.26	1.05	1	2.55
C14	CIRCULAR	1.05	0.87	0.26	1.05	1	3.04
C140	CIRCULAR	1.05	0.87	0.26	1.05	1	2.17
C141	CIRCULAR	1.85	2.69	0.46	1.85	1	9.26
C142	CIRCULAR	1.05	0.87	0.26	1.05	1	1.82
C143	CIRCULAR	1.05	0.87	0.26	1.05	1	2.15
C144	CIRCULAR	1.05	0.87	0.26	1.05	1	4.03
C145	CIRCULAR	1.05	0.87	0.26	1.05	1	5.60
C146	CIRCULAR	1.05	0.87	0.26	1.05	1	2.08
C147	CIRCULAR	1.35	1.43	0.34	1.35	1	6.45
C148	CIRCULAR	2.05	3.30	0.51	2.05	1	12.13
C149	CIRCULAR	2.05	3.30	0.51	2.05	1	11.33
C15	CIRCULAR	1.05	0.87	0.26	1.05	1	6.01
C150	CIRCULAR	1.05	0.87	0.26	1.05	1	1.94
C151	CIRCULAR	1.05	0.87	0.26	1.05	1	2.92
C152	CIRCULAR	2.40	4.52	0.60	2.40	1	11.12
C153	CIRCULAR	2.40	4.52	0.60	2.40	1	11.23
C154	CIRCULAR	1.85	2.69	0.46	1.85	1	9.38
C155	CIRCULAR	2.40	4.52	0.60	2.40	1	9.48
C156	CIRCULAR	1.05	0.87	0.26	1.05	1	2.96
C157	CIRCULAR	1.05	0.87	0.26	1.05	1	2.19
C158	CIRCULAR	1.05	0.87	0.26	1.05	1	2.76
C159	CIRCULAR	1.50	1.77	0.38	1.50	1	7.18
C16_1	CIRCULAR	1.05	0.87	0.26	1.05	1	2.54
C160	CIRCULAR	1.05	0.87	0.26	1.05	1	3.79
C161	CIRCULAR	1.05	0.87	0.26	1.05	1	2.17
C162	CIRCULAR	1.05	0.87	0.26	1.05	1	2.52
C163	CIRCULAR	1.05	0.87	0.26	1.05	1	3.00
C164	CIRCULAR	1.05	0.87	0.26	1.05	1	2.95
C165	CIRCULAR	1.35	1.43	0.34	1.35	1	7.46
C166	CIRCULAR	1.05	0.87	0.26	1.05	1	2.75
C167	CIRCULAR	1.05	0.87	0.26	1.05	1	2.58
C168	CIRCULAR	1.05	0.87	0.26	1.05	1	2.41
C169	CIRCULAR	1.05	0.87	0.26	1.05	1	0.72
C17	CIRCULAR	1.05	0.87	0.26	1.05	1	4.66
C170	CIRCULAR	1.05	0.87	0.26	1.05	1	2.61
C171	CIRCULAR	1.05	0.87	0.26	1.05	1	2.65
C172	CIRCULAR	1.05	0.87	0.26	1.05	1	2.77
C173	CIRCULAR	1.05	0.87	0.26	1.05	1	3.12
C174_1	CIRCULAR	1.05	0.87	0.26	1.05	1	2.49

C174_2	CIRCULAR	1.05	0.87	0.26	1.05	1	2.54
C175_1	CIRCULAR	1.05	0.87	0.26	1.05	1	2.83
C175_2	CIRCULAR	1.05	0.87	0.26	1.05	1	2.83
C176_1	CIRCULAR	1.05	0.87	0.26	1.05	1	3.35
C177	CIRCULAR	1.65	2.14	0.41	1.65	1	6.84
C178	CIRCULAR	1.65	2.14	0.41	1.65	1	6.67
C179	CIRCULAR	1.65	2.14	0.41	1.65	1	7.47
C18	CIRCULAR	1.05	0.87	0.26	1.05	1	2.31
C18_2	TRAPEZOIDAL	2.00	28.00	1.48	18.00	1	171.70
C182	CIRCULAR	1.05	0.87	0.26	1.05	1	1.38
C183	CIRCULAR	1.05	0.87	0.26	1.05	1	1.26
C184	CIRCULAR	1.20	1.13	0.30	1.20	1	1.79
C185	CIRCULAR	1.50	1.77	0.38	1.50	1	3.20
C186	CIRCULAR	1.85	2.69	0.46	1.85	1	7.18
C19	TRAPEZOIDAL	1.00	12.00	0.83	14.00	1	48.99
C2	TRAPEZOIDAL	1.00	6.00	0.64	9.00	1	186.33
C20	CIRCULAR	1.05	0.87	0.26	1.05	1	3.33
C21	CIRCULAR	1.20	1.13	0.30	1.20	1	2.60
C21_1	CIRCULAR	1.05	0.87	0.26	1.05	1	2.85
C21_2	CIRCULAR	1.05	0.87	0.26	1.05	1	3.09
C217	CIRCULAR	1.50	1.77	0.38	1.50	1	6.87
C22	CIRCULAR	1.05	0.87	0.26	1.05	1	2.54
C227	TRIANGULAR	1.00	2.50	0.46	5.00	1	11.35
C23	CIRCULAR	0.37	0.11	0.09	0.37	1	0.39
C235	TRAPEZOIDAL	1.00	12.00	0.83	14.00	1	46.83
C236	CIRCULAR	1.05	0.87	0.26	1.05	1	2.47
C237	TRAPEZOIDAL	1.00	12.00	0.83	14.00	1	45.63
C238	CIRCULAR	1.05	0.87	0.26	1.05	1	2.37
C239	TRAPEZOIDAL	1.00	12.00	0.83	14.00	1	40.65
C24	CIRCULAR	1.05	0.87	0.26	1.05	1	2.49
C240	CIRCULAR	1.05	0.87	0.26	1.05	1	1.76
C241	TRAPEZOIDAL	1.00	12.00	0.83	14.00	1	25.55
C242	TRAPEZOIDAL	1.00	12.00	0.83	14.00	1	23.41
C243	TRAPEZOIDAL	1.00	8.00	0.71	11.00	1	22.00
C244	CIRCULAR	1.05	0.87	0.26	1.05	1	1.15
C245	CIRCULAR	1.05	0.87	0.26	1.05	1	0.99
C246	TRAPEZOIDAL	2.00	28.00	1.48	18.00	1	137.25
C247	CIRCULAR	1.20	1.13	0.30	1.20	1	3.48
C248	TRAPEZOIDAL	2.00	28.00	1.48	18.00	1	153.63
C249	CIRCULAR	1.05	0.87	0.26	1.05	1	2.60

C25	CIRCULAR	1.05	0.87	0.26	1.05	1	2.82
C250	TRAPEZOIDAL	2.00	28.00	1.48	18.00	1	162.37
C251	CIRCULAR	1.05	0.87	0.26	1.05	1	2.61
C252	TRAPEZOIDAL	2.00	28.00	1.48	18.00	1	171.01
C256	CIRCULAR	1.05	0.87	0.26	1.05	1	2.25
C257	CIRCULAR	1.05	0.87	0.26	1.05	1	1.06
C258	CIRCULAR	1.05	0.87	0.26	1.05	1	1.06
C259	CIRCULAR	1.05	0.87	0.26	1.05	1	1.02
C26	CIRCULAR	1.20	1.13	0.30	1.20	1	1.03
C260_1	CIRCULAR	1.05	0.87	0.26	1.05	1	3.58
C260_2	CIRCULAR	1.05	0.87	0.26	1.05	1	4.64
C261	TRAPEZOIDAL	1.00	12.00	0.83	14.00	1	41.79
C262	TRAPEZOIDAL	1.00	12.00	0.83	14.00	1	42.34
C263	CIRCULAR	1.05	0.87	0.26	1.05	1	2.24
C264	CIRCULAR	1.05	0.87	0.26	1.05	1	1.24
C265	CIRCULAR	1.05	0.87	0.26	1.05	1	2.14
C266	CIRCULAR	1.05	0.87	0.26	1.05	1	1.22
C267	CIRCULAR	1.05	0.87	0.26	1.05	1	2.12
C268	CIRCULAR	1.05	0.87	0.26	1.05	1	2.01
C269	CIRCULAR	1.05	0.87	0.26	1.05	1	1.96
C27	CIRCULAR	1.20	1.13	0.30	1.20	1	3.14
C270	CIRCULAR	1.05	0.87	0.26	1.05	1	1.91
C271	CIRCULAR	1.05	0.87	0.26	1.05	1	2.72
C272	CIRCULAR	1.05	0.87	0.26	1.05	1	2.51
C273_1	CIRCULAR	1.05	0.87	0.26	1.05	1	2.78
C273_2	CIRCULAR	1.05	0.87	0.26	1.05	1	2.61
C274	CIRCULAR	1.05	0.87	0.26	1.05	1	2.49
C275	CIRCULAR	1.05	0.87	0.26	1.05	1	1.73
C276	TRIANGULAR	1.00	2.50	0.46	5.00	1	11.85
C277	TRAPEZOIDAL	1.00	8.00	0.71	11.00	1	50.80
C278	TRAPEZOIDAL	1.00	8.00	0.71	11.00	1	56.57
C28	CIRCULAR	1.20	1.13	0.30	1.20	1	0.77
C283	TRAPEZOIDAL	1.00	8.00	0.71	11.00	1	77.79
C284	TRAPEZOIDAL	1.00	8.00	0.71	11.00	1	78.63
C285	TRAPEZOIDAL	1.00	8.00	0.71	11.00	1	70.30
C286	TRAPEZOIDAL	1.00	8.00	0.71	11.00	1	72.26
C287	TRAPEZOIDAL	1.00	8.00	0.71	11.00	1	70.98
C288	TRAPEZOIDAL	1.00	8.00	0.71	11.00	1	50.82
C29	CIRCULAR	1.35	1.43	0.34	1.35	1	4.32
C293	TRAPEZOIDAL	1.00	8.00	0.71	11.00	1	109.67

C294	TRIANGULAR	1.00	2.50	0.46	5.00	1	28.39
C295	TRAPEZOIDAL	1.00	8.00	0.71	11.00	1	71.28
C296	TRAPEZOIDAL	1.00	8.00	0.71	11.00	1	51.35
C297	TRAPEZOIDAL	1.00	8.00	0.71	11.00	1	53.59
C3	TRAPEZOIDAL	2.00	22.00	1.25	17.00	1	560.44
C30	CIRCULAR	1.35	1.43	0.34	1.35	1	4.26
C302	TRIANGULAR	1.00	2.50	0.46	5.00	1	10.71
C306	CIRCULAR	1.05	0.87	0.26	1.05	1	6.50
C31	CIRCULAR	1.05	0.87	0.26	1.05	1	3.26
C310	TRIANGULAR	1.00	2.50	0.46	5.00	1	14.06
C311	TRIANGULAR	1.00	2.50	0.46	5.00	1	13.48
C32	CIRCULAR	1.05	0.87	0.26	1.05	1	2.44
C33	CIRCULAR	1.05	0.87	0.26	1.05	1	3.34
C34	CIRCULAR	1.05	0.87	0.26	1.05	1	2.29
C35	CIRCULAR	1.20	1.13	0.30	1.20	1	1.07
C36	CIRCULAR	1.05	0.87	0.26	1.05	1	3.29
C37	CIRCULAR	1.50	1.77	0.38	1.50	1	5.09
C38	CIRCULAR	1.50	1.77	0.38	1.50	1	5.49
C39	CIRCULAR	1.05	0.87	0.26	1.05	1	4.17
C4	TRAPEZOIDAL	1.05	8.56	0.74	11.30	1	50.25
C41	CIRCULAR	1.05	0.87	0.26	1.05	1	2.12
C42	CIRCULAR	1.05	0.87	0.26	1.05	1	1.36
C43	CIRCULAR	1.20	1.13	0.30	1.20	1	2.88
C44	CIRCULAR	1.20	1.13	0.30	1.20	1	2.15
C45	CIRCULAR	1.05	0.87	0.26	1.05	1	4.78
C46	CIRCULAR	1.05	0.87	0.26	1.05	1	2.54
C47	CIRCULAR	1.20	1.13	0.30	1.20	1	3.45
C48	CIRCULAR	1.05	0.87	0.26	1.05	1	1.18
C49	CIRCULAR	1.20	1.13	0.30	1.20	1	1.73
C5	TRAPEZOIDAL	1.00	6.00	0.64	9.00	1	53.90
C50_1	CIRCULAR	1.05	0.87	0.26	1.05	1	2.54
C50_2	CIRCULAR	1.05	0.87	0.26	1.05	1	2.94
C51	CIRCULAR	1.35	1.43	0.34	1.35	1	2.72
C52	CIRCULAR	1.20	1.13	0.30	1.20	1	4.24
C53_1	CIRCULAR	1.35	1.43	0.34	1.35	1	3.07
C53_2	CIRCULAR	1.35	1.43	0.34	1.35	1	3.24
C54	CIRCULAR	1.20	1.13	0.30	1.20	1	5.01
C55	CIRCULAR	1.20	1.13	0.30	1.20	1	1.07
C56	CIRCULAR	1.20	1.13	0.30	1.20	1	0.91
C57	CIRCULAR	1.05	0.87	0.26	1.05	1	2.45

C58	CIRCULAR	1.05	0.87	0.26	1.05	1	2.30
C6	TRAPEZOIDAL	1.00	6.00	0.64	9.00	1	135.90
C62	TRIANGULAR	1.00	2.50	0.46	5.00	1	11.30
C63	TRIANGULAR	1.00	2.50	0.46	5.00	1	19.65
C64	TRIANGULAR	1.00	2.50	0.46	5.00	1	6.37
C65	CIRCULAR	1.05	0.87	0.26	1.05	1	1.62
C66	CIRCULAR	1.05	0.87	0.26	1.05	1	2.51
C67	CIRCULAR	1.05	0.87	0.26	1.05	1	2.35
C68	TRAPEZOIDAL	2.00	28.00	1.48	18.00	1	168.80
C69	CIRCULAR	1.05	0.87	0.26	1.05	1	4.39
C69_1	CIRCULAR	1.20	1.13	0.30	1.20	1	3.68
C69_2	CIRCULAR	1.65	2.14	0.41	1.65	1	6.85
C7	TRAPEZOIDAL	1.00	6.00	0.64	9.00	1	100.15
C70	CIRCULAR	1.05	0.87	0.26	1.05	1	0.91
C71	CIRCULAR	1.05	0.87	0.26	1.05	1	6.05
C71_1	CIRCULAR	1.85	2.69	0.46	1.85	1	9.13
C71_2	CIRCULAR	1.85	2.69	0.46	1.85	1	8.55
C72	CIRCULAR	1.85	2.69	0.46	1.85	1	8.68
C73	TRIANGULAR	1.00	2.50	0.46	5.00	1	11.64
C74_1	TRIANGULAR	1.00	2.50	0.46	5.00	1	13.32
C74_2	TRIANGULAR	1.00	2.50	0.46	5.00	1	10.20
C75	TRAPEZOIDAL	1.00	8.00	0.71	11.00	1	22.82
C76	TRIANGULAR	1.00	2.50	0.46	5.00	1	7.44
C77	CIRCULAR	1.20	1.13	0.30	1.20	1	3.09
C78	CIRCULAR	1.05	0.87	0.26	1.05	1	0.69
C79	TRAPEZOIDAL	1.00	8.00	0.71	11.00	1	57.62
C8	TRAPEZOIDAL	1.05	6.46	0.67	9.30	1	45.87
C80	TRAPEZOIDAL	1.00	8.00	0.71	11.00	1	54.14
C81	CIRCULAR	1.05	0.87	0.26	1.05	1	1.74
C82	CIRCULAR	1.05	0.87	0.26	1.05	1	6.36
C83	CIRCULAR	1.05	0.87	0.26	1.05	1	1.54
C83_1	TRAPEZOIDAL	2.00	18.00	1.15	15.00	1	143.45
C83_2	TRAPEZOIDAL	2.00	18.00	1.15	15.00	1	85.92
C84	TRAPEZOIDAL	2.00	18.00	1.15	15.00	1	40.11
C85	TRAPEZOIDAL	1.00	6.00	0.64	9.00	1	27.59
C86	CIRCULAR	1.05	0.87	0.26	1.05	1	1.01
C87	TRAPEZOIDAL	1.00	6.00	0.64	9.00	1	60.42
C88	CIRCULAR	2.05	3.30	0.51	2.05	1	9.91
C89	CIRCULAR	2.40	4.52	0.60	2.40	1	13.48
C9	TRAPEZOIDAL	1.00	6.00	0.64	9.00	1	46.97

C90	CIRCULAR	1.80	2.54	0.45	1.80	1	7.66
C91	CIRCULAR	1.80	2.54	0.45	1.80	1	8.93
C92	CIRCULAR	1.20	1.13	0.30	1.20	1	2.84
C93	CIRCULAR	1.20	1.13	0.30	1.20	1	2.71
C94	CIRCULAR	1.05	0.87	0.26	1.05	1	2.28
C95	CIRCULAR	1.35	1.43	0.34	1.35	1	3.88
C96	CIRCULAR	1.80	2.54	0.45	1.80	1	9.27
C97	CIRCULAR	1.80	2.54	0.45	1.80	1	10.02
C98	CIRCULAR	1.20	1.13	0.30	1.20	1	2.96
C99_1	CIRCULAR	1.05	0.87	0.26	1.05	1	2.73
C99_2	CIRCULAR	1.05	0.87	0.26	1.05	1	2.59

****

Analysis Options

****

Flow Units ..... CMS

Process Models:

  Rainfall/Runoff ..... YES

  RDII ..... NO

  Snowmelt ..... NO

  Groundwater ..... NO

  Flow Routing ..... YES

  Ponding Allowed ..... NO

  Water Quality ..... NO

Infiltration Method ..... MODIFIED_GREEN_AMPT

Flow Routing Method ..... DYNWAVE

Surcharge Method ..... EXTRAN

Starting Date 08/08/2024 00:00:00

Ending Date 08/10/2024 00:00:00

Antecedent Dry Days 0.0

Report Time Step 00:00:05

Wet Time Step 00:00:05

Dry Time Step 00:00:05

Routing Time Step ..... 5.00 sec

Variable Time Step ..... YES

Maximum Trials 8

Number of Threads 8

Head Tolerance ..... 0.001500 m

**********	Volume	Depth
Runoff Quantity Continuity	hectare-m	mm
**********	---	---
Initial LID Storage	0.046	0.107
Total Precipitation	25.904	60.300
Outfall Runon	10.899	25.370
Evaporation Loss	0.000	0.000
Infiltration Loss	20.697	48.177
Surface Runoff	15.432	35.923
LID Drainage	0.176	0.410
Final Storage	0.544	1.267
Continuity Error (%)	-0.000	

**********	Volume	Volume
Flow Routing Continuity	hectare-m	10^6 ltr
**********	---	---
Dry Weather Inflow	0.000	0.000
Wet Weather Inflow	15.612	156.121
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	0.000	0.000
External Outflow	14.224	142.238
Flooding Loss	0.000	0.000
Evaporation Loss	0.000	0.000
Exfiltration Loss	0.000	0.000
Initial Stored Volume	3.875	38.748
Final Stored Volume	5.264	52.641
Continuity Error (%)	-0.005	

****

Highest Continuity Errors

****

Node J107 (8.26%)

Node J206 (3.18%)

Node J164 (1.44%)

Node J207 (1.24%)

****

Time-Step Critical Elements

****

Link C115 (59.21%)

Link C12 (26.11%)

Link C25 (2.60%)

****

Highest Flow Instability Indexes

****

Link C155 (3)

Link C25 (3)

****

Most Frequent Nonconverging Nodes

****

Node J35 (0.02%)

Node OF_Pond1 (0.02%)

Node OF_Pond2 (0.02%)

Node OF_Pond3 (0.02%)

Node OF_Pond4 (0.02%)

****

Routing Time Step Summary

****

Minimum Time Step : 0.50 sec

Average Time Step : 3.13 sec

Maximum Time Step : 5.00 sec

% of Time in Steady State : 0.00

Average Iterations per Step : 2.00

% of Steps Not Converging : 0.02

Time Step Frequencies :

5.000 - 3.155 sec : 43.65 %

3.155 - 1.991 sec : 46.22 %

1.991 - 1.256 sec : 6.69 %

1.256 - 0.792 sec : 3.04 %

0.792 - 0.500 sec : 0.39 %

****

Subcatchment Runoff Summary

****

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Imperv Runoff mm	Perv Runoff mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff CMS	Runoff Coeff
S_Pond1	60.30	5432.59	0.00	20.15	0.00	0.00	5273.61	11.06	3.86	0.960
S_Pond2	60.30	2080.78	0.00	1401.61	0.00	739.48	739.48	24.33	10.16	0.345
S_Pond3	60.30	1608.34	0.00	1027.51	0.00	641.14	641.14	3.91	2.72	0.384
S_Pond4	60.30	407.81	0.00	17.24	0.00	0.00	266.69	0.33	0.18	0.570
S_Pond5	60.30	2920.88	0.00	18.90	0.00	0.00	2752.63	12.35	2.71	0.923
S_Pond6	60.30	0.00	0.00	0.62	0.00	0.00	6.50	0.01	0.01	0.108
S_Pond7	60.30	693.53	0.00	17.87	0.00	0.00	541.72	1.46	0.53	0.719
S_Pond8	60.30	1876.20	0.00	18.65	0.00	0.00	1719.28	3.52	0.97	0.888
S1	60.30	0.00	0.00	0.00	58.80	0.00	58.80	0.17	0.06	0.975
S1_4	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S1_8	60.30	0.00	0.00	0.00	58.78	0.00	58.78	0.73	0.19	0.975
S10	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S11	60.30	0.00	0.00	0.00	58.80	0.00	58.80	0.01	0.00	0.975
S11_1	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.06	0.02	0.975
S11_10	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.05	0.02	0.975
S11_11	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.04	0.01	0.975
S11_12	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.07	0.02	0.975
S11_2	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.05	0.02	0.975
S11_4	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.10	0.03	0.975
S11_5	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.07	0.02	0.975
S11_6	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.08	0.03	0.975
S11_7	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.07	0.02	0.975
S11_8	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.08	0.02	0.975
S11_9	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.06	0.02	0.975
S12	60.30	0.00	0.00	0.00	58.45	0.00	58.45	0.05	0.02	0.969
S12_1	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S12_2	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S12_3	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S12_5	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S12_6	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S12_7	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S12_8	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000

S13	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S13_11	60.30	0.00	0.00	0.00	58.79	0.00	58.79	1.94	0.63	0.975
S13_12	60.30	0.00	0.00	0.00	58.79	0.00	58.79	1.68	0.52	0.975
S13_14	60.30	0.00	0.00	0.00	58.79	0.00	58.79	1.28	0.41	0.975
S13_2	60.30	0.00	0.00	0.00	58.79	0.00	58.79	2.18	0.70	0.975
S13_8	60.30	0.00	0.00	0.00	58.79	0.00	58.79	1.35	0.43	0.975
S136_1	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.52	0.16	0.983
S136_3	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.35	0.11	0.983
S136_4	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.68	0.22	0.983
S136_5	60.30	0.00	0.00	0.00	59.29	0.00	59.29	1.05	0.33	0.983
S139_1	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.11	0.04	0.975
S139_2	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.15	0.04	0.975
S14	60.30	0.00	0.00	0.00	58.80	0.00	58.80	0.25	0.09	0.975
S140_1	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.14	0.04	0.975
S140_2	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.12	0.03	0.975
S141_1	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.12	0.04	0.975
S141_2	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.10	0.03	0.975
S141_4	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.16	0.05	0.975
S141_5	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.06	0.02	0.975
S143_1	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.07	0.02	0.975
S143_2	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.11	0.03	0.975
S143_3	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.09	0.03	0.975
S144_1	60.30	0.00	0.00	0.00	58.80	0.00	58.80	0.11	0.04	0.975
S144_3	60.30	0.00	0.00	0.00	58.78	0.00	58.78	0.18	0.05	0.975
S144_4	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.08	0.03	0.975
S144_5	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.09	0.03	0.975
S145_2	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.06	0.02	0.975
S147	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.25	0.07	0.975
S148_1	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.12	0.03	0.975
S15	60.30	0.00	0.00	0.00	58.78	0.00	58.78	0.12	0.03	0.975
S15_3	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S15_4	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S150	60.30	0.00	0.00	0.00	58.77	0.00	58.77	0.21	0.05	0.975
S152	60.30	0.00	0.00	0.00	58.80	0.00	58.80	0.01	0.00	0.975
S153	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.76	0.24	0.975
S155	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.07	0.02	0.975
S156_1	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.10	0.03	0.975
S157	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.05	0.02	0.975
S158_1	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.05	0.02	0.975
S158_2	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.09	0.03	0.975

S16	60.30	0.00	0.00	0.00	58.80	0.00	58.80	0.13	0.05	0.975
S160_2	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.09	0.03	0.975
S161_1	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.02	0.01	0.975
S161_2	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.06	0.02	0.975
S161_3	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.08	0.02	0.975
S161_5	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.06	0.02	0.975
S161_6	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.09	0.03	0.975
S163	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.10	0.03	0.975
S164_1	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.09	0.03	0.975
S164_3	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.06	0.02	0.975
S164_4	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.06	0.02	0.975
S164_5	60.30	0.00	0.00	0.00	58.80	0.00	58.80	0.03	0.01	0.975
S165	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.06	0.02	0.975
S166_1	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.06	0.02	0.975
S166_3	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.07	0.02	0.975
S166_4	60.30	0.00	0.00	0.00	58.78	0.00	58.78	0.11	0.03	0.975
S167_1	60.30	0.00	0.00	0.00	58.78	0.00	58.78	0.07	0.02	0.975
S167_2	60.30	0.00	0.00	0.00	58.78	0.00	58.78	0.15	0.04	0.975
S168_1	60.30	0.00	0.00	0.00	58.80	0.00	58.80	0.05	0.02	0.975
S168_2	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.07	0.02	0.975
S168_3	60.30	0.00	0.00	0.00	58.80	0.00	58.80	0.05	0.02	0.975
S168_4	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.07	0.02	0.975
S17	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.06	0.02	0.975
S170_1	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.16	0.05	0.975
S170_2	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.05	0.02	0.975
S170_3	60.30	0.00	0.00	0.00	58.78	0.00	58.78	0.16	0.04	0.975
S170_4	60.30	0.00	0.00	0.00	58.78	0.00	58.78	0.35	0.09	0.975
S170_5	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.05	0.02	0.975
S170_7	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.10	0.03	0.975
S170_8	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.14	0.05	0.975
S171_1	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.07	0.02	0.975
S171_10	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.07	0.02	0.975
S171_13	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.10	0.03	0.975
S171_14	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.08	0.03	0.975
S171_16	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.11	0.04	0.975
S171_17	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.08	0.02	0.975
S171_18	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.09	0.03	0.975
S171_19	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.08	0.02	0.975
S171_2	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.12	0.04	0.975
S171_3	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.06	0.02	0.975

S171_4	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.07	0.02	0.975
S171_5	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.10	0.03	0.975
S171_7	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.06	0.02	0.975
S171_8	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.08	0.03	0.975
S173_1	60.30	0.00	0.00	15.07	44.10	0.00	44.10	0.06	0.02	0.731
S173_2	60.30	0.00	0.00	15.08	44.10	0.00	44.10	0.12	0.04	0.731
S173_3	60.30	0.00	0.00	15.08	44.10	0.00	44.10	0.12	0.04	0.731
S173_5	60.30	0.00	0.00	15.07	44.10	0.00	44.10	0.14	0.05	0.731
S173_6	60.30	0.00	0.00	15.07	44.10	0.00	44.10	0.17	0.06	0.731
S173_7	60.30	0.00	0.00	15.08	44.10	0.00	44.10	0.29	0.10	0.731
S174_1	60.30	0.00	0.00	15.07	44.10	0.00	44.10	0.13	0.05	0.731
S174_2	60.30	0.00	0.00	15.07	44.10	0.00	44.10	0.05	0.02	0.731
S175_1	60.30	0.00	0.00	15.08	44.10	0.00	44.10	0.28	0.10	0.731
S175_3	60.30	0.00	0.00	15.07	44.10	0.00	44.10	0.18	0.06	0.731
S175_4	60.30	0.00	0.00	15.08	44.10	0.00	44.10	0.24	0.08	0.731
S176_1	60.30	0.00	0.00	15.07	44.10	0.00	44.10	0.29	0.10	0.731
S176_3	60.30	0.00	0.00	15.07	44.10	0.00	44.10	0.18	0.06	0.731
S176_4	60.30	0.00	0.00	15.07	44.10	0.00	44.10	0.24	0.08	0.731
S177_1	60.30	0.00	0.00	15.07	44.10	0.00	44.10	0.43	0.15	0.731
S177_2	60.30	0.00	0.00	15.08	44.10	0.00	44.10	0.60	0.20	0.731
S178_1	60.30	0.00	0.00	15.08	44.10	0.00	44.10	0.43	0.15	0.731
S178_2	60.30	0.00	0.00	15.07	44.10	0.00	44.10	0.60	0.20	0.731
S179_1	60.30	0.00	0.00	15.08	44.10	0.00	44.10	0.34	0.12	0.731
S179_2	60.30	0.00	0.00	15.07	44.10	0.00	44.10	0.14	0.05	0.731
S179_3	60.30	0.00	0.00	15.07	44.10	0.00	44.10	0.10	0.03	0.731
S18	60.30	7.38	0.00	67.68	0.00	0.00	0.00	0.00	0.00	0.000
S18_3	60.30	0.00	0.00	0.00	58.78	0.00	58.78	0.11	0.03	0.975
S18_6	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S180	60.30	0.00	0.00	15.08	44.10	0.00	44.10	0.06	0.02	0.731
S181	60.30	0.00	0.00	15.08	44.10	0.00	44.10	0.16	0.06	0.731
S182_2	60.30	0.00	0.00	15.08	44.10	0.00	44.10	0.12	0.04	0.731
S182_3	60.30	0.00	0.00	15.07	44.10	0.00	44.10	0.40	0.13	0.731
S182_4	60.30	0.00	0.00	15.08	44.10	0.00	44.10	0.31	0.10	0.731
S183	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S184_1	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S184_3	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S184_4	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S185	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S186	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S187	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000

S188_1	60.30	0.00	0.00	15.07	44.10	0.00	44.10	0.05	0.02	0.731
S188_2	60.30	0.00	0.00	15.08	44.10	0.00	44.10	0.08	0.03	0.731
S189	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S19	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S190	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S191	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S192	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.00	0.00	0.975
S193_2	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S193_3	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S193_4	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S193_5	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S193_6	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S193_7	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S194_1	60.30	0.00	0.00	15.08	44.10	0.00	44.10	0.08	0.03	0.731
S194_3	60.30	0.00	0.00	15.08	44.10	0.00	44.10	0.05	0.02	0.731
S194_4	60.30	0.00	0.00	15.07	44.10	0.00	44.10	0.07	0.02	0.731
S195_1	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S195_2	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S196_1	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.07	0.02	0.975
S196_2	60.30	0.00	0.00	0.00	58.80	0.00	58.80	0.04	0.01	0.975
S196_3	60.30	0.00	0.00	0.00	58.80	0.00	58.80	0.04	0.01	0.975
S197_1	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S197_3	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S197_4	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S197_5	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S197_6	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S198_1	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S198_10	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S198_2	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S198_3	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S198_4	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S198_5	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S198_6	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S198_7	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S198_8	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S199	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S2	60.30	0.00	0.00	0.00	58.78	0.00	58.78	0.75	0.20	0.975
S2_1	60.30	0.00	0.00	0.00	58.78	0.00	58.78	0.64	0.17	0.975
S2_11	60.30	0.00	0.00	0.00	58.78	0.00	58.78	1.33	0.35	0.975
S2_12	60.30	0.00	0.00	0.00	58.78	0.00	58.78	0.32	0.08	0.975

S2_2	60.30	0.00	0.00	0.00	58.78	0.00	58.78	0.19	0.05	0.975
S2_21	60.30	0.00	0.00	0.00	58.78	0.00	58.78	0.53	0.14	0.975
S2_22	60.30	0.00	0.00	0.00	58.78	0.00	58.78	0.64	0.17	0.975
S2_23	60.30	0.00	0.00	0.00	58.78	0.00	58.78	0.22	0.06	0.975
S2_24	60.30	0.00	0.00	0.00	58.78	0.00	58.78	0.55	0.14	0.975
S2_25	60.30	0.00	0.00	0.00	58.78	0.00	58.78	0.34	0.09	0.975
S2_26	60.30	0.00	0.00	0.00	58.78	0.00	58.78	0.87	0.23	0.975
S2_27	60.30	0.00	0.00	0.00	58.78	0.00	58.78	0.51	0.13	0.975
S2_28	60.30	0.00	0.00	0.00	58.78	0.00	58.78	0.14	0.04	0.975
S2_3	60.30	0.00	0.00	0.00	58.78	0.00	58.78	1.57	0.41	0.975
S2_4	60.30	0.00	0.00	0.00	58.78	0.00	58.78	0.34	0.09	0.975
S2_5	60.30	0.00	0.00	0.00	58.78	0.00	58.78	0.87	0.23	0.975
S2_6	60.30	0.00	0.00	0.00	58.78	0.00	58.78	1.53	0.40	0.975
S2_7	60.30	0.00	0.00	0.00	58.78	0.00	58.78	0.43	0.11	0.975
S2_8	60.30	0.00	0.00	0.00	58.78	0.00	58.78	0.45	0.12	0.975
S20	60.30	0.00	0.00	0.00	58.79	0.00	58.79	3.15	1.01	0.975
S200_1	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S200_2	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S201	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S202	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S203	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S204	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S205	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S206_1	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S206_2	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S206_3	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S207	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S208_1	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S208_2	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S208_3	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S208_4	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S209	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S21	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S210_1	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S210_3	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S210_4	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S210_5	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S211_1	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S211_2	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S212_1	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000

S212_2	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S213_1	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S213_2	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S213_3	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S214	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S215	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S216	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S217_1	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S217_2	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S217_3	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S218	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S219	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S22	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S220	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S221	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S222	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S223_1	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S223_2	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S224	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S225	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S226	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S227	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S228	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S229_1	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S229_2	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S229_3	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S229_4	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S23	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.11	0.04	0.975
S23_2	60.30	0.00	0.00	0.00	58.79	0.00	58.79	1.10	0.30	0.975
S23_3	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.21	0.06	0.975
S23_4	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.05	0.01	0.975
S230_1	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S230_2	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S231	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S232	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S233	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S234	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S235	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S236	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S237	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000

S238	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S239	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S24	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.10	0.03	0.975
S24_2	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.23	0.07	0.975
S24_3	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.31	0.09	0.975
S24_4	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.27	0.08	0.975
S240_1	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S240_2	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S241	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S242	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S25	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.04	0.01	0.975
S26	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.19	0.06	0.975
S27	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.05	0.02	0.975
S28	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S29	60.30	8.92	0.00	69.22	0.00	0.00	0.00	0.00	0.00	0.000
S3	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S3_1	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.37	0.11	0.975
S3_11	60.30	0.00	0.00	0.00	58.80	0.00	58.80	0.06	0.02	0.975
S3_119	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S3_122	60.30	9.66	0.00	69.96	0.00	0.00	0.00	0.00	0.00	0.000
S3_124	60.30	20.29	0.00	80.59	0.00	0.00	0.00	0.00	0.00	0.000
S3_126	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S3_127	60.30	29.82	0.00	90.12	0.00	0.00	0.00	0.00	0.00	0.000
S3_17	60.30	22.14	0.00	82.44	0.00	0.00	0.00	0.00	0.00	0.000
S3_18	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S3_19	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S3_20	60.30	34.41	0.00	94.71	0.00	0.00	0.00	0.00	0.00	0.000
S3_21	60.30	29.33	0.00	89.63	0.00	0.00	0.00	0.00	0.00	0.000
S3_23	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S3_24	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S3_27	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S3_3	60.30	0.00	0.00	0.00	58.80	0.00	58.80	0.11	0.04	0.975
S3_32	60.30	31.95	0.00	92.25	0.00	0.00	0.00	0.00	0.00	0.000
S3_4	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.23	0.08	0.975
S3_42	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S3_5	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.39	0.11	0.975
S3_69	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S3_7	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S3_8	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S30	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.19	0.06	0.975

S31	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.05	0.02	0.975
S32	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S32_1	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S32_10	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S32_11	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S32_12	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S32_13	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S32_3	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S32_4	60.30	0.00	0.00	15.07	44.10	0.00	44.10	0.35	0.13	0.731
S32_6	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S32_8	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S33	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.10	0.03	0.975
S34	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.13	0.04	0.975
S35	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.06	0.02	0.975
S36	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S37	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S38	60.30	13.44	0.00	73.74	0.00	0.00	0.00	0.00	0.00	0.000
S39	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S39_1	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S39_2	60.30	4.24	0.00	64.54	0.00	0.00	0.00	0.00	0.00	0.000
S39_4	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S4	60.30	74.12	0.00	134.42	0.00	0.00	0.00	0.00	0.00	0.000
S40	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S43	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.15	0.05	0.975
S45_1	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.15	0.04	0.975
S45_10	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.12	0.04	0.975
S45_11	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S45_12	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S45_13	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.12	0.04	0.975
S45_14	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S45_15	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.09	0.03	0.975
S45_16	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S45_17	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S45_18	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.08	0.03	0.975
S45_19	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S45_2	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S45_20	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S45_21	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.08	0.02	0.975
S45_22	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S45_23	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000

S45_24	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.10	0.03	0.975
S45_25	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S45_26	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S45_27	60.30	5.64	0.00	0.00	64.43	0.00	64.43	0.10	0.03	0.977
S45_28	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S45_29	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S45_3	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S45_30	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.09	0.03	0.975
S45_31	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S45_32	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S45_33	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.12	0.04	0.975
S45_34	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S45_36	60.30	0.00	0.00	0.00	58.80	0.00	58.80	0.09	0.03	0.975
S45_37	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S45_38	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S45_39	60.30	0.00	0.00	0.00	58.80	0.00	58.80	0.07	0.02	0.975
S45_4	60.30	0.00	0.00	0.00	58.80	0.00	58.80	0.05	0.02	0.975
S45_40	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S45_41	60.30	0.00	0.00	0.00	58.80	0.00	58.80	0.05	0.02	0.975
S45_42	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S45_43	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S45_44	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.22	0.07	0.975
S45_45	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S45_46	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S45_47	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S45_48	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S45_49	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S45_5	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S45_6	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S45_7	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S45_8	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S48_1	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.43	0.12	0.975
S48_2	60.30	0.00	0.00	0.00	58.78	0.00	58.78	0.74	0.19	0.975
S49	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.22	0.06	0.975
S5	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S50	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.53	0.17	0.975
S51_1	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S51_2	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S52	60.30	0.00	0.00	0.00	58.80	0.00	58.80	0.16	0.06	0.975
S52_1	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.58	0.17	0.975

S52_11	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.78	0.21	0.975
S52_12	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.22	0.06	0.975
S52_13	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.91	0.25	0.975
S52_14	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.50	0.13	0.975
S52_15	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.79	0.21	0.975
S52_17	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.86	0.23	0.975
S52_18	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.49	0.13	0.975
S52_19	60.30	0.00	0.00	0.00	58.79	0.00	58.79	1.01	0.27	0.975
S52_2	60.30	0.00	0.00	0.00	58.79	0.00	58.79	1.01	0.27	0.975
S52_20	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.36	0.10	0.975
S52_21	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.89	0.24	0.975
S52_22	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.64	0.17	0.975
S52_23	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.65	0.18	0.975
S52_3	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.36	0.10	0.975
S52_4	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.89	0.24	0.975
S52_5	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.73	0.20	0.975
S52_8	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.59	0.17	0.975
S52_9	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.73	0.20	0.975
S54	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S55	60.30	0.00	0.00	0.00	58.78	0.00	58.78	0.41	0.11	0.975
S56	60.30	0.00	0.00	0.00	58.78	0.00	58.78	0.62	0.16	0.975
S6	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S66_3	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S66_4	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S66_5	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S67	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S7	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.81	0.22	0.975
S7_1	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S7_11	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S7_12	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S7_2	60.30	0.00	0.00	0.00	58.78	0.00	58.78	0.12	0.03	0.975
S7_3	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S7_39	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S7_4	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S7_41	60.30	11.39	0.00	71.69	0.00	0.00	0.00	0.00	0.00	0.000
S7_44	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S7_45	60.30	10.93	0.00	71.23	0.00	0.00	0.00	0.00	0.00	0.000
S7_46	60.30	11.55	0.00	71.85	0.00	0.00	0.00	0.00	0.00	0.000
S7_48	60.30	10.99	0.00	71.29	0.00	0.00	0.00	0.00	0.00	0.000
S7_5	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000

S7_50	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S7_51	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S7_53	60.30	11.35	0.00	71.65	0.00	0.00	0.00	0.00	0.00	0.000
S7_6	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S7_7	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S7_8	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S70	60.30	0.00	0.00	0.00	58.79	0.00	58.79	0.73	0.22	0.975
S70_1	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S70_3	60.30	0.00	0.00	0.00	58.80	0.00	58.80	0.06	0.02	0.975
S70_4	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S71_1	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S71_10	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S71_11	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S71_3	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S71_5	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S71_6	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S71_7	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S71_8	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S71_9	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S72	60.30	0.00	0.00	0.00	58.80	0.00	58.80	0.10	0.03	0.975
S8	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S8_1	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S8_2	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S8_4	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S8_6	60.30	0.00	0.00	0.00	58.80	0.00	58.80	0.04	0.01	0.975
S824_1	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.32	0.10	0.983
S824_2	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.78	0.25	0.983
S825	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.73	0.23	0.983
S826	60.30	0.00	0.00	0.00	59.29	0.00	59.29	1.16	0.33	0.983
S827	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.03	0.01	0.983
S828	60.30	0.00	0.00	0.00	59.29	0.00	59.29	1.09	0.32	0.983
S829	60.30	0.00	0.00	0.00	59.30	0.00	59.30	0.11	0.04	0.983
S830	60.30	0.00	0.00	0.00	59.30	0.00	59.30	0.19	0.07	0.983
S831_1	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.57	0.18	0.983
S831_2	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.58	0.19	0.983
S832_1	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.43	0.14	0.983
S832_2	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.90	0.29	0.983
S833	60.30	0.00	0.00	0.00	59.29	0.00	59.29	1.97	0.63	0.983
S834	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.03	0.01	0.983
S835_1	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.14	0.04	0.983

S835_2	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.32	0.10	0.983
S836_1	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.32	0.10	0.983
S836_2	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.34	0.11	0.983
S837_1	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.29	0.09	0.983
S837_2	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.25	0.08	0.983
S838_1	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.25	0.08	0.983
S838_2	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.29	0.09	0.983
S839	60.30	0.00	0.00	0.00	59.29	0.00	59.29	1.03	0.33	0.983
S840	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.83	0.27	0.983
S841	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.21	0.07	0.983
S842	60.30	0.00	0.00	0.00	59.30	0.00	59.30	0.16	0.05	0.983
S843	60.30	0.00	0.00	0.00	59.30	0.00	59.30	0.45	0.15	0.983
S844	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000
S845	60.30	0.00	0.00	0.00	59.30	0.00	59.30	0.12	0.04	0.983
S846	60.30	0.00	0.00	0.00	59.28	0.00	59.28	0.69	0.18	0.983
S847	60.30	0.00	0.00	0.00	59.30	0.00	59.30	0.10	0.04	0.983
S848	60.30	0.00	0.00	0.00	59.30	0.00	59.30	0.11	0.04	0.983
S849	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.26	0.08	0.983
S850	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.45	0.14	0.983
S851	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.24	0.08	0.983
S852_1	60.30	0.00	0.00	0.00	59.28	0.00	59.28	0.75	0.20	0.983
S852_2	60.30	0.00	0.00	0.00	59.28	0.00	59.28	0.68	0.18	0.983
S853	60.30	0.00	0.00	0.00	59.30	0.00	59.30	0.04	0.01	0.983
S854	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.56	0.18	0.983
S855	60.30	0.00	0.00	0.00	59.30	0.00	59.30	0.16	0.05	0.983
S856	60.30	0.00	0.00	0.00	59.30	0.00	59.30	0.12	0.04	0.983
S857_1	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.35	0.11	0.983
S857_2	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.29	0.09	0.983
S858_1	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.44	0.14	0.983
S858_2	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.42	0.13	0.983
S859	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.50	0.16	0.983
S860_1	60.30	0.00	0.00	0.00	59.29	0.00	59.29	1.30	0.41	0.983
S860_2	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.53	0.17	0.983
S861	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.65	0.21	0.983
S862	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.06	0.02	0.983
S863	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.06	0.02	0.983
S864	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.07	0.02	0.983
S865	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.07	0.02	0.983
S866	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.07	0.02	0.983
S867	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.15	0.05	0.983

S868_1	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.29	0.09	0.983
S868_2	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.25	0.08	0.983
S869_1	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.14	0.04	0.983
S869_2	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.14	0.05	0.983
S870_1	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.34	0.11	0.983
S870_3	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.31	0.10	0.983
S870_4	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.35	0.11	0.983
S870_5	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.37	0.12	0.983
S871_1	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.13	0.04	0.983
S871_2	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.30	0.10	0.983
S872	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.60	0.19	0.983
S873	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.38	0.12	0.983
S874	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.59	0.19	0.983
S875	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.81	0.26	0.983
S876_1	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.50	0.16	0.983
S876_2	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.37	0.12	0.983
S876_3	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.29	0.09	0.983
S877_1	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.29	0.09	0.983
S877_2	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.51	0.16	0.983
S878	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.35	0.11	0.983
S879	60.30	0.00	0.00	0.00	59.30	0.00	59.30	0.33	0.11	0.983
S880	60.30	0.00	0.00	0.00	59.28	0.00	59.28	0.55	0.15	0.983
S881	60.30	0.00	0.00	0.00	59.28	0.00	59.28	0.37	0.10	0.983
S882	60.30	0.00	0.00	0.00	59.28	0.00	59.28	0.35	0.09	0.983
S883_1	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.79	0.25	0.983
S883_2	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.81	0.26	0.983
S884	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.47	0.15	0.983
S885	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.37	0.12	0.983
S886	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.42	0.13	0.983
S887	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.42	0.13	0.983
S888	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.37	0.12	0.983
S889	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.42	0.13	0.983
S890	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.42	0.13	0.983
S891_1	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.67	0.21	0.983
S891_3	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.42	0.13	0.983
S891_4	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.56	0.18	0.983
S892_1	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.66	0.21	0.983
S892_3	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.43	0.14	0.983
S892_4	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.56	0.18	0.983
S893	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.37	0.11	0.983

S894_1	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.45	0.14	0.983
S894_2	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.66	0.21	0.983
S895	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.27	0.09	0.983
S896	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.50	0.16	0.983
S897	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.31	0.10	0.983
S898	60.30	0.00	0.00	0.00	59.29	0.00	59.29	0.18	0.05	0.983
S9	60.30	0.00	0.00	60.30	0.00	0.00	0.00	0.00	0.00	0.000

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LID Performance Summary

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Subcatchment	LID Control	Total Inflow mm	Evap Loss mm	Infil Loss mm	Surface Outflow mm	Drain Outflow mm	Initial Storage mm	Final Storage mm	Continuity Error %
S_Pond1	Pond1	5492.89	0.00	20.15	5096.03	177.58	34.00	233.13	-0.00
S_Pond4	Pond4	468.11	0.00	17.24	232.92	33.78	34.00	218.18	-0.00
S_Pond5	Pond5	2981.18	0.00	18.90	2572.14	180.50	34.00	243.65	-0.00
S_Pond6	Pond6	60.30	0.00	0.62	6.50	0.00	34.00	87.18	-0.00
S_Pond7	Pond7	753.83	0.00	17.87	452.37	89.35	34.00	228.24	-0.00
S_Pond8	Pond8	1936.50	0.00	18.65	1575.63	143.65	34.00	232.57	-0.00

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Node Depth Summary

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Node	Type	Average Depth Meters	Maximum Depth Meters	Maximum HGL Meters	Time of Max Occurrence days hr:min	Reported Max Depth Meters
J1	JUNCTION	0.01	0.03	98.91	0 12:31	0.03
J10	JUNCTION	0.02	0.16	122.36	0 12:06	0.16
J100	JUNCTION	0.07	0.60	117.02	0 11:59	0.60
J101	JUNCTION	0.05	0.73	113.63	0 12:03	0.73
J102	JUNCTION	0.01	0.05	117.76	0 11:54	0.05
J103	JUNCTION	0.06	0.54	118.07	0 11:58	0.54
J104	JUNCTION	0.06	0.52	118.43	0 11:56	0.52
J105	JUNCTION	0.08	0.74	118.04	0 11:59	0.74
J106	JUNCTION	0.05	0.36	118.76	0 11:56	0.36

J107	JUNCTION	1.03	1.44	121.01	0	11:55	1.44
J108	JUNCTION	0.05	0.45	121.01	0	11:55	0.45
J109	JUNCTION	0.08	0.68	119.21	0	11:58	0.68
J11	JUNCTION	0.01	0.02	119.22	0	13:10	0.02
J110	JUNCTION	0.01	0.08	119.44	0	12:00	0.08
J111	JUNCTION	0.07	0.53	120.74	0	11:56	0.53
J112	JUNCTION	0.08	0.70	118.39	0	11:58	0.70
J113	JUNCTION	0.05	0.39	120.99	0	11:55	0.39
J114	JUNCTION	0.03	0.32	120.98	0	11:55	0.32
J115	JUNCTION	0.21	1.21	111.44	0	12:03	1.21
J116	JUNCTION	0.08	0.69	119.04	0	11:58	0.69
J117	JUNCTION	0.08	0.67	118.86	0	11:58	0.67
J118	JUNCTION	0.01	0.45	110.40	0	12:08	0.45
J119	JUNCTION	0.02	0.61	110.39	0	12:08	0.61
J12	JUNCTION	0.01	0.09	110.50	0	11:55	0.09
J120	JUNCTION	0.02	0.20	116.84	0	11:54	0.20
J121	JUNCTION	0.02	0.17	114.83	0	11:54	0.17
J122	JUNCTION	0.00	0.00	114.64	0	00:00	0.00
J123	JUNCTION	0.02	0.19	114.08	0	11:54	0.19
J124	JUNCTION	0.05	0.44	113.72	0	11:55	0.44
J125	JUNCTION	0.03	0.22	117.79	0	12:00	0.22
J127	JUNCTION	0.01	0.08	115.46	0	11:54	0.08
J128	JUNCTION	0.06	0.58	109.76	0	11:59	0.58
J129	JUNCTION	0.03	0.25	115.83	0	11:55	0.25
J13	JUNCTION	0.04	0.31	96.46	0	11:54	0.31
J130	JUNCTION	0.01	0.11	113.63	0	11:55	0.11
J131	JUNCTION	0.03	0.23	110.11	0	11:59	0.23
J132	JUNCTION	0.04	0.68	110.39	0	12:06	0.68
J133	JUNCTION	0.05	0.39	113.62	0	11:56	0.39
J134	JUNCTION	0.05	0.38	114.17	0	11:54	0.38
J136	JUNCTION	0.04	0.34	114.05	0	11:55	0.34
J137	JUNCTION	0.03	0.22	114.27	0	11:54	0.22
J139	JUNCTION	0.01	0.09	113.77	0	11:54	0.09
J14	JUNCTION	0.19	1.01	116.51	0	12:00	1.01
J140	JUNCTION	0.04	0.27	113.12	0	11:55	0.27
J141	JUNCTION	0.13	1.04	111.79	0	11:58	1.04
J142	JUNCTION	0.05	0.38	101.49	0	12:00	0.38
J143	JUNCTION	0.11	0.87	113.08	0	11:56	0.87
J144	JUNCTION	0.10	0.86	112.03	0	11:57	0.86
J145	JUNCTION	0.03	0.23	105.67	0	11:56	0.23

J146	JUNCTION	0.02	0.18	111.28	0	11:54	0.18
J147	JUNCTION	0.23	1.30	111.04	0	12:05	1.30
J148	JUNCTION	0.10	0.78	117.43	0	11:59	0.78
J149	JUNCTION	0.10	0.80	117.02	0	12:00	0.80
J15	JUNCTION	0.22	1.27	110.35	0	12:08	1.27
J150	JUNCTION	0.06	1.14	112.61	0	12:03	1.14
J151	JUNCTION	0.09	0.84	116.64	0	12:00	0.84
J152	JUNCTION	0.16	0.85	116.02	0	12:00	0.85
J153	JUNCTION	0.18	0.96	115.01	0	12:01	0.96
J154	JUNCTION	0.03	0.24	116.37	0	11:55	0.24
J155	JUNCTION	0.01	0.08	121.50	0	11:57	0.08
J156	JUNCTION	0.07	0.52	121.40	0	11:54	0.52
J157	JUNCTION	0.04	0.36	120.07	0	11:54	0.36
J158	JUNCTION	0.04	0.32	119.89	0	11:55	0.32
J159	JUNCTION	0.01	0.07	120.72	0	11:57	0.07
J16	JUNCTION	0.00	0.00	93.44	0	00:00	0.00
J160	JUNCTION	0.03	0.20	119.87	0	11:55	0.20
J161	JUNCTION	0.03	0.16	109.55	0	12:00	0.16
J162	JUNCTION	0.03	0.13	97.99	0	12:01	0.13
J163	JUNCTION	0.04	0.19	107.38	0	12:02	0.19
J164	JUNCTION	0.10	0.40	122.53	0	12:05	0.40
J165	JUNCTION	0.00	0.02	105.84	0	12:03	0.02
J168	JUNCTION	0.00	0.03	104.77	0	12:04	0.03
J169	JUNCTION	0.00	0.03	111.13	0	12:00	0.03
J17	JUNCTION	0.02	0.12	114.46	0	11:55	0.12
J170	JUNCTION	0.00	0.05	102.69	0	12:00	0.05
J171	JUNCTION	0.01	0.06	101.82	0	12:02	0.06
J172	JUNCTION	0.00	0.00	108.92	0	00:00	0.00
J173	JUNCTION	0.00	0.00	106.00	0	00:00	0.00
J174	JUNCTION	0.00	0.01	105.25	0	11:57	0.01
J176	JUNCTION	0.00	0.03	108.17	0	12:00	0.03
J179	JUNCTION	0.01	0.07	104.44	0	11:54	0.07
J18	JUNCTION	0.03	0.21	110.79	0	11:54	0.21
J182	JUNCTION	0.02	0.10	104.34	0	11:59	0.10
J183	JUNCTION	0.00	0.02	105.05	0	12:01	0.02
J185	JUNCTION	0.00	0.03	98.94	0	12:02	0.03
J186	JUNCTION	0.02	0.11	103.61	0	11:56	0.11
J189	JUNCTION	0.00	0.04	106.12	0	12:00	0.04
J19	JUNCTION	0.03	0.21	119.21	0	12:00	0.21
J190	JUNCTION	0.00	0.04	95.54	0	12:03	0.04

J194	JUNCTION	0.18	1.07	112.69	0	12:03	1.06
J2	JUNCTION	0.00	0.00	92.20	0	12:03	0.00
J20	JUNCTION	0.01	0.07	85.21	0	11:54	0.07
J203	JUNCTION	0.23	1.28	110.65	0	12:06	1.28
J205	JUNCTION	0.05	0.79	110.38	0	12:07	0.79
J206	JUNCTION	0.29	1.06	110.39	0	12:08	1.06
J207	JUNCTION	0.14	0.91	110.39	0	12:07	0.91
J208	JUNCTION	0.03	0.75	110.39	0	12:06	0.75
J209	JUNCTION	0.01	0.07	101.27	0	12:00	0.07
J21	JUNCTION	0.00	0.00	94.80	0	00:00	0.00
J212	JUNCTION	0.06	0.48	120.05	0	11:56	0.48
J217	JUNCTION	0.16	0.91	116.23	0	12:01	0.91
J218	JUNCTION	0.08	0.35	99.60	0	12:03	0.35
J22	JUNCTION	0.01	0.07	99.99	0	12:00	0.07
J223	JUNCTION	0.02	0.12	102.10	0	11:55	0.12
J23	JUNCTION	0.16	0.86	115.94	0	12:00	0.86
J230	JUNCTION	0.03	0.22	96.42	0	12:06	0.22
J231	JUNCTION	0.13	0.81	99.12	0	12:07	0.81
J233	JUNCTION	0.00	0.00	107.68	0	00:00	0.00
J234	JUNCTION	0.06	0.44	101.74	0	12:00	0.44
J235	JUNCTION	0.00	0.00	99.66	0	00:00	0.00
J237	JUNCTION	0.02	0.13	96.74	0	11:56	0.13
J239	JUNCTION	0.03	0.14	93.51	0	12:00	0.14
J24	JUNCTION	0.17	0.95	114.86	0	12:01	0.95
J240	JUNCTION	0.04	0.32	107.54	0	11:55	0.32
J242	JUNCTION	0.05	0.38	105.65	0	11:55	0.38
J243	JUNCTION	0.01	0.05	102.06	0	11:59	0.05
J244	JUNCTION	0.03	0.27	99.02	0	11:55	0.27
J25	JUNCTION	0.04	0.34	122.66	0	12:02	0.34
J253	JUNCTION	0.03	0.25	101.86	0	11:54	0.25
J255	JUNCTION	0.01	0.27	102.14	0	11:56	0.27
J256	JUNCTION	0.07	0.51	101.95	0	12:00	0.51
J257	JUNCTION	0.01	0.09	106.84	0	11:54	0.09
J258	JUNCTION	0.03	0.20	106.54	0	11:55	0.20
J259	JUNCTION	0.05	0.35	116.01	0	11:57	0.35
J26	JUNCTION	0.00	0.02	100.83	0	12:00	0.02
J260	JUNCTION	0.06	0.50	102.37	0	11:58	0.50
J263	JUNCTION	0.07	0.45	109.32	0	12:03	0.45
J265	JUNCTION	0.07	0.38	109.87	0	12:15	0.38
J267	JUNCTION	0.07	0.58	114.55	0	11:57	0.58

J27	JUNCTION	0.01	0.07	100.53	0	12:01	0.07
J270	JUNCTION	0.06	0.42	115.82	0	11:57	0.42
J273	JUNCTION	0.06	0.34	110.43	0	12:15	0.34
J274	JUNCTION	0.06	0.33	111.56	0	12:14	0.33
J275	JUNCTION	0.05	0.32	111.86	0	12:13	0.32
J277	JUNCTION	0.33	0.95	109.67	0	12:30	0.95
J279	JUNCTION	0.16	0.82	109.72	0	12:34	0.82
J28	JUNCTION	0.00	0.00	104.67	0	00:00	0.00
J280	JUNCTION	0.07	0.57	113.46	0	11:56	0.57
J281	JUNCTION	0.00	0.00	105.38	0	00:00	0.00
J282	JUNCTION	0.07	0.65	109.72	0	12:34	0.65
J285	JUNCTION	0.02	0.13	110.44	0	12:12	0.13
J289	JUNCTION	0.00	0.00	114.60	0	00:00	0.00
J29	JUNCTION	0.01	0.09	93.84	0	11:55	0.09
J299	JUNCTION	0.10	0.50	111.33	0	12:12	0.50
J30	JUNCTION	0.07	0.48	94.55	0	11:57	0.48
J301	JUNCTION	0.08	0.46	113.14	0	12:12	0.46
J302	JUNCTION	0.02	0.18	115.19	0	11:54	0.18
J305	JUNCTION	0.08	0.74	111.80	0	11:57	0.74
J306	JUNCTION	0.08	0.68	112.71	0	11:57	0.68
J308	JUNCTION	0.05	0.32	113.36	0	12:10	0.32
J309	JUNCTION	0.01	0.08	111.92	0	12:11	0.08
J31	JUNCTION	0.06	0.49	100.26	0	11:57	0.49
J310	JUNCTION	0.02	0.39	111.05	0	12:04	0.39
J311	JUNCTION	0.08	0.39	112.88	0	12:09	0.39
J312	JUNCTION	0.08	0.45	114.66	0	12:09	0.45
J316	JUNCTION	0.03	0.23	116.72	0	12:00	0.23
J317	JUNCTION	0.05	0.32	114.89	0	12:07	0.32
J319	JUNCTION	0.01	0.07	116.26	0	12:01	0.07
J32	JUNCTION	0.06	0.48	101.52	0	11:56	0.48
J321	JUNCTION	0.10	0.83	118.06	0	11:58	0.83
J325	JUNCTION	0.01	0.06	117.31	0	11:57	0.06
J327	JUNCTION	0.01	0.06	118.73	0	11:57	0.06
J33	JUNCTION	0.01	0.07	108.26	0	11:54	0.07
J330	JUNCTION	0.01	0.05	116.69	0	12:02	0.05
J331	JUNCTION	0.07	0.36	114.72	0	12:08	0.36
J333	JUNCTION	0.01	0.08	113.46	0	12:05	0.08
J334	JUNCTION	0.05	0.25	104.54	0	12:03	0.25
J336	JUNCTION	0.01	0.05	103.34	0	12:06	0.05
J338	JUNCTION	0.05	0.28	102.28	0	12:10	0.28

J34	JUNCTION	0.06	0.49	103.32	0	11:55	0.49
J345	JUNCTION	0.01	0.05	101.36	0	12:11	0.05
J348	JUNCTION	0.07	0.34	100.66	0	12:09	0.34
J349	JUNCTION	0.04	0.32	114.01	0	11:55	0.32
J35	JUNCTION	0.18	1.26	111.04	0	12:05	1.26
J350	JUNCTION	0.01	0.06	99.23	0	12:10	0.06
J351	JUNCTION	0.07	0.52	102.13	0	11:59	0.52
J353	JUNCTION	0.01	0.07	103.99	0	12:00	0.07
J357	JUNCTION	0.02	0.13	109.76	0	12:21	0.13
J358	JUNCTION	0.03	0.14	112.66	0	12:00	0.14
J359	JUNCTION	0.05	0.36	104.21	0	11:57	0.36
J36	JUNCTION	0.03	0.26	115.66	0	11:54	0.26
J360	JUNCTION	0.00	0.04	83.93	0	11:59	0.04
J361	JUNCTION	0.02	0.20	93.83	0	11:57	0.20
J37	JUNCTION	0.04	0.29	118.91	0	11:54	0.29
J38	JUNCTION	0.06	0.48	120.49	0	11:56	0.48
J39	JUNCTION	0.02	0.18	116.26	0	11:54	0.18
J4	JUNCTION	0.01	0.03	88.03	0	13:45	0.03
J40	JUNCTION	0.02	0.19	116.45	0	11:54	0.19
J41	JUNCTION	0.06	0.47	116.37	0	11:57	0.47
J42	JUNCTION	0.01	0.09	122.66	0	11:54	0.09
J43	JUNCTION	0.01	0.06	118.61	0	11:54	0.06
J44	JUNCTION	0.03	0.27	122.67	0	12:01	0.27
J45	JUNCTION	0.07	0.62	119.84	0	11:56	0.62
J46	JUNCTION	0.04	0.33	121.30	0	11:54	0.33
J47	JUNCTION	0.17	1.01	113.55	0	12:02	1.01
J48	JUNCTION	0.01	0.07	118.63	0	11:55	0.07
J49	JUNCTION	0.08	0.65	119.73	0	11:57	0.65
J5	JUNCTION	0.00	0.01	80.01	0	12:31	0.01
J50	JUNCTION	0.08	0.70	119.36	0	11:58	0.70
J51	JUNCTION	0.02	0.46	119.36	0	11:58	0.46
J52	JUNCTION	0.15	0.71	109.73	0	12:07	0.71
J53	JUNCTION	0.02	0.18	117.15	0	11:55	0.18
J54	JUNCTION	0.05	0.62	118.07	0	11:58	0.62
J55	JUNCTION	0.17	0.95	115.15	0	12:01	0.95
J56	JUNCTION	0.07	0.64	115.65	0	12:00	0.64
J57	JUNCTION	0.03	0.33	115.63	0	12:01	0.33
J58	JUNCTION	0.17	0.93	115.62	0	12:00	0.93
J59	JUNCTION	0.08	0.68	118.40	0	11:54	0.68
J6	JUNCTION	0.01	0.02	90.14	0	12:45	0.02

J60	JUNCTION	0.10	0.82	118.29	0	11:56	0.82
J61	JUNCTION	0.04	0.52	123.14	0	12:01	0.52
J62	JUNCTION	0.06	0.59	123.14	0	12:01	0.59
J63	JUNCTION	0.05	0.50	123.16	0	12:00	0.50
J64	JUNCTION	0.01	0.10	110.92	0	11:55	0.10
J65	JUNCTION	0.07	0.61	123.14	0	12:00	0.61
J66	JUNCTION	0.01	0.09	110.23	0	11:56	0.09
J67	JUNCTION	0.08	0.62	123.15	0	12:00	0.62
J68	JUNCTION	0.05	0.43	104.95	0	11:55	0.43
J69	JUNCTION	0.02	0.15	102.01	0	11:54	0.15
J7	JUNCTION	0.02	0.04	107.76	0	14:05	0.04
J70	JUNCTION	0.10	0.65	123.12	0	12:00	0.65
J71	JUNCTION	0.00	0.00	102.23	0	00:00	0.00
J72	JUNCTION	0.09	0.78	113.78	0	11:55	0.78
J73	JUNCTION	0.01	0.06	95.77	0	11:57	0.06
J74	JUNCTION	0.06	0.53	123.06	0	12:00	0.53
J75	JUNCTION	0.05	0.45	110.11	0	11:58	0.45
J76	JUNCTION	0.13	0.64	123.06	0	12:01	0.64
J77	JUNCTION	0.10	0.83	117.60	0	11:58	0.83
J78	JUNCTION	0.03	0.25	121.51	0	11:54	0.25
J79	JUNCTION	0.01	0.09	93.57	0	11:58	0.09
J8	JUNCTION	0.08	0.67	118.69	0	11:58	0.67
J80	JUNCTION	0.01	0.08	121.74	0	11:54	0.08
J81	JUNCTION	0.13	1.02	111.23	0	11:58	1.02
J82	JUNCTION	0.05	0.41	112.81	0	11:56	0.41
J83	JUNCTION	0.03	0.21	120.69	0	11:54	0.21
J84	JUNCTION	0.09	0.72	116.86	0	11:59	0.72
J85	JUNCTION	0.20	1.30	112.36	0	12:03	1.30
J86	JUNCTION	0.03	0.23	120.72	0	11:54	0.23
J87	JUNCTION	0.04	0.35	114.08	0	11:55	0.35
J88	JUNCTION	0.01	0.08	120.83	0	11:54	0.08
J89	JUNCTION	0.03	0.26	118.97	0	11:54	0.26
J9	JUNCTION	0.10	0.78	118.04	0	11:59	0.78
J90	JUNCTION	0.06	0.62	118.30	0	11:57	0.62
J91	JUNCTION	0.02	0.12	111.14	0	11:54	0.12
J92	JUNCTION	0.05	0.36	117.72	0	11:54	0.36
J93	JUNCTION	0.06	0.48	118.51	0	11:56	0.48
J94	JUNCTION	0.06	0.48	118.79	0	11:55	0.48
J95	JUNCTION	0.17	0.94	114.30	0	12:00	0.94
J96	JUNCTION	0.05	0.36	117.09	0	11:57	0.36

J97	JUNCTION	0.05	0.42	119.08	0	11:54	0.42	
J98	JUNCTION	0.05	0.42	118.80	0	11:54	0.42	
J99	JUNCTION	0.05	0.40	117.42	0	11:57	0.40	
OF1	JUNCTION	0.03	0.56	116.51	0	12:01	0.56	
OF_Pond1	OUTFALL	0.09	0.72	116.77	0	11:59	0.72	
OF_Pond2	OUTFALL	0.07	0.45	108.70	0	12:03	0.45	
OF_Pond3	OUTFALL	0.02	0.20	93.20	0	11:57	0.20	
OF_Pond4	OUTFALL	0.00	0.04	83.54	0	11:59	0.04	
OF_Pond5	OUTFALL	0.03	0.22	96.22	0	12:06	0.22	
OF_Pond6	OUTFALL	0.00	0.04	94.04	0	12:03	0.04	
OF_Pond7	OUTFALL	0.01	0.06	100.56	0	12:02	0.06	
OF_Pond8	OUTFALL	0.02	0.16	122.16	0	12:06	0.16	
OF2	OUTFALL	0.02	0.04	106.54	0	14:05	0.04	
OF3	OUTFALL	0.01	0.02	87.02	0	12:45	0.02	
OF4	OUTFALL	0.00	0.01	78.01	0	12:31	0.01	
OF5	OUTFALL	0.01	0.03	87.03	0	13:45	0.03	
OF6	OUTFALL	0.00	0.00	92.00	0	12:03	0.00	
OF7	OUTFALL	0.01	0.03	98.03	0	12:31	0.03	
OF8	OUTFALL	0.01	0.02	115.02	0	13:10	0.02	
SU1_Pond1	STORAGE	0.50	1.26	117.26	0	13:00	1.26	
SU2_Pond2	STORAGE	3.22	3.80	108.80	0	14:04	3.80	
SU3_Pond3	STORAGE	0.23	0.80	93.80	0	12:45	0.80	
SU4_Pond4	STORAGE	0.04	0.20	83.70	0	12:30	0.20	
SU5_Pond5	STORAGE	0.51	1.34	97.34	0	13:45	1.34	
SU6_Pond6	STORAGE	0.00	0.03	94.03	0	12:00	0.03	
SU7_Pond7	STORAGE	0.13	0.94	101.44	0	12:31	0.94	
SU8_Pond8	STORAGE	0.27	0.95	122.95	0	13:09	0.95	

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Node Inflow Summary

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Node	Type	Maximum Lateral Inflow CMS	Maximum Total Inflow CMS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 ltr	Total Inflow Volume 10^6 ltr	Flow Balance Error Percent
J1	JUNCTION	0.000	0.120	0 12:31	0	1.46	0.007
J10	JUNCTION	0.000	0.885	0 12:06	0	3.84	0.006
J100	JUNCTION	0.000	1.046	0 11:56	0	3.57	0.037

J101	JUNCTION	0.045	1.007	0	12:05	0.14	2.45	0.034
J102	JUNCTION	0.013	0.013	0	11:54	0.0382	0.0382	-0.151
J103	JUNCTION	0.010	1.285	0	11:56	0.028	4.21	0.005
J104	JUNCTION	0.000	1.056	0	11:55	0	3.43	0.017
J105	JUNCTION	0.000	1.272	0	11:57	0	4.21	0.003
J106	JUNCTION	0.000	0.560	0	11:55	0	1.8	0.010
J107	JUNCTION	0.054	0.054	0	11:54	0.177	0.192	9.002
J108	JUNCTION	0.098	0.887	0	11:55	0.288	2.84	0.001
J109	JUNCTION	0.001	1.730	0	11:58	0.00459	5.75	-0.003
J11	JUNCTION	0.000	0.115	0	13:09	0	3.47	0.007
J110	JUNCTION	0.032	0.032	0	12:00	0.122	0.122	-0.010
J111	JUNCTION	0.030	1.412	0	11:55	0.112	4.58	0.004
J112	JUNCTION	0.015	1.760	0	11:58	0.0461	5.84	-0.002
J113	JUNCTION	0.234	0.502	0	11:55	0.752	1.64	-0.007
J114	JUNCTION	0.000	0.280	0	11:54	0	0.891	0.020
J115	JUNCTION	0.054	6.792	0	12:03	0.169	34	0.007
J116	JUNCTION	0.015	1.744	0	11:58	0.0467	5.79	0.004
J117	JUNCTION	0.000	1.743	0	11:58	0	5.79	0.001
J118	JUNCTION	0.000	0.104	0	12:02	0	0.0172	2.558
J119	JUNCTION	0.019	0.177	0	12:00	0.0516	0.115	-0.263
J12	JUNCTION	0.000	0.044	0	11:55	0	0.134	0.002
J120	JUNCTION	0.204	0.204	0	11:54	0.604	0.604	-0.015
J121	JUNCTION	0.173	0.173	0	11:54	0.542	0.542	-0.015
J122	JUNCTION	0.000	0.000	0	00:00	0	0	0.000 ltr
J123	JUNCTION	0.187	0.187	0	11:54	0.589	0.589	-0.017
J124	JUNCTION	0.052	0.869	0	11:55	0.21	2.87	0.006
J125	JUNCTION	0.000	0.194	0	12:00	0	0.738	0.019
J127	JUNCTION	0.037	0.037	0	11:54	0.102	0.102	-0.128
J128	JUNCTION	0.000	6.535	0	11:58	0	22.3	-0.018
J129	JUNCTION	0.320	0.320	0	11:54	1.13	1.13	-0.004
J13	JUNCTION	0.598	1.072	0	11:54	1.93	3.52	-0.003
J130	JUNCTION	0.014	0.014	0	11:54	0.0356	0.0356	-0.219
J131	JUNCTION	0.161	0.161	0	11:54	0.505	0.505	-0.048
J132	JUNCTION	0.159	0.321	0	11:54	0.5	1.03	0.095
J133	JUNCTION	0.325	0.638	0	11:55	1.02	2.18	0.005
J134	JUNCTION	0.224	0.224	0	11:54	0.692	0.692	-0.023
J136	JUNCTION	0.429	0.676	0	11:54	1.46	2.25	0.008
J137	JUNCTION	0.434	0.434	0	11:54	1.45	1.45	-0.010
J139	JUNCTION	0.044	0.044	0	11:54	0.139	0.139	-0.016
J14	JUNCTION	0.042	3.212	0	12:01	0.151	21	0.009

J140	JUNCTION	0.320	0.363	0	11:54	1.02	1.16	-0.038
J141	JUNCTION	0.042	5.630	0	11:58	0.132	19.2	0.005
J142	JUNCTION	0.000	1.330	0	12:00	0	4.68	-0.023
J143	JUNCTION	0.947	3.496	0	11:56	2.94	11.9	-0.002
J144	JUNCTION	0.092	3.593	0	11:56	0.297	12.2	-0.002
J145	JUNCTION	0.057	0.276	0	11:55	0.177	0.992	0.009
J146	JUNCTION	0.168	0.168	0	11:54	0.528	0.528	-0.207
J147	JUNCTION	0.000	6.505	0	12:04	0	34.6	0.011
J148	JUNCTION	0.000	3.050	0	11:59	0	10.1	0.000
J149	JUNCTION	0.000	3.055	0	11:59	0	10.1	-0.001
J15	JUNCTION	0.026	6.483	0	12:06	0.0802	36.1	0.046
J150	JUNCTION	0.134	2.491	0	12:03	0.442	4.97	0.059
J151	JUNCTION	0.000	3.056	0	12:00	0	10.1	-0.008
J152	JUNCTION	0.000	3.396	0	12:01	0	21.8	0.001
J153	JUNCTION	0.000	4.575	0	12:01	0	26	0.004
J154	JUNCTION	0.109	0.312	0	11:54	0.404	1.01	0.009
J155	JUNCTION	0.000	0.039	0	11:54	0	0.122	0.062
J156	JUNCTION	0.577	0.751	0	11:54	1.81	2.38	-0.005
J157	JUNCTION	0.371	0.565	0	11:54	1.18	1.8	-0.008
J158	JUNCTION	0.260	0.524	0	11:54	0.799	1.63	-0.022
J159	JUNCTION	0.000	0.028	0	11:54	0	0.0846	-0.077
J16	JUNCTION	0.000	0.000	0	00:00	0	0	0.000 ltr
J160	JUNCTION	0.206	0.241	0	11:54	0.645	0.756	-0.054
J161	JUNCTION	0.037	0.094	0	11:59	0.115	0.327	-0.031
J162	JUNCTION	0.000	0.050	0	11:56	0	0.16	-0.392
J163	JUNCTION	0.000	0.090	0	12:00	0	0.327	0.099
J164	JUNCTION	0.040	0.938	0	12:02	0.124	3.89	1.459
J165	JUNCTION	0.000	0.086	0	12:02	0	0.327	0.008
J168	JUNCTION	0.033	0.105	0	12:00	0.102	0.429	0.005
J169	JUNCTION	0.173	0.173	0	12:00	0.638	0.638	-0.000
J17	JUNCTION	0.045	0.045	0	11:54	0.139	0.139	-0.145
J170	JUNCTION	0.197	0.369	0	12:00	0.728	1.37	0.003
J171	JUNCTION	0.000	0.481	0	12:00	0	1.87	0.013
J172	JUNCTION	0.000	0.000	0	00:00	0	0	0.000 ltr
J173	JUNCTION	0.000	0.000	0	00:00	0	0	0.000 ltr
J174	JUNCTION	0.025	0.025	0	11:54	0.0794	0.0794	-0.030
J176	JUNCTION	0.097	0.097	0	12:00	0.357	0.357	0.004
J179	JUNCTION	0.017	0.017	0	11:54	0.0518	0.0518	-0.025
J18	JUNCTION	0.291	0.291	0	11:54	0.921	0.921	-0.010
J182	JUNCTION	0.000	0.016	0	11:54	0	0.0518	0.176

J183	JUNCTION	0.000	0.095	0	12:00	0	0.357	0.003
J185	JUNCTION	0.000	0.134	0	12:00	0	0.506	0.014
J186	JUNCTION	0.031	0.044	0	11:55	0.0976	0.149	-0.073
J189	JUNCTION	0.211	0.211	0	12:00	0.78	0.78	-0.003
J19	JUNCTION	0.162	0.194	0	12:00	0.616	0.738	-0.016
J190	JUNCTION	0.023	0.146	0	12:01	0.0713	0.578	0.010
J194	JUNCTION	0.000	5.595	0	12:02	0	29	0.008
J2	JUNCTION	0.000	0.001	0	12:00	0	0.0059	-0.304
J20	JUNCTION	0.039	0.039	0	11:54	0.123	0.123	-0.009
J203	JUNCTION	0.037	6.500	0	12:05	0.122	34.6	0.011
J205	JUNCTION	0.029	0.711	0	12:01	0.0875	1.67	-0.062
J206	JUNCTION	0.000	0.506	0	12:01	0	0.538	3.280
J207	JUNCTION	0.030	0.388	0	12:02	0.0938	0.378	1.259
J208	JUNCTION	0.000	0.256	0	12:00	0	0.189	-0.006
J209	JUNCTION	0.060	0.540	0	12:00	0.222	2.01	0.004
J21	JUNCTION	0.000	0.000	0	00:00	0	0	0.000 ltr
J212	JUNCTION	0.000	1.445	0	11:56	0	4.71	-0.002
J217	JUNCTION	0.259	3.397	0	12:00	0.812	21.8	0.002
J218	JUNCTION	0.023	0.563	0	12:01	0.0701	2.15	0.086
J22	JUNCTION	0.247	0.592	0	11:59	0.913	2.18	-0.060
J223	JUNCTION	0.051	0.051	0	11:54	0.16	0.16	-0.262
J23	JUNCTION	0.027	3.425	0	12:01	0.102	21.9	0.003
J230	JUNCTION	0.050	2.400	0	12:06	0.156	13.1	0.025
J231	JUNCTION	0.168	2.432	0	12:00	0.637	10.7	0.221
J233	JUNCTION	0.000	0.000	0	00:00	0	0	0.000 ltr
J234	JUNCTION	0.032	1.331	0	11:59	0.0992	4.68	0.005
J235	JUNCTION	0.000	0.000	0	00:00	0	0	0.000 ltr
J237	JUNCTION	0.060	0.060	0	11:54	0.188	0.188	-0.114
J239	JUNCTION	0.021	0.076	0	11:56	0.0658	0.254	0.108
J24	JUNCTION	0.004	4.575	0	12:01	0.0116	26	0.003
J240	JUNCTION	0.415	0.695	0	11:54	1.3	2.22	0.002
J242	JUNCTION	0.236	0.912	0	11:54	0.741	2.96	0.003
J243	JUNCTION	0.357	0.357	0	11:54	1.26	1.26	0.000
J244	JUNCTION	0.362	0.498	0	11:54	1.14	1.6	0.003
J25	JUNCTION	0.123	0.977	0	12:00	0.384	3.77	-0.019
J253	JUNCTION	0.304	0.304	0	11:54	0.953	0.953	-0.058
J255	JUNCTION	0.000	0.050	0	11:53	0	0.0212	2.071
J256	JUNCTION	0.000	0.518	0	11:59	0	1.8	0.008
J257	JUNCTION	0.037	0.037	0	11:54	0.109	0.109	-0.028
J258	JUNCTION	0.187	0.221	0	11:54	0.706	0.814	-0.000

J259	JUNCTION	0.093	0.540	0	11:56	0.35	1.97	0.021
J26	JUNCTION	0.021	0.021	0	11:54	0.0666	0.0666	-0.031
J260	JUNCTION	0.167	0.798	0	11:56	0.524	2.78	0.005
J263	JUNCTION	0.000	11.642	0	12:02	0	68.5	0.009
J265	JUNCTION	0.263	0.533	0	12:13	0.928	3.54	-0.037
J267	JUNCTION	0.739	1.618	0	11:56	2.38	5.63	0.004
J27	JUNCTION	0.000	0.554	0	12:00	0	2.08	-0.006
J270	JUNCTION	0.414	0.923	0	11:56	1.28	3.25	-0.001
J273	JUNCTION	0.058	0.454	0	12:14	0.221	2.61	0.013
J274	JUNCTION	0.000	0.434	0	12:13	0	2.39	0.009
J275	JUNCTION	0.000	0.435	0	12:12	0	2.39	0.010
J277	JUNCTION	0.048	1.070	0	12:38	0.183	10.3	0.180
J279	JUNCTION	0.000	0.753	0	12:39	0	6.56	0.073
J28	JUNCTION	0.000	0.000	0	00:00	0	0	0.000 ltr
J280	JUNCTION	0.000	1.291	0	11:56	0	4.43	0.005
J281	JUNCTION	0.000	0.000	0	00:00	0	0	0.000 ltr
J282	JUNCTION	0.213	0.815	0	12:19	0.786	6.45	0.088
J285	JUNCTION	0.000	0.761	0	12:13	0	5.3	0.036
J289	JUNCTION	0.000	0.000	0	00:00	0	0	0.000 ltr
J29	JUNCTION	0.036	0.036	0	11:54	0.12	0.12	-0.004
J299	JUNCTION	0.403	0.803	0	12:06	1.53	5.31	0.233
J30	JUNCTION	0.025	1.873	0	11:57	0.0713	6.16	0.000
J301	JUNCTION	0.000	0.437	0	12:10	0	2.39	-0.003
J302	JUNCTION	0.260	0.260	0	11:54	0.775	0.775	-0.015
J305	JUNCTION	0.072	2.015	0	11:57	0.249	6.88	0.003
J306	JUNCTION	0.329	1.946	0	11:56	1.03	6.63	0.003
J308	JUNCTION	0.000	0.438	0	12:10	0	2.39	0.009
J309	JUNCTION	0.000	0.602	0	12:09	0	3.78	0.020
J31	JUNCTION	0.158	1.859	0	11:56	0.501	6.09	0.008
J310	JUNCTION	0.138	0.138	0	11:54	0.432	0.432	-0.149
J311	JUNCTION	0.000	0.623	0	12:05	0	3.78	0.154
J312	JUNCTION	0.000	0.440	0	12:08	0	2.39	-0.004
J316	JUNCTION	0.280	0.308	0	12:00	1.05	1.15	0.003
J317	JUNCTION	0.174	0.605	0	12:00	0.644	2.4	0.257
J319	JUNCTION	0.088	0.481	0	11:58	0.336	1.75	-0.018
J32	JUNCTION	0.020	1.423	0	11:55	0.061	4.64	0.006
J321	JUNCTION	0.061	2.129	0	11:58	0.192	7.12	0.005
J325	JUNCTION	0.218	0.388	0	11:57	0.678	1.42	-0.002
J327	JUNCTION	0.362	0.362	0	11:54	1.33	1.33	0.002
J33	JUNCTION	0.057	0.057	0	11:54	0.173	0.173	-0.082

J330	JUNCTION	0.000	0.361	0	12:00	0	1.33	-0.023
J331	JUNCTION	0.412	0.711	0	12:00	1.57	2.9	0.378
J333	JUNCTION	0.242	0.624	0	12:04	0.894	3.78	-0.000
J334	JUNCTION	0.350	0.350	0	12:00	1.33	1.33	0.235
J336	JUNCTION	0.000	0.256	0	12:03	0	1.33	0.020
J338	JUNCTION	0.177	0.376	0	12:00	0.668	1.99	0.306
J34	JUNCTION	0.245	1.347	0	11:55	0.768	4.4	0.000
J345	JUNCTION	0.000	0.318	0	12:10	0	1.99	0.023
J348	JUNCTION	0.313	0.500	0	12:00	1.19	3.18	0.167
J349	JUNCTION	0.051	0.702	0	11:54	0.16	2.25	-0.019
J35	JUNCTION	0.015	0.307	0	11:55	0.0476	0.633	0.072
J350	JUNCTION	0.000	0.466	0	12:09	0	3.17	0.016
J351	JUNCTION	0.550	0.550	0	11:54	1.8	1.82	-0.037
J353	JUNCTION	0.274	0.485	0	12:00	1.01	1.79	0.008
J357	JUNCTION	0.097	0.818	0	12:15	0.357	5.65	0.044
J358	JUNCTION	0.024	0.066	0	11:54	0.0734	0.212	-0.010
J359	JUNCTION	0.395	0.651	0	11:55	1.27	2.26	-0.013
J36	JUNCTION	0.314	0.490	0	11:54	0.985	1.54	-0.010
J360	JUNCTION	0.000	0.147	0	11:59	0	0.511	-0.005
J361	JUNCTION	0.000	2.945	0	11:57	0	9.8	0.004
J37	JUNCTION	0.431	0.431	0	11:54	1.31	1.31	-0.093
J38	JUNCTION	0.000	1.443	0	11:56	0	4.71	0.002
J39	JUNCTION	0.178	0.178	0	11:54	0.558	0.558	-0.006
J4	JUNCTION	0.000	0.270	0	13:45	0	11.9	0.002
J40	JUNCTION	0.130	0.130	0	11:54	0.406	0.406	-0.048
J41	JUNCTION	0.253	0.891	0	11:55	0.793	3.13	0.008
J42	JUNCTION	0.039	0.039	0	11:54	0.122	0.122	-0.050
J43	JUNCTION	0.032	0.032	0	11:54	0.101	0.101	-0.034
J44	JUNCTION	0.066	0.066	0	11:54	0.198	0.198	-0.195
J45	JUNCTION	0.000	1.446	0	11:56	0	4.71	-0.000
J46	JUNCTION	0.282	0.282	0	11:54	0.891	0.891	-0.021
J47	JUNCTION	0.031	5.999	0	12:02	0.0967	29	0.007
J48	JUNCTION	0.031	0.031	0	11:54	0.0952	0.0952	-0.070
J49	JUNCTION	0.134	1.575	0	11:56	0.446	5.15	0.001
J5	JUNCTION	0.000	0.020	0	12:30	0	0.325	0.025
J50	JUNCTION	0.133	1.731	0	11:57	0.353	5.75	0.001
J51	JUNCTION	0.040	0.085	0	11:53	0.154	0.246	0.059
J52	JUNCTION	0.000	7.523	0	12:08	0	35.9	0.008
J53	JUNCTION	0.150	0.150	0	11:54	0.47	0.47	-0.074
J54	JUNCTION	0.251	0.251	0	11:54	0.786	0.786	-0.028

J55	JUNCTION	0.000	4.573	0	12:01	0	26	0.001
J56	JUNCTION	0.042	1.194	0	11:56	0.131	4.13	-0.006
J57	JUNCTION	0.279	0.279	0	11:54	0.876	0.876	-0.013
J58	JUNCTION	0.000	4.566	0	12:00	0	26	0.007
J59	JUNCTION	1.012	1.012	0	11:54	3.15	3.15	-0.014
J6	JUNCTION	0.000	0.138	0	12:45	0	3.72	0.006
J60	JUNCTION	0.116	1.871	0	11:55	0.341	6.14	0.005
J61	JUNCTION	0.047	0.051	0	11:53	0.145	0.145	-0.007
J62	JUNCTION	0.000	0.067	0	11:54	0	0.177	0.037
J63	JUNCTION	0.311	0.311	0	11:54	0.958	0.958	-0.045
J64	JUNCTION	0.000	0.045	0	11:54	0	0.134	0.008
J65	JUNCTION	0.030	0.332	0	11:58	0.101	1.24	0.029
J66	JUNCTION	0.000	0.044	0	11:55	0	0.134	-0.240
J67	JUNCTION	0.413	0.413	0	11:54	1.31	1.31	-0.022
J68	JUNCTION	0.213	1.115	0	11:55	0.669	3.63	-0.002
J69	JUNCTION	0.143	0.143	0	11:54	0.453	0.453	-0.009
J7	JUNCTION	0.000	0.208	0	14:04	0	11.8	0.023
J70	JUNCTION	0.019	0.698	0	11:59	0.0598	2.57	0.005
J71	JUNCTION	0.000	0.000	0	00:00	0	0	0.000 ltr
J72	JUNCTION	1.060	2.596	0	11:56	3.29	8.92	-0.000
J73	JUNCTION	0.020	0.020	0	11:54	0.0609	0.0609	0.000
J74	JUNCTION	0.157	0.157	0	11:54	0.503	0.503	-0.031
J75	JUNCTION	0.205	6.530	0	11:58	0.645	22.3	0.000
J76	JUNCTION	0.029	0.846	0	12:00	0.109	3.19	-0.004
J77	JUNCTION	0.216	2.326	0	11:58	0.674	7.79	0.000
J78	JUNCTION	0.184	0.184	0	11:54	0.57	0.57	-0.005
J79	JUNCTION	0.023	0.040	0	11:55	0.0731	0.134	0.025
J8	JUNCTION	0.000	1.745	0	11:58	0	5.79	-0.001
J80	JUNCTION	0.029	0.029	0	11:54	0.0846	0.0846	-0.053
J81	JUNCTION	0.640	6.206	0	11:58	2.01	21.2	-0.003
J82	JUNCTION	0.000	1.291	0	11:56	0	4.33	-0.009
J83	JUNCTION	0.200	0.200	0	11:54	0.614	0.614	-0.016
J84	JUNCTION	0.014	3.362	0	11:59	0.043	11.4	0.004
J85	JUNCTION	0.030	8.524	0	12:04	0.0956	34	0.002
J86	JUNCTION	0.270	0.270	0	11:54	0.834	0.834	-0.011
J87	JUNCTION	0.093	0.646	0	11:54	0.292	2.08	0.006
J88	JUNCTION	0.036	0.036	0	11:54	0.111	0.111	-0.020
J89	JUNCTION	0.295	0.295	0	11:54	0.898	0.898	-0.033
J9	JUNCTION	0.021	3.044	0	11:59	0.0682	10.1	0.002
J90	JUNCTION	0.000	0.817	0	11:56	0	2.65	0.003

J91	JUNCTION	0.045	0.045	0	11:54	0.134	0.134	-0.012
J92	JUNCTION	0.491	0.491	0	11:54	1.78	1.78	-0.007
J93	JUNCTION	0.008	0.825	0	11:55	0.0246	2.65	0.014
J94	JUNCTION	0.000	0.546	0	11:54	0	1.72	0.003
J95	JUNCTION	0.133	4.671	0	12:01	0.446	26.5	0.008
J96	JUNCTION	0.015	0.540	0	11:54	0.0474	1.93	0.009
J97	JUNCTION	0.548	0.548	0	11:54	1.72	1.72	-0.010
J98	JUNCTION	0.644	0.644	0	11:54	2.15	2.15	-0.029
J99	JUNCTION	0.020	0.670	0	11:55	0.0657	2.26	0.022
OF1	JUNCTION	0.000	0.275	0	13:00	0	10.7	-0.001
OF_Pond1	OUTFALL	0.000	3.360	0	11:59	0	11.4	0.000
OF_Pond2	OUTFALL	0.000	11.637	0	12:03	0	68.5	0.000
OF_Pond3	OUTFALL	0.000	2.945	0	11:57	0	9.8	0.000
OF_Pond4	OUTFALL	0.000	0.147	0	11:59	0	0.511	0.000
OF_Pond5	OUTFALL	0.000	2.399	0	12:06	0	13.1	0.000
OF_Pond6	OUTFALL	0.000	0.142	0	12:03	0	0.578	0.000
OF_Pond7	OUTFALL	0.000	0.464	0	12:02	0	1.87	0.000
OF_Pond8	OUTFALL	0.000	0.885	0	12:06	0	3.84	0.000
OF2	OUTFALL	0.000	0.208	0	14:05	0	11.8	0.000
OF3	OUTFALL	0.000	0.138	0	12:45	0	3.72	0.000
OF4	OUTFALL	0.000	0.020	0	12:31	0	0.325	0.000
OF5	OUTFALL	0.000	0.270	0	13:45	0	11.9	0.000
OF6	OUTFALL	0.000	0.001	0	12:03	0	0.00592	0.000
OF7	OUTFALL	0.000	0.120	0	12:31	0	1.46	0.000
OF8	OUTFALL	0.000	0.114	0	13:10	0	3.47	0.000
SU1_Pond1	STORAGE	3.860	3.860	0	11:59	11.1	11.1	0.001
SU2_Pond2	STORAGE	10.156	10.156	0	12:05	24.3	63.1	0.002
SU3_Pond3	STORAGE	2.720	2.720	0	11:59	3.91	3.91	0.001
SU4_Pond4	STORAGE	0.181	0.181	0	11:59	0.335	0.335	0.001
SU5_Pond5	STORAGE	2.711	2.711	0	12:03	12.4	12.4	0.001
SU6_Pond6	STORAGE	0.011	0.011	0	11:54	0.00596	0.00596	0.001
SU7_Pond7	STORAGE	0.533	0.533	0	11:59	1.47	1.47	0.001
SU8_Pond8	STORAGE	0.965	0.965	0	12:03	3.52	3.52	0.001

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Node Surcharge Summary

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No nodes were surcharged.

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Node Flooding Summary

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No nodes were flooded.

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Storage Volume Summary

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Storage Unit	Average Volume 1000 m³	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 m³	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow CMS
SU1_Pond1	2.461	17.1	0.0	0.0	6.478	45.1	0 13:00	0.275
SU2_Pond2	51.468	56.5	0.0	0.0	61.797	67.9	0 14:04	0.208
SU3_Pond3	0.967	10.0	0.0	0.0	3.469	35.8	0 12:45	0.138
SU4_Pond4	0.041	1.9	0.0	0.0	0.213	10.1	0 12:30	0.020
SU5_Pond5	2.506	17.8	0.0	0.0	6.856	48.8	0 13:45	0.270
SU6_Pond6	0.001	0.2	0.0	0.0	0.006	1.6	0 12:00	0.001
SU7_Pond7	0.074	2.9	0.0	0.0	0.624	24.5	0 12:31	0.120
SU8_Pond8	0.488	10.6	0.0	0.0	1.831	39.8	0 13:09	0.115

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Outfall Loading Summary

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Outfall Node	Flow Freq Pcnt	Avg Flow CMS	Max Flow CMS	Total Volume 10^6 ltr
OF_Pond1	96.74	0.142	3.360	11.398
OF_Pond2	99.32	0.749	11.637	68.466
OF_Pond3	93.99	0.125	2.945	9.803
OF_Pond4	72.11	0.009	0.147	0.511
OF_Pond5	99.43	0.149	2.399	13.101
OF_Pond6	79.59	0.009	0.142	0.578
OF_Pond7	88.71	0.025	0.464	1.875
OF_Pond8	87.34	0.051	0.885	3.837
OF2	73.15	0.109	0.208	11.772

OF3	75.98	0.040	0.138	3.719
OF4	77.96	0.004	0.020	0.325
OF5	90.49	0.100	0.270	11.916
OF6	28.86	0.000	0.001	0.006
OF7	81.95	0.017	0.120	1.458
OF8	89.14	0.032	0.114	3.475
System	82.32	1.561	21.240	142.237

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Link Flow Summary

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Link	Type	Maximum |Flow| CMS	Time of Max Occurrence days hr:min	Maximum |Veloc| m/sec	Max/ Full Flow	Max/ Full Depth
C1	CONDUIT	0.060	0 11:54	0.46	0.10	0.31
C10	CONDUIT	0.464	0 12:02	1.40	0.01	0.06
C100	CONDUIT	0.122	0 12:04	0.32	0.04	0.55
C101	CONDUIT	0.044	0 11:54	0.45	0.02	0.18
C102	CONDUIT	1.408	0 12:04	1.57	0.15	0.50
C103_1	CONDUIT	0.178	0 11:54	0.62	0.13	0.37
C103_2	CONDUIT	0.742	0 11:55	1.92	0.51	0.46
C104	CONDUIT	3.325	0 12:04	2.16	0.17	0.58
C105	CONDUIT	0.147	0 11:59	1.21	0.00	0.04
C106	CONDUIT	0.354	0 11:55	0.83	0.09	0.35
C107	CONDUIT	0.018	0 12:02	0.14	0.01	0.24
C108	CONDUIT	11.637	0 12:03	5.98	0.05	0.22
C109	CONDUIT	0.000	0 00:00	0.00	0.00	0.02
C11	CONDUIT	0.487	0 11:55	2.54	0.14	0.27
C110	CONDUIT	0.000	0 00:00	0.00	0.00	0.00
C111	CONDUIT	0.000	0 00:00	0.00	0.00	0.01
C112	CONDUIT	0.000	0 00:00	0.00	0.00	0.01
C113	CONDUIT	0.120	0 12:31	1.48	0.00	0.03
C114	CONDUIT	0.001	0 12:03	0.00	0.00	0.00
C115	CONDUIT	0.270	0 13:45	2.76	0.00	0.03
C116	CONDUIT	0.020	0 12:31	0.81	0.00	0.01
C117	CONDUIT	0.138	0 12:45	1.98	0.00	0.02
C118	CONDUIT	0.208	0 14:05	1.72	0.00	0.04

C119_1	CONDUIT	0.196	0	11:54	1.05	0.09	0.27
C119_2	CONDUIT	0.560	0	11:55	2.16	0.25	0.34
C12	CONDUIT	3.360	0	11:59	4.36	0.55	0.53
C12_1	CONDUIT	0.915	0	12:02	0.75	0.09	0.27
C12_2	CONDUIT	0.885	0	12:06	0.97	0.08	0.21
C120	CONDUIT	0.549	0	11:56	1.59	0.25	0.42
C121	CONDUIT	1.048	0	11:57	2.39	0.49	0.51
C122	CONDUIT	3.050	0	11:59	3.08	0.45	0.47
C122_1	CONDUIT	1.272	0	11:57	1.69	0.18	0.39
C122_2	CONDUIT	1.267	0	11:58	1.35	0.17	0.46
C123	CONDUIT	1.743	0	11:58	2.63	0.63	0.57
C124	CONDUIT	1.745	0	11:58	2.68	0.60	0.56
C125	CONDUIT	1.747	0	11:58	2.62	0.59	0.57
C126	CONDUIT	1.764	0	11:59	2.43	0.60	0.61
C127	CONDUIT	0.012	0	11:54	0.10	0.00	0.22
C128	CONDUIT	0.546	0	11:54	1.55	0.34	0.43
C129	CONDUIT	0.638	0	11:55	2.08	0.33	0.39
C13	CONDUIT	1.113	0	11:55	3.05	0.35	0.44
C130	CONDUIT	0.645	0	11:57	1.47	0.24	0.42
C131	CONDUIT	1.019	0	11:59	1.62	0.47	0.55
C132	CONDUIT	0.417	0	11:54	1.34	0.17	0.42
C133	CONDUIT	0.291	0	11:54	1.12	0.14	0.35
C134	CONDUIT	0.535	0	11:55	1.40	0.43	0.45
C135	CONDUIT	0.817	0	11:56	1.63	0.33	0.46
C136	CONDUIT	0.821	0	11:57	1.20	0.33	0.60
C137	CONDUIT	3.427	0	12:01	2.96	0.50	0.54
C138	CONDUIT	4.573	0	12:01	3.35	0.49	0.51
C139	CONDUIT	0.278	0	11:54	0.97	0.11	0.46
C14	CONDUIT	1.351	0	11:56	3.43	0.44	0.46
C140	CONDUIT	1.164	0	11:57	1.89	0.54	0.74
C141	CONDUIT	4.689	0	12:01	3.48	0.51	0.53
C142	CONDUIT	0.127	0	11:54	0.58	0.07	0.31
C143	CONDUIT	0.884	0	11:57	2.01	0.41	0.52
C144	CONDUIT	0.259	0	11:54	1.56	0.06	0.25
C145	CONDUIT	0.032	0	11:54	0.28	0.01	0.20
C146	CONDUIT	0.530	0	11:57	1.67	0.26	0.40
C147	CONDUIT	1.290	0	11:56	3.60	0.20	0.55
C148	CONDUIT	5.595	0	12:02	3.42	0.46	0.50
C149	CONDUIT	5.390	0	12:03	2.96	0.48	0.58
C15	CONDUIT	0.056	0	11:54	0.34	0.01	0.26

C150	CONDUIT	0.494	0	11:55	1.89	0.25	0.34
C151	CONDUIT	0.029	0	11:55	0.38	0.01	0.14
C152	CONDUIT	6.482	0	12:05	2.62	0.58	0.54
C153	CONDUIT	6.452	0	12:06	2.70	0.57	0.53
C154	CONDUIT	0.537	0	12:17	0.62	0.06	0.56
C155	CONDUIT	7.523	0	12:08	4.33	0.79	0.41
C156	CONDUIT	0.307	0	12:00	1.58	0.10	0.28
C157	CONDUIT	0.144	0	11:55	0.85	0.07	0.25
C158	CONDUIT	0.176	0	11:54	1.33	0.06	0.21
C159	CONDUIT	0.481	0	11:54	1.99	0.07	0.20
C16_1	CONDUIT	0.018	0	11:57	0.66	0.01	0.07
C160	CONDUIT	0.000	0	00:00	0.00	0.00	0.15
C161	CONDUIT	0.628	0	11:56	1.62	0.29	0.46
C162	CONDUIT	0.312	0	11:55	1.40	0.12	0.31
C163	CONDUIT	0.035	0	11:54	0.29	0.01	0.20
C164	CONDUIT	0.668	0	11:55	1.88	0.23	0.43
C165	CONDUIT	0.432	0	11:54	1.74	0.06	0.23
C166	CONDUIT	0.000	0	00:00	0.00	0.00	0.09
C167	CONDUIT	0.184	0	11:54	0.87	0.07	0.30
C168	CONDUIT	0.870	0	11:56	2.66	0.36	0.40
C169	CONDUIT	0.218	0	11:55	0.82	0.30	0.34
C17	CONDUIT	0.000	0	00:00	0.00	0.00	0.15
C170	CONDUIT	0.203	0	11:54	1.57	0.08	0.21
C171	CONDUIT	0.302	0	11:55	1.53	0.11	0.28
C172	CONDUIT	0.638	0	11:55	2.16	0.23	0.37
C173	CONDUIT	0.171	0	11:54	1.13	0.05	0.23
C174_1	CONDUIT	0.267	0	11:54	1.48	0.11	0.26
C174_2	CONDUIT	0.512	0	11:55	1.63	0.20	0.40
C175_1	CONDUIT	0.035	0	11:54	0.50	0.01	0.14
C175_2	CONDUIT	0.233	0	11:55	0.93	0.08	0.35
C176_1	CONDUIT	0.285	0	11:54	1.67	0.09	0.25
C177	CONDUIT	3.055	0	11:59	3.02	0.45	0.48
C178	CONDUIT	3.056	0	12:00	2.89	0.46	0.50
C179	CONDUIT	3.053	0	12:00	2.51	0.41	0.56
C18	CONDUIT	0.193	0	12:00	2.81	0.08	0.13
C18_2	CONDUIT	0.344	0	11:59	0.58	0.00	0.03
C182	CONDUIT	0.104	0	12:02	0.52	0.08	0.51
C183	CONDUIT	0.165	0	12:00	0.59	0.13	0.64
C184	CONDUIT	0.256	0	12:00	0.53	0.14	0.69
C185	CONDUIT	0.369	0	12:02	0.43	0.12	0.65

C186	CONDUIT	0.506	0	12:01	0.62	0.07	0.50
C19	CONDUIT	0.361	0	12:00	0.71	0.01	0.05
C2	CONDUIT	0.000	0	00:00	0.00	0.00	0.28
C20	CONDUIT	0.683	0	11:55	2.70	0.21	0.33
C21	CONDUIT	3.206	0	12:01	3.35	1.23	0.80
C21_1	CONDUIT	0.044	0	11:55	1.25	0.02	0.08
C21_2	CONDUIT	0.044	0	11:56	0.31	0.01	0.25
C217	CONDUIT	0.699	0	11:55	2.55	0.10	0.33
C22	CONDUIT	0.135	0	11:54	0.37	0.05	0.69
C227	CONDUIT	0.043	0	11:55	1.04	0.00	0.13
C23	CONDUIT	0.039	0	11:58	3.18	0.10	0.17
C235	CONDUIT	0.319	0	12:02	0.16	0.01	0.20
C236	CONDUIT	0.488	0	12:08	3.79	0.20	0.21
C237	CONDUIT	0.623	0	12:05	0.27	0.01	0.23
C238	CONDUIT	0.602	0	12:09	4.11	0.25	0.23
C239	CONDUIT	0.600	0	12:11	0.20	0.01	0.29
C24	CONDUIT	0.044	0	11:55	1.14	0.02	0.09
C240	CONDUIT	0.761	0	12:13	3.52	0.43	0.30
C241	CONDUIT	0.787	0	12:15	0.60	0.03	0.13
C242	CONDUIT	0.759	0	12:21	0.21	0.03	0.39
C243	CONDUIT	0.753	0	12:39	0.15	0.03	0.73
C244	CONDUIT	0.771	0	12:39	1.01	0.67	0.84
C245	CONDUIT	1.080	0	12:37	2.18	1.09	0.59
C246	CONDUIT	0.000	0	00:00	0.00	0.00	0.06
C247	CONDUIT	0.256	0	12:03	3.15	0.07	0.12
C248	CONDUIT	0.251	0	12:06	0.15	0.00	0.08
C249	CONDUIT	0.318	0	12:10	3.65	0.12	0.16
C25	CONDUIT	0.346	0	11:57	0.45	0.12	1.00
C250	CONDUIT	0.317	0	12:11	0.15	0.00	0.10
C251	CONDUIT	0.466	0	12:09	3.96	0.18	0.19
C252	CONDUIT	0.465	0	12:10	0.10	0.00	0.22
C256	CONDUIT	1.831	0	12:07	4.37	0.81	0.49
C257	CONDUIT	0.050	0	11:53	0.22	0.05	0.37
C258	CONDUIT	0.518	0	11:59	1.23	0.49	0.49
C259	CONDUIT	0.517	0	12:00	1.35	0.51	0.46
C26	CONDUIT	0.055	0	12:04	0.12	0.05	0.46
C260_1	CONDUIT	1.330	0	12:00	4.19	0.37	0.39
C260_2	CONDUIT	1.329	0	12:00	3.32	0.29	0.54
C261	CONDUIT	0.393	0	11:58	0.62	0.01	0.06
C262	CONDUIT	0.444	0	12:01	0.25	0.01	0.19

C263	CONDUIT	0.440	0	12:08	1.54	0.20	0.37
C264	CONDUIT	0.438	0	12:10	1.51	0.35	0.37
C265	CONDUIT	0.437	0	12:10	1.51	0.20	0.37
C266	CONDUIT	0.435	0	12:12	1.49	0.36	0.37
C267	CONDUIT	0.434	0	12:13	1.89	0.21	0.31
C268	CONDUIT	0.432	0	12:14	1.81	0.21	0.32
C269	CONDUIT	0.452	0	12:15	1.72	0.23	0.34
C27	CONDUIT	0.540	0	11:57	1.73	0.17	0.32
C270	CONDUIT	0.530	0	12:15	1.03	0.28	0.61
C271	CONDUIT	0.000	0	00:00	0.00	0.00	0.04
C272	CONDUIT	0.035	0	11:54	0.50	0.01	0.14
C273_1	CONDUIT	0.221	0	11:55	1.76	0.08	0.20
C273_2	CONDUIT	0.273	0	11:56	1.36	0.10	0.28
C274	CONDUIT	0.642	0	11:57	1.93	0.26	0.41
C275	CONDUIT	0.791	0	11:58	2.13	0.46	0.45
C276	CONDUIT	0.086	0	12:02	2.95	0.01	0.11
C277	CONDUIT	0.086	0	12:03	0.66	0.00	0.03
C278	CONDUIT	0.101	0	12:04	0.46	0.00	0.04
C28	CONDUIT	0.090	0	12:03	0.17	0.12	0.50
C283	CONDUIT	0.172	0	12:00	0.89	0.00	0.04
C284	CONDUIT	0.367	0	12:00	1.36	0.00	0.05
C285	CONDUIT	0.000	0	00:00	0.00	0.00	0.00
C286	CONDUIT	0.000	0	00:00	0.00	0.00	0.00
C287	CONDUIT	0.023	0	11:57	0.15	0.00	0.04
C288	CONDUIT	0.095	0	12:00	0.84	0.00	0.02
C29	CONDUIT	0.920	0	11:57	1.91	0.21	0.37
C293	CONDUIT	0.092	0	12:01	0.85	0.00	0.02
C294	CONDUIT	0.044	0	11:57	4.31	0.00	0.07
C295	CONDUIT	0.130	0	12:02	0.79	0.00	0.03
C296	CONDUIT	0.211	0	12:00	0.75	0.00	0.06
C297	CONDUIT	0.480	0	12:00	1.35	0.01	0.07
C3	CONDUIT	0.114	0	13:10	1.40	0.00	0.01
C30	CONDUIT	1.611	0	11:57	2.27	0.38	0.50
C302	CONDUIT	0.537	0	12:04	2.69	0.05	0.28
C306	CONDUIT	1.072	0	11:55	6.79	0.16	0.24
C31	CONDUIT	1.421	0	11:56	3.61	0.44	0.46
C310	CONDUIT	0.000	0	00:00	0.00	0.00	0.06
C311	CONDUIT	0.056	0	11:56	1.26	0.00	0.14
C32	CONDUIT	0.295	0	11:54	1.16	0.12	0.35
C33	CONDUIT	0.139	0	11:54	1.16	0.04	0.20

C34	CONDUIT	0.035	0	11:55	0.50	0.02	0.14
C35	CONDUIT	0.317	0	12:03	0.57	0.30	0.53
C36	CONDUIT	0.910	0	11:55	2.97	0.28	0.38
C37	CONDUIT	2.609	0	11:56	2.64	0.51	0.55
C38	CONDUIT	3.506	0	11:56	3.32	0.64	0.58
C39	CONDUIT	1.851	0	11:57	4.73	0.44	0.46
C4	CONDUIT	0.434	0	12:07	1.00	0.01	0.55
C41	CONDUIT	0.000	0	00:00	0.00	0.00	0.04
C42	CONDUIT	0.280	0	11:54	1.24	0.21	0.31
C43	CONDUIT	0.276	0	11:55	0.98	0.10	0.30
C44	CONDUIT	0.497	0	11:55	1.24	0.23	0.39
C45	CONDUIT	0.054	0	11:54	0.08	0.01	0.71
C46	CONDUIT	0.885	0	11:55	2.24	0.35	0.47
C47	CONDUIT	1.406	0	11:56	3.08	0.41	0.42
C48	CONDUIT	0.234	0	11:58	0.42	0.20	0.69
C49	CONDUIT	0.990	0	11:54	1.40	0.57	0.62
C5	CONDUIT	0.000	0	00:00	0.00	0.00	0.02
C50_1	CONDUIT	0.039	0	11:54	1.15	0.02	0.08
C50_2	CONDUIT	0.037	0	11:57	0.20	0.01	0.27
C51	CONDUIT	1.856	0	11:56	2.04	0.68	0.61
C52	CONDUIT	1.445	0	11:56	3.40	0.34	0.40
C53_1	CONDUIT	2.132	0	11:58	2.32	0.69	0.61
C53_2	CONDUIT	2.331	0	11:59	2.76	0.72	0.57
C54	CONDUIT	1.446	0	11:56	2.86	0.29	0.46
C55	CONDUIT	0.686	0	12:00	1.11	0.64	0.54
C56	CONDUIT	0.838	0	12:01	1.94	0.92	0.41
C57	CONDUIT	0.032	0	12:00	0.45	0.01	0.14
C58	CONDUIT	0.194	0	12:00	1.56	0.08	0.20
C6	CONDUIT	0.000	0	00:00	0.00	0.00	0.01
C62	CONDUIT	0.061	0	12:00	1.09	0.01	0.15
C63	CONDUIT	0.073	0	12:00	3.44	0.00	0.09
C64	CONDUIT	0.000	0	00:00	0.00	0.00	0.04
C65	CONDUIT	0.159	0	11:54	0.75	0.10	0.32
C66	CONDUIT	0.164	0	11:54	1.24	0.07	0.38
C67	CONDUIT	0.318	0	11:55	2.06	0.14	0.69
C68	CONDUIT	0.569	0	12:00	0.15	0.00	0.22
C69	CONDUIT	1.869	0	11:57	7.74	0.43	0.32
C69_1	CONDUIT	3.396	0	12:01	3.82	0.92	0.73
C69_2	CONDUIT	3.400	0	12:01	3.18	0.50	0.52
C7	CONDUIT	0.000	0	00:00	0.00	0.00	0.00

C70	CONDUIT	0.139	0	11:54	0.35	0.15	0.56
C71	CONDUIT	0.039	0	11:54	2.50	0.01	0.05
C71_1	CONDUIT	4.575	0	12:01	3.26	0.50	0.52
C71_2	CONDUIT	4.573	0	12:01	3.25	0.53	0.52
C72	CONDUIT	4.574	0	12:01	3.31	0.53	0.51
C73	CONDUIT	0.090	0	12:00	1.19	0.01	0.18
C74_1	CONDUIT	0.050	0	11:56	1.34	0.00	0.13
C74_2	CONDUIT	0.045	0	12:01	0.82	0.00	0.17
C75	CONDUIT	0.018	0	12:00	0.08	0.00	0.04
C76	CONDUIT	0.015	0	11:59	0.60	0.00	0.10
C77	CONDUIT	1.447	0	11:57	2.38	0.47	0.53
C78	CONDUIT	0.398	0	11:54	0.82	0.58	0.61
C79	CONDUIT	0.536	0	12:00	1.46	0.01	0.07
C8	CONDUIT	2.399	0	12:06	2.99	0.05	0.21
C80	CONDUIT	0.547	0	12:01	0.47	0.01	0.21
C81	CONDUIT	0.016	0	11:54	0.52	0.01	0.08
C82	CONDUIT	0.000	0	00:00	0.00	0.00	0.03
C83	CONDUIT	0.045	0	11:54	0.91	0.03	0.11
C83_1	CONDUIT	6.535	0	11:58	2.79	0.05	0.26
C83_2	CONDUIT	6.526	0	11:59	2.94	0.08	0.25
C84	CONDUIT	6.443	0	12:08	2.47	0.16	0.29
C85	CONDUIT	0.885	0	12:06	1.63	0.03	0.16
C86	CONDUIT	0.295	0	11:54	0.80	0.29	0.53
C87	CONDUIT	2.945	0	11:57	4.11	0.05	0.20
C88	CONDUIT	6.762	0	12:03	3.29	0.68	0.61
C89	CONDUIT	6.426	0	12:04	2.71	0.48	0.52
C9	CONDUIT	0.142	0	12:03	1.17	0.00	0.04
C90	CONDUIT	2.027	0	11:58	1.62	0.26	0.49
C91	CONDUIT	5.626	0	11:58	3.74	0.63	0.57
C92	CONDUIT	1.577	0	11:57	2.43	0.56	0.56
C93	CONDUIT	1.729	0	11:58	2.59	0.64	0.57
C94	CONDUIT	1.293	0	11:57	2.41	0.57	0.59
C95	CONDUIT	1.945	0	11:57	2.55	0.50	0.53
C96	CONDUIT	3.590	0	11:57	2.65	0.39	0.53
C97	CONDUIT	6.203	0	11:58	6.29	0.62	0.41
C98	CONDUIT	1.730	0	11:58	2.60	0.59	0.57
C99_1	CONDUIT	0.028	0	11:54	1.06	0.01	0.07
C99_2	CONDUIT	0.026	0	11:57	0.45	0.01	0.25
OR1	ORIFICE	0.113	0	13:00		1.00	
OR10	ORIFICE	0.001	0	12:00		0.28	

OR11	ORIFICE	0.076	0	14:04	1.00
OR12	ORIFICE	0.000	0	00:00	
OR13	ORIFICE	0.101	0	13:45	1.00
OR14	ORIFICE	0.169	0	13:45	1.00
OR15	ORIFICE	0.000	0	00:00	
OR16	ORIFICE	0.020	0	12:30	1.00
OR17	ORIFICE	0.000	0	00:00	0.00
OR18	ORIFICE	0.000	0	00:00	
OR19	ORIFICE	0.049	0	12:45	1.00
OR2	ORIFICE	0.098	0	13:00	1.00
OR20	ORIFICE	0.061	0	12:45	1.00
OR21	ORIFICE	0.000	0	00:00	
OR22	ORIFICE	0.128	0	14:04	1.00
OR23	ORIFICE	0.005	0	14:04	0.15
OR24	ORIFICE	0.000	0	00:00	
OR25	ORIFICE	0.065	0	13:00	0.87
OR26	ORIFICE	0.061	0	13:09	1.00
OR3	ORIFICE	0.000	0	00:00	
OR4	ORIFICE	0.054	0	13:09	1.00
OR5	ORIFICE	0.028	0	12:45	1.00
OR6	ORIFICE	0.000	0	00:00	
OR7	ORIFICE	0.054	0	12:31	1.00
OR8	ORIFICE	0.066	0	12:31	1.00
OR9	ORIFICE	0.000	0	00:00	

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Flow Classification Summary

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	Adjusted	---------- Fraction of Time in Flow Class ----------								
	/Actual	Up	Down	Sub	Sup	Up	Down	Norm	Inlet	
Conduit	Length	Dry	Dry	Dry	Crit	Crit	Crit	Crit	Ltd	Ctrl
C1	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.90	0.00
C10	1.00	0.01	0.00	0.00	0.02	0.97	0.00	0.00	0.21	0.00
C100	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.99	0.00
C101	1.00	0.00	0.03	0.00	0.97	0.00	0.00	0.00	1.00	0.00
C102	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.99	0.00
C103_1	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	1.00	0.00
C103_2	1.00	0.00	0.00	0.00	0.94	0.06	0.00	0.00	0.00	0.00

C104	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.99	0.00
C105	1.00	0.00	0.00	0.00	0.23	0.77	0.00	0.00	0.15	0.00
C106	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	1.00	0.00
C107	1.00	0.00	0.31	0.00	0.69	0.00	0.00	0.00	1.00	0.00
C108	1.00	0.01	0.00	0.00	0.00	0.99	0.00	0.00	0.31	0.00
C109	1.00	0.12	0.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C11	1.00	0.00	0.00	0.00	0.47	0.53	0.00	0.00	1.00	0.00
C110	1.00	0.27	0.73	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C111	1.00	0.13	0.87	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C112	1.00	0.19	0.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C113	1.00	0.19	0.00	0.00	0.00	0.80	0.00	0.00	0.16	0.00
C114	1.00	0.27	0.00	0.00	0.30	0.43	0.00	0.00	0.07	0.00
C115	1.00	0.12	0.00	0.00	0.00	0.88	0.00	0.00	0.00	0.00
C116	1.00	0.22	0.00	0.00	0.00	0.78	0.00	0.00	0.12	0.00
C117	1.00	0.24	0.00	0.00	0.00	0.76	0.00	0.00	0.00	0.00
C118	1.00	0.25	0.00	0.00	0.00	0.75	0.00	0.00	0.00	0.00
C119_1	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	1.00	0.00
C119_2	1.00	0.00	0.00	0.00	0.53	0.47	0.00	0.00	0.93	0.00
C12	1.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.11	0.00
C12_1	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.94	0.00
C12_2	1.00	0.01	0.08	0.00	0.91	0.00	0.00	0.00	0.00	0.00
C120	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	1.00	0.00
C121	1.00	0.00	0.00	0.00	0.52	0.47	0.00	0.00	0.22	0.00
C122	1.00	0.00	0.00	0.00	0.50	0.50	0.00	0.00	0.40	0.00
C122_1	1.00	0.00	0.00	0.00	0.75	0.25	0.00	0.00	0.40	0.00
C122_2	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.57	0.00
C123	1.00	0.00	0.00	0.00	0.56	0.44	0.00	0.00	0.08	0.00
C124	1.00	0.00	0.00	0.00	0.54	0.46	0.00	0.00	0.12	0.00
C125	1.00	0.00	0.00	0.00	0.54	0.46	0.00	0.00	0.90	0.00
C126	1.00	0.00	0.00	0.00	0.96	0.03	0.00	0.00	0.99	0.00
C127	1.00	0.00	0.18	0.00	0.82	0.00	0.00	0.00	1.00	0.00
C128	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.98	0.00
C129	1.00	0.00	0.00	0.00	0.85	0.15	0.00	0.00	0.51	0.00
C13	1.00	0.00	0.00	0.00	0.43	0.57	0.00	0.00	1.00	0.00
C130	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	1.00	0.00
C131	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.98	0.00
C132	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.99	0.00
C133	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.99	0.00
C134	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.53	0.00
C135	1.00	0.00	0.00	0.00	0.97	0.02	0.00	0.00	0.20	0.00

C136	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.99	0.00
C137	1.00	0.00	0.00	0.00	0.09	0.91	0.00	0.00	0.48	0.00
C138	1.00	0.00	0.00	0.00	0.05	0.95	0.00	0.00	0.87	0.00
C139	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	1.00	0.00
C14	1.00	0.00	0.00	0.00	0.40	0.60	0.00	0.00	0.18	0.00
C140	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.98	0.00
C141	1.00	0.00	0.00	0.00	0.05	0.95	0.00	0.00	0.48	0.00
C142	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	1.00	0.00
C143	1.00	0.00	0.00	0.00	0.85	0.15	0.00	0.00	0.99	0.00
C144	1.00	0.00	0.00	0.00	0.98	0.02	0.00	0.00	1.00	0.00
C145	1.00	0.00	0.13	0.00	0.87	0.00	0.00	0.00	1.00	0.00
C146	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	1.00	0.00
C147	1.00	0.00	0.00	0.00	0.30	0.69	0.00	0.00	0.01	0.00
C148	1.00	0.00	0.00	0.00	0.14	0.86	0.00	0.00	0.95	0.00
C149	1.00	0.00	0.00	0.00	0.68	0.32	0.00	0.00	0.98	0.00
C15	1.00	0.00	0.11	0.00	0.89	0.00	0.00	0.00	1.00	0.00
C150	1.00	0.00	0.00	0.00	0.87	0.13	0.00	0.00	0.51	0.00
C151	1.00	0.00	0.08	0.00	0.92	0.00	0.00	0.00	1.00	0.00
C152	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.46	0.00
C153	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.63	0.00
C154	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.99	0.00
C155	1.00	0.00	0.00	0.00	0.50	0.50	0.00	0.00	0.00	0.00
C156	1.00	0.00	0.00	0.00	0.91	0.09	0.00	0.00	1.00	0.00
C157	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	1.00	0.00
C158	1.00	0.00	0.00	0.00	0.99	0.01	0.00	0.00	1.00	0.00
C159	1.00	0.00	0.00	0.00	0.56	0.44	0.00	0.00	1.00	0.00
C16_1	1.00	0.00	0.10	0.00	0.89	0.00	0.00	0.00	1.00	0.00
C160	1.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C161	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.99	0.00
C162	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	1.00	0.00
C163	1.00	0.00	0.15	0.00	0.84	0.00	0.00	0.00	1.00	0.00
C164	1.00	0.00	0.00	0.00	0.99	0.01	0.00	0.00	1.00	0.00
C165	1.00	0.00	0.00	0.00	0.96	0.04	0.00	0.00	1.00	0.00
C166	1.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C167	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	1.00	0.00
C168	1.00	0.00	0.00	0.00	0.47	0.53	0.00	0.00	0.20	0.00
C169	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.45	0.00
C17	1.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C170	1.00	0.00	0.00	0.00	0.94	0.06	0.00	0.00	0.98	0.00
C171	1.00	0.00	0.00	0.00	0.97	0.03	0.00	0.00	1.00	0.00

C172	1.00	0.00	0.00	0.00	0.51	0.49	0.00	0.00	0.99	0.00
C173	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	1.00	0.00
C174_1	1.00	0.00	0.00	0.00	0.99	0.01	0.00	0.00	1.00	0.00
C174_2	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.99	0.00
C175_1	1.00	0.00	0.02	0.00	0.98	0.00	0.00	0.00	1.00	0.00
C175_2	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	1.00	0.00
C176_1	1.00	0.00	0.00	0.00	0.80	0.20	0.00	0.00	1.00	0.00
C177	1.00	0.00	0.00	0.00	0.53	0.47	0.00	0.00	0.94	0.00
C178	1.00	0.00	0.00	0.00	0.49	0.51	0.00	0.00	0.02	0.00
C179	1.00	0.00	0.00	0.00	0.99	0.01	0.00	0.00	0.97	0.00
C18	1.00	0.00	0.00	0.00	0.39	0.61	0.00	0.00	0.00	0.00
C18_2	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.96	0.00
C182	1.00	0.00	0.97	0.00	0.03	0.00	0.00	0.00	0.74	0.00
C183	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.09	0.00
C184	1.00	0.00	0.20	0.00	0.80	0.00	0.00	0.00	0.97	0.00
C185	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.07	0.00
C186	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.11	0.00
C19	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.00	0.78	0.00
C2	1.00	0.07	0.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C20	1.00	0.00	0.00	0.00	0.45	0.55	0.00	0.00	1.00	0.00
C21	1.00	0.00	0.00	0.00	0.06	0.94	0.00	0.00	0.38	0.00
C21_1	1.00	0.00	0.00	0.00	0.57	0.43	0.00	0.00	0.13	0.00
C21_2	1.00	0.00	0.11	0.00	0.88	0.01	0.00	0.00	0.98	0.00
C217	1.00	0.00	0.00	0.00	0.48	0.52	0.00	0.00	0.01	0.00
C22	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.97	0.00
C227	1.00	0.00	0.00	0.00	0.96	0.04	0.00	0.00	0.93	0.00
C23	1.00	0.00	0.00	0.00	0.28	0.72	0.00	0.00	0.26	0.00
C235	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.99	0.00
C236	1.00	0.00	0.00	0.00	0.06	0.94	0.00	0.00	0.02	0.00
C237	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.97	0.00
C238	1.00	0.00	0.00	0.00	0.05	0.95	0.00	0.00	0.00	0.00
C239	1.00	0.00	0.04	0.00	0.96	0.00	0.00	0.00	0.96	0.00
C24	1.00	0.00	0.01	0.00	0.71	0.28	0.00	0.00	0.30	0.00
C240	1.00	0.00	0.00	0.00	0.06	0.94	0.00	0.00	0.00	0.00
C241	1.00	0.01	0.03	0.00	0.96	0.00	0.00	0.00	0.89	0.00
C242	1.00	0.00	0.01	0.00	0.99	0.00	0.00	0.00	0.99	0.00
C243	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.78	0.00
C244	1.00	0.00	0.02	0.00	0.98	0.00	0.00	0.00	0.59	0.00
C245	1.00	0.00	0.01	0.00	0.98	0.01	0.00	0.00	0.07	0.00
C246	1.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

C247	1.00	0.00	0.00	0.00	0.10	0.90	0.00	0.00	0.00	0.00
C248	1.00	0.00	0.03	0.00	0.97	0.00	0.00	0.00	0.97	0.00
C249	1.00	0.00	0.00	0.00	0.05	0.95	0.00	0.00	0.00	0.00
C25	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.03	0.00
C250	1.00	0.00	0.03	0.00	0.97	0.00	0.00	0.00	0.97	0.00
C251	1.00	0.00	0.00	0.00	0.03	0.97	0.00	0.00	0.00	0.00
C252	1.00	0.00	0.02	0.00	0.98	0.00	0.00	0.00	0.98	0.00
C256	1.00	0.00	0.00	0.00	0.03	0.97	0.00	0.00	0.01	0.00
C257	1.00	0.00	0.88	0.00	0.12	0.00	0.00	0.00	0.75	0.00
C258	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.97	0.00
C259	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
C26	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.87	0.00
C260_1	1.00	0.00	0.00	0.00	0.26	0.74	0.00	0.00	0.05	0.00
C260_2	1.00	0.00	0.00	0.00	0.84	0.16	0.00	0.00	0.94	0.00
C261	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.90	0.00
C262	1.00	0.00	0.01	0.00	0.99	0.00	0.00	0.00	0.99	0.00
C263	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.98	0.00
C264	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.00	0.00
C265	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.98	0.00
C266	1.00	0.01	0.00	0.00	0.99	0.00	0.00	0.00	0.00	0.00
C267	1.00	0.02	0.00	0.00	0.58	0.41	0.00	0.00	0.85	0.00
C268	1.00	0.00	0.02	0.00	0.86	0.13	0.00	0.00	0.98	0.00
C269	1.00	0.00	0.00	0.00	0.97	0.03	0.00	0.00	1.00	0.00
C27	1.00	0.00	0.00	0.00	0.97	0.02	0.00	0.00	0.99	0.00
C270	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	1.00	0.00
C271	1.00	0.08	0.92	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C272	1.00	0.00	0.08	0.00	0.92	0.00	0.00	0.00	1.00	0.00
C273_1	1.00	0.00	0.00	0.00	0.55	0.45	0.00	0.00	1.00	0.00
C273_2	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	1.00	0.00
C274	1.00	0.00	0.00	0.00	0.95	0.05	0.00	0.00	1.00	0.00
C275	1.00	0.00	0.00	0.00	0.87	0.13	0.00	0.00	0.01	0.00
C276	1.00	0.01	0.00	0.00	0.16	0.83	0.00	0.00	0.01	0.00
C277	1.00	0.00	0.06	0.00	0.91	0.03	0.00	0.00	0.94	0.00
C278	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.98	0.00
C28	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.54	0.00
C283	1.00	0.00	0.00	0.00	0.73	0.26	0.00	0.00	1.00	0.00
C284	1.00	0.00	0.00	0.00	0.50	0.50	0.00	0.00	0.95	0.00
C285	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C286	1.00	0.18	0.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C287	1.00	0.00	0.17	0.00	0.82	0.00	0.00	0.00	0.98	0.00

C288	1.00	0.00	0.01	0.00	0.49	0.50	0.00	0.00	0.00	0.00
C29	1.00	0.00	0.00	0.00	0.99	0.01	0.00	0.00	1.00	0.00
C293	1.00	0.00	0.00	0.00	0.47	0.53	0.00	0.00	0.99	0.00
C294	1.00	0.00	0.00	0.00	0.35	0.65	0.00	0.00	0.32	0.00
C295	1.00	0.00	0.01	0.00	0.90	0.09	0.00	0.00	0.99	0.00
C296	1.00	0.00	0.00	0.00	0.99	0.01	0.00	0.00	0.98	0.00
C297	1.00	0.00	0.00	0.00	0.54	0.45	0.00	0.00	0.91	0.00
C3	1.00	0.13	0.00	0.00	0.00	0.87	0.00	0.00	0.09	0.00
C30	1.00	0.00	0.00	0.00	0.97	0.03	0.00	0.00	0.99	0.00
C302	1.00	0.00	0.00	0.00	0.04	0.96	0.00	0.00	0.00	0.00
C306	1.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00
C31	1.00	0.00	0.00	0.00	0.39	0.61	0.00	0.00	0.93	0.00
C310	1.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C311	1.00	0.00	0.00	0.00	0.54	0.46	0.00	0.00	0.98	0.00
C32	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.99	0.00
C33	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	1.00	0.00
C34	1.00	0.00	0.02	0.00	0.98	0.00	0.00	0.00	1.00	0.00
C35	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.71	0.00
C36	1.00	0.00	0.00	0.00	0.43	0.57	0.00	0.00	0.99	0.00
C37	1.00	0.00	0.00	0.00	0.84	0.16	0.00	0.00	0.99	0.00
C38	1.00	0.00	0.00	0.00	0.45	0.54	0.00	0.00	0.01	0.00
C39	1.00	0.00	0.00	0.00	0.31	0.69	0.00	0.00	0.98	0.00
C4	1.00	0.07	0.00	0.00	0.01	0.00	0.00	0.91	0.00	0.00
C41	1.00	0.02	0.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C42	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
C43	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.98	0.00
C44	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.98	0.00
C45	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.05	0.00
C46	1.00	0.00	0.00	0.00	0.67	0.33	0.00	0.00	0.99	0.00
C47	1.00	0.00	0.00	0.00	0.45	0.55	0.00	0.00	0.03	0.00
C48	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.97	0.00
C49	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.98	0.00
C5	1.00	0.25	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C50_1	1.00	0.00	0.00	0.00	0.70	0.30	0.00	0.00	0.03	0.00
C50_2	1.00	0.00	0.09	0.00	0.91	0.00	0.00	0.00	1.00	0.00
C51	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.92	0.00
C52	1.00	0.00	0.00	0.00	0.40	0.60	0.00	0.00	0.01	0.00
C53_1	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.97	0.00
C53_2	1.00	0.00	0.00	0.00	0.67	0.33	0.00	0.00	0.43	0.00
C54	1.00	0.00	0.00	0.00	0.44	0.56	0.00	0.00	0.98	0.00

C55	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.52	0.00
C56	1.00	0.00	0.00	0.00	0.99	0.01	0.00	0.00	0.00	0.00
C57	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	1.00	0.00
C58	1.00	0.00	0.00	0.00	0.94	0.05	0.00	0.00	0.99	0.00
C6	1.00	0.24	0.76	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C62	1.00	0.00	0.00	0.00	0.93	0.07	0.00	0.00	0.97	0.00
C63	1.00	0.00	0.00	0.00	0.27	0.73	0.00	0.00	0.23	0.00
C64	1.00	0.09	0.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C65	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.94	0.00
C66	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	1.00	0.00
C67	1.00	0.00	0.00	0.00	0.52	0.48	0.00	0.00	0.47	0.00
C68	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.99	0.00
C69	1.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00
C69_1	1.00	0.00	0.00	0.00	0.01	0.99	0.00	0.00	0.58	0.00
C69_2	1.00	0.00	0.00	0.00	0.03	0.96	0.00	0.00	0.58	0.00
C7	1.00	0.22	0.78	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C70	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.65	0.00
C71	1.00	0.00	0.00	0.00	0.38	0.62	0.00	0.00	0.44	0.00
C71_1	1.00	0.00	0.00	0.00	0.17	0.83	0.00	0.00	0.56	0.00
C71_2	1.00	0.00	0.00	0.00	0.25	0.75	0.00	0.00	0.60	0.00
C72	1.00	0.00	0.00	0.00	0.16	0.84	0.00	0.00	0.04	0.00
C73	1.00	0.00	0.00	0.00	0.95	0.05	0.00	0.00	0.97	0.00
C74_1	1.00	0.00	0.00	0.00	0.57	0.43	0.00	0.00	0.95	0.00
C74_2	1.00	0.00	0.00	0.00	0.61	0.39	0.00	0.00	0.56	0.00
C75	1.00	0.00	0.06	0.00	0.94	0.00	0.00	0.00	0.97	0.00
C76	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.99	0.00
C77	1.00	0.00	0.00	0.00	0.57	0.43	0.00	0.00	0.90	0.00
C78	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.73	0.00
C79	1.00	0.00	0.00	0.00	0.49	0.51	0.00	0.00	0.91	0.00
C8	1.00	0.00	0.00	0.00	0.01	0.99	0.00	0.00	0.45	0.00
C80	1.00	0.00	0.02	0.00	0.98	0.00	0.00	0.00	0.98	0.00
C81	1.00	0.00	0.09	0.00	0.91	0.00	0.00	0.00	1.00	0.00
C82	1.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C83	1.00	0.00	0.00	0.00	0.99	0.01	0.00	0.00	0.00	0.00
C83_1	1.00	0.00	0.00	0.00	0.59	0.41	0.00	0.00	0.98	0.00
C83_2	1.00	0.00	0.00	0.00	0.96	0.03	0.00	0.00	0.75	0.00
C84	1.00	0.00	0.00	0.00	0.99	0.01	0.00	0.00	0.02	0.00
C85	1.00	0.09	0.00	0.00	0.67	0.24	0.00	0.00	0.11	0.00
C86	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.96	0.00
C87	1.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.11	0.00

C88	1.00	0.00	0.00	0.00	0.71	0.29	0.00	0.00	0.87	0.00
C89	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.98	0.00
C9	1.00	0.00	0.00	0.00	0.01	0.98	0.00	0.00	0.14	0.00
C90	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.99	0.00
C91	1.00	0.00	0.00	0.00	0.56	0.44	0.00	0.00	0.99	0.00
C92	1.00	0.00	0.00	0.00	0.81	0.19	0.00	0.00	0.99	0.00
C93	1.00	0.00	0.00	0.00	0.56	0.44	0.00	0.00	0.21	0.00
C94	1.00	0.00	0.00	0.00	0.84	0.16	0.00	0.00	0.99	0.00
C95	1.00	0.00	0.00	0.00	0.51	0.49	0.00	0.00	0.06	0.00
C96	1.00	0.00	0.00	0.00	0.85	0.15	0.00	0.00	0.98	0.00
C97	1.00	0.00	0.00	0.00	0.26	0.74	0.00	0.00	0.01	0.00
C98	1.00	0.00	0.00	0.00	0.56	0.44	0.00	0.00	0.93	0.00
C99_1	1.00	0.00	0.00	0.00	0.84	0.16	0.00	0.00	0.68	0.00
C99_2	1.00	0.00	0.05	0.00	0.95	0.00	0.00	0.00	0.97	0.00

Analysis begun on: Mon Aug 12 08:46:15 2024

Analysis ended on: Mon Aug 12 08:46:39 2024

Total elapsed time: 00:00:24

ANNEXURE 11: WILDLIFE HAZARD MANAGEMENT PLAN (incl. Birds)

(This will be a condition of approval if Environmental Authorisation is obtained)

Cape Winelands Airport

Bird and Wildlife Hazard Management

Landscape and Open Space Planning Guidelines

Albert Froneman

February 2024

Background & motivation

Bird and wildlife management on an aerodrome is a critical part of the airport safety management system and an integrated approach is required to adequately address this risk. The purpose of this document is to provide guidance for the pro-active management of bird and wildlife hazards through landscape and open space planning.

The Cape Winelands Airport is located within the Fynbos Biome. The primary vegetation type classification of the aerodrome site is the critically endangered Swartland Granite Renosterveld. Almost 80% of this vegetation type has been transformed as a result of agriculture and urban sprawl.

Fynbos vegetation typically has low animal biomass but very high levels of plan diversity and endemism. In its natural state fynbos vegetation does not support many large bird species that would pose a bird strike risk to aircraft. Most of the larger bird species that at present occur in large numbers (e.g. Egyptian Geese) within the fynbos biome have established and proliferated in the area as a result of agriculture (e.g. grassland type habitats) and the associated establishment of farm dams and other artificial water reservoirs.

As a general rule aerodromes typically establish grasslands on the airfield around the runways, taxiways and outer airfield. Grass is well suited for this purpose as it binds the soil and can easily be maintained, through regular mowing, at a short height.

The short grass habitat that is created and artificially maintained is a significant attractant for hazardous bird species. In the case of the Cape Winelands Airport the sandy soils and low rainfall during the hot dry summer months will make if exceptionally challenging to successfully maintain a dense growth of grass that will bind the soil. Vast open grassland habitats are not native to the western cape. Many or most of the bird species, with a potential high-risk classification for bird strikes with aircraft, that occur in the area (e.g. Egyptian Geese, Spur-winged Geese, Lapwings, Black-headed Herons and Hadada Ibises) are present in unnaturally high numbers as a result of grassland habitats created through agriculture and urbanisation. In addition, every time the grass is cut to maintain it at a short height it creates a significant disturbance event that attracts birds to the area to feed on invertebrates etc. The windrows of cut grass left behind following the grass cutting event also provide ideal micro habitats where invertebrates can proliferate and even rodents can hide under the dense grass mats.

A unique opportunity thus exists where natural fynbos vegetation could be established in stead of the typical grass and in so doing minimise (or to a large degree eliminate) the bird strike risk. Establishing natural renosterveld and fynbos could also contribute towards the conservation of a critically endangered vegetation type. If short growing renosterveld and fynbos species are selected and cultivated for this purpose maintenance costs (i.e. grass cutting) can be eliminated or at least greatly reduced.

The below table provides an overview of the different aerodrome landscapes and open spaces and provides guidance from a bird and wildlife management perspective.

Airport development area	Vegetation description	Motivation	Implementation & establishment	Management	Other considerations
Airside					
Airside – RWY strip (50m) & TWY strip (23m)	Short growing indigenous fynbos / renosterveld vegetation - 20cm maximum height	Offset initial cost through reduced maintenance over time.	Would need specialist guidance on soil preparation, species composition, cultivation of seedlings(?) and establishment planting of plugs etc? Uncertain about how long establishment would take / weed control etc.	As little as possible if the right vegetation has been established – may require annual or bi-annual 'trim' in case some elements grow a bit too tall. Will the fynbos need to burn every few years? i.e. burning regime requirement if any?	Establish a track for use by patrol vehicles on the edge of the short grass section around the runway that delineates the boundary between the runway strip and the rest of the airfield. Initial dust suppression during and post initial establishment.
Outer airfield – remainder of airfield vegetated area	Shorter growing fynbos vegetation - vegetation species composition can include some slightly taller growing species - not more than 40-50cm maximum.	Offset initial cost through reduced maintenance over time.	Would need specialist guidance on soil preparation, species composition, cultivation of seedlings(?) and establishment planting of plugs etc? Uncertain about how long establishment would take / weed control etc.	Annual or by annual trimming. Burning requirement -frequency.	Establish a 2m underground mole barrier fence around the outer perimeter.

Airport development area	Vegetation description	Motivation	Implementation & establishment	Management	Other considerations
Airport precinct – landside and tenant areas					
Airport landside precinct gardens and tenant garden areas	Follow the same theme of natural fynbos gardens throughout. No lawns! Do not establish any ponds or water features.	Drastic saving in terms of irrigation costs as most indigenous fynbos species is quite drought resistant.	Options should be more readily available through existing garden and landscaping service providers.	General garden maintenance – no grass cutting or mowing	
Stormwater retention ponds	Anything else than grass to cover the base of the stormwater retention ponds. Shorter wetland type fynbos and restios perhaps. Vegetation should not hinder quick drainage of the area. Any water that stands for long will become an attractant for birds	Retention of storm water should not create suitable habitat for birds. The areas should drain fairly rapidly and no residual wetland habitat should remain.			
Other open areas on land owned by CWA	Eliminate any agricultural or cultivation activities	Agricultural and cultivation activities will attract numerous large			

	on land owned or managed by CWA	hazardous birds to the area.			
Waste management				All waste skips should be covered at all time and waste storage facilities should all be under roofed and closed off.	

Airport development area	Vegetation description	Motivation	Implementation & establishment	Management	Other considerations
Off-airport habitats and considerations					
Existing water bodies on site and in immediate surrounds	Specific waterbodies or dams in the landscape are known to attract large numbers of waterbirds. Increase edge depth, remove shallow edges, establish dense typha or phragmites stands along the edge of the water. Remove all islands and eliminate dry tress that would provide roosting and perching space for the birds.	Minimise the attractiveness of existing water bodies to birds and have them move to alternate areas away from risk zones.	Challenges of changing existing dams and water bodies on private land?	Maintain vegetation along edges and monitor that shallow areas or islands don't form again over time.	Permits to do this?
Wastewater treatment works (WWTW)	Maintain status quo – short vegetation around evaporation ponds.	Few waterbirds were present during site visit.		Regular monitoring required.	Future expansion should maintain similar design.

ANNEXURE 12: EMERGENCY PREPAREDNESS AND RESPONSE PLAN

(This will be a condition of approval if Environmental Authorisation is obtained)

ANNEXURE 13: ARCHITECTURAL DESIGN GUIDELINES

ARCHITECTURAL DESIGN GUIDELINES FOR THE CAPE WINELANDS AIRPORT DEVELOPMENT.

Introduction:

In the pursuit of creating an exceptional and harmonious airport complex, this document outlines comprehensive architectural design guidelines. Envisioned to encompass various facilities catering to a diverse range of needs, from terminal buildings and commercial spaces including hotels and retail establishments, to passenger services like car hire facilities, this development strives for excellence in every aspect.

The airport complex is not only set to serve as a functional hub for travellers but also to establish a vibrant community centre. With a focus on holistic planning, the complex will boast a large public plaza and well-landscaped areas, fostering an environment where aesthetics and functionality intertwine seamlessly. Moreover, recognizing the diverse requirements of modern aviation, this complex will incorporate vital elements such as general aviation facilities, aircraft storage and maintenance hangars, and the full spectrum of support buildings necessary for accommodating aircraft as substantial as the A380.

An integrated approach extends to logistics and commerce, as warehousing and logistics facilities coexist alongside commercial office buildings. The holistic vision of this airport development aligns modernity with sustainability, embraces the local identity, and strives to be a pinnacle of architectural and functional achievement.

Design Principles:

1. Modern Aesthetics: All structures within the complex should embody a contemporary design language that harmonizes innovation with timeless allure.

2. Engaging Public Areas: Spaces that interface with the public, like walkways and plazas, should embrace "active boundaries," cultivating interactive and inviting environments.

3. Innovative Roofscape: Recognize rooftops as an integral fifth facet, offering a canvas to infuse creativity into the design, generating an extraordinary visual impact.

4. Functional Colonnades: For structures facing the public, incorporate colonnades to provide shelter from the elements. Extending roof eaves can further heighten weather protection, drawing inspiration from successful past examples.

5. Abundant Landscaping: Seamlessly intertwine landscaping with the areas encircling buildings, weaving in greenery, pathways, and water features to enhance both visual charm and user **experience.**

6. Local Material Palette: Incorporate finishes and materials that pay homage to the local context. Integrate elements like timber and stone cladding to establish a robust link with the region's distinctive identity.

7. Elevating Traditional Elements: Employ inventive design solutions to elevate the visual and utilitarian facets of buildings that employ conventional industrial construction methods.

8. Harmonious Signage: Adhere to the complex's signage guidelines for any building signs, including tenant logos, ensuring uniformity and visual cohesion throughout the compound.

9. Enhanced Road Infrastructure and Landscaping for a People-Centric Environment:

- 9.1 Pedestrian Walkways and Pathways: Craft pedestrian pathways that are secure, well-illuminated, and seamlessly interconnected throughout the complex.
- 9.2 Bicycle Facilities: Integrate designated bicycle lanes and parking zones to encourage sustainable transportation alternatives for travellers and staff.
- 9.3 Landscape-Enhanced Corridors: Ensure roadways are meticulously landscaped with verdant elements and visual motifs that heighten aesthetics, fostering a delightful ambiance.

10. Sustainable Inclusions:

- 10.1 Eco-Friendly Design: Incorporate sustainable design practices, including energy-efficient systems, renewable materials, and optimal use of natural light and ventilation.

- 10.2 Water Management: Implement water-saving technologies, such as rainwater harvesting and efficient irrigation systems, to minimize water consumption and promote responsible water use.

- 10.3 Energy Efficiency: Integrate energy-efficient lighting, HVAC systems, and appliances throughout the complex to reduce energy consumption and lower the environmental impact.

- 10.4 Green Building Certification: Strive for recognized green building certifications to ensure the complex meets rigorous sustainability standards and contributes positively to the environment.

- 10.5 Waste Reduction: Implement waste reduction and recycling programs to minimize the **generation of waste and encourage responsible disposal practices.**

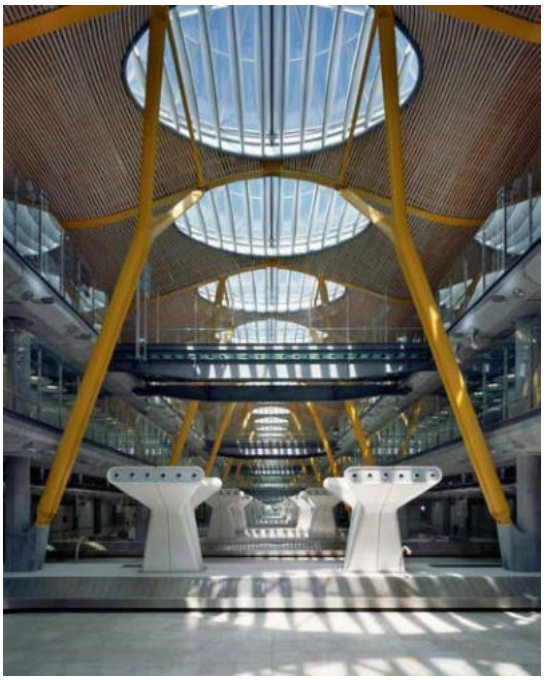
11. Architectural Precedents (Annexure A): A collection of carefully curated architectural precedents will serve as invaluable sources of inspiration and guidance throughout the design process, aiding in creating a unique and forward-looking airport complex that integrates seamlessly with the surrounding environment.

12. Height Guidelines (Annexure B): Refer to Annexure B for detailed height guidelines that provide clarity on the permissible building heights within the airport complex, ensuring visual harmony and effective space utilization.

Conclusion: These comprehensive architectural directives operate as a navigational chart for shaping a contemporary airport complex that reconciles inventive design, pragmatic functionality, sustainable practices, and local integration. By embracing these guiding principles, the airport's development can forge a united and captivating setting that caters to travellers, visitors, and the local community while exalting the very essence of the region's identity.

- **Examples of buildings with large roof overhangs/structural expression/double height curtain wall and public colonnade.**

- **Examples of buildings with large roof overhangs/structural expression/double height curtain wall and public colonnade.**



PRECEDENT

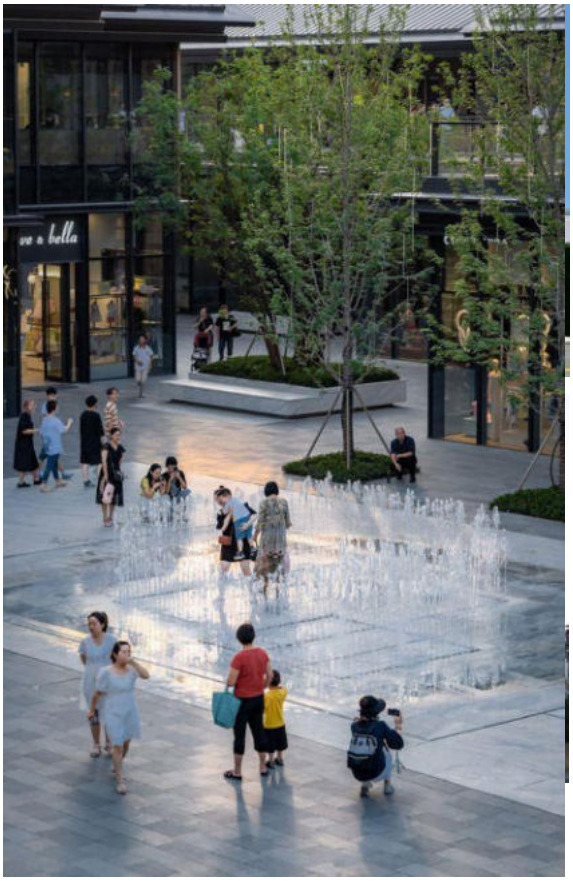
vivid architects

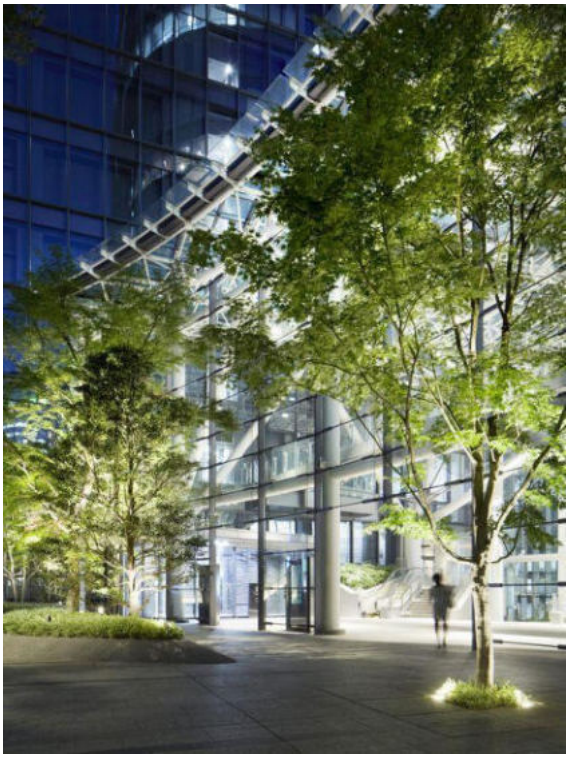
- **Examples of commercial hotel low rise buildings and public space**

PRECEDENT

vivid architects

- **Examples of public space design elements/ scale and landscaping**





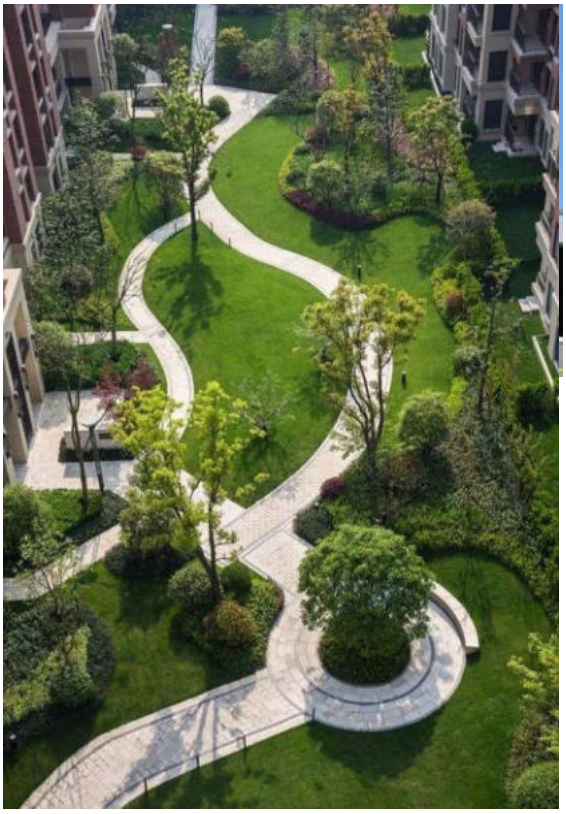
PRECEDENT

vivid architects

Examples of public space with active edges using extensive glazing.

- **Examples of landscaping design elements to create interest and public space for people to use and enjoy**

- **Examples of landscaping design elements to create interest and public space for people to use and enjoy**



- **Examples of landscaping design elements to create interest and public space for people to use and enjoy**

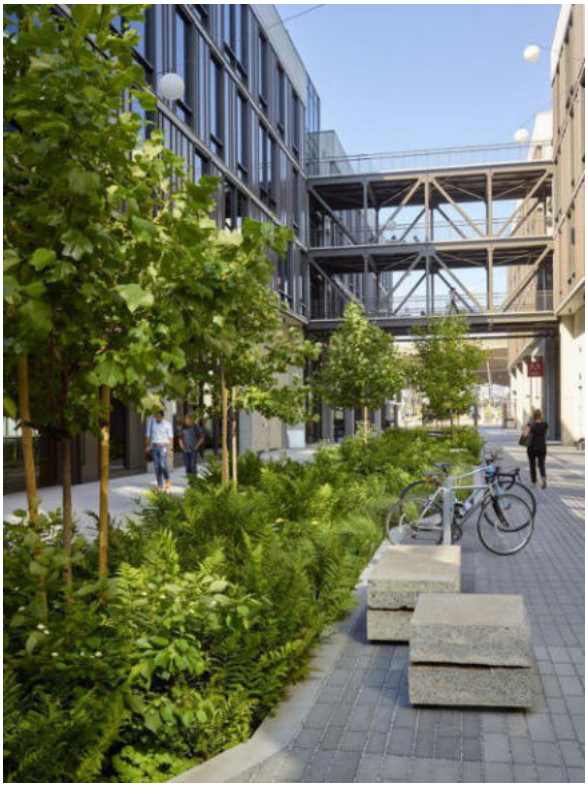
- **Examples of industrial type buildings that use clever design elevate the facades to more than a utilitarian solution. They have visual appeal and interest**

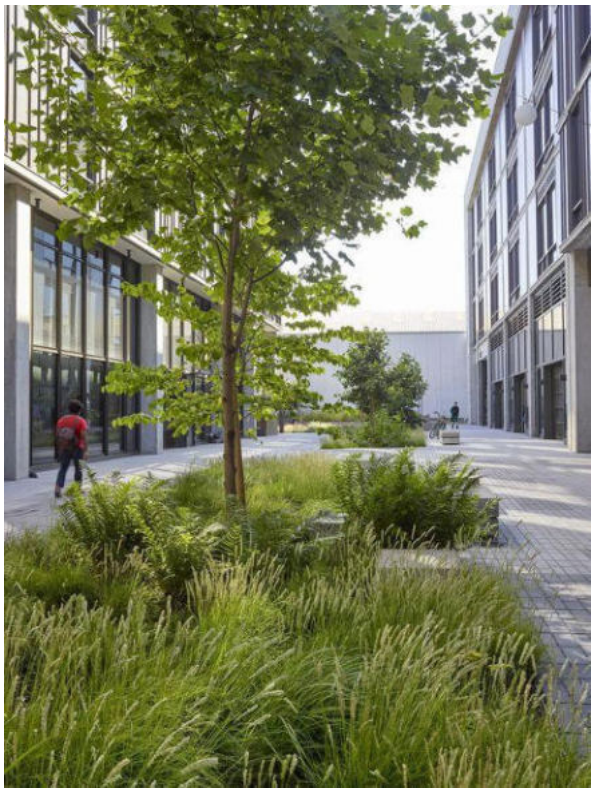
PRECEDENT

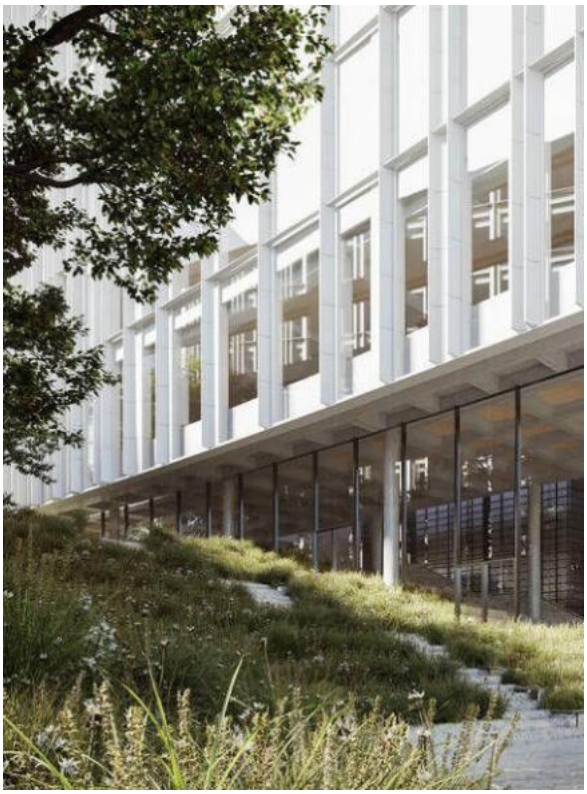
vivid architects

- **Examples of buildings with interesting roof profiles and clever use of industrial type materials**

- **Examples of landscaping between buildings to create a user friendly pedestrian interface**







PRECEDENT

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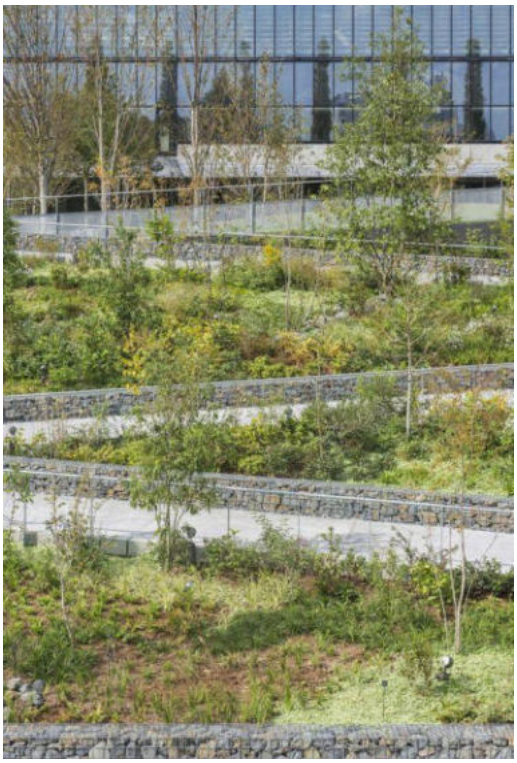
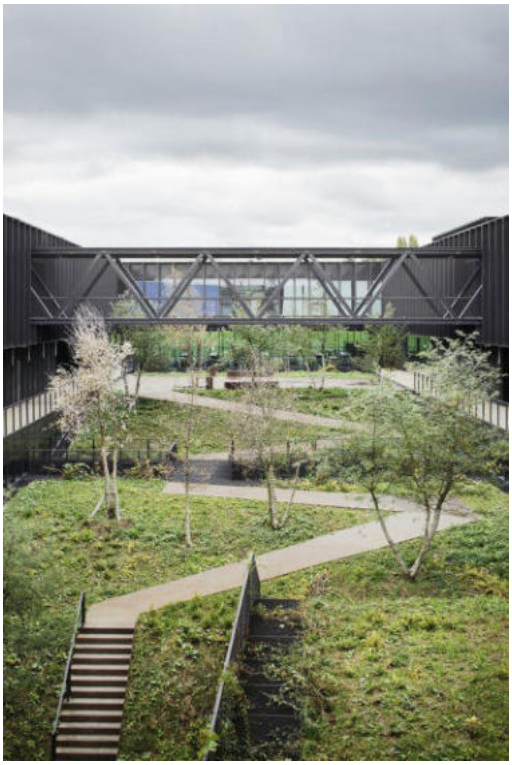
- **Examples of landscaping around buildings to create a user friendly pedestrian interface**

PRECEDENT

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- **Artist impressions of the terminal building reflecting it 3 storey height and transparent glass facades**

- **Artist impressions of the terminal building reflecting the possibility of a dynamic roof profile**

ARTIST IMPRESSIONS

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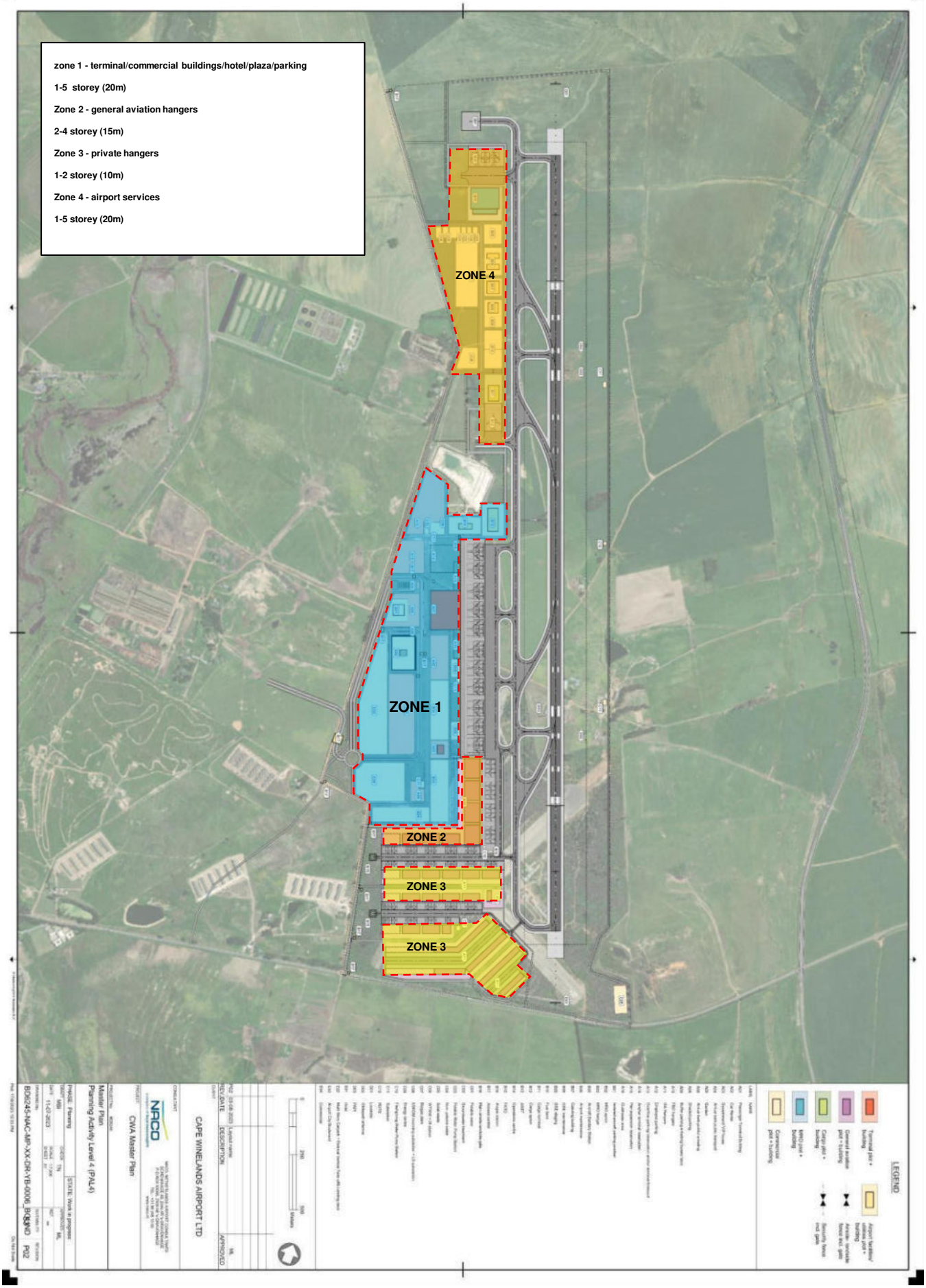
- **Artist impressions of the commercial warehousing and hanger architecture that will be 1-3 storeys in height**



HEIGHT ZONES

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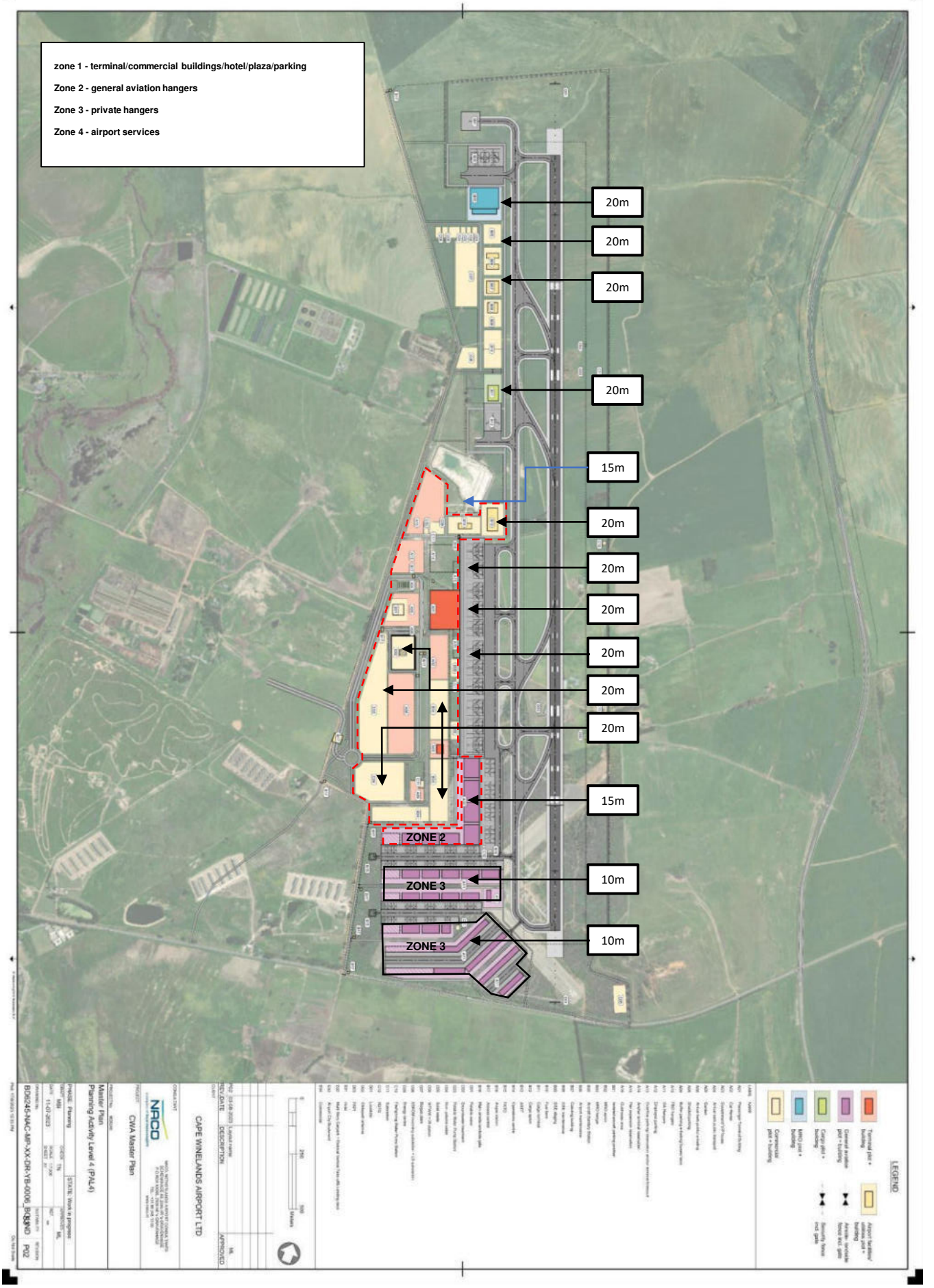
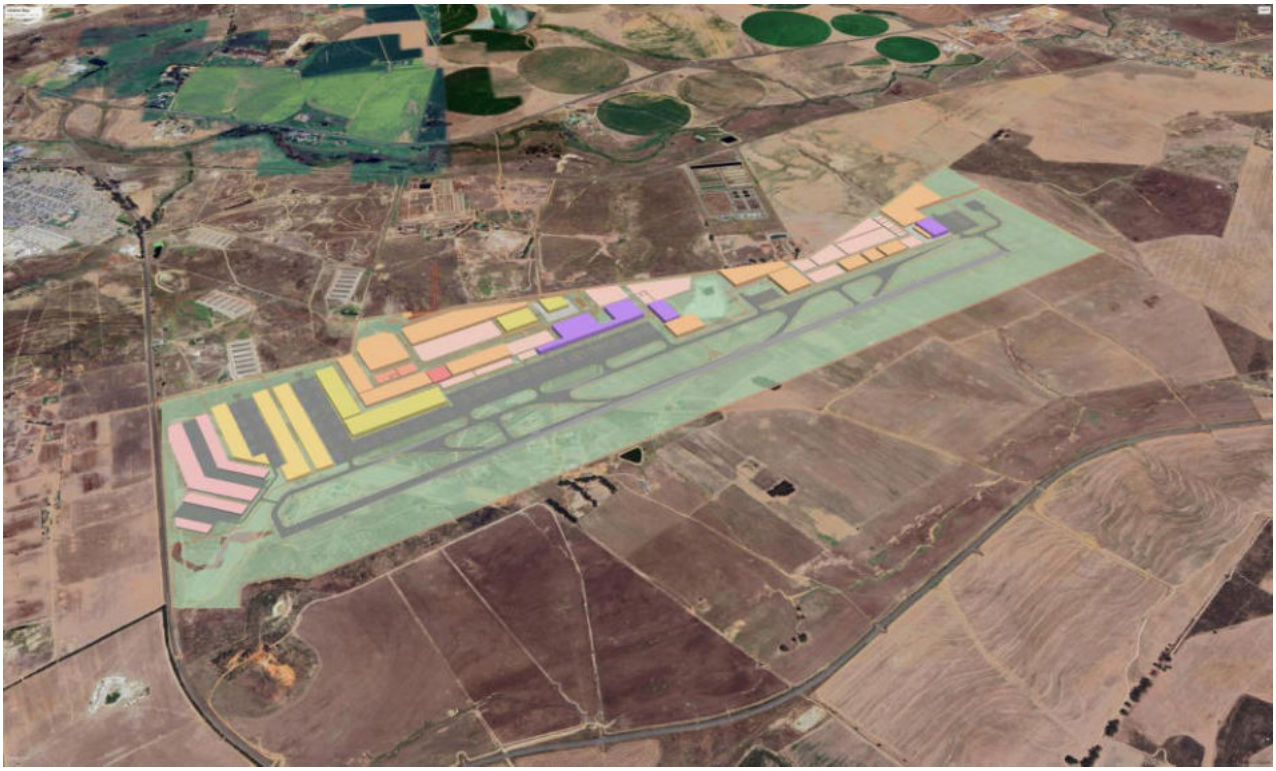
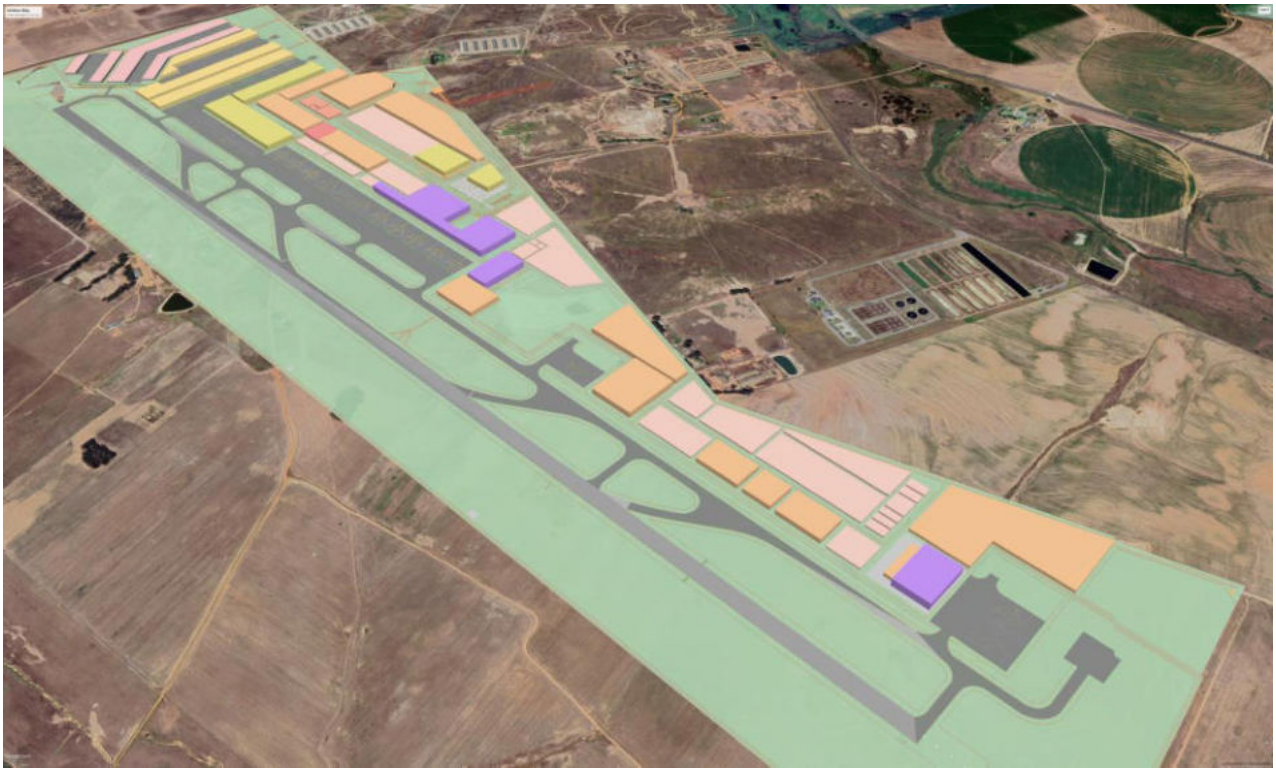


ESTIMATED BUILDING HEIGHTS

vivid architects





MASSING VIEWS

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ANNEXURE 14: OUTDOOR SIGNAGE GUIDELINES / PLAN

Scope & Principles

Outdoor Advertising Signage

28th September 2024

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	Advertising Standards Authority	15
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Document Type	Scope of Outdoor Advertising
Project	Cape Winelands Airport EIA
Purpose	To provide Outdoor Advertising Principles as input into the EIA process.
For	Cape Winelands Airport
Version Control	Version 5 A

Document Owner	Zelda Francis		
Position	Lead: Advertising and Events		
Telephone	+27 82 337 4700	Landline	n/a
Email	zelda@capewinelands.aero		

1 Introduction

The Cape Winelands Airport is an exciting new development that embodies environmental consciousness and modern infrastructure. Set in scenic surroundings, this airport takes pride in blending innovation with eco-friendly practices.

As part of this development, the airport will incorporate state-of-the-art advertising signage that highlights its offerings and provides unique opportunities for businesses.

2 Purpose of the report

The primary objective of this report is to provide Outdoor Advertising principles that will be integrated into the Environmental Impact Assessment (EIA) process for Cape Winelands Airport.

This report will focus on the types of outdoor advertising signage proposed for implementation at The Cape Winelands Airport. These principles for Outdoor Advertising will be provided in the context of environmental considerations.

These proposed advertising mediums aim to optimize brand visibility, engage travelers, and contribute to the overall ambience and functionality of the airport environment.

3 Scope of this report

This report focuses on the **scope and principles** of both 1st party and 3rd party outdoor signage at the Cape Winelands Airport ensuring compliance of the Cape Town Outdoor Signage By-Law 8969, 2023.

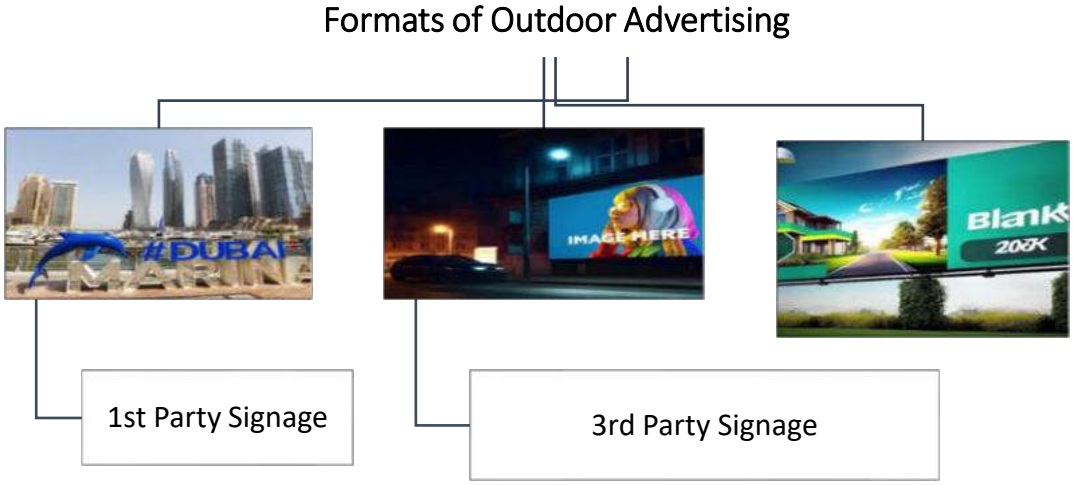
4. Formats of Outdoor Advertising Signage

The Cape Winelands Airport will use a variety of advertising signage formats to showcase its offerings and provide business opportunities to interested parties.

The formats include:

- **1st Party Signage**: Signage for Cape Winelands Airport (Naming and / or Welcome to Cape Winelands Airport). Signage that is directly related to the airport's own services and facilities.
- **3rd Party Signage**: Advertising opportunities made available for external businesses to promote their Products and Services

Below images are examples of both 1st & 3rd Party Outdoor Advertising Signage



5. City of Cape Town Outdoor Advertising By-Law No. 8969, 2023

Compliance

Compliance involves adhering to all regulations, guidelines, and specifications set forth in the City of Cape Town Outdoor Advertising By-law No 8969, 2023. This ensures that all signage formats are legally approved, safe, and contribute positively to the visual and functional environment of the Cape Winelands Airport.

5.1 Outdoor Advertising Signage: This includes freestanding billboards, digital boards, custom-made designs, flat signs, etc., must comply with the City of Cape Town Outdoor Advertising By-Law No. 8969, 2023.

5.2 Areas of Control: As set out in the City of Cape Town Outdoor Signage By-Law No. 8969, 2023, Schedule 1 refers to the classification of different landscapes, areas, sites and reflects the degree of control within these areas.

The future proposed Cape Winelands Airport precinct will be classified as a transport interchange/terminal and will only then be designated as "minimum control." This classification dictates the level of regulation and oversight required for signage in this area.

5.3 Approval Process: All outdoor advertising signage, whether 1st Party or 3rd Party must comply with the approval process as per the City of Cape Town Outdoor Signage By-Law 8969, 2023. Approval must be from the City or by its officials in writing before it can be erected.

5.4 Signage Master Plan (SMP): The development of an Outdoor Signage Master Plan is essential. The City requires and approves a SMP in respect of any new development where the erection of numerous signs is proposed.

The SMP must set out the specifics of the location, placement, type and design of signs to be erected on a premises or within a particular area.

This plan should be created in collaboration with the City Officials, Environmental Management Department to ensure all environmental considerations are addressed.

Components of an Outdoor Signage Master Plan

- Signage Inventory: A detailed list of all proposed outdoor signage, e.g., billboards, digital boards etc. and the locations and conditions
- Design Guidelines: Standards for the visual aspects of signage, such as size, colour, typography, materials, and lighting. Inclusive will be examples of structural details relating to all outdoor signs.
- Placement Strategy: Guidelines for where signs should be located to maximize visibility and effectiveness without causing clutter or obstruction to any traffic signage.
- Regulatory Compliance: Ensuring all signage adheres to local laws e.g. Advertising Standards Authority and regulations, such as the City of Cape Town Outdoor Advertising By-Law No. 8969, 2023.
- Environmental Considerations: Collaboration with environmental management to minimize the impact of signage on the surrounding area.

Input Required

- Stakeholder Engagement: Input from various stakeholders, including City, Environmental Management, Traffic Engineers, Business and or Landowners
- Site Analysis: Detailed surveys and studies of the area to understand traffic patterns, visibility, and Environmental impact.
- Regulatory Review: Consultation with Environmental Management to ensure compliance with all relevant laws and regulations.
- Design Expertise: Collaboration with Graphic Designers and Architects to develop aesthetically pleasing and functional signage.

Process Involved

- Initial Assessment: Conducting surveys and audits to gather data on site conditions.
- Stakeholder Consultation: Engaging with stakeholders to gather input and address concerns.
- Drafting the Plan: Developing the signage inventory, location, size, format, illumination, area of control (design guidelines, placement strategy, and maintenance plan).
- Submission of Application to be applied for in writing or electronically to the City on the prescribed application form. The following information must accompany the application.
    - a site plan showing the site on which it is proposed
    - a drawing which complies with National Building Regulations as per the by-law
    - detailed scaled drawings of the sign and a site plan indicating the position of the sign on the site
    - notification to the city when an approved 3rd party fixed graphic sign are to be changed, this must be submitted to the City to check for compliance
- Application fees: Payment to be made to the City on application. The fee is determined by the City in terms of the City's approved tariffs.
- Review and Approval: Submitting the draft plan for pre-scrutiny by relevant authorities and stakeholders, making necessary revisions.
- Implementation: Installing new and approved outdoor signage according to the approved Signage Master Plan.

Timeframe to Complete

Completion of an Outdoor Signage Master Plan can vary depending on the complexity and scale of the project. Typically, it can take anywhere from 6 months to 1 year to complete the entire process, from initial assessment to final implementation.

6. Proposed Outdoor Advertising Signage - Formats and Placements

The outdoor advertising signage at the Cape Winelands Airport will consist of both 1st Party and 3rd Party Outdoor Advertising Signage.

As part of this development, both 1st Party and 3rd Party Outdoor Advertising Signage will be implemented to showcase the airport's offerings, welcome visitors, and provide a unique advertising opportunity for businesses.

Below, we provide a detailed summary of the proposed advertising signage formats, including the ideal placement, principles, and design considerations for each.

6.1 1st Party Advertising Signage

Principles and Placement:

1. Importance of Clarity: The 1st Party Signage must be clear and legible from a distance, ensuring that visitors and / or motorists can read and understand the message.
2. Compliance: The design and placement of 1st Party Signage should always comply with the City of Cape Town Outdoor Advertising By-law: No 8969, 2023.

    2.1 Compliance Overview: Adhering to all regulations, guidelines, and specifications set forth in the City of Cape Town Outdoor Advertising By-law. This includes, but is not limited to:

    - Ensuring the signage does not obstruct traffic signals or road signs
    - Using materials and lighting that do not cause glare or distraction to motorists
    - Obtaining the necessary permits and approvals before installation of 1st Party signage

- Adhering to the size, height, and placement restrictions as specified in the by-law
- Regular maintenance to ensure the signage remains in good condition and legible
- Conduct an annual inspection to ensure a certificate of compliance is in hand, particularly for electrified signage

3. Size & Style Relevance: Signage will be bespoke "tailor made" for The Cape Winelands Airport. The sign must be designed, located, and sized appropriately to suit the purpose of the signage while integrating the background environment to provide excellent visibility and readability.

4. Minimal Visual Impact: Careful thought should be given to the location of 1st Party Signage to minimize visual impact on the environment and ensure that the sign blend well with the surrounding environment.

5. Branding Consistency: The 1st Party Signage must be consistent with the airport's branding and should be designed with aesthetically pleasing design and colour coordination.

6. Effective Placement: 1st Party Signage should be strategically placed in high visibility areas to achieve maximum effect. The entrance circle following the approach road at The Cape Winelands Airport is an ideal location for 1st Party Signage. This location forms part of the entrance/exit roads for motorists entering and leaving the airport, and it also connects them to the terminal building, parking, drop-off zones, and exit etc.

7. Maintenance: The Signage should be well maintained to ensure it maintains its clarity and visibility, and any damaged sign should be promptly removed or repaired.

8. Welcoming Passengers and Visitors: The signage should be carefully crafted to create a welcoming ambiance and environment for passengers and visitors.

The above principles will ensure that the 1st party signage is effective, safe, and tailored to the unique airport needs. It also ensures airport staff and visitors are safe around the sign and fully engaged with them.

6.2 3rd Party Outdoor Advertising Signage

Principles & Placement:

1. Compliance with By-Law: All 3rd party advertising signage displayed at the airport must comply with the City of Cape Town Outdoor Advertising Signage By-law No 8969, 2023.

1.1 Compliance Overview: Adhering to all regulations, guidelines, and specifications set forth in the City of Cape Town Outdoor Advertising By-law No 8969, 2023.

This includes, but is not limited to:

- Ensuring the signage does not obstruct traffic signals or road signs
- Using materials and lighting that do not cause glare or distraction to motorists
- Obtaining the necessary permits and approvals before installation of 3rd Party signage
- Adhering to the size, height, and placement restrictions as specified in the by-law
- Regular maintenance to ensure the signage remains in good condition and legible
- Conduct an annual inspection to ensure a certificate of compliance is in hand, particularly for electrified signage

2. Impact on Environment: The design and placement of the 3rd party signage should be done with the aim of maintaining or enhancing the aesthetic quality of the environment and ensuring that they do not have any negative impact on the environment.

3. Size & Style Relevance: Outdoor signage should be designed, located, and sized appropriately to suit their purpose whilst integrating with the background environment to provide excellent visibility and readability.

   All advertising signage will have a uniform appearance that complements the airport facilities while incorporating the "vineyard" look and feel. By using a variety of advertising signage formats, the Cape Winelands Airport aims to create an impressive visual impact while still maintaining eco-friendliness and sustainability."

4. Strategic Placement: The placement of 3rd party signage should be strategically located to achieve maximum impact and visibility while ensuring that it does not cause any obstruction to transportation networks around the airport facilities.

5. Safety Considerations: Safety is a vital element in the design and placement of 3rd party signage and should be carefully considered, ensuring that it does not lead to any safety hazards for airport users.

6. Consistency with Airport Theme: The 3rd party signage must be consistent with the airport's aesthetic theme, and the design should blend well with the surrounding environment.

7. Maintenance: The 3rd party signage should be well maintained to ensure they remain clear and visible, and any damaged signs should be promptly removed or repaired.

8. Illumination: Freestanding structures to be internally illuminated. This will ensure that the sign structure has less impact on the greater airport surroundings.

By adhering to these principles, third party signage at The Cape Winelands airport can contribute to the overall success of the facility and enhance the brand image while maintaining respect for the environment and safety of its users.

7. 3rd Party Advertising Signage By-Law Requirements

7.1 Freestanding Billboards

City of Cape Town Outdoor Advertising By-Law 8969, 2023 Requirements:

Size Restrictions: In terms of Schedule 2 of the Outdoor Advertising By-Law No 8969, 2023 freestanding billboards are restricted to either 18m^2 or 36m^2 single side **or** 36m^2 or 72 m^2 for a double-sided sign.

Height and Clearance:

- Landscape format billboard – have a minimum clear height of 2.4 m and a sign structure which does not exceed a maximum height of 7.5 m above natural ground level.

- Portrait format billboards – where a maximum height of 9 m above natural ground level is permitted

Illumination: Freestanding structures to be internally illuminated. This will ensure that the sign structure has less impact on the greater airport surroundings.

Style and Profile: To enhance and complement the urban profile of the airport facility, all freestanding billboard structures must have a uniform appearance. This would be the advertising space, stem of the structure and cladding that embodies the "vineyard" look and feel of the airport.

7.2 Custom-Made Designs (Iconic Signage)

City of Cape Town Outdoor Advertising By-Law No 8969, 2023 Requirements:

Size: The chosen location will determine the subsequent size, height, and layout for approval by the Environmental Management Department.

Illumination: Custom-made signage to be internally illuminated. This will ensure that the sign structure has less impact on the greater airport surroundings.

Style and Profile: Custom-made signage will be of bespoke "tailor made" design which features special effects such as character cut outs/shapes or moving parts.

The unique size, combination of shapes and colours, will make this signage attractive and memorable.

Location: Custom-made signage is uniquely designed and / or constructed for erection in a chosen location.

7.3 Flat Wall Mounted Signs

City of Cape Town Outdoor Advertising By-Law No 8969, 2023 Requirements:

Size Restrictions: In terms of Schedule 4 of the Outdoor Advertising By-law, flat signs are limited to 54m^2. Application can be made to the Environmental Management Department requesting a waiver, to increase the size of the advertisement.

Location: Flat Wall Mounted signage is affixed to a wall or building façade. Advertisers use this opportunity to showcase life-size images and in turn the airport comes alive with boldness and vibrancy to what could otherwise be large concrete walls.

No advertising or part thereof may cover the windows, openings, ventilation apertures or architectural features.

Illumination: Internal illumination to enhance and uplift the unique appeal of the airport precinct.

Style and Profile: The advertising sign is designed, and custom made to fit the exact area of a building and therefore considered custom made.

7.4 Digital Format Screens

City of Cape Town Outdoor Advertising By-Law No 8969,2023 Requirements:

Size Restrictions: In terms of Schedule 2 of the Outdoor Advertising and Signage By-Law No 8969, 2023, digital screens are restricted to either 18m^2 or 36m^2 single side or 36m^2 or 72 m^2 for a double-sided sign.

Height and Clearance:

- Landscape digital screen – the maximum height of a landscape digital screen may not exceed 7.5m with a minimum clearance above the ground level of 2.4m.
- Portrait shape digital screen – may not exceed a maximum height of 9m above natural ground level.

Illumination: Digital format screens have proven to be more economical to operate. Digital format screens display more graphics than conventional static signs. Graphics are uploaded either on site or remotely.

Style and Profile: In order to enhance and complement the urban profile of the airport facility, digital format screens must have a uniform appearance throughout, e.g. cladding, structure stem and the digital advertising space.

7.5 Sky Signage

City of Cape Town Outdoor Advertising By-Law No 8969, 2023 Requirements:

Size: Sky signage is limited to a maximum of 4.5m^2. This size can be increased up to 18m^2 with an Environmental Impact Assessment submission, providing the sign does not obstruct the view of any other building.

Format: Sky signage must have minimum content which will be measured in "bits" of information as per the table in Schedule 5 of the by-law. Total bits may not exceed 1.5.

Illumination: Due to the nature of these types of signs internal illumination to be used.

Location: Sky Signage can be constructed on roof tops of buildings and / or entry and exit lanes of parking areas.

8. Environmental Considerations

The growing importance of sustainability has been one of the key marketing trends of recent years. Out of home advertising has several advantages from a green point of view, e.g. digital screens can be used to showcase multiple messages sequentially, without needing any extra materials. Digital solutions are designed to last several years. LED lighting delivers the same high standards of quality, with lower electricity requirements.

Environmental initiatives such as the use of LED lights, recycling paper, plastic, and monitoring waste sorting, which enables the industry to truly incorporate sustainability into its core processes.

Stakeholders will be encouraged to have an environmentally friendly approach when purchasing outdoor advertising furniture, by making use of recyclable materials such as steel, glass, sourcing or disposing of paper and plastics, that they are most likely to use in their campaigns.

Stakeholders must be committed to reducing the use of PVC where possible by using alternative plastics, or less polluting recyclable materials.

9. Advertising Standards Authority

The Advertising Standards Authority of South Africa (ASASA) is an independent body set up to regulate advertising in the public interest through a system of self-regulation. ASASA works closely with government, statutory bodies, consumer organisations and the advertising industry to ensure that the content of advertising meets the requirements of the Code of Advertising Practice.

This Code of Advertising Practice is a voluntary code applicable to the marketing and communication industry. The airport must monitor all content to ensure compliance with the Advertising Standards Authority of South Africa.

10. Future Trends of Advertising

The future of advertising looks to involve increasingly sophisticated technology and an ever-greater focus on personalisation across different media platforms.

The use of augmented and virtual reality to create immersive brand experiences, as well as Artificial Intelligence are expected to become more prevalent in the future.

11. Summary

The proposed outdoor billboards will be placed on Airport land in the following zones of the Site Development Plan. Refer the attached drawing as a reference for both below zones.

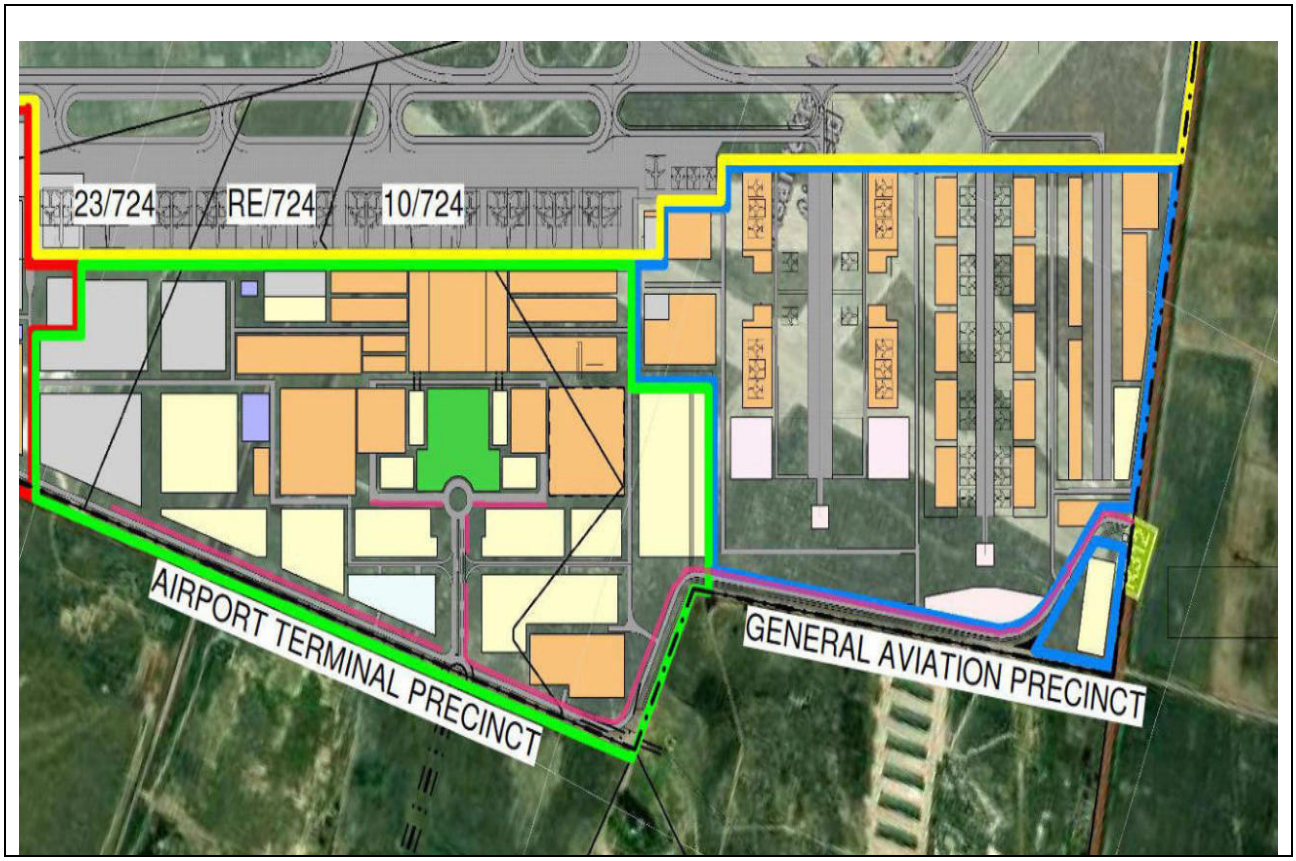
- Airport Precinct (Landside)
- General Aviation Precinct (Landside)

The primary entry and exit road to the Cape Winelands Airport is called Mellish Road. The total number of proposed billboards exceeding $18m^2$ to be erected in Mellish Road is estimated to be x 12 – 15 outdoor billboards. Refer the below drawing showing a "pink" line adjacent to Mellish Road leading from Lichtenburg Road towards the main entrance of the Airport Precinct.

Key points to determine the number of outdoor billboards that can be placed on Mellish Road:

- Minimum Control Area: The controls within a transport / terminal interchange can typically have stricter regulations to ensure safety and visibility.
- Spacing Requirements: The spacing of outdoor billboards must comply with the Road Traffic Safety Requirements as per the Linear spacing road speed limit as per the by-law, Table 3 Linear Spacing between signs.
- Traffic Impact Assessment: The assessment of the impact on traffic and road safety to be conducted by a qualified traffic engineer practitioner.

- **Size and Height Restrictions**: The size and height restrictions to comply with the City of Cape Town Outdoor Signage By-Law No 8969,2023 to avoid interference with aviation operations.
- **Approval Process**: Cape Winelands Airport will need to obtain approval from the local municipality, which will review the application based on the specific criteria outlined in the by-law.



Thank you.

ANNEXURE 15: ENVIRONMENTAL AWARENESS PLAN

DEA&DP IN-PROCESS NR: 16/3/3/2/A5/20/2046/24

ENVIRONMENTAL AWARENESS PLAN FOR THE EXPANSION OF THE CAPE WINELANDS AIRPORT

(P10 OF FARM 724, RE OF FARM 724, P23 OF FARM 724, P7 OF FARM 942, RE OF FARM 474, P3 OF FARM 474 AND P4 OF FARM 474)

MARCH 2025

COVER IMAGE NOT REPRESENTATIVE OF THE PROPERTY SITE

PREPARED FOR
CAPEWINELANDS AERO (PTY) LTD

PREPARED BY
PHS CONSULTING

P.O. BOX 1752, HERMANUS, 7200 I TEL: +27 28 312 1734 I FAX: 086 508 3249,
JT@PHSCONSULTING.CO.ZA / PAUL@PHSCONSULTING.CO.ZA

ENVIRONMENTAL AWARENESS PLAN

The Environmental Manager (EM) for the operator/owner/applicant will implement an Environmental Awareness Plan at the proposed Cape Winelands Airport (CWA), situated within the administrative district of the City of Cape Town, Western Cape. The material/source of information for the Environmental Awareness Plan will be the approved Environmental Management Programme (EMPr), as well as other relevant specialist reports/ permits/ licences. These documents will be utilised by the EM to compile an electronic database which will contain environmental aspects and issues with medium to high significance. The environmental issues and aspects will be entered into the database with associated mitigation measures and responses, along with the specific legislation that governs such an impact or aspect. The environmental awareness plan is detailed in the sections below.

The purpose of this section is to outline the methodology that will be used to educate employees and contractors of any environmental risks associated with their work and the manner in which these risks must be dealt with so as to avoid pollution and minimize the degradation of the environment.

Once approved, a copy of the EMPr will be handed to the Environmental Manager (EM). Issues such as site establishment, site clearance, protection of sensitive features, erosion control and waste management to name a few will be discussed with the Contractors/ Subcontractors/Operators to ensure that they understand the goals as set out in the EMPr. An induction meeting will also be held with all the site workers to inform them of the basic steps towards environmental awareness regarding the environment.

The EM must ensure that he/she understands the EMPr document and its requirement and commitments. An Environmental Control Officer (ECO) needs to check compliance of the construction and operational activities to the management programmes described in the EMPr.

1. INDUCTION & ENVIRONMENTAL MEETINGS

All full-time staff and contractors are required to attend an induction session. Employees are inducted when they start on site and when they return from leave. Any contractor, who works on site for a period of 24 hours or more, is required to undergo the respective induction training. Environmental issues and aspects related to the construction / operation will be addressed in these induction sessions.

All environmental impacts and aspects with their mitigating measures will be discussed, explained and communicated to employees. The induction sessions will be modified according to the level of employee attending the induction session, so that all employees gain a suitable understanding of environmental issues and pollution.

The basic content of the induction programme for full time employees is as follows:

- Welcome and Registration;
- Disciplinary Code;
- Fire Extinguisher;
- Employee Assistance Program;
- Security;
- HIV/Aids Awareness;
- Environmental Issues as per EMPr
- Environmental and Quality Checklists

A Basic Environmental Training Course should be developed by management.

Environmental meetings can be held with management, and selected groups/ teams and/or their Environmental Control Officers (ECO). This will take the form of an open discussion between the relevant department and these individuals. The symposiums will aid in environmental awareness being generated at all levels, as well as assist the relevant department in defining all, and identifying new environmental issues, concerns and pollution sources.

2. TRAINING NEEDS

A training needs analysis will be performed through all levels of the organization. Each of the categories / levels of the organization have different responsibilities and roles, accordingly different knowledge requirements are applicable. These are summarized in Table 1 below.

After the training needs have been identified, it is the responsibility of the SHE Office/ EM to ensure that personnel attend the relevant identified training. Training will also address the specific measures and actions as listed in the EMPr. This Environmental Awareness Plan is intended to supplement the Safety, Health and Environmental (SHE) training and awareness requirements.

3. SPECIALIZED SKILLS

The Training Department in conjunction with the SHE Officer & EM are responsible for ensuring job specific training for personnel performing tasks, which can cause significant environmental and social impacts (e.g. receipt of bulk hazardous chemicals/fuel, hazardous materials handling, responding to emergency situations, fire management etc.). The EM with the assistance of the SHE Officer must identify relevant personnel and training courses.

3.1 In-house Training

In-house training sessions will be held with relevant employees. The training sessions will be determined by the relevant department and will allow for employees to participate in determining what the environmental issues and concerns are with regard to their specific occupation. Education with regard to environmental incident reporting will be detailed at these sessions.

3.2 On the Job Training

On the job training is an essential tool in environmental awareness. Employees will be given details of the expected environmental issues and concerns specifically related to their occupation. Employees will be trained on how to respond if an environmental problem or source of environmental pollution arises. The training will be on-going, and all new employees will be provided with the same standard of training as existing employees.

3.3 General Training and Skills Development

Human Resources Development Programmes will include appropriate training and skills development programmes as required by the workforce in support of operation specific business plans. Training will be offered in portable skills, being competencies that will enable employees to find jobs elsewhere within similar industries, or to become self-employed.

Basic environmental and pollution control skills will be included in this training.

4. REVIEW OF TRAINING MATERIAL

The effectiveness of the environmental management training will be done by the management through task observations and during internal and external audits.

All training material for presentation to personnel and contractors will be reviewed annually to ensure consistency with organizational requirements and best practice guidelines. In addition to this, annual monitoring reports, audit results and all incident reports will be reviewed, any shortcomings and non-compliancy will be highlighted and management measures incorporated or improved upon within the training material.

5. RECORDS

Records from the implementation of this environmental awareness plan will be kept and controlled in accordance with the Management System Control of Records Procedure, which is required to be implemented to provide evidence of conformity and effective operation of the relevant requirements of the management system.

6. ENVIRONMENTAL COMMUNICATION STRATEGY

Management shall establish and maintain procedures for the internal communication between the various levels and functions of the organisation, and receiving, documenting and responding to relevant communication from external interested & affected parties. The organisation shall consider processes for external communication on its significant environmental aspects and record its decision. Communication is a management responsibility. All supervisors are responsible for effective communication within their own sections. Environmental communication can be divided into two categories, namely internal communication and external communication.

6.1 Internal Communication

The following communication channels and media will/can be used to communicate environmental issues.

HOD Meetings: The EM communicates information to senior management on environmental issues.

HSEC/ECO Meetings: Environmental issues should be an item on plant and section monthly safety, health & environmental meeting agendas.

Publications: Leaflets, posters etc. are produced by the relevant department or other designated persons.

Daily/ Weekly Safety Meeting: All meetings are scheduled to commence with a discussion on safety, health & environmental topics.

6.2 External Communication

The following communication channels and media will/can be used to communicate environmental issues to individuals who are not employed.

Publications: Selected publications should be produced and used to communicate environmental issues to outside parties. Examples include newsletters and Annual Reports.

E-mail: E-mail communication received must be stored, with replies, in an appropriate folder on a server. E-mail messages, relevant to environmental management, should be kept for a minimum of two years before deletion.

Mail: Correspondence received by mail must be filed, along with the response (where relevant), within the relevant department's filing system for a minimum period of 2 years. Paper correspondence will be archived in this department.

Telephone: A register of telephonic environmental queries should be kept by the relevant department detailing caller, contact details, date, query, action taken and response. Furthermore, the person answering the call will be responsible for logging their particulars against the call, as well as ensuring that all communication that leads to an aspect or an impact, is entered on the database.

Storage of Correspondence: All original correspondence must be retained by the EM for a minimum period of two years.

Environmental Reports: Copies of relevant specialist study reports and Environmental Impact Assessments will be made available by the EM should these be requested by an external party.

Queries from Interested and Affected Parties: Response to queries about environmental impacts and aspects will be addressed by the relevant department and approved by the EM.

7. INCIDENT REPORTING STRUCTURE & PROCEDURE

Environmental incident reporting is a vital part of communication. Employees are required to report any and all environmentally related problems, incidents and pollution, so that the appropriate mitigating action can be implemented timeously. Refer to the Incident Report Template in **Annexure A**.

Table 1: Environmental incident reporting procedure.

ENVIRONMENTAL INCIDENT REPORTING STRUCTURE	**ACTION REQUIRED**
Line Management in relevant area of responsibility where the incident occurred	Shall investigate the incident and record the following information: • How the incident happened; • The reasons the incident happened; • How rehabilitation or clean up needs to take place; • The nature of the impact that occurred; • The type of work, process or equipment involved; and • Recommendations to avoid future such incidents and/or occurrences. Shall inform the Environmental Manager on a daily basis of all incidents that were reported in the area/section. Shall consult with the relevant department / person for recommendations on actions to be taken or implemented where appropriate (e.g. clean-ups). Shall assist the Environmental Manager with applicable data in order to accurately capture the incident into the reporting database.
Area / Line Managers	Shall forward a copy of the incident form to other line managers. Shall forward a copy of the incident form to the Environmental Manager. Shall inform the relevant department / person on a weekly basis of the incident by e-mail or by submitting a copy of the incident report. Once a High-Risk Incident (any incident which results from a significant aspect and has the potential to cause a significant impact on the environment) occurred it must be reported immediately to the Environmental Manager by telephone or email to ensure immediate response / action. Shall forward a copy of the completed Incident Reporting Form (and where applicable a copy of the incident investigation) to the relevant department / person
Environmental Manager	Shall complete an incident assessment form to assess what level of incident occurred. Shall make recommendations for clean-up and / or appropriate alternate actions. Shall enter actions necessary to remediate environmental impacts into the database in conjunction with the responsible line manager. Shall enter the incident onto the database to monitor the root causes of incidents. Shall include the reported incidents in an appropriate monthly / quarterly report. Shall highlight all incidents for discussion at meetings

APPENDIX A: INCIDENT REPORT TEMPLATE

Environmental Incident Report

Date:	**File reference number:**
Name:	
Exact location of incident:	

Section 1: Description of incident

Section 2: Remedial action required

Section 3: Relevant Documentation

Section 4: Steps to prevent recurrence

Section 5: Signatures

Environmental manager:	Date: .....
ECO:	Date: .....
Landowner:	Date: .....

ANNEXURE 16: MAINTENANCE MANAGEMENT PLAN

Request for the relevant Competent Authority to define or adopt a Maintenance Management Plan for a watercourse in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), Environmental Impact Assessment Regulations, 2014 (as amended).

		(For official use only)
File Reference Number:	16/3/3/2/A5/20/2046/24	
Date Received by Department:		
Date Received by Component:		
Form Duly Signed and Dated:		Yes No

PROJECT TITLE

Proposed Expansion of Cape Winelands Airport on P10/Farm 724, RE/Farm 724, P23/Farm 724, P7/Farm 942, RE/Farm 474, P3/Farm 474 & P4/Farm 474, Fisantekraal, Western Cape

July 2025

cell:082 327 2100 | Tel:(028) 312 1734 | Fax:086 508 3249 | amanda@phsconsulting.co.za | | PO Box 1752 | Hermanus 7200

PLEASE NOTE THAT ALL CHANGES FROM THE NOVEMBER 2024 DRAFT CWA MMP ARE UNDERLINED IN BLACK WHILE ALL CHANGES FROM THE MARCH 2025 DRAFT CWA MMP ARE UNDERLINED IN GREEN. GENERAL TEXT CHANGES ARE NOT UNDERLINED.

A. SCOPE AND IMPORTANT INFORMATION

1) This document is to be used to ensure that the request for adopting or defining a Maintenance Management Plan (MMP) in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) ("NEMA"), Environmental Impact Assessment (EIA) Regulations, 2014 (as amended) is undertaken to the sufficient standard and requirements as defined by the competent authority, the Department of Environmental Affairs and Development Planning of the Western Cape Government (henceforth the Department). It is advised that the determination of applicability regarding the scale of the proposed maintenance/management activity(ies) be undertaken through a pre-application consultation with the Department.

2) The geographical scope of the MMP is limited to watercourses as defined in the EIA Regulations, 2014(as amended). The document does not relate to coastal activities or activities to be undertaken in an estuary.

3) The use of this document for the development of a MMP for a watercourse **will only** be considered when the proposed maintenance activities constitute any one of the following listed activities identified in terms of the NEMA EIA Regulations, 2014 (as amended):

EIA Regulations Listing Notice 1 of 2014 (as amended)

- Activity 19, Listing Notice 1: The infilling or depositing of any material of more than 10 cubic meters into, or the dredging, excavation, removal or moving of soil, sand, shell grit, pebbles or rock of more than 10 cubic metres from a watercourse; but excluding where such infilling, depositing, dredging, excavation, removal or moving-
  (a) will occur behind a development setback;
  (b) is for maintenance purposes undertaken in accordance with a maintenance management plan;
  (c) falls within the ambit of activity 21 in this Notice, in which case that activity applies;
  (N.B. Points (d) and (e) does not apply as these activities fall within the coastal zone)

- Activity 27, Listing Notice 1: The clearance of an area of 1 hectares or more, but less than 20 hectares of indigenous vegetation, except where such clearance of indigenous vegetation is required for-
  i. The undertaking of a linear activity; or
  ii. Maintenance purposes undertaken in accordance with a MMP.

EIA Regulations Listing Notice 2 of 2014 (as amended)

- Activity 15, Listing Notice 2: The clearance of an area of 20 hectares or more of indigenous vegetation, excluding where such clearance of indigenous vegetation is required for-
  I. The undertaking of a linear activity; or
  II. Maintenance purposes undertaken in accordance with a MMP.

- Activity 24, Listing Notice 2: The extraction or removal of peat or peat soils, including the disturbance of vegetation or soils in anticipation of the extraction or removal of peat or peat soils, but excluding where such extraction or removal is for the rehabilitation of wetlands in accordance with a MMP.

EIA Regulations Listing Notice 3 of 2014 (as amended)

- Activity 12, Listing Notice 3: The clearance of an area of 300 square metres or more of indigenous vegetation except where such clearance of indigenous vegetation is required for maintenance purposes undertaken in accordance with a MMP.

  i. Western Cape

  i. Within any critically endangered or endangered ecosystem listed in terms of section 52 of the NEMBA or prior to the publication of such a list, within an area that has been identified as critically endangered in the National Spatial Biodiversity Assessment 2004;
  ii. Within critical biodiversity areas identified in bioregional plans;
  iv. On land, where, at the time of the coming into effect of this Notice or thereafter such land was zoned open space, conservation or had an equivalent zoning; or
  v. On land designated for protection or conservation purposes in an Environmental Management Framework adopted in the prescribed manner, or a Spatial Development Framework adopted by the MEC or Minister.

  (NB. Point iii does not apply as this activity falls within the coastal zone)

4) In deciding the request, the competent authority may define conditions related to auditing compliance with the MMP; monitoring requirements; reporting requirements, review; updating and amending the document and period for which the MMP is defined/adopted.

5) The purpose of the MMP is to maintain both man-made and ecological infrastructure in a manner that either improves the current state of, and/or reduces the negative impacts on a watercourse to ensure that ecosystems services are preserved/improved and to prevent further deterioration of the watercourse.

6) Notwithstanding the MMP possibly being defined or adopted by the Competent Authority, any other applicable statutory requirement must still be complied with (e.g. any obligations under the National Water Act, 1998 (Act 36 of 1998) or the Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983)).

7) The proponent must note that a MMP for a watercourse **must** be undertaken through consultation with the Department of Water and Sanitation and/or the relevant Catchment Management Agency (responsible water authority). This is to ensure compliance in terms of a Permissible Water Use as set out in the National Water Act, 1998 (Act No. 36 of 1998). It is recommended that this process for authorisation in terms of the National Water Act be clarified prior to the drafting and submission of the MMP.

8) The development of this document has been done in such a way so as to meet the requirements of both this Department as the competent authority in terms of the NEMA EIA Regulations, 2014 (as amended), as well as the requirements of the delegated water authority, regarding general authorisation considerations for sections 21(c) and (i) of the National Water Act, 1998 (Act No. 36 of 1998), to ensure alignment between the two authorities when defining or adopting the MMP.

9) In situations where a Water Use Licence Application (WULA) is required by the water authority regarding the proposed activities within a MMP, this will not prevent the proponent from submitting a request for a MMP to be defined or adopted by the Department.

10) Unless protected by law, all information contained in, and attached to this document, shall become public information on receipt by the competent authority.

11) A duly dated and originally signed copy of this document together with one hard copy and one electronic copy of the MMP must be posted to the Department at the postal address given below or delivered to the Registry Office of the Department.

12) A copy of the final defined/adopted MMP and cover letter **must** be submitted to the responsible water authority.

13) **NOTE: Adopting or defining the MMP does not absolve the** proponent **from complying with any applicable legislation or the general "duty of care" set out in Section 28(1) of the NEMA that states, *"Every person who causes, has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring, or, in so far as such harm to the environment is authorised by law or cannot reasonably be avoided or stopped, to minimise and rectify such pollution or degradation of the environment*." (Note: When interpreting this "duty of care" responsibility, cognisance must be taken of the national environmental management principles contained in Section 2 of the NEMA.**

14) **NOTE: This document can be used as a template to assist in the information required and is to be filled out in full. The Department reserves the right to request any additional information during the initial development and submission of the draft MMP.**

15) **NOTE: The Department reserves the right to not adopt the MMP and require that an application be submitted to obtain Environmental Authorisation for the respective activities. Furthermore, consideration for the review should also be aligned to the periodic reviews of the General Authorisation for sections 21 (c) and (i) of the National Water Act, 1998 (Act No. 36 of 1998) to ensure continued alignment and compliance.**

B. MAINTENANCE MANAGEMENT PRINCIPLES

1) The following are overarching principles to be used by landowners and managers when considering the development and implementation of a MMP:

    a. The anticipation and prevention of negative impacts and risks, then minimisation, rehabilitation or 'repair', where a sequence of possible mitigation measures to avoid, minimize, rehabilitate and/or remedy negative impacts is explicitly considered;
    b. Avoid and reduce unnecessary maintenance;
    c. Maintenance and management of a watercourse must be informed by the condition of the physical and ecological processes that drive and maintain aquatic ecosystems within a catchment, relative to the desired state of the affected system;
    d. Management actions must aim to prevent further deterioration to the condition of affected watercourses and, overall, be guided by a general commitment to improving and maintaining ecological infrastructure for the delivery of ecosystem services;
    e. Managers and organs of state must identify, address and, where feasible, eliminate the factors that necessitate intrusive, environmentally-damaging maintenance; and
    f. A process of continuous management improvement be applied, namely Planning; Implementing; Checking (monitoring, auditing, determine corrective action) and Acting (management review).

2) The following table provides a simple overview for the determination of the need for a MMP:

	Question	**If the answer to any of the questions is YES, then a MMP may be applicable.**
2.1	Is there a watercourse on or adjacent to the property?	Yes
2.2	Has there been a history of flood damage or vandalism to the existing infrastructure or watercourse – erosion and/or sedimentation?	Yes
2.3	Is there infrastructure or any community at risk of being damaged by flooding?	No
2.4	Is the design of infrastructure considered inadequate in terms of managing the risk of flooding, erosion and/or sedimentation?	No
2.5	Would you consider an improved design to existing infrastructure to reduce maintenance needs?	No
2.6	Are there specific incidences where the watercourse is obstructed or blockages occur that alter the flow of the river during floods?	No
2.7	Is there an existing obstruction in the watercourse that has changed the flow of the river under normal conditions?	No
2.8	Is there a marked increase in the rate of erosion/sedimentation being experienced which threatens operations and assets?	No
2.9	Is there a presence of alien or bush encroachment vegetation within the watercourse and/or the presence of woody debris after flooding?	Alien vegetation within wetland areas

3) It is important to consider that the type of maintenance required will impact on the level of assessment needed in terms of the impact the activity will have on the system and how best to mitigate the impact. Types of maintenance can broadly be classified in the following categories, with recognition that maintenance activities vary across the rural and urban context:

Maintenance Category	Types of maintenance activities (examples only)

Category A:
Sediment removal as a result of deposition or sediment deposition as a result of erosion
	• Clearing sediment or placing sediment at:
	  o Pump hole/trench
	  o Return flow (irrigation)
	  o Off-take weir
	  o Stormwater outfall
	  o Detention/retention ponds
	  o Canalized urban rivers
	  o Bridges, culverts and drifts
	• Prevent formation of islands in the channel of the river
	• Dredging of in-stream dams

Category B: Emergency repairs – urgent action required to manage risk and damage to assets	• Repair to erosion of river bank or servicing infrastructure (e.g. pipelines/roads) • Removal of material built up as a result of flooding/sedimentation and increasing risk to infrastructure • Address damage or replacement of infrastructure (e.g. bridge, pipeline, pump house) • Manage the condition of flood protection berms, and existing structures such as gabions, canalized and stormwater systems • Installing temporary gravel approaches at flood-damaged river crossings
Category C: Managing alien invasive and bush encroachment plant species	• Clearing of alien invasive vegetation out of a watercourse to reduce maintenance requirements as they relate to erosion and sedimentation • Management of indigenous species categorized as bush encroachment, to improve hydrological flow and reduce associated flooding impacts
Category D: Rehabilitation and restoration activities for maintaining ecological infrastructure	• Development and maintenance of ecological buffering systems to improve and/or restore functioning (e.g. wetlands and stormwater detention ponds) • Actively rehabilitating riparian zones through planting of locally indigenous species • Bank grading and movement/removal of berms and barriers to flow

4) The development of appropriate method statements to mitigate the impact of the maintenance needs, should be aligned within the framework of these considerations:

   a. Watercourses experience a natural process of sedimentation and erosion, with varying rates depending on the geomorphology and the integrity of the land-uses within the catchment;

b. Manipulation of the watercourse results in increased erosion and/or deposition being experienced further downstream, perpetuating greater need for manipulation and more drastic and costly maintenance interventions;

c. Locally indigenous riparian and wetland vegetation assists in the stabilization of river banks through effective root structures, while contributing to improve in-stream habitat and water quality conditions;

d. Invasive alien and bush encroachment vegetation significantly impacts on the functioning of a watercourse, often leading to increased flood associated damage, with further implications and a reduction in water quality and availability;

e. Persons undertaking maintenance activities have a responsibility to ensure a sense of duty of care is applied as prescribed within NEMA Section 28(1).

5) It is recognized that within urban areas, sedimentation and erosion rates are significantly amplified because of development in urban areas and thus systems associated with watercourses in such areas can no longer be considered as 'natural'. In such a context, the drivers of such a process are often located outside the control of the landowner or responsible authority (i.e. Municipality). Therefore, the response taken to address the needs of a maintenance management plan for a watercourse within the urban environment may be limited in mitigating the requirement for maintenance to be undertaken.

C. REQUEST FOR THE COMPETENT AUTHORITY TO DEFINE OR ADOPT A MAINTENANCE MANAGEMENT PLAN FOR A WATERCOURSE IN TERMS OF THE NEMA, EIA REGULATIONS 2014 (AS AMENDED).

The following information must be submitted as part of the request for the competent authority to define or adopt the MMP:

1. PERSONAL DETAILS

Highlight the Departmental Sub-Region(s) in which the maintenance is to be undertaken. (mark the appropriate box with an 'X'). For Departmental details see Annexure A.

REGION 1 (City of Cape Town Metropolitan and West Coast District) X	REGION 2 (Cape Winelands District, Overberg District) ☐	REGION 3 (Eden & Central Karoo Districts) ☐

Name of person/authority who will undertake responsibility for the activity:	Capewinelands Aero (Pty) Ltd		
Contact person (if other):	Deon Cloete		
Postal address:	P.O. Box 12449, Mill Street		
Telephone:	n/a	Postal code:	8001
Fax:	n/a	Cell:	+27(0) 82 339 2807
Email:	d.cloete@capewinelands.aero		
Name of person who has prepared the MMP:	Amanda Fritz-Whyte (EAP) & Olivia Brunings (Candidate EAP) Input from Zutari (Bulk Infrastructure Engineers), FEN (Freshwater Ecological specialist).		
Contact Person (if other):	n/a		
Postal address:	PO Box 1752, Hermanus		
Telephone:	028 312 1734	Postal code:	7200
Fax:	(086) 508 3249	Cell:	082 327 2100
E-mail:	amanda@phsconsulting.co.za; paul@phsconsulting.co.za		
Expertise of EAP	Twenty-three years' experience in Environmental Impact Assessments, Public Participation, auditing, water resource management, WULA applications and compilation of EMPrs.		
EAP Registrations/Associations	IAIAsa, Pri.Sci.Nat (118385), WISA fellow; Registered EAP - 2019/367 (EAPASA)		
Name of landowner(s) on whose behalf the plan has been developed:	Capewinelands Aero (Pty) Ltd		

<table>
<tr><td>Contact person(s):</td><td colspan="3">Deon Cloete</td></tr>
<tr><td>Postal address:</td><td colspan="3">P.O. Box 12449, Mill Street</td></tr>
<tr><td>Telephone:</td><td>n/a</td><td>Postal code:</td><td>8001</td></tr>
<tr><td>Fax:</td><td>n/a</td><td>Cell:</td><td>+27(0) 82 339 2807</td></tr>
<tr><td>E-mail:</td><td colspan="3">d.cloete@capewinelands.aero</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td>Municipality for proposed project:</td><td colspan="3">City of Cape Town Metropole</td></tr>
<tr><td>Farm name(s), erf(s) and portion number(s) etc*:</td><td colspan="3"><table><tr><th>Land portion</th><th>Landowner</th></tr><tr><td>P23 of Farm 724</td><td>Corobrik (Pty) Ltd</td></tr><tr><td>P7 of Farm 942</td><td>Buurmanskraal Boerdery (Pty) Ltd</td></tr><tr><td>RE of Farm 474</td><td>Buurmanskraal Boerdery (Pty) Ltd</td></tr><tr><td>P3 of Farm 474</td><td>Buurmanskraal Boerdery (Pty) Ltd</td></tr><tr><td>RE of Farm 724</td><td>Capewinelands Aero (Pty) Ltd</td></tr><tr><td>P10 of Farm 724</td><td>Cape Winelands Airport (Pty) Ltd</td></tr><tr><td>P4 of Farm 474</td><td>Cape Winelands Airport (Pty) Ltd</td></tr></table>
Please refer to and for locality maps.</td></tr>
<tr><td>Magisterial District or Town:</td><td colspan="3">City of Cape Town Metropole</td></tr>
<tr><td>Name(s) of watercourse(s) in question:</td><td colspan="3">Mapped wetland systems within the CWA cadastral areas (refer Figure 1):
- Seep Wetland 1
- Seep Wetland 2
- Channelled Valley Bottom (CVB) Wetland 1
- Channelled Valley Bottom (CVB) Wetland 2
- Channelled Valley Bottom (CVB) Wetland 3</td></tr>
</table>

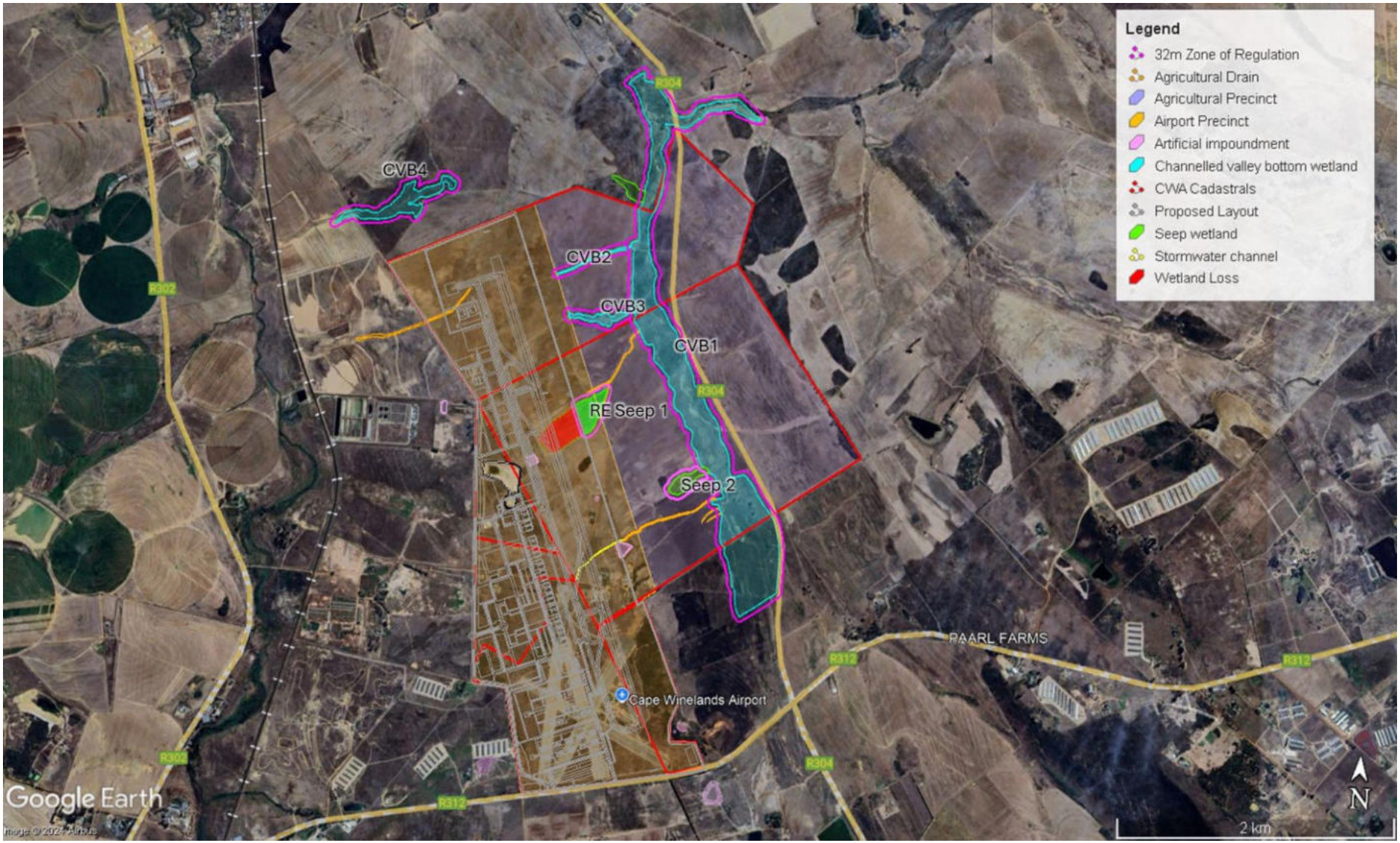


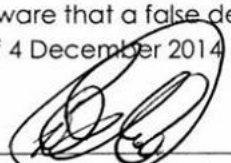
Figure 1: The delineated extent of the watercourses and artificial features associated with the proposed development area and applicable NEMA 32m Buffers. Wetland delineations were undertaken by FEN Consulting (map produced by PHS Consulting, November 2024).

DECLARATION

THE PERSON THAT WILL BE UNDERTAKING THE MAINTENANCE

I Deon Cloete, **duly authorised** by Capewinelands Aero (Pty) Ltd thereto hereby declare that I/we:

- Request the MMP to be adopted by the Competent Authority;
- Regard the information contained herein to be true and correct for this Maintenance Management Plan;
- Am fully aware of my responsibilities in terms of the National Environmental Management Act of 1998 ("NEMA") (Act No. 107 of 1998) and that, notwithstanding the adoption of this MMP, I/we shall comply with any other statutory requirement applicable, which may include, but not limited to the Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983), the National Water Act, 1998 (Act No. 36 of 1998) and the Environmental Impact Assessment Regulations, 2014 (as amended) ("EIA Regulations"), in terms of NEMA;
- Am fully aware that the proposed maintenance constitutes a listed activity in terms of the NEMA EIA Regulations, 2014 (as amended) and that an environmental assessment for environmental authorisation may be required for any other listed activities not included as part of this MMP;
- Acknowledge that any activity undertaken that does not form part of the defined and adopted MMP, will be subject to the Section 24(F) of NEMA and that appropriate enforcement and compliance requirements will follow;
- Shall undertake only those tasks described in the MMP, failing which environmental authorisation will be required, where applicable;
- Shall provide the competent authorities with access to all information at my disposal that is relevant to this request;
- Shall be responsible for any costs incurred in complying with environmental legislation;
- Hereby indemnify the government of the Republic, the competent authority and all its officers, agents and employees, from any liability arising out of, inter alia, any loss or damage to property or person as a consequence of undertaking this MMP; and
- Am aware that a false declaration is an offence in terms of Regulation 48(1)(a) GN No. R. 982 of 4 December 2014 (as amended).



10 June 2025

Signature of ~~the proponent~~: Date:

Capewinelands Aero (Pty) Ltd

Name of institution/company:

RESOLUTION – CAPE WINELANDS AERO (PTY) LTD, (Reg 2021/542277/07

RESOLUTION PASSED BY THE DIRECTORS OF

CAPEWINELANDS AERO (PTY) LTD, (Reg 2021/542277/07) ("COMPANY")

PASSED AT Cape Town ON 1 September 2023

RESOLVED as a director's resolution that this Company apply to the City of Cape Town, and various other departments for all statutory authorisations and permissions in respect of various fixed properties whereby Power of Attorney has been obtained in order to develop an airport; and

RESOLVED FURTHER that Mr Deon Cloete (ID 6509295209088) in his capacity as the director of the Company be and is hereby authorised on behalf of this Company to:

(i) do all such things and sign all such other documents as may be necessary or requisite to give effect to this resolution; and

(ii) to give Power of Attorney to Paul Slabbert (Id: 7305235224082) from PHS Consulting and Jacob Hugo (Id:5903215021080) from H&A PLANNING with power of substitution with other relevant registered professionals to obtain such approvals on the Company's behalf.

(iii) in order to submit application documents, sign documents and to perform all such acts which may be necessary in relation to the following legislation as amended:

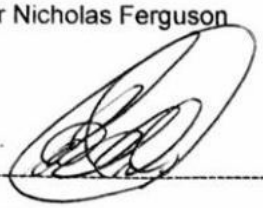
1. National Environmental Management Act, 1998 (Act No. 107 of 1998)
2. National Environmental Management: Waste Act, 2008 (Act 59 of 2008)
3. National Environmental Management: Air Quality Act, 2004 (Act 39 of 2004)
4. National Water Act, 1998 (Act No. 36 of 1998) Water Use Licensing and/or General Authorization
5. Water Services Act, 1997 (Act No. 108 of 1997)
6. National Heritage Resources Act, 1999 (act no. 25 of 1999)
7. Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002), mine closure/removal of mining right
8. Subdivision of Agricultural Land Act (Act 70 of 1970)
9. The Western Cape Land-Use Planning Act, 2014 (Act No 3 of 2014)
10. The City of Cape Town Municipal Planning By-Law, 2015 (as amended)
11. The City of Cape Town Immovable Property By-Law, 2014 (as amended)

SIGNED at CAPE TOWN on 1 SEPTEMBER 2023.

As directors:

N S Ferguson

Mr Nicholas Ferguson



Mr Deon Cloete

M J Wilkinson

Mr Mark Wilkinson

BACKGROUND AND INTRODUCTION

2.1. Contextual Information

This report aims to develop a Maintenance Management Plan for the proposed expansion of the existing Cape Winelands Airport. The site is located approximately 10.5km northeast of Durbanville and 25km northeast of Cape Town International Airport (CTIA) (Figure 2).

The proposed development will extend across a total of seven cadastrals namely, Portion 23 of Farm 724, RE of Farm 724, Portion 10 of Farm 724, Portion 4 of Farm 474, RE of Farm 474, Portion 7 of Farm 942, and Portion 3 of Farm 474, creating a combined area of approximately 885ha (Figure 3). Of this area, approximately 470ha will be allocated for airport development, including an airside precinct, terminal precinct, services precinct, general aviation precinct and associated landscaping (Figure 4 & Figure 5). The remaining land will remain as agricultural zones, designated as an agricultural precinct (Figure 4 & Figure 5). This agricultural precinct will feature a combination of dryland agriculture, conservation of botanically sensitive areas, and wetland offsets.

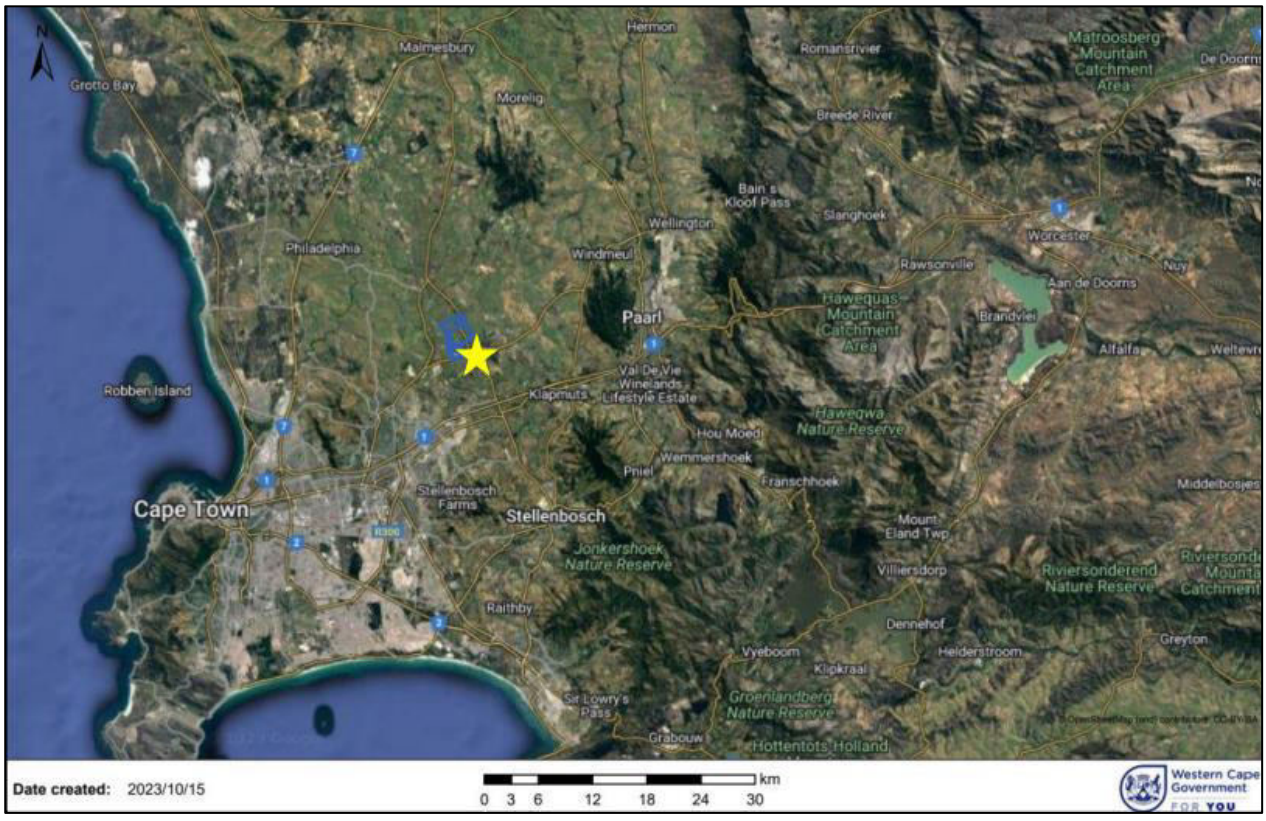


Figure 2: Regional location of current CWA indicated by yellow star. The blue lines indicate land parcels that form part of the application area (PHS Consulting, Oct 2023)

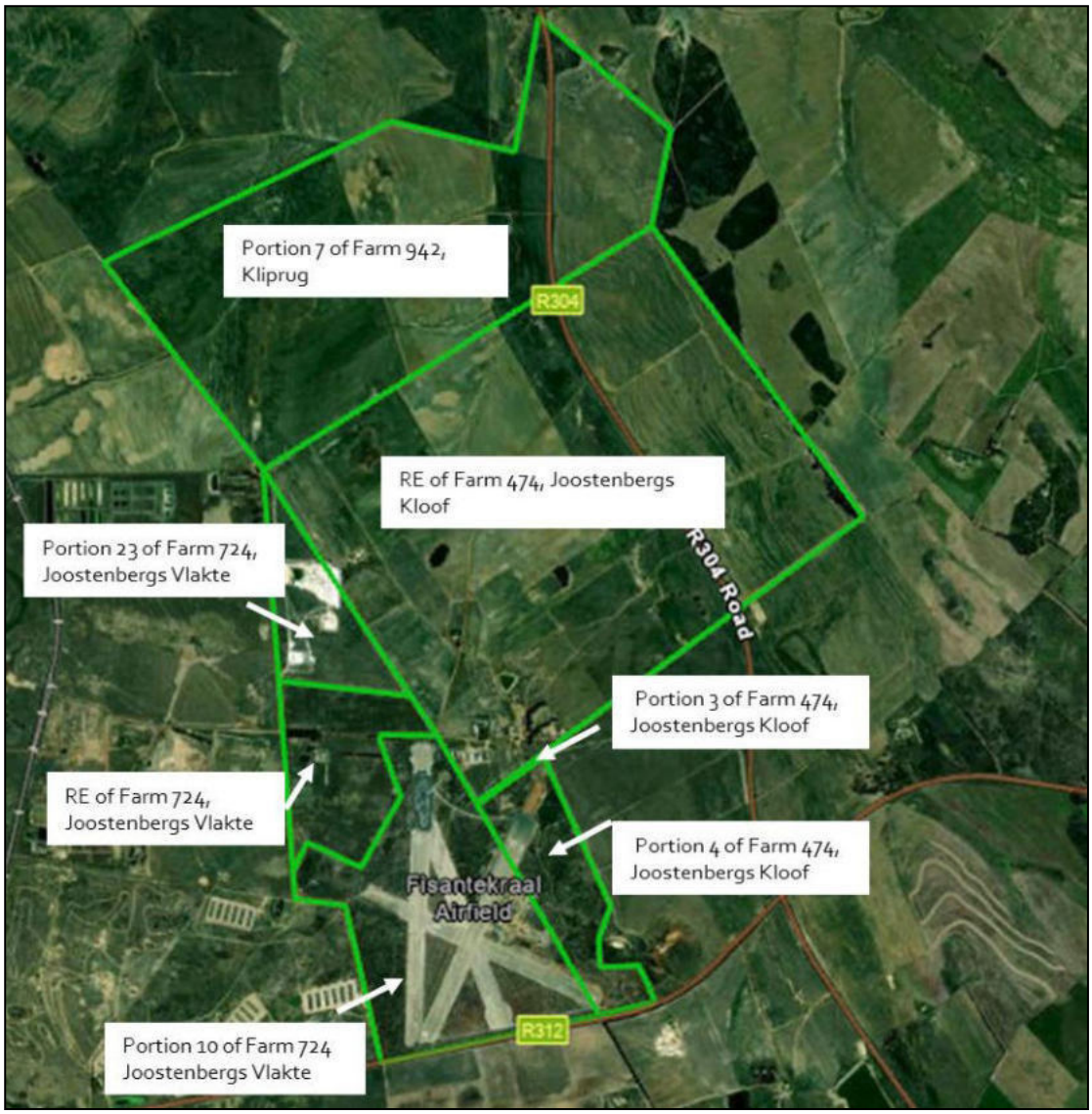


Figure 3: Cadastrals Forming Part of Application Area (PHS Consulting, February 2024)

Figure 4: Phase 1 Concept SDP (Capex Projects, August 2024).

Figure 5: Phase 2 Concept SDP (Capex Projects, January 2025).

The CWA site is located within Quaternary Catchment G21E in the Berg Water Management Area. The Mosselbank River is located West of the study area, and the Klapmutsrivier North of the site (refer Figure 2). Both rivers are considered largely modified.

A freshwater ecological site verification was undertaken in 2022 by FEN Consulting and the following watercourses were identified (refer Figure 1):

- A channelled valley bottom (CVB) wetland (hereafter referred to as CVB wetland 1) associated with the unnamed tributary of the Klapmuts River was identified bisecting the eastern portion of the study area, west of the R304;
- Two CVB wetlands (CVB wetlands 2 and 3) were identified within the northern portion of the study area and are linked to CVB wetland 1. The upper reach/western portions of the two CVB wetlands were also identified to encroach into the airport precinct;
- Another CVB wetland (CVB wetland 4) was identified North of the study area.
- Two seep wetlands were identified within the central western portion of the study area. One of these seep wetlands is directly linked to CVB wetland 1, while the other is indirectly linked via an agricultural drain;
- Several stormwater channels (some with concrete channels and others with excavated earth channels) and agricultural drains (usually with excavated earth channels) that convey surface water runoff (predominantly from the cultivated areas) into the identified freshwater systems, including into CVB wetland 1. It is possible that some of these agricultural drains may have functioned as natural watercourses in the past, but due to the high degree of land use transformation, agricultural activities and historical mining activities they now only function as drainage channels.
- Two artificial impoundments, one isolated and relic and the other connected to CVB wetland 1 via a stormwater channel and agricultural drain, and a quarry associated with historical open-pit clay mining activities were identified.

1.2. Scope of proposed project

An overview of the proposed SDP is provided in Figure 4 and Figure 5

Airside Precinct Development

In Phase 1, the airport will comprise of one runway, which will be at an orientation of 01-19 and a length of 3.5km and will be constructed to serve up to Code 4F instrument operations.

This runway will be shared by all operators, including scheduled commercial as well as general aviation, where intersection take-off points will be introduced on the runway to improve efficiency for general aviation operations.

The airside runway development in Phase 1 will also include, but not be limited to, airside systems such as CAT III Instrument Landing System (ILS), Precision Approach Path Indicator, Glidepath Antennas, Meteorological Systems, Airfield Ground Lighting (AGL) and Remote Digital Control Tower Systems. Aircraft parking stands range from ICAO Code B up to ICAO Code F stands. As part of the Development, 11 MARS stands (21 code C equivalent stands) is foreseen.

In Phase 2 the airport development strategy is based on the continued development of the various precincts based on market demand with the main runway (Figure 6) still shared by all operators, including scheduled commercial as well as general aviation.

Airside service roads will be constructed to provide access to airport assets for vehicles such as buses, ground service equipment and maintenance vehicles. An airport security fence will be erected in line with aviation security standards.

In addition to the runway development, the following airside, terminal and landside developments are proposed as part of the proposed airport expansion:

- Passenger & Cargo Terminals
- Aircraft Hangers & Services
- Aircraft Parking Aprons
- Airside Service Roads
- Internal & External Road Infrastructure
- Runways, Taxiways & Taxi lanes
- Airport Security Fence
- VIP Processing Facility
- Hotel
- General Aviation & Fixed Base Operations Facilities
- Airport Support Facilities
- Bulk Fuel Storage Facility
- Petrol Filling Station
- Cargo Facility
- Airport Maintenance Facility
- Ground Support Equipment Maintenance Facility
- MRO (Maintenance, Repair & Overhaul) Facility
- Inflight Catering Facility
- Solar PV Plant & Biodigester
- Potable Water & Sewage Treatment Infrastructure
- Stormwater Management Infrastructure
- Airport Operations Centre
- Air Traffic Control Centre

Landside Developments

The landside development will include the following:

- Access, egress (departure) and an internal vehicular road system
- Drop & go facilities which will allow passengers to drop passengers off close to the passenger terminal building
- Public transport facilities
- Car rental facilities
- Vehicular parking (multi-storey parking, at-grade parking)
- Pedestrian walkways
- Billboards (indoor & outdoor, static & electronic)
- Droneport & vertiports

Commercial Developments

Included in the Development, and in addition to aeronautical development, are commercial developments. Approximately 350 000m² of lettable area will be provided for. The terminal precinct encompasses a terminal plaza with a landmark hotel building, aviation museum, amphitheatre, offices, and MICE (Meetings, Incentives, Conferences, & Exhibitions) developments along the landside access road to the terminal. Included in the aeronautical hub functions are hangars, aviation clubs, an aviation training centre, workshops, light manufacturing, logistics, warehousing, and food processing.

Access

There is existing access through the existing Cape Winelands Airport. Main access proposed is from the South off Lichtenburg Road (R312) and from the West off Klipheuwel Road (R302).

1.3. Purpose of the MMP

The purpose of this MMP is to ensure that any environmental impacts associated with proposed maintenance activities within the regulated areas of watercourses and designated wetland offsets are effectively managed, mitigated, and minimized. Possible maintenance is anticipated, associated risk identified, and these are mitigated/ managed to minimise the impact. It also provides clear guidance to the person responsible for the maintenance in future to avoid possible transgressions in terms of NEMA listed activities. In this way maintenance is also minimised and directional when it occurs.

1.4. Listed Activities

This MMP is applicable to the following listed activities in terms of NEMA:

Description of listed activity	Description of maintenance activities

EIA Regulations Listing Notice 1 of 2014 (as amended) **Activity 19, Listing Notice 1**: The infilling or depositing of any material of more than 10 cubic meters into, or the dredging, excavation, removal or moving of soil, sand, shell grit, pebbles or rock of more than 10 cubic metres from a watercourse; but excluding where such infilling, depositing, dredging, excavation, removal or moving- (a) will occur behind a development setback; (b) is for maintenance purposes undertaken in accordance with a maintenance management plan; (c) falls within the ambit of activity 21 in this Notice, in which case that activity applies; (N.B. Points (d) and (e) does not apply as these activities fall within the coastal zone)	Ongoing sediment removal from stormwater ponds, infrastructure, and areas upstream of existing roads within wetland areas may be necessary to maintain drainage, with additional removal potentially required following heavy rains.
EIA Regulations Listing Notice 3 of 2014 (as amended) **Activity 12, Listing Notice 3:** The clearance of an area of 300 square metres or more of indigenous vegetation except where such clearance of indigenous vegetation is required for maintenance purposes undertaken in accordance with a MMP. **i. Western Cape** i. Within any critically endangered or endangered ecosystem listed in terms of section 52 of the NEMBA or prior to the publication of such a list, within an area that has been identified as critically endangered in the National Spatial Biodiversity Assessment 2004; ii. Within critical biodiversity areas identified in bioregional plans; iii. Within the littoral active zone or 100 metres inland from high water mark of the sea or an estuarine functional zone, whichever distance is the greater, excluding where such removal will occur behind the development setback line on erven in urban areas iv. On land, where, at the time of the coming into effect of this Notice or thereafter such land was zoned open space, conservation or had an equivalent zoning; or	During the operation of the proposed development, maintenance of infrastructure such as fences, pipelines, and roads within 32m of designated wetland offset areas may be required. These maintenance activities could also involve the removal of rehabilitated indigenous vegetation to access and repair infrastructure.

v. On land designated for protection or conservation purposes in an Environmental Management Framework adopted in the prescribed manner, or a Spatial Development Framework adopted by the MEC or Minister. (NB. Point iii does not apply as this activity falls within the coastal zone)	

The MMP must form part of all contractual documents for maintenance projects in the future. The adoption of the MMP by DEA&DP will require that the applicant/ landowner and all appointed contractors must comply with the requirements therein. Any amendments/ changes/ upgrades to the MMP required will require submission to and approval by DEA&DP.

1.5. Description of Proposed Maintenance Activities

a) Infrastructure associated with onsite wetlands

Limited infrastructure and associated maintenance activities are proposed within 32m from the onsite wetlands. This includes perimeter fence which traverse Seep Wetland 1 and runs adjacent (>32m) to CVB Wetland 2 and 3. Additionally, service infrastructure (bulk water pipeline & stormwater infrastructure) encroaches into the 32m NEMA ZoR from onsite wetlands.

Maintenance activities for fences and water pipelines focus on ensuring structural integrity, preventing blockages, and managing surrounding vegetation. Routine inspections are essential to identify wear, damage, leaks, or obstructions. Repairs often involve replacing damaged or broken sections, tightening loose fasteners, or addressing corrosion. Vegetation removal and excavation/trenching may be needed to conduct the necessary repairs or replacements. For fences, removing overgrown vegetation prevents damage and maintains clear access. Water pipelines require routine cleaning to prevent blockages and maintain flow.

b) Wetland offset areas

Seep wetland 1 located within the airport precinct will be partially lost as a result of the proposed development. The proposed development activities will result in loss of approximately 6.74ha of wetland habitat. When accounting for indirect impacts, the total loss extends to 7.44ha (Figure 6). A freshwater offset has been developed to compensate for the loss of freshwater habitat (FEN, Wetland Offset Study and Implementation Plan, February 2025). The proposed offset involves rehabilitating the remaining seep wetland habitat (3.68ha) in the eastern part of the airport precinct along with a portion of CVB Wetland 1 (36.2ha) further East of the airport precinct into which the seep wetland drains (via an agricultural drain)(Figure 6). In addition, the agricultural drain connecting the seep

wetland to the CVB wetland is also earmarked for rehabilitation (Figure 6). Offset consideration is being done in consultation with the CoCT, Cape Nature, the DEA&DP and the DWS.

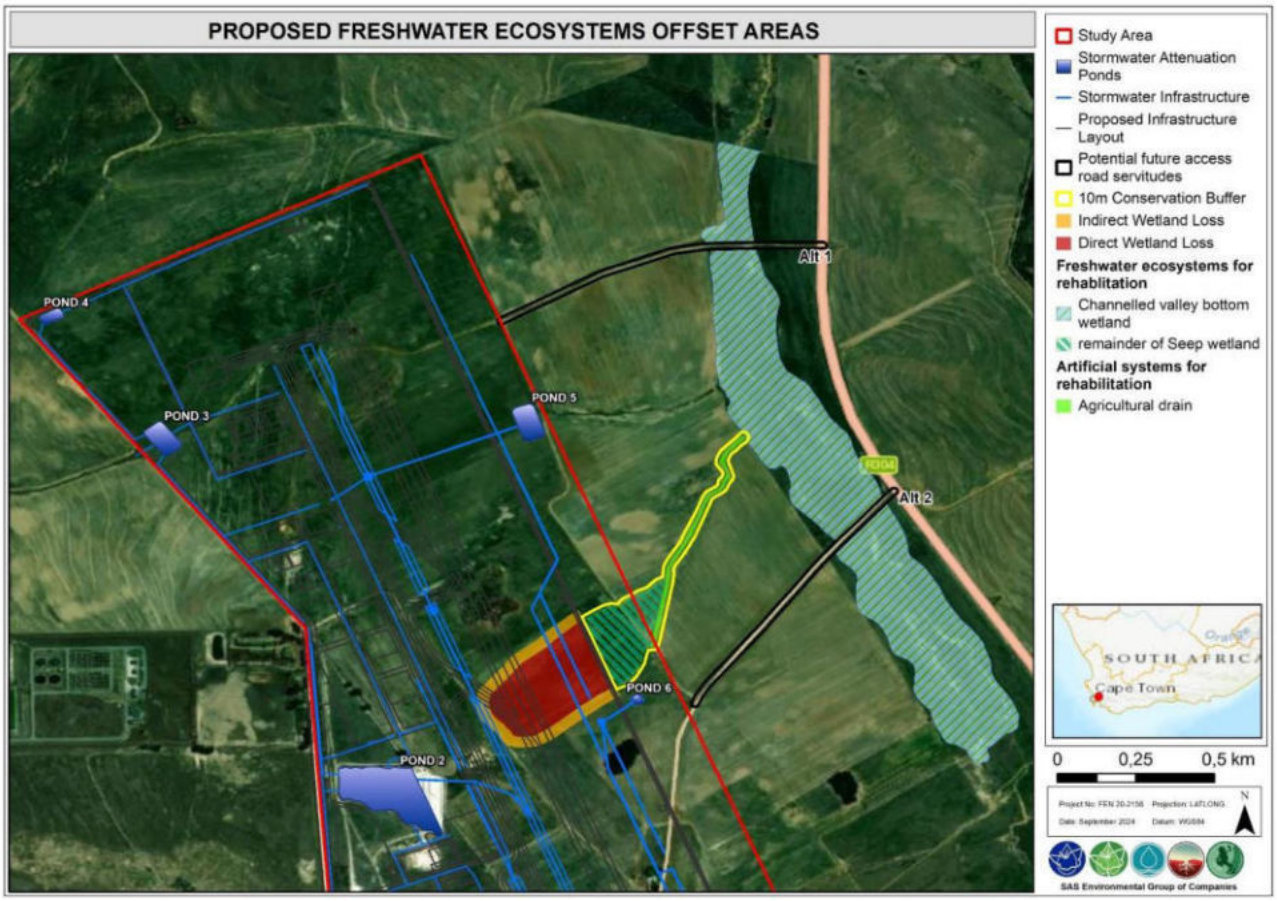


Figure 6: Extent of wetland to be lost (7.44ha) vs identified wetland areas to be rehabilitated (Draft Wetland Offset Study and Implementation Plan, February 2025)

The freshwater specialist recommends extensive rehabilitation work within CVB wetland 1, the agricultural drain, and surrounding areas to meet the Wetland Offset requirements and achieve a Category D Present Ecological State (PES) over the long term. In contrast, the seep wetland requires less extensive restoration.

Key rehabilitation activities identified include:

- Removing alien invasive plants (AIPs) and harvesting native wetland plants for revegetation.
- Addressing gully and headcut erosion, and regrading sections of the CVB wetland and agricultural drain.
- Revegetating the restored wetland areas and agricultural drain.
- Implementing stormwater management measures for the site.

The rehabilitation is envisaged to take no more than one year with minor potential aftercare and maintenance where interventions took place. Maintenance activities for the wetland offset include establishing a monitoring program to regularly assess water quality, hydrological parameters, wetland health, and key ecological indicators to maintain and improve the wetland's condition. This

includes plans for addressing issues like stormwater blockages and changes in vegetation health. An adaptive management plan will be implemented that allows for adjustments stormwater management, erosion control, and other practices based on monitoring results and evolving environmental conditions. All rehabilitated wetlands and associated 15m/16m operational buffers must be maintained in the desired ecological state (PES Category D).

Maintenance activities for wetland offset areas will involve ongoing monitoring and targeted removal of alien invasive plants (AIPs) to mitigate erosion and sedimentation impacts. Continuous monitoring and maintenance should cover all areas where AIPs have been cleared, with an additional five-year annual control program to address re-sprouting and reduce the existing alien seed bank. Following this period, the need for AIP control will be reassessed through adaptive management practices based on actual conditions as managed by the Alien Invasive Vegetation Management Plan developed for the proposed development (PHS Consulting, March 2025). Control measures within the 32meter regulated buffer around wetlands must be undertaken in accordance with the measures outlined in the Wetland Offset Study and Rehabilitation Plan (FEN, February 2025) and must include necessary follow-up treatments after initial removal.

To ensure the long-term effectiveness of the remediation efforts for head-cut and gully erosion in CVB Wetland 1 and the associated agricultural drain, active maintenance is required. This involves regular monitoring for signs of erosion and sedimentation, with interventions as needed. While no major remediation work is expected, regular oversight will assist with ensuring that the integrity of the initial rehabilitation efforts is maintained. If erosion or sediment deposition is observed, the underlying causes must be identified, and appropriate control measures implemented. Additionally, the offset wetlands should remain free from dumped waste and debris; any discarded materials must be promptly removed manually.

Areas that have been revegetated with indigenous plants will need ongoing monitoring throughout their establishment, with replanting carried out as needed. It is anticipated that there will be loss of some planted saplings during the rehabilitation phase. To maximize success of revegetation efforts, additional plants should be added one year after rehabilitation, prior to the rainy season. For the first three years following construction, saplings should be replanted annually during the winter months. Additionally, since the wetlands and surrounding areas are grazed by resident cattle, regular monitoring for signs of damaged grazing is essential, with prompt action taken to address any damage observed.

In addition to the planned rehabilitation and maintenance of wetland offsets, storm events may cause damage to onsite wetlands that will require targeted restoration. After heavy rains, wetland areas downstream of roads should be inspected for silt and debris accumulation. Prompt manual removal of debris and excess sediment will help preserve the natural flow, protecting water quality and vegetation from long-term impacts.

c) Maintenance associated with stormwater infrastructure

The proposed stormwater drainage network is based on a dual stormwater system, consisting of a major and a minor network, conveying stormwater generated on site via pipes and overland flow routes into seven (7) dry attenuation ponds with engineered layerworks and one (1) wet detention pond, positioned at strategic locations along the proposed CWA development site boundary (Figure 7). The proposed stormwater infrastructure also includes a series of dry swales that will serve to convey stormwater.

The basic stormwater design principles used to inform the concept design of stormwater infrastructure for the CWA site can be best described as follows:

- The natural drainage direction of stormwater of the site will remain unchanged as the site generally falls in a South to North direction with outfalls positioned strategically along the eastern and western boundaries.
- The minor system will comprise of open drains, an underground piped network complete with channels, inlet catchpits, oil separators, manholes and outlet structures sized to accommodate stormwater runoff from the roads, buildings, and other hard surfaced area for at least minor storm events up to the 1:5-year RI storm.
- The major system will comprise of roads and on-site overland flow paths which will operate in conjunction with the minor system to accommodate stormwater runoff from roofs and other hard surfaced areas for major storm events up to and including the 1:50-year RI storm.
    - The design levels allow for on-site overland flow routes in the event of a blockage or failure of the minor system.
- Where no on-site overland flow paths exist to accommodate run-off from major storm events, the underground piped network will be sized to accommodate run-off for major storm events (up to the 1:50 year).
- The overland flow routes on the CWA site are designed to safely convey the 1:100-year storm event towards the ponds situated along the boundary of the site. From there formal overland escape routes, in the form of pond overflows, will be designed to convey peak runoff from the 1:100-year storm which cannot be handled by the above proposed stormwater system before discharging into the adjacent infrastructure.

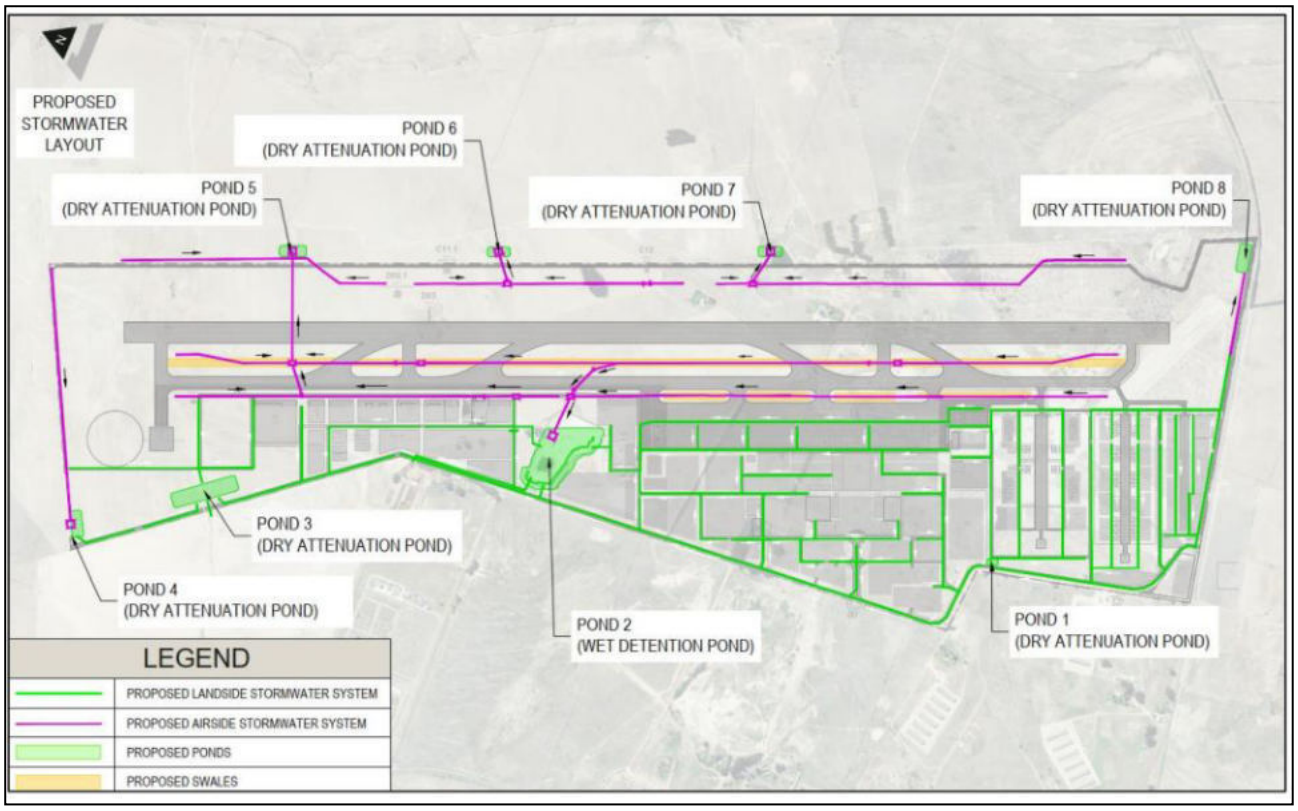


Figure 7: Proposed stormwater management layout (Zutari, Stormwater Management Plan, September 2024)

The proposed stormwater infrastructure, including dry attenuation ponds, stormwater pipes, and dry swales, will require ongoing maintenance activities within the 32m Zone of Regulation (ZoR) from wetlands. The maintenance activities will include:

- Monthly Litter and Debris Removal: Regular removal of sand, litter, and refuse from stormwater infrastructure, including kerbs and channels.
- Pipe Maintenance: Monthly removal of refuse from pipes, along with sand and silt using high-pressure jetting.
- Vegetation Management: Monthly management of vegetation to maintain design levels.
- Annual Cleanup: Removal of dead vegetation within and around the stormwater infrastructure before the growing season begins.
- Inspection of Covers and Frames: Monthly inspections of covers and frames, with replacement, repositioning, or repairs as needed.
- Embankment Inspections: Monthly or post-rain inspections of embankments, reshaping them if required to restore the original slope.
- Headwall Inspections: Monthly or post-rain inspections of headwalls, removing any blockages and trimming natural vegetation for unobstructed drainage.
- Inlet, Outlet, and Basin Inspections: Monthly checks for overflows, blockages, and sediment accumulation, with necessary corrective actions taken.
- Sediment Removal: Annual (or as required) removal of sediment from inlets, outlets, and forebays.

- Forebay and Outlet Inspection: Semi-annual inspections of the sedimentation forebay and outlet apron, especially before the first seasonal rains, to remove any accumulated silt and debris, ensuring proper disposal at suitable landfill sites without introducing silt into the stormwater system.
- Vegetation Replanting: Replanting or reseeding in degraded areas as needed and pruning plants for optimal stormwater management.
- Repair and Maintenance of Infrastructure: Prompt repairs of any erosion or damage to the stormwater infrastructure, ensuring design levels are maintained, which may involve vegetation removal, excavation, reshaping, and replanting.
- Headwall Maintenance in Dry Swales: Monthly removal of refuse from headwalls in dry swales, along with sand and silt removal using high-pressure jetting.

d) Maintenance associated with access and maintenance roads

A maintenance road will be constructed along the eastern boundary of the study area and two existing gravel access roads currently traverse CVB Wetland 1. Maintenance activities for gravel roads will involve several key tasks to ensure their safety, functionality, and longevity:

- Inspection and Reporting: Conducting regular inspections to assess the overall condition of the road, identifying issues that require attention, and documenting any necessary repairs.
- Grading: Grading of the road surface will likely be necessary to maintain a smooth and even driving surface, addressing ruts and washboarding caused by weather and vehicle traffic.
- Drainage Management: Regular inspection and maintenance of drainage ditches, culverts, and cross-drainage structures will be essential to prevent water accumulation and erosion. This includes clearing debris and sediment from these areas.
- Infrastructure Repairs: Timely identification and repair of potholes, erosion and other surface irregularities will help prevent further damage, erosion and potential for sedimentation of downstream wetlands.
- Vegetation Control: Removal of overgrown vegetation and weeds along the road edges.
- Flood Damage Repair: After a storm event, roads should be inspected for washouts, erosion, and structural damage. Where damage is found, eroded areas should be filled with compacted gravel or soil and the surface should be regraded to restore safe access and prevent further erosion.

1.6. MMP process project team

Team member	Expertise	Role
Amanda Fritz-Whyte	EAP – MMP compilation	Compilation of MMP
Olivia Brunings	Candidate EAP – MMP compilation	Compilation of MMP
Zutari	Project Engineer	Compilation of Stormwater Management plan
FEN	Freshwater Ecologist	Compiled Freshwater Ecological report, Wetland offset report
Deon Cloete	Landowner Representative responsible for implementation of MMP	Input into MMP

1.7. Roles and Responsibilities

This Maintenance Management Plan (MMP) forms a subsidiary component, as Annexure 16, of the overarching Environmental Management Plan (EMPr) for the proposed development. For a comprehensive overview of the roles and responsibilities, please refer to Section 3 of the EMPr.

The responsibility for implementing the MMP lies with the Environmental Management Division of the Cape Winelands Airport as stated in the Section 3.3 of the EMPr.

2. DEFINITIONS OF TERMS AND ACRONYMS

Definitions:

"**Activity**" means an activity identified in any notice published by the Minister or MEC in terms of section 24D(1)(a) of the Act as a listed activity or specified activity. Activity in this document refers to the activities as listed in Listing Notice 1, 2 and 3 of the Environmental Impact Assessment Regulations, 2014 (as amended).

"**Bush Encroachment**" means stands of plants of the kinds specified in column 1 of Table 4 of the Conservation of Agricultural Resources Act (Act No. 43 of 1983) where individual plants are closer to each other than three times the mean crown diameter.

"**Diverting**" as defined in the General Authorisation, in terms of section 39 of the National Water Act, 1998 (Act no 36 of 1998) for Water Uses as defined in Section 21(c) and 21(i) (GN. 509 of 26 August 2016), means to, in any manner, cause the instream flow of water to be rerouted temporarily or permanently.

"**Ecological Infrastructure**" refers to naturally functioning ecosystems that deliver valuable services to people, such as water and climate regulation, soil formation and disaster risk reduction.

"**Estuary**" has the meaning assigned to it in the National Environmental Management: Integrated Coastal Management Act, 2008 (Act No. 24 of 2008)

"**Flood event**" is the event where land is inundated by the overflowing of water from a river channel and where this event causes significant damage to infrastructure or results in watercourse erosion and/or sediment deposition.

"**Flow-altering**" as defined in the General Authorisation, in terms of section 39 of the National Water Act, 1998 (Act no 36 of 1998) for Water Uses as defined in Section 21(c) and 21(i) (GN. 509 of 26 August 2016), means to, in any manner, alter the instream flow route, speed or quantity of water temporarily or permanently.

"**General Authorisation**" in this document refers to the General Authorisation in terms of section 39 of the National Water Act, 1998 (Act no 36 of 1998) for Water Uses as defined in Section 21(c) or Section 21(i) (GN. 509 of 26 August 2016).

"**Impeding**" as defined in the General Authorisation, in terms of section 39 of the National Water Act, 1998 (Act no 36 of 1998) for Water Uses as defined in Section 21(c) and 21(i) (GN. 509 of 26 August 2016), means to, in any manner, hinder or obstruct the instream flow of water temporarily or permanently, but excludes the damming of flow so as to cause storage of water.

"**Indigenous vegetation**" refers to vegetation consisting of indigenous plant species occurring naturally in an area, regardless of the level of alien infestation and where the topsoil has not been lawfully disturbed during the preceding ten years.

"**Maintenance**" means actions performed to keep a structure or system functioning or in service on the same location, capacity and footprint.

"**Maintenance Management Plan**" means a management plan for maintenance purposes defined or adopted by the competent authority.

"**River Management Plans**" as defined in the General Authorisation, in terms of section 39 of the National Water Act, 1998 (Act no 36 of 1998) for Water Uses as defined in Section 21(c) and 21(i) (GN. 509 of 26 August 2016), any river management plan developed for the purposes of river or storm water management in any municipal/metropolitan area or described river section, river reach, entire river or sub quaternary catchment that considers the river in a catchment context.

"**River reach**", a length of river characterised by a particular channel pattern and channel morphology, resulting from a uniform set of local constraints on channel form. A river reach is typically hundreds of meters in length.

"**Stretch**" a section of watercourse, delineated between two or more mapped coordinates, within which proposed maintenance activities are to take place as guided by a MMP.

"**Thalweg**" refers to the line of lowest elevation within a valley or watercourse.

"**Watercourse**" means:

(a) a river or spring;

(b) a natural channel in which water flows regularly or intermittently;

(c) a wetland, lake or dam into which, or from which, water flows; and

any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse as defined in the National Water Act, 1998 (Act No. 36 of 1998); and a reference to a watercourse includes, where relevant, its bed and banks.

"**Wetland**" means, land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil.

Acronyms:

CBA	Critical Biodiversity Area
CVB	Channelled Valley Bottom
DEA&DP	Department of Environmental Affairs & Development Planning
DWS	Department of Water & Sanitation
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
GA	General Authorisation, in terms of the National Water Act, 1998 (Act No. 36 of 1998)
GN	Government Notice
HGM unit	Hydrogeomorphic unit
MEC	Member of Executive Council
MMP	Maintenance Management Plan
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
NEMBA	National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004)
NFEPA	National Freshwater Ecosystem Priority Areas
NWA	National Water Act, 1998 (Act No. 36 of 1998)
PES	Present Ecological State
PPP	Public Participation Process
REC	Recommended Ecological Category
RI	Rapid Intensification
RQO's	Resource Quality Objectives
SANParks	South African National Parks Authority
WCBSP	Western Cape Biodiversity Spatial Plan
WUA	Water Users Association
WULA	Water Use Licence Application

3. ENGAGEMENT PROCESS

4.1. AUTHORITY ENGAGEMENT

Please indicate (with an 'x') which of the following authorities have been consulted to provide input based on the proposed maintenance activities:

- X Department of Water and Sanitation (as an I&AP and as CMA)
- X Catchment Management Agency
- X CapeNature
- ☐ SANParks
- X Western Cape Department of Agriculture, Directorate: Land Use Management
- X Local Municipality (City of Cape Town)
- X Heritage Western Cape
- ☐ Department of Agriculture, Forestry and Fisheries
- X Department of Environmental Affairs & Development Planning
- ☐ Other (please list):
  - X West Coast District Municipality
  - X Swartland District Municipality
  - X Cape Winelands District Municipality
  - X Western Cape Transport and Public Works
  - X DEA&DP: Waste Management Directorate
  - X DEA&DP: Pollution and Chemical Management

The above authorities will be consulted for their input during the EIA process PPP and comments received will be captured in a Comments and Responses report to be submitted with the final EIA to DEA&DP. Amendments to the MMP will be included in the final MMP submitted for approval to DEA&DP.

4.2. PUBLIC PARTICIPATION

The following public participation recommendations, regarding the different scale or geographical extent of the request, are as follows. If no, then motivation must be given as to why a particular process was not undertaken.

Single or Multiple properties / WUA / IB / local authority applying for a single MMP to cover a stretch of a watercourse <u>longer than 1 kilometer (>1000 meters) OR</u> a catchment or sub-catchment area

(i) Given written notice to the owner(s) or person(s) in control of the land if the person(s) undertaking the maintenance activity(ies) is not the owner or person in control of the land.	***Yes***	***POA for P7/942, RE/474; P3/474 and P23/724 in place***
(ii) Given written notice to non-participating adjacent landowners (up to 1km upstream and downstream from furthest upstream and downstream maintenance site and opposite side of the riverbanks) of the development of the	***Yes***	***Electronic communications to adjacent landowners as***

MMP. *This must also include general notice to adjacent WUA or IB of the proposed MMP development if application is made by a WUA or IB.*		***part of Scoping & EIA PPP.***
(iii) Stakeholder meeting held for all participating and non-participating landowners, in which details and methodology of MMP is presented. A minimum of two meetings are required, to present on the development of the plan and a final draft version of the plan.	***Yes***	***A 1st Open public meeting was held on 8 May 2024, explaining the extent of watercourses and wetlands to be affected, and assessed as part of the development.*** ***Adjacent landowners to provide comment on the MMP as part of EIA PPP which will consist of a minimum of two commenting periods.*** ***A 2nd Open day held on 20 November 2024 during EIA Phase to enable stakeholders to engage re MMP and with specialists and to make comment to EAP.*** ***3rd Open day held on 15 April 2025 to enable stakeholders to engage re MMP and with specialists and to make comment to EAP.***
(iv) Given written notice to any organ of state having jurisdiction in respect of any aspect of the activity(ies) proposed within the development of the MMP.	***Yes***	***Electronic communications sent to organs of state as per Scoping & EIA PPP. Meeting and engagement also held with DWS.***
(v) Provide written notice and confirmation to the relevant Water Users Association (WUA) or Irrigation Board (IB), of the development of the MMP (*if a MMP is not requested and managed through a WUA/IB).*	***Yes***	***DWS included as I&APs for Scoping & EIA PPP. No irrigation board in this area.***
(vi) Describe any other measures taken to inform the public about this MMP. A complete list of measures that are in place to deal with interactions with the public, if it becomes	***Yes***	***- Site notices placed as part of Scoping & IA Phase.***

necessary and required by the competent authority during implementation of the project, must be provided for.		***- Advert placed in Tygerburger to inform potential IAPs of Scoping & IA Phase and MMP and opportunity to comment for a two 30 day PPP periods and an additional 45 day PPP period*** ***- Email and sms communication to all registered IAPs for the project.*** ***- Hard Copy of documents placed in Fisantekraal library.*** ***- Copy of EIA and MMP and all other documentation placed on PHS Consulting website for two separate 30 day commenting periods as well as an additional 45 day commenting period***

Please refer to Appendix 40 of the EIAR for a detailed breakdown of all the PPP undertaken to date.

5. DATA COLLECTION AND ASSESSMENT

5.1. Activities during Maintenance Phase

The following activities will be undertaken during the maintenance phase of the proposed development:

- General maintenance and repairs to perimeter fences. This includes replacing damaged sections, securing loose fasteners or treating areas affected by corrosion.
- Maintenance and repairs to water pipelines including replacing damaged sections, securing loose fittings, or treating corrosion.
- Excavation or trenching may be required to facilitate necessary maintenance works such as replacement of fence posts or pipeline repairs.
- Vegetation and debris removal from areas where maintenance work is required.
- Vegetation management to maintain stormwater infrastructure capacity and road visibility and prevent potential damage from overgrown vegetation.
- Erosion control measures associated with the dam, its infrastructure and areas exposed during vegetation removal
- Periodic flushing or scouring of pipelines to maintain capacity and address the build-up of organic materials.
- Disturbance of instream habitat and potentially increased risk of erosion because of periodic vegetation removal to maintain ecological integrity of the natural areas onsite
- Upkeep of rehabilitated offset wetlands including replanting indigenous vegetation if required, addressing erosion and sedimentation that may arise.
- Silt removal from stormwater ponds and associated stormwater infrastructure. This work will likely require using an excavator or similar equipment both within and around the ponds.
- Removal of
- Gravel road maintenance will involve regular inspections to identify issues and grading and pothole repair to keep the surface even.
- Drainage features, such as ditches and culverts, will be cleared regularly to prevent erosion.

PLEASE NOTE: The information provided in this section is largely obtained from the Detailed EIA Phase Freshwater Ecological Assessment by FEN Consulting (February 2025) as provided in Appendix A of this report. The Risk Matrix for the S21(c) and (i) activities is provided in the Freshwater Ecological report and used for the water use applications and registrations associated with the maintenance activities. The Terms of Reference for the specialist appointment is also provided for in Appendix A.

Additionally, please consult the Wetland Offset Monitoring Plan included in Appendix B of this document (FEN, Draft Wetland Offset Study and Implementation Plan, January 2025). Appendix C provides the coordinates for all sites where maintenance activities will be conducted.

5.2. Catchment context:

The proposed development site is located within the Breede-Olifants Water Management Area, quaternary catchment G21E. According to the FEPA database, the sub-quaternary catchment is not currently considered important in terms of fish or freshwater ecological conservation. However, the NGI river line vector dataset for the Western Cape does indicate several perennial and non-perennial drainage lines within the vicinity of the study area (Figure 8). The Mosselbank River is located West of the study area, and the Klapmuts River North of the site. Both rivers are considered largely modified (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025).

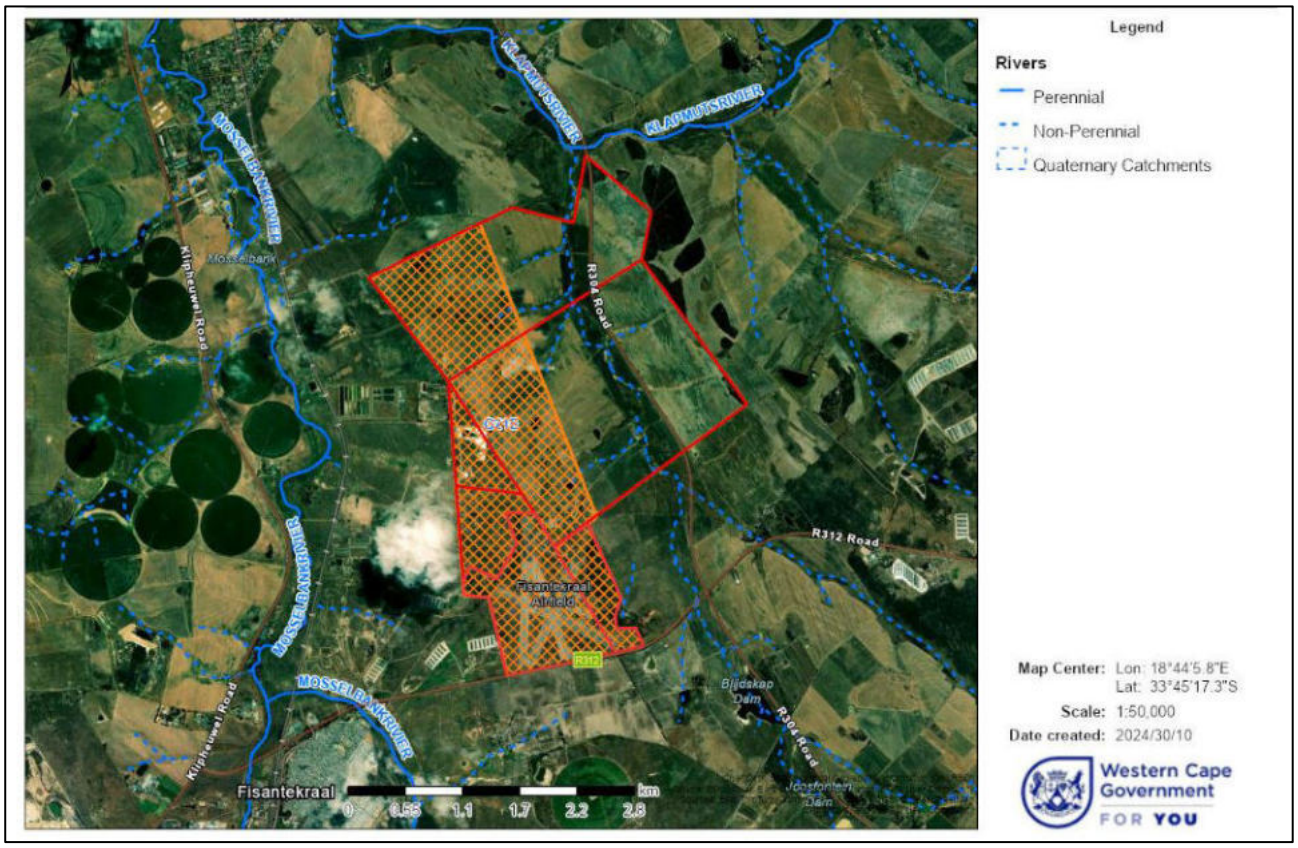


Figure 8: Development area (hatched orange) and cadastrals (red outline) in relation to identified rivers and drainage lines in the area (PHS Consulting, CapeFarmMapper, October 2024).

5.3. Context in terms of the Berg Resource Quality Objectives

The proposed CWA is located within Quaternary Catchment G21E which falls within what used to be the Berg WMA. While draft resource quality objectives (RQO) are available for the Berg Catchment, Quaternary Catchment G21E is not listed. Quaternary Catchment G21E is located within the Diep River Catchment IUA. Where RQO have been listed for quaternary catchments within the Diep River Catchment, the target ecological category ranges between C and D.

5.4. Regional and National Conservation context

To establish a comprehensive regional and national conservation context, various national and provincial wetland databases were consulted during the desktop assessment of the site. Key resources included the NFEPA 2011 wetlands database (Figure 9 & Figure 10), the National Wetlands Map 5 (included in Figure 11), and the CoCT 2017 wetland dataset (Figure 12 - Figure 14). An overview of the desktop information gathered from these datasets is presented in Table 1.

Table 1: Desktop data (from desktop databases only) relating to the characteristics of the freshwater ecosystems associated with the study and investigation areas (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025).

Aquatic ecoregion and sub-regions in which the study area is located		Detail of the study area in terms of the National Freshwater Ecosystem Priority Area (NFEPA) (2011) database	
Ecoregion	South Western Coastal Belt		
Catchment	Berg/Bort/Potberg	River FEPA	The study area is located within a sub-quaternary catchment currently not considered important in terms of fish or freshwater ecological conservation.
Quaternary Catchment	G21E		
WMA	Berg		
subWMA	Lower Berg	NFEPA Wetlands (Figure 9)	According to the NFEPA database (2011), no natural wetlands are located within the study area. One artificial seep wetland is indicated within the central eastern portion of the study area. This artificial seep wetland is considered to be in a critically modified ecological condition (Class Z3). Three artificial wetland flats are located within the investigation area. These artificial wetlands are also considered to be in a critically modified ecological condition (Class Z3). During the site assessment, all artificial wetlands were identified as artificial impoundments not associated with any natural freshwater ecosystems.
Dominant characteristics of the South Western Coastal Belt Ecoregion Level II (24.05) (Kleynhans *et al.*, 2007)			
Dominant primary terrain morphology	Moderately Undulating Plains, Hills		
Dominant primary vegetation types	West Coast Renosterveld, Mountain Fynbos, Sand Plain Fynbos, Central Mountain Renosterveld		
Altitude (m a.m.s.l)	100 – 500	Wetland Vegetation Type (Figure 10)	The majority of the study area is situated within the West Coast Shale Renosterveld wetland vegetation type, while the south eastern and central northern portions of the study area are located within the West Coast Silcrete Renosterveld. The central western portion of the study area is located in the Southwest Sand Fynbos wetland vegetation types. All three wetland vegetation types are considered Critically Endangered as per Mbona *et al.* (2015).
MAP (mm)	400 – 500		
The coefficient of Variation (% of MAP)	25 – 35		
Rainfall concentration index	30 – 55		
Rainfall seasonality	Winter	NFEPA Rivers (Figure 9)	As per the NFEPA database (2011), there are no rivers located in the study area. The Mosselbank River is located approximately 1 km west of the study area (based on the centre line of the river). According to the NFEPA database (2011), the Mosselbank River is considered to be in a largely modified ecological condition (Class D). The Klapmuts River is located approximately 1.1 km north east of the study area. According to the NFEPA database (2011), the Klapmuts River is considered to be in a largely modified ecological condition (Class D).
Mean annual temp. (°C)	16 – 18		
Winter temperature (July)	6 – 20		
Summer temperature (Feb)	14 – 30		
Median annual simulated runoff (mm)	60 – 250		
National Biodiversity Assessment (2018): South African Inventory of Inland Aquatic Ecosystems (SAIIAE) (Figure 11) (National Wetland Map 5 is included in the NBA)			
According to the NBA 2018: SAIIAE, three natural seep wetlands are located within the study area. The seep wetlands indicated within the study area are considered to be in a largely and critically modified ecological condition (Class D/E/F), are indicated as being affected by mining, are considered to be critically endangered according to the Ecosystem Threat Status (ETS), and poorly protected according to the ecosystem protection level (EPL). Eight more natural seep wetlands are located within the investigation area, five of which are located directly adjacent to the western boundary of the study area. According to the available database, these seep wetlands range from being considered to be in a moderately modified (Class C) to a largely and critically modified (Class D/E/F) ecological condition, and one is impacted by roads. Five of the seep wetlands are considered vulnerable according to the ETS, and well protected according to the EPL, while the remaining three are considered to be critically endangered according to the ETS and poorly protected according to the EPL. The Mosselbank River is located approximately 1 km west of the study area and is considered to be in a largely modified ecological condition (Class D), critically endangered according to the ETS and not protected according to the EPL as per the NBA dataset.			

Importance of the study area according to the City of Cape Town wetlands Dataset (2017) (Figure 12 and Figure 13)	
The CoCT Wetlands Dataset (2017) indicates three natural seep wetlands and a natural depression wetland within the north eastern and central portion of the study area. Additionally, eight natural seep and four depression wetlands are indicated within the investigation area, including five seep wetlands located directly adjacent to the central western boundary of the study area (corresponding with the findings from the NBA (2018)). The seep wetlands within the study area and three of the eight seep wetlands within the investigation area, are considered to be Critical Ecological Support Areas (CESA) according to the CoCT Wetlands Dataset (2017). CESA are unselected areas which host natural vegetation and considered essential for ecological support for Critical Biodiversity Areas and protected sites. The depression wetlands in the study and investigation areas, and the remaining two seep wetlands in the investigation area are categorised as Other Ecological Support Areas (OESA). OESAs are lower ranking artificial wetlands and lowest ranking natural and semi-natural wetlands. OESA wetlands should be managed for maintenance of ecological functioning within and around the wetland.	
City of Cape Town Biodiversity Network (2017) (Figure 14)	
The south eastern portion of the study area is located in an area classified as a CBA 1b of terrestrial importance. CBA 1b are irreplaceable good and fair condition sites that host critically endangered vegetation of good and fair quality. These sites are required to achieve biodiversity targets, and any loss of these areas is a permanent and irrevocable loss. Portions within the southern extent of the study area are classified as CBA 2 of terrestrial importance. CBA 2 are restorable irreplaceable sites that host critically endangered vegetation and sometimes associated with rivers and wetlands of restoration condition. CBA 2 are required to meet national biodiversity targets. A small portion within the south eastern extent of the investigation area is classified as an Other Ecological Support Area).	
National web based environmental screening tool (2020) (Figure 15)	
The screening tool is intended for pre-screening of sensitivities in the landscape to be assessed within the Environmental Impact Assessment (EIA) process. This assists with implementing the mitigation hierarchy by allowing developers to adjust their proposed development footprint to avoid sensitive areas.	The majority of the study area is located in an area considered to be of **low aquatic biodiversity** importance. Scattered portions within the study area are considered to be areas of **very high aquatic biodiversity** sensitivity due to the presence of wetlands and CESA as identified by the CoCT wetlands Dataset (2017). The sensitivity of some of the freshwater ecosystems was disputed. Refer to **Appendix E** for more information.

CBA = Critical Biodiversity Area; CESA = Critical Ecological Support Area; CR = Critically Endangered; EI = Ecological Importance; ES = Ecological Sensitivity; ESA = Ecological Support Area; EN = Endangered; m.a.m.s.l = Metres above mean sea level; MAP = Mean Annual Precipitation; NFEPA = National Freshwater Ecosystem Priority Area; OESA = Other Ecological Support Area; PES = Present Ecological State; WMA = Water Management Area.

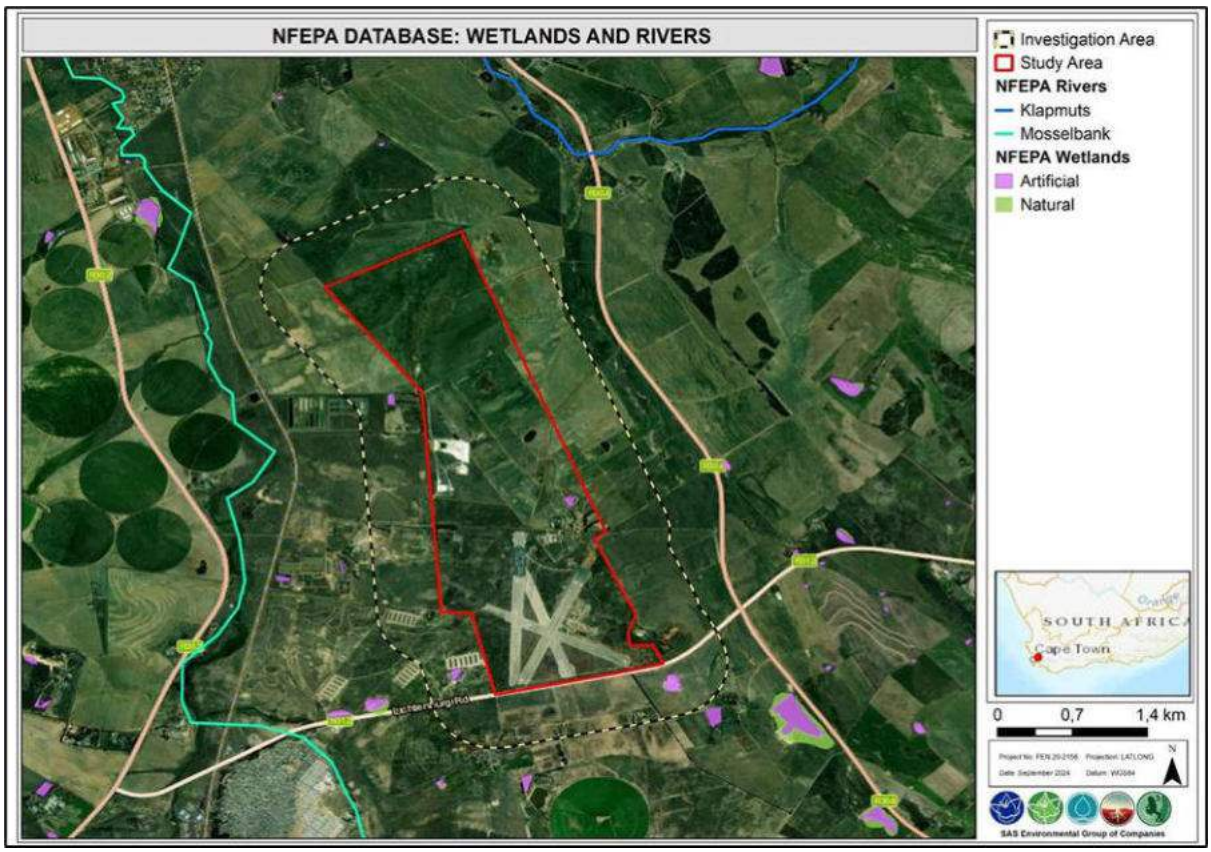


Figure 9: Rivers and natural and artificial wetlands associated with the study and investigation areas, according to the NFEPA database (2011) (FEN Detailed EIA Phase Freshwater Ecological Assessment, February 2025).

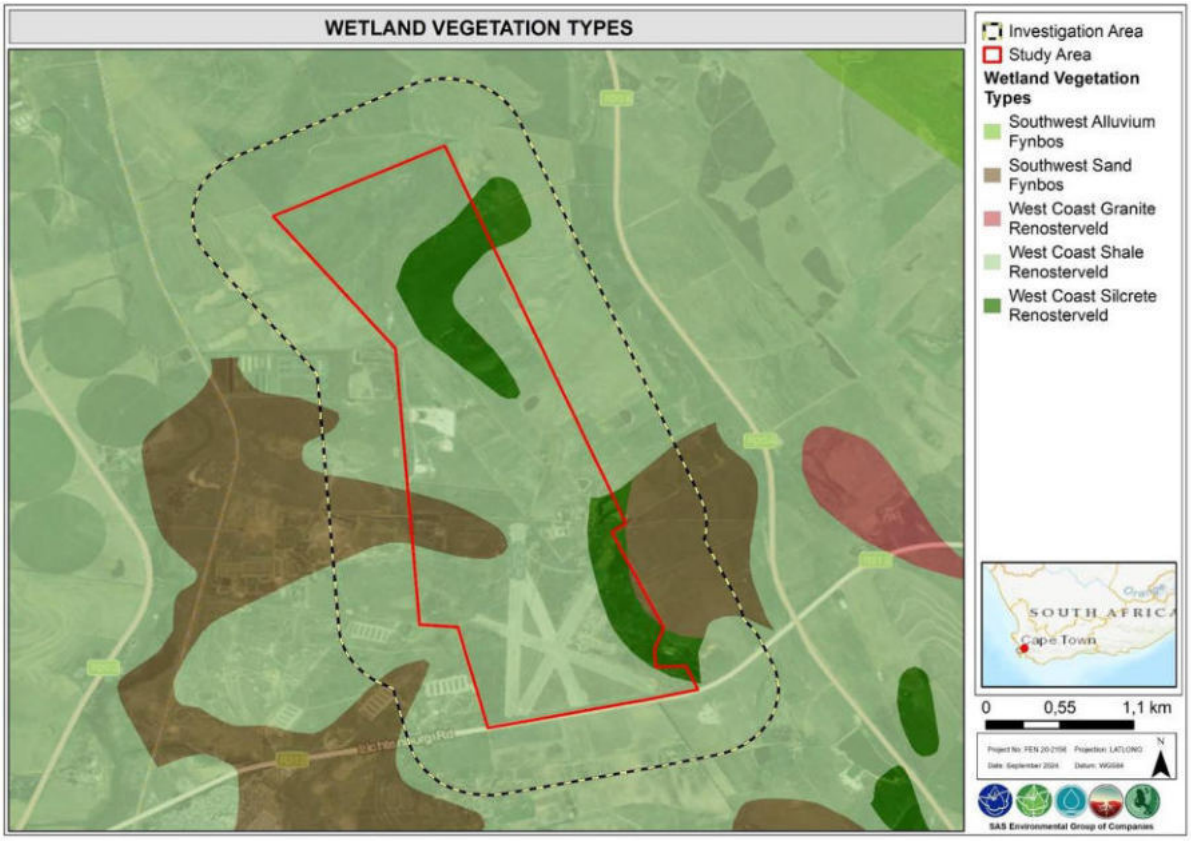


Figure 10: Wetland vegetation types associated with the study and investigation areas according to the NFEPA database (2011) (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025).

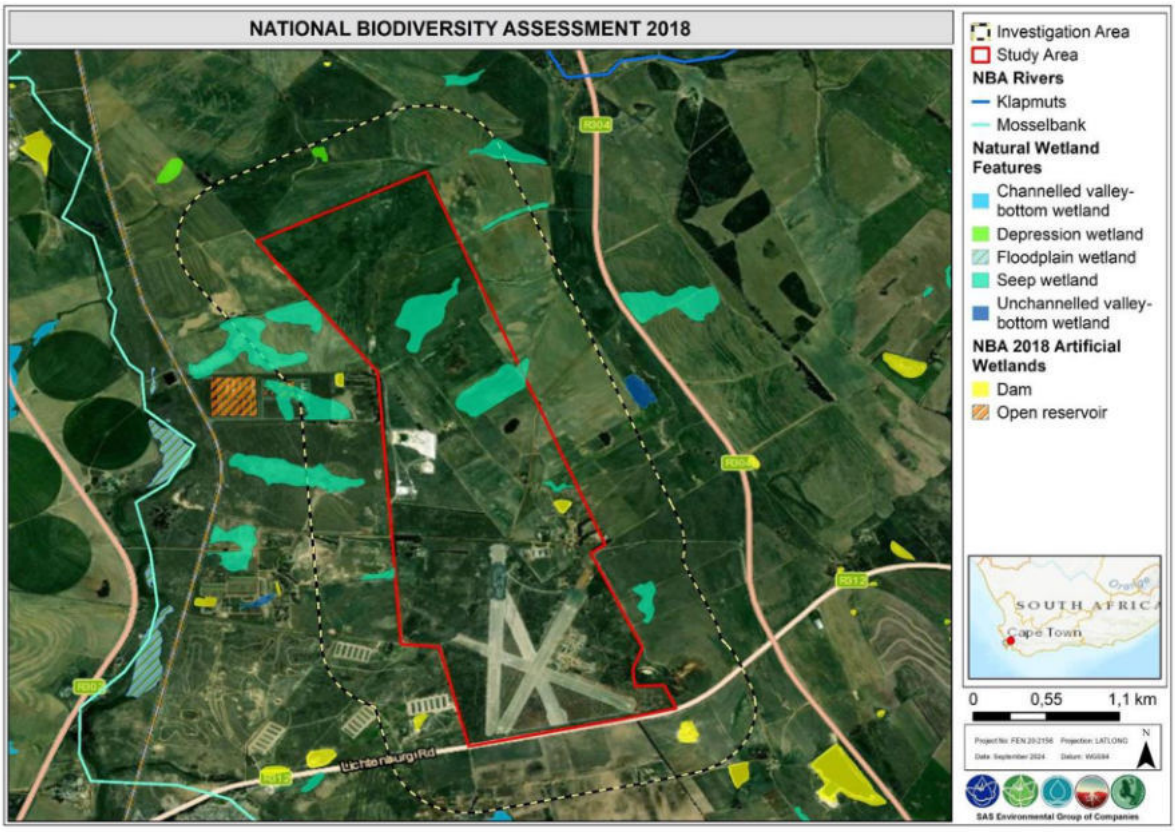


Figure 11: Wetlands and rivers associated with the study and investigation areas according to the National Biodiversity Assessment database (2018) (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025).

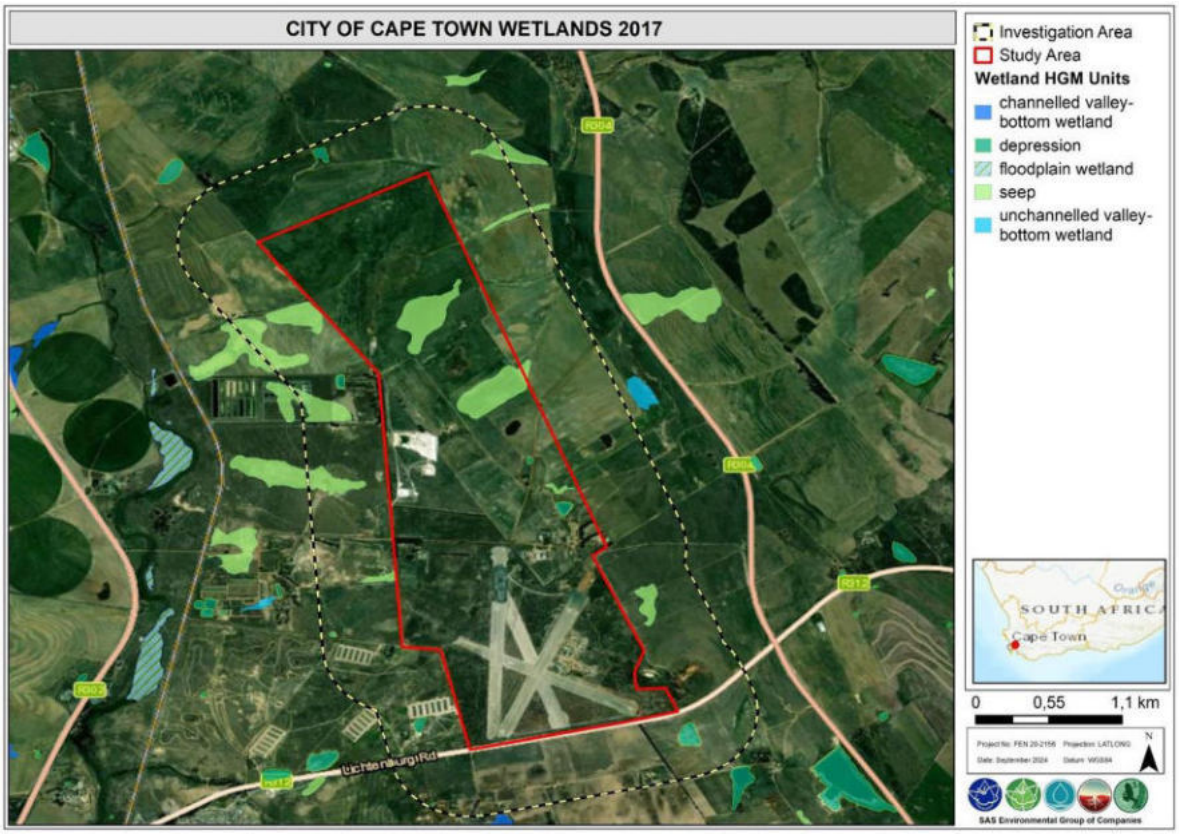


Figure 12: Wetlands identified by the City of Cape Town Wetlands Dataset (2017) to be associated with the study and investigation areas (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025).

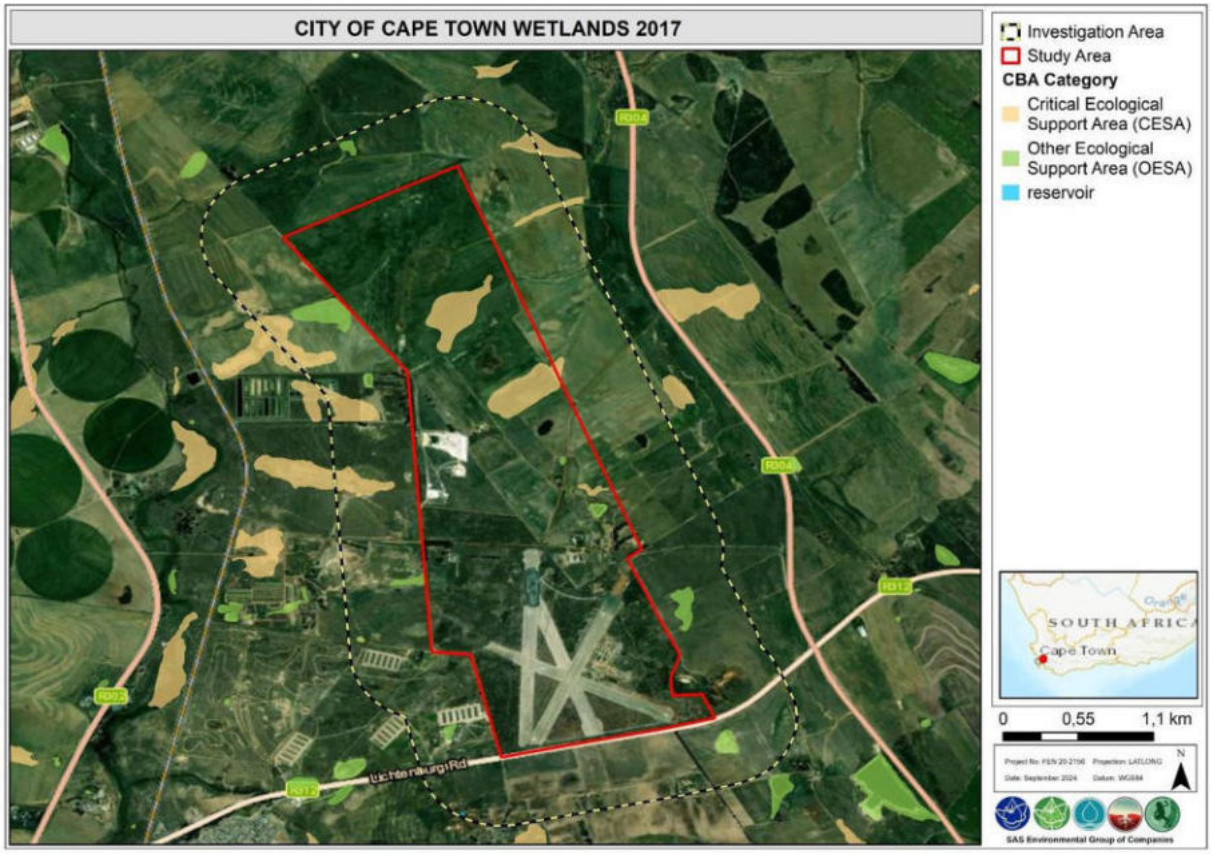


Figure 13: The ecological importance categories of the wetlands in the study and investigation areas according to the City of Cape Town Wetlands (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025).

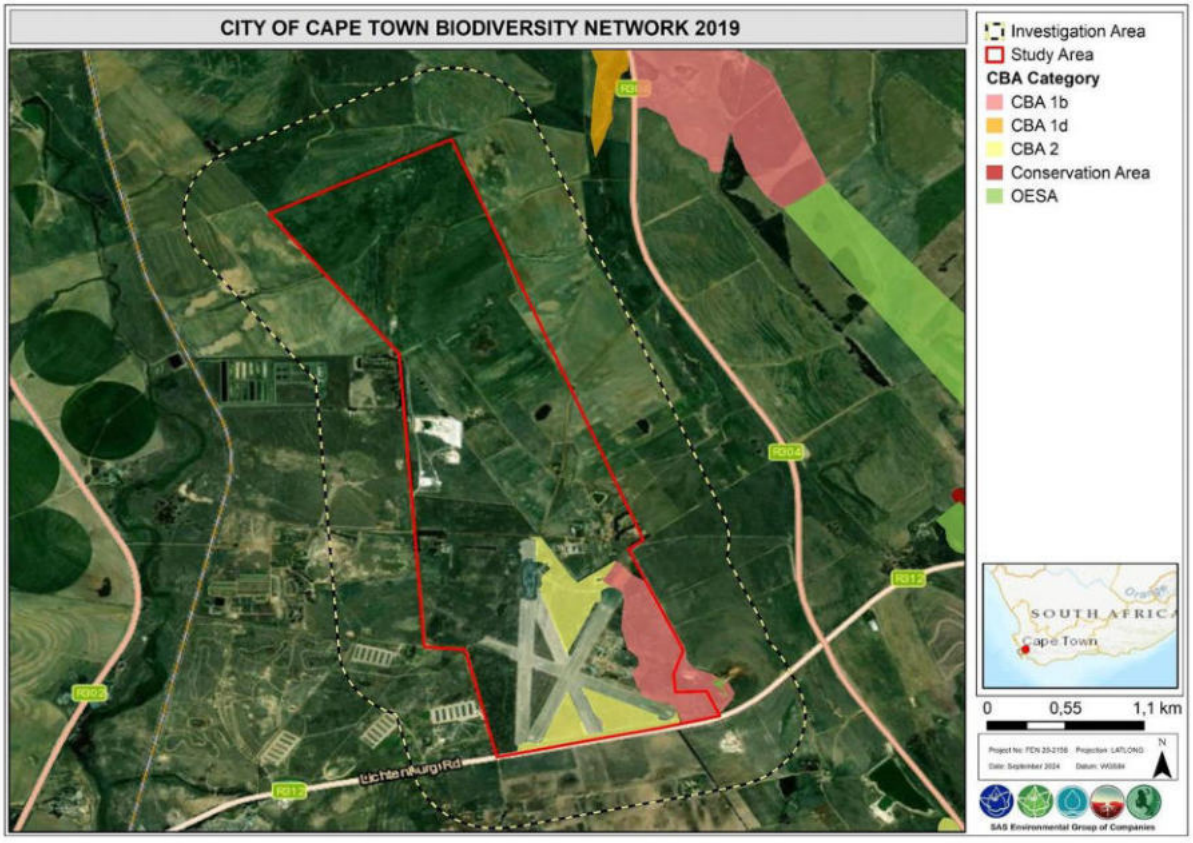


Figure 14: Areas of ecological importance associated with the study and investigation areas according to the City of Cape Town Biodiversity Network (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025).

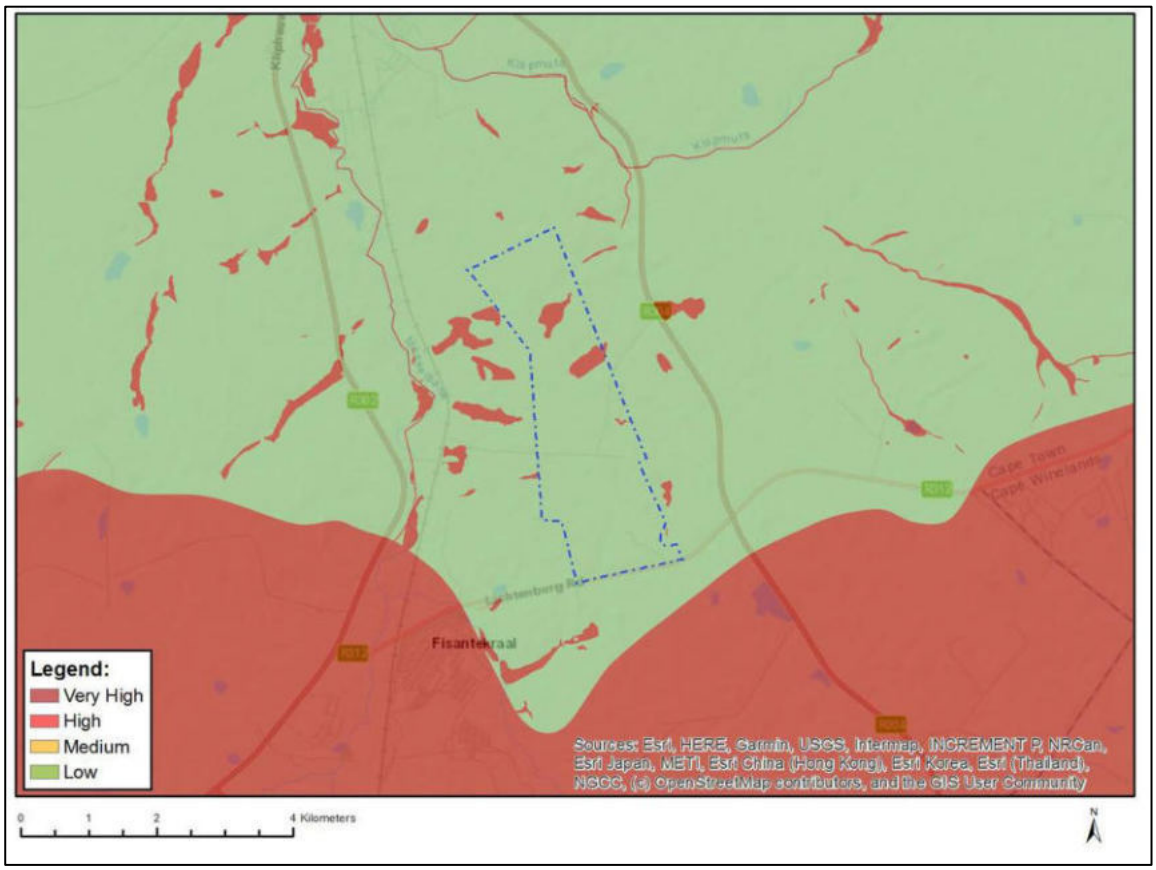


Figure 15: Map of relative aquatic biodiversity theme sensitivity for the proposed CWA development's affected properties according to the National (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025).

5.5. Watercourses associated with the proposed expansion of the Cape Winelands Airport

Overview

Field verification confirmed the presence of a single seep wetland (Seep 1) within the central portion of the proposed airport precinct (Figure 16) (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025). This seep wetland is indirectly linked, via an agricultural drain, to a channelled valley bottom (CVB) wetland located to the east and outside of the freshwater study and investigation areas (Figure 16). In addition to the onsite wetland, the following natural freshwater features were identified within 500m from the proposed airport precinct (investigation area) (Figure 16):

- A large CVB wetland system, CVB wetland 1, was identified running parallel with the eastern boundary of the investigation area, with only a small portion located within 500m from the proposed development area. This wetland is associated with the unnamed tributary of the Klapmuts River.
- Two smaller CVB wetlands (CVB wetland 2 and CVB wetland 3) linked to CVB wetland 1 were identified immediately East of the proposed development area. Neither of these two wetlands encroach into the development area.

- A fourth CVB wetland, CVB wetland 4) was identified North of the study area.
- Lastly, an additional seep wetland (Seep 2) was identified approximately 310m East of the study area and is directly linked to the CVB wetland 1.

Although numerous wetlands were identified within the investigation area, only a representative subset of those directly impacted by the proposed CWA development underwent quantitative assessment. This includes seep wetland 1 and CVB wetlands 2 and 3, where seep wetland 1 and CVB wetland 2 served as proxies for their nearby counterparts due to similar ecological conditions. CVB wetlands 1 and 4 were assessed qualitatively, given their distance from the study area and low risk of impact; however, CVB wetland 1 was also evaluated in greater detail within the Wetland Offset Study, as it was identified as a suitable site for offsetting.

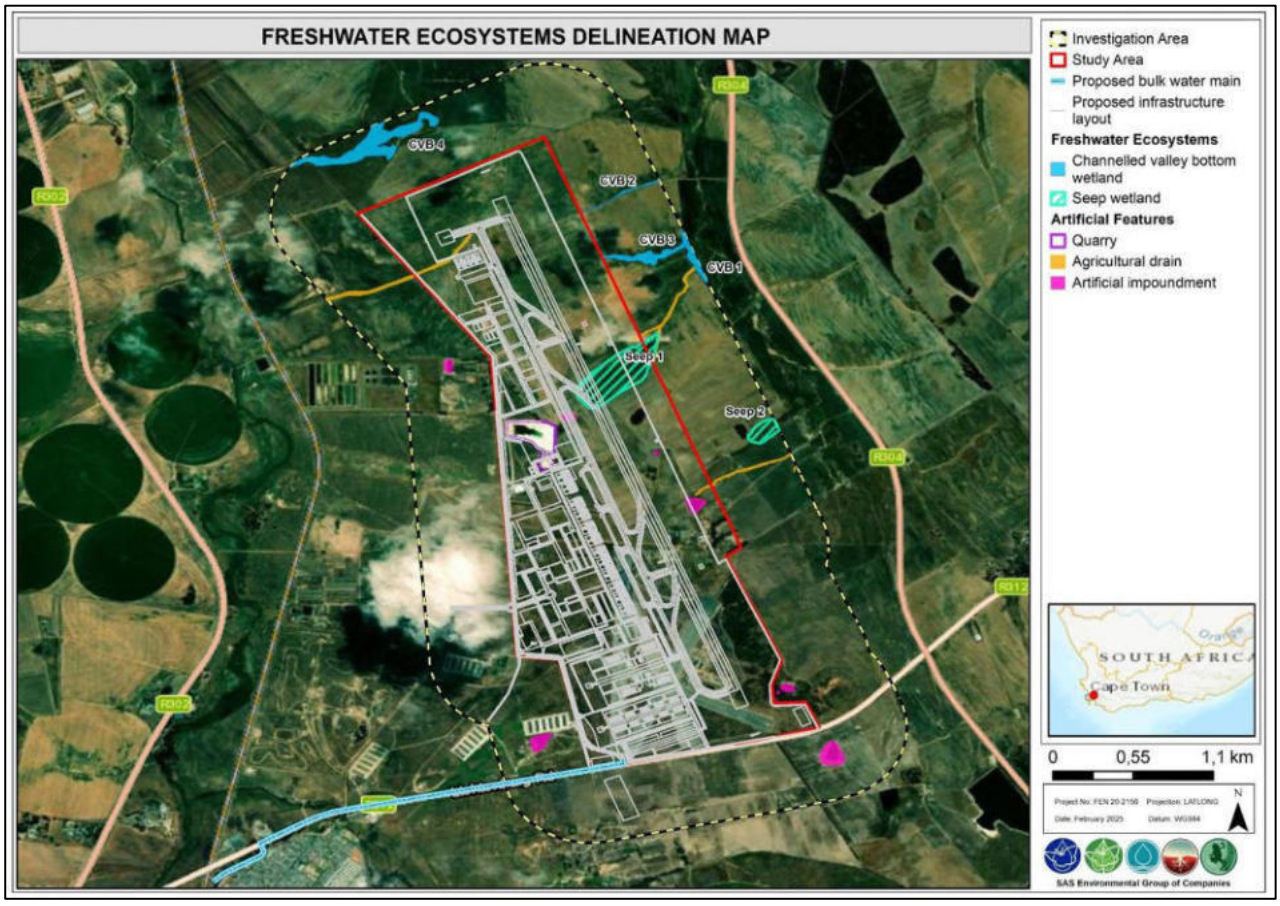


Figure 16: Map depicting the delineated extent of the freshwater ecosystems and artificial features associated with the study and investigation areas (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025).

CVB Wetland 1

CVB wetland 1 originates approximately 4km South of the proposed development area and flows in a generally northerly direction across adjoining farmland, eventually joining the Klapmuts River to the North and outside of the investigation area.

CVB wetland 1 has been impacted by land use changes in the upstream catchment and direct habitat impacts. The disturbance created by agricultural activities has had a significant impact on the vegetation associated with CVB wetland 1. Wetland vegetation has been removed from the temporary and seasonal zones of the wetland to make way for cultivated fields. Although the vegetation composition is considered significantly disturbed, CVB wetland 1 still provides habitat to support obligate wetland species such as *Juncus sp*. and *Phragmites australis* but also AIPs including *P. clandestinum* and *Acacia saligna* (Port Jackson).

CVB wetland 1 acts as an important migratory corridor within the largely transformed landscape and plays an important role in maintaining hydrological functioning and connectivity in the landscape. CVB wetland 1 can thus be considered to have an ecological importance on a local scale. However, CVB wetland 1 is not considered to be sensitive to changes in the landscape due to historical and ongoing impacts.

The CVB wetland (termed CVB wetland 1 in FEN, 2025) was indicated to be in a seriously modified state (PES Category E) and indicated to have a moderate Ecological Importance and Sensitivity (EIS), based on the following assumptions:

- The wetland is within Critically Endangered terrestrial and wetland vegetation types, and very rare, although limited natural vegetation in the wetland remains;
- The wetland is a tributary of the Klapmuts River, which drains surface runoff from the adjacent agricultural areas toward the Klapmuts River in the north-eastern portion of the focus area;
- According to Scientific Terrestrial Services (STS; 2023a), *Grus paradisea* (Blue Crane - Vulnerable) is considered likely to pass through or utilise this CVB wetland for foraging while breeding likely takes place in adjacent cultivated fields; and
- The PES of the wetland is estimated to be seriously modified.

The WET-EcoServices model determined a moderately low to moderate supply importance for sediment trapping, nutrient and toxicant assimilation, food for livestock and cultivated foods, whereas the demand importance for regulating services, particularly sediment trapping and nutrient assimilation is considered high. This is attributed to the current land use of the greater area in which the CVB wetland is located, which is predominantly agricultural. The demand for biodiversity maintenance is moderate as a result of the critically endangered vegetation type in which the CVB wetland is located. The moderately high carbon storage demand importance of the CVB wetland stems from the potential of the wetland to store carbon.

After integrating the supply and demand importance scores for the central wetland, the model determined an overall moderate importance for sediment trapping and a moderately low to low importance for nutrient and toxicant assimilation, and food for livestock, yet a very low ecoservice provision for cultural and other provisioning services.

Figure 17: Representative photographs of CVB wetland 1. (Top) The topographical setting of the CVB wetland 1 (blue dashed line) in a valley bottom position between two distinct and highly cultivated valley side slopes; (Bottom left) Vegetation composition of the CVB wetland hosting facultative wetland species such as Juncus sp. but also AIPs including P. clandestinum; (Bottom right) Active grazing by cattle noted within the CVB wetland (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025).

Seep Wetland 1 and Seep Wetland 2

Seep 1 and Seep 2 are both located on the side-slope of a valley, on gently sloping land dominated by extensive cultivation, with unidirectional movement of material (soil and water) down-slope. Agricultural activities in the catchment of the seep wetlands have resulted in a decrease in vegetation cover, and an increase in soil disturbance and erosion. This has in turn resulted in a moderate increase of sediment supply to the receiving wetlands.

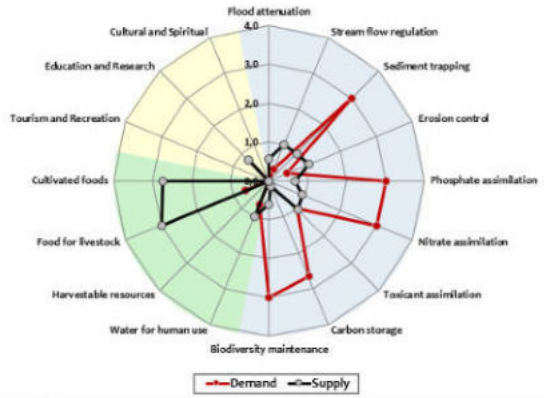
The vegetation composition of the seep wetlands has been replaced by ruderal and opportunistic AIPs such as Kikuyu Grass, which is heavily grazed, and no longer representing the natural vegetation (Figure 18). These seep wetlands are considered of low/marginal ecological importance and sensitivity due to their seriously modified ecological state. These seep wetlands may be regarded of importance due to hydrological connectivity in the landscape through their connection with the larger CVB wetland 1. In addition, the identified seep wetlands are classified as a CESA. Therefore, although significantly disturbed, these seep wetlands still act as a natural corridor within a highly

transformed landscape, which makes these wetlands important in terms of overall wetland conservation in the area.

Table 2 below provides a summary of the field verification findings for Seep Wetland 1 and Seep Wetland 2, covering key aspects of freshwater ecology, including hydrology, geomorphology, and vegetation. The table details the Present Ecological State (PES), Ecological Importance and Sensitivity (EIS), Recommended Ecological Category (REC), Resource Management Objectives (RMO), and Ecosystem Service provision for each wetland.

Figure 18: Overview of the vegetation component of the seep wetland 1. Patches of the alien grass species *P. clandestinum* were identified in the seep wetland, of which in some cases, can be distinguished from the surrounding cultivated terrestrial areas (as indicated by the yellow dashed line) (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025).

Table 2: Summary of the results of the seep wetlands 1 and 2 associated with the proposed CWA development (The ecological condition of seep wetland 2 is based on the representative assessment of seep wetland 1.) (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025).

<table>
<tr><td colspan="2">Ecological & socio-cultural service provision graph for seep wetland 1:
 
</td><td colspan="2">Freshwater ecosystem characteristics (hydraulic regime, geomorphology and sediment balance, water quality and habitat and biota):

Agricultural activities in the catchment of the seep wetlands have resulted in a decrease in vegetation cover (thus an increase in bare surface areas) and in the disturbance and erosion of soil. This in turn results in a moderate increase of sediment supply to the receiving wetlands. The vegetation composition of the seep wetlands has been replaced by ruderal and opportunistic AIPs such as C. clandestinus, which is heavily grazed, and no longer representing the reference vegetation species of the local biome (Figure 32). The hydrology of the seep wetlands is driven by lateral flows in the landscape with some groundwater inputs, evidenced by the presence of ferricrete and perched aquifers as indicated by GEOSS (2023). Excess sediment was also noted in the wetland, likely as a result of the land use of the surrounding landscape, which is predominantly cultivation.</td></tr>
<tr><td>PES discussion</td><td>PES Category: D (Largely Modified)
The wetlands have been modified as a result of direct and indirect impacts associated with extensive cultivation in the wetlands' catchment. This includes alteration to the hydrological regime (altered distribution and retention patterns) of the wetlands and altered geomorphology and sediment balance resulting in increased sediment transfer to the wetlands. Vegetation composition of the wetlands have also been seriously modified as a result.</td><td>EIS discussion</td><td>EIS Category: Low/ marginal
The EIS of the seep wetlands can be considered to be low/marginal due to their largely modified ecological state. Their EIS is attributed to their importance in the landscape, particularly due to the protection status of the wetland vegetation type (critically endangered West Coast Silcrete Renosterveld and West Coast Shale Renosterveld). The wetlands are also important for streamflow regulation, particularly during the winter rainfall period, considering their connectivity to the downgradient CVB wetland 1, but the wetlands do not provide direct human benefits, other than limited harvestable resources and cultivated foods services.</td></tr>
<tr><td>Ecoservice provision</td><td>Ecoservice Provisioning: 0,4 (Very Low)
The overall ecoservice provision of the wetlands are considered very low, with the exception of sediment trapping, nitrate assimilation and cultivated food services for which a low importance was determined. This is based on the agricultural landscape in which the wetlands are located as well as the critically endangered state of the wetland vegetation type. The wetlands are however considered of moderate importance for food for livestock considering its agricultural catchment.</td><td>REC Category and RMO</td><td>REC: Category D (Largely modified)
BAS: Category D
RMO: Maintain
Existing agricultural activities surrounding in the wetlands have likely contributed to the impact of decades' worth of impacts on the wetlands. The proposed CWA development will result in a 6.74 ha loss of the seep wetland 1. A wetland offset investigation is being undertaken to mitigate the loss of wetland habitat.</td></tr>
<tr><td>Extent of modification</td><td colspan="3">High (seep wetland 1)
The proposed CWA will result in the loss of 6.74 ha of wetland habitat due to the construction of the runway over the seep wetland 1. Furthermore, stormwater release into seep wetland 1 will also pose a risk to the ecological functioning of the wetland. As a result, wetland offsetting should be investigated to account for the 6.74 ha of wetland that will be lost. With the implementation of control measures (as described in Section 8 below) and that construction activities associated with the proposed development is conducted during the dry, summer season, the impacts arising from the proposed activities can be localised, effectively reduced and managed. Due to the approximate location of the seep wetland 2 relative to the study area (~320 m east of the study area), the impact to seep wetland 2 is considered negligible considering that stormwater from the proposed development will be contained in stormwater attenuation ponds prior to release into the surrounding environment.</td></tr>
<tr><td rowspan="2">Impact Significance and Business Case:</td><td colspan="3">Moderate (with the implementation of control measures) (particularly seep wetland 1 – 6.74 ha loss)</td></tr>
<tr><td colspan="3">The activities associated with the proposed development pose a 'Moderate' risk to the overall integrity of seep wetland 1 as a result of the anticipated construction and operation of the CWA that will result in the loss of 6.74 ha of wetland habitat. As a result, wetland offsetting is being investigated to account for the 6.74 ha of wetland that will be lost. Careful planning of the stormwater management and surface runoff of the proposed CWA development is also imperative to ensure the impact to the hydraulic regime of the remaining extent of the wetland is not further impaired by significant stormwater influxes, and water quality impacts are minimised. It is imperative that adherence to the site-specific control measures provided in this report as well as general good construction practice are adhered to.</td></tr>
</table>

CVB Wetland 2 and CVB Wetland 3:

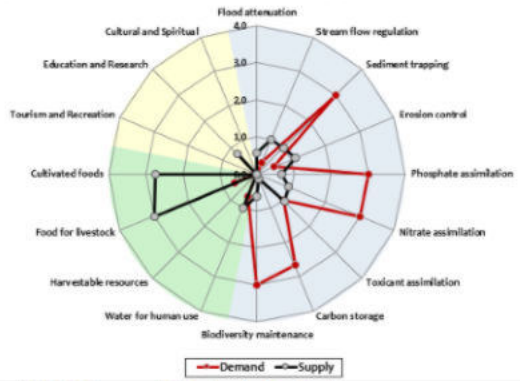
CVB wetlands 2 and 3 originate from the cultivated slopes to the East of the proposed development area. These CVB wetlands generally flow in an easterly direction towards the larger CVB wetland 1. CVB wetlands 2 and 3 have been heavily modified as a result of the surrounding cultivation and grazing practices. The seasonal and temporary zones of these wetlands have been replaced by cultivated fields and infilling from farm roads. At present, these CVB wetlands exist as narrow and straightened channels surrounded by cultivated fields.

While CVB wetlands 2 and 3 are relatively small and disturbed, they still offer habitat and may be important for attenuating high velocity flows from the upstream catchment and filtering the water (albeit limited) before it enters the larger downstream CVB wetland 1.

Table 3 below provides a summary of the field verification findings for Seep Wetland 1 and Seep Wetland 2, covering key aspects of freshwater ecology, including hydrology, geomorphology, and vegetation. The table details the Present Ecological State (PES), Ecological Importance and Sensitivity (EIS), Recommended Ecological Category (REC), Resource Management Objectives (RMO), and Ecosystem Service provision for each wetland.

Figure 19: Representative photographs of CVB wetlands 2 and 3. (Top left) An overview of CVB wetland 2 and (Bottom left) CVB wetland 3, both surrounded by cultivated fields and farm roads; (Top right and bottom right) Vegetation composition of CVB wetland 2 (top) and CVB wetland 3 (bottom) hosting a facultative wetland species Juncus sp. AIPs including P. clandestinum are also present in CVB wetland 3 (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025).

Table 3: Summary of the results of the channelled valley bottom (CVB) wetlands 2 and 33 associated with the proposed CWA development (The ecological condition of CVB wetland 3 is based on the representative assessment of CVB wetland 2) (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025).

<table>
<tr><td colspan="2">Ecological & socio-cultural service provision graph of the CVB wetland 2:
 
</td><td colspan="2">Freshwater ecosystem characteristics (hydraulic regime, geomorphology and sediment balance, water quality, habitat and biota):

CVB wetlands 2 and 3 have been heavily modified as a result of the surrounding cultivation and grazing practices. The wetlands are driven by lateral flows from the immediate catchment and interflow. These CVB wetlands have experienced excessive erosion due to the surrounding agricultural setting and lack of substantive vegetation in and around the wetlands. The soil of the wetland is characterised by soft plinthic B horizons. The above have resulted in altered geomorphic integrity and sediment balance as a result of increased bare areas surrounding the wetlands, thus increased sediment input into these receiving wetlands. Reaches of the CVB wetlands historically extended more westwards within the study area (Figure 17 and Figure 18). The CVB wetlands have been fragmented by an existing farm road and only extend downgradient of the road, owing to land use transformation in the study area and surrounds, with the headwaters of the wetlands now formalised as drainage channels, with no wetland indicators (in terms of soil and vegetation) observed within the study area[4]. Vegetation of the wetlands have been significantly altered with little indigenous vegetation remaining. Nevertheless, the wetlands are still considered important as breeding habitat for bird (including Grus paradisea (Blue Crane)), invertebrate and amphibian species as it acts as an important migratory corridor due to high levels of connectivity in a largely transformed landscape (refer to STS, 2023).</td></tr>
<tr><td>PES discussion</td><td>PES Category: E (Seriously Modified)
The CVB wetlands are in a seriously modified state due to surrounding cultivation and grazing practices. The seasonal and temporary zones of these wetlands have been replaced by cultivated fields and infilling from farm roads thereby resulting in reduced vegetation cover and surface roughness (Figure 29). Both CVB wetland 2 and CVB wetland 3's extent have been significantly reduced and currently exist as narrow and straightened channels surrounded by cultivated fields (Figure 30). As such the extent of the wetlands have been significantly reduced and modifications to the existing channel have resulted in altered water and sediment distribution and retention patterns within the wetlands. In addition to the above, on-site impacts associated with the ongoing agricultural activities have resulted in a loss of habitat diversity and the proliferation of AIPs.</td><td>EIS discussion</td><td>EIS Category: Low/marginal
The EIS of the CVB wetlands can be considered to be low/marginal due to their largely modified ecological state. Their EIS is attributed to their importance in the landscape, particularly due to the protection status of the wetland vegetation type (critically endangered West Coast Silcrete Renosterveld and West Coast Shale Renosterveld) as well as providing numerous regulating and supporting benefits – e.g. streamflow regulation, considering their connectivity to the downgradient CVB wetland 1. The wetlands provide limited direct human benefits, particularly harvestable resources and cultivated foods services. The wetlands however are likely to provide important breeding and foraging habitat for numerous fauna (STS, 2023).</td></tr>
<tr><td>Ecoservice provision</td><td>Ecoservice Provisioning: 0,4 (Very Low)
The overall ecoservice provision of the wetlands are considered very low, with the exception of sediment trapping and cultivated foods services for which a low importance was determined. This is based on the agricultural landscape in which the wetlands are located as well as the critically</td><td>REC Category and RMO</td><td>REC: Category D (Largely Modified) (Improve) BAS: Category D (Improve) RMO: Improve
The method to determine RMO states that the ecological condition of the CVB wetlands must be maintained. However, according to Malan and Day (2012), a PES Category E is considered unacceptable and therefore, it is recommended that no further degradation to these wetlands be permitted as a result of the proposed activities. The rehabilitation of the wetlands to improve the PES falls beyond the scope of</td></tr>
</table>

	endangered state of the wetland vegetation type. The wetlands are however considered of moderate importance for food for livestock considering its agricultural catchment. The wetlands also play an important role in maintaining hydrological functioning and connectivity in the landscape and attenuating high velocity flows and can thus be considered to have an ecological importance on a local scale.		works and property rights of the proponent. Therefore, effort should be directed to ensuring that the proposed CWA development remains outside the delineated extent of the wetlands and their conservation buffer, if at all possible. Careful planning of stormwater management must be undertaken to ensure the hydraulic regime of the receiving environment is retained and not further impaired by stormwater peaks.
Extent of modification	Low With the exception of the fences, maintenance road and stormwater release into CVB wetland 3, no significant or long-term modifications are anticipated to the CVB wetlands as a result of the proposed CWA development since the proposed development will remain outside of the recommended 15 m conservation buffer of the wetlands. Stormwater release into the surrounding area also pose a risk to the ecological functioning of the wetlands, albeit to a limited extent. With the implementation of control measures, ensuring that stormwater is managed effectively (as described in Section 8 below) and that construction activities associated with the proposed development is conducted during the dry, summer season, the impacts arising from the proposed activities can be localised, effectively reduced and managed.		
Impact Significance and Business Case:	**Low** (with the implementation of control measures) The activities associated with the proposed development pose a 'Low' risk to the overall integrity of the CVB wetlands as a result of the anticipated construction and operation of the CWA within at least ~ 255 m of the wetlands (with the exception of one of the dry attenuation ponds directly upgradient of the CVB wetland 3). Careful planning of the stormwater management and surface runoff of the proposed CWA development particularly at CVB wetland 3 is imperative to ensure the impact to the hydraulic regime is not impaired by significant stormwater influxes, and water quality impacts are minimised. It is imperative that adherence to the site-specific control measures provided in this report as well as general good construction practice are adhered to.		

6. RISKS ASSOCIATED WITH NOT IMPLEMENTING THE MMP

The following risks were identified should the MMP not be implemented:

1) Uncoordinated maintenance of stormwater infrastructure and roads could lead to degradation of infrastructure, possible erosion over time and even failure through neglect.
2) Ad hoc clearing to provide access for maintenance work could lead to siltation downstream and water quality impairment downstream.
3) Alien vegetation encroachment into sensitive buffer areas due to non-removal or ineffective methods.
4) Possible siltation of stormwater structures over time.
5) Water quality impacts caused by spillage from heavy vehicles accessing sensitive areas for cleaning purposes.
6) Loss of riparian vegetation from heavy vehicles through movement within sensitive buffer areas, outside of demarcated access routes.
7) Water quality impairment and siltation downstream if maintenance work conducted during wet season, or if silt removed is placed too close to drainage lines.

7. METHOD STATEMENT

6.1 The method statement must provide a step-by-step plan (which may include a schematic diagram etc.) to inform the responsible person(s) on the process and actions to take in a sequential and logical manner, which aims to reduce the impact of undertaking the activity within a reasonable timeframe and cost.

6.2 A method statement should be compiled for each individual activity given the likely specific circumstances and conditions of a site requiring maintenance. However, in situations whereby uniform conditions and circumstances are evident for multiple sites requiring the same type of activity, a method statement can be given for a specific type of activity to be undertaken at multiple sites given the aforementioned requirements.

6.3 The detail of the method statement will be assessed by the Department and other relevant regulatory authorities to ensure actions that are taken are such that they do not perpetuate increased incidences of erosion/deposition of material.

6.4 Time periods must be given within which the maintenance actions contemplated need to be implemented. An indication must be made whether maintenance actions will be repeated, e.g. clearing of silt/debris from under a bridge annually or after flood events.

6.5 The following serves as a general guide required to minimise the spatial impact of the maintenance activity:

- The boundaries of footprint areas, including contractor laydown areas, are to be clearly defined and it should be ensured that all activities remain within defined footprint areas. Edge effects must be strictly controlled.
- Repairs and maintenance should be undertaken within the dry season, except for emergency maintenance works.
- Where at all possible, existing access routes should be used. In cases where none exist, a route should be created through the most degraded area avoiding sensitive/indigenous vegetation areas.
- It must be ensured that all hazardous storage containers and storage areas comply with the relevant SABS standards to prevent leakage. All hazardous chemicals as well as stockpiles should be stored on bunded surfaces and have facilities constructed to control runoff from these areas.
- Appropriate sanitation facilities must be provided onsite for the duration of the construction, operational and maintenance phases of the development.

- An adequate number of waste and "spill" bins must be provided throughout the construction, operational and maintenance phases of the development.
- When machinery is involved, ensure effective operation with no leaking parts and refuel outside of the riparian area, at a safe distance from the watercourse to manage any accidental spillages and pose no threat of pollution.
- In the event of a vehicle breakdown, maintenance of vehicles must take place with care and the recollection of spillage should be practised near the surface area to prevent ingress of hydrocarbons into topsoil and subsequent habitat loss.
- All spills should they occur, should be immediately cleaned up and treated accordingly.
- At no time should the flow of the watercourse be blocked (temporary diversions may be allowed) nor should the movement of aquatic and riparian biota (noting breeding periods) be prevented during maintenance actions.
- No new berms may be created.
- In circumstances which require the removal of any top soil, this must be sufficiently restored through sustainable measures and practices.
- Concerted effort must be made to actively rehabilitate repaired or reshaped banks with indigenous local vegetation.
- No deepening of the watercourse beyond the original, pre-damage determined thalweg, unless such deepening is directly related to the natural improved functioning and condition of such a watercourse.
- The build-up of debris/sediment removed from a maintenance site may:
    - be utilised for the purpose of in-filling or other related maintenance actions related to managing erosion, which form part of an adopted MMP;
    - not be used to enlarge the height, width or any extent of existing berms;
    - not be deposited anywhere within the watercourse or anywhere along the banks of a river where such action is not part of the proposed maintenance activity (ies). Material that cannot be used for maintenance purposes must be removed out of the riparian area to a suitable stockpile location or disposal site. Further action and consideration may be required where the possibility of contaminated material may occur, such as in urban watercourses.

- The use of foreign material, such as concrete, rubble, woody debris and/or dry land based soil, is strictly prohibited from being used in maintenance actions, unless for the specific purpose of repairs to existing infrastructure, coupled with appropriate mitigation measures.
- On completion of the maintenance action, the condition of the site in terms of relative topography should be similar to the pre-damaged state (i.e. the shape of the riverbank should be similar or in a state which is improved to manage future damage). This ultimately dictates that the channel, banks and bed cannot be made narrower, higher or deepened respectively. Exceptions are considered for systems involved with the management of stormwater and improvements for water quality within the urban context.

The following method statements have been developed for maintenance activities required within the 32m regulated area of a wetland:

1) Monitoring, maintenance, and repair of fences
2) Inspection and servicing water pipelines
3) Disturbance of instream habitat and potentially increased risk of erosion as a result of periodic alien vegetation removal.
4) Maintenance of rehabilitated wetland offsets.
5) Monitoring, maintenance and repairs of stormwater infrastructure including sediment removal, litter management, erosion control etc.
6) Upkeep and repairs of maintenance and access roads.

MS1: Monitoring, maintenance, and repair of fences

Description of activity	A perimeter fence is proposed around the airport precinct. This fence will cross Seep Wetland 1. Maintenance activities will prioritize preserving the fence's structural integrity, which may require replacing damaged sections, securing loose fasteners, or treating areas affected by corrosion. To replace fence posts, maintain clear access, and prevent potential damage from overgrown vegetation, selective vegetation removal or limited excavation may be carried out where necessary.
Actions	The following general sequence of actions are required: 1. Identify and demarcate the area of fence line to be repaired/ replaced. 2. Clear area of debris or vegetation in order to access the fence (if required). 3. Replace/ repair fence portion and remove old debris or materials. 4. Rehabilitate disturbed areas, remediate any erosion and suitably loosen any compacted soil. 5. Reshape areas and/or replant as required.
Impacts of actions	The following potential impacts may result from the proposed maintenance activities: • Potential fragmentation of the freshwater ecosystems caused by the property fences. • Proliferation of AIP species within the disturbed freshwater ecosystems. • Potential loss of indigenous vegetation as a result of maintenance works. • Disturbance to and compaction of soil resulting in erosion. • Potential conveyance of sediment laden stormwater into the freshwater ecosystems
Severity of impacts	If all mitigation measures are implemented the severity of the impact will be Low.
Measures to mitigate the severity of the impact	• Conduct routine maintenance to minimize the risk of infrastructure failures that could necessitate more extensive work within regulated wetland areas. • Only existing roadways should be utilized during maintenance and repairs to avoid indiscriminate movement of vehicles within the wetlands.

	• No vehicles are permitted to enter the freshwater ecosystems. Any maintenance works within wetlands must be undertaken by foot, or the relevant authorizations obtained beforehand. • Any AIPs within the maintenance area must ideally be removed prior to the initiation of soil disturbing maintenance activities. This will assist in reducing the long-term AIP management requirements. • The soil within 15m of the freshwater ecosystems must be suitably loosened on completion of maintenance activities and revegetated to prevent erosion. • Stockpiling of excavated materials may only be temporary (i.e. may only be stockpiled during the period of maintenance at a particular site). Soil must be stockpiled on the upgradient side of the excavated area to avoid sedimentation of the downgradient areas. • Excavated areas must be backfilled as soon as infrastructure has been installed/repaired in any given section to reduce potential erosion of exposed soil. • Limit routine maintenance activities to the dry summer months as far as possible. • As far as possible, physical movement in the freshwater ecosystems by personnel must be limited.
Remedial measures	There are no additional remedial mitigation measures other than those listed above if implemented in full.
Method of Access	Existing access roads should be utilised as far as possible.
Period of activity	The period of the maintenance management activity will vary depending on the level of maintenance required. The activity will be ongoing.

MS2: Inspection and servicing of water pipelines

Description of activity	Service infrastructure, including a bulk irrigation and fire water pipeline, is planned near the onsite wetlands. Maintenance efforts will focus on maintaining the structural integrity of these pipelines and preventing blockages. Typical repairs may involve replacing damaged sections, securing loose fittings, or treating corrosion. Vegetation removal and excavation or trenching will be required to facilitate these repairs or replacements. Routine cleaning of water pipelines is also essential to avoid blockages and ensure consistent flow.
Actions	The following general sequence of actions are required: 1. Identify and demarcate area of pipeline to be repaired/ replaced; 2. Clear area of debris or vegetation in order to access pipeline if required; 3. Replace/ repair pipeline and remove old pipeline debris or materials; 4. All water/material discharged from the pipeline should be collected directly into a tank or other waterproof collection device and disposed of appropriately where it will not contaminate any watercourse or soils; 5. Rehabilitate disturbed areas, remediate any erosion areas identified, suitably loosen any compacted and remove siltation if required; 6. Reshape areas and/or plant as required.
Impacts of actions	The following potential impacts may result from the proposed maintenance activities: • Maintenance or repairs of the service infrastructure could result in similar impacts as those experienced during service installation: o Disturbances of soil potentially leading to increased AIP proliferation, and in turn to altered freshwater ecosystem habitat. o Earthworks could be potential sources of sediment, which may be transported as runoff into the freshwater ecosystems.

	○ Potential fragmentation of freshwater habitats. ○ Potential loss of indigenous vegetation as a result of maintenance works. ○ Potential disturbance to hydrological functioning and activity of the freshwater ecosystems. ○ Disturbance to and compaction of soil resulting in erosion. • Periodic flushing of pipelines to maintain capacity and address the build-up of sediment and other materials could result in the passage of water, sediment or sewage into any of the watercourses identified within the site/investigation area resulting in water quality impacts. • If a portion of the pipeline(s) ruptures under pressure or while carrying flows, then passage of sediment and/or sewage might enter nearby watercourses resulting in water quality impacts. • Potential eutrophication of water as a result of enriched water draining into the freshwater ecosystems
Severity of impacts	If all mitigation measures are implemented the severity of the impact will be Low.
Measures to mitigate the severity of the impact	• Implement a monitoring programme to detect and prevent the pollution of soils, surface water and groundwater. • Conduct routine maintenance to minimize the risk of infrastructure failures that that could lead to substantial environmental impacts, avoiding the need for extensive interventions within regulated wetland areas. • Implement the wetland monitoring programme outlined within the FEN Wetland Offset Study and Implementation Plan (February 2025). • A Service Infrastructure Management Plan should be compiled which details the frequency in which service infrastructure must be serviced. • An emergency plan must be compiled to ensure a quick response and attendance to the matter in case of a leakage or bursting of a pipeline. • Only existing roadways should be utilized during maintenance and repairs to avoid indiscriminate movement of vehicles within the wetlands.

	• No vehicles are permitted to enter the freshwater ecosystems. Any maintenance works within wetlands must be undertaken by foot, or the relevant authorizations obtained beforehand. • Any AIPs within the maintenance area must ideally be removed prior to the initiation of soil disturbing maintenance activities. This will assist in reducing the long-term AIP management requirements. • The soil within 15m of the freshwater ecosystems must be suitably loosened on completion of maintenance activities and revegetated to prevent erosion. • Stockpiling of excavated materials may only be temporary (i.e. may only be stockpiled during the period of maintenance at a particular site). Soil must be stockpiled on the upgradient side of the trench to avoid sedimentation of the downgradient areas. • Trenches must be backfilled as soon as infrastructure has been installed/repaired in any given section to reduce potential erosion of exposed soil. • Limit routine maintenance activities to the dry summer months as far as possible. • As far as possible, physical movement in the freshwater ecosystems by personnel must be limited. • No stormwater generated during construction may be directly released into the freshwater environment. • Under no circumstances must linear infrastructure be trenched within the CVB wetlands 2 and 3 or their conservation buffer. • Any erosion, sedimentation or other damage to watercourses caused because of the above incidents / activities should be rectified immediately, with rehabilitation activities potentially including removal of sediment, reshaping of banks and replanting where it is deemed necessary
Remedial measures	There are no additional remedial mitigation measures other than those listed above if implemented in full.
Method of Access	Existing access roads should be utilised as far as possible.
Period of activity	The period of the maintenance management activity will vary depending on the level of maintenance required. The activity will be ongoing.

MS3: Disturbance of instream habitat and potentially increased risk of erosion as a result of periodic alien vegetation removal

Description of activity	Disturbance of instream habitat and potentially increased risk of erosion because of periodic vegetation removal to maintain ecological integrity of the natural areas onsite.
Actions	The following general sequence of actions are required to remove and control the alien vegetation: 1) Identify alien invasive species; 2) Cutting or pulling of target plants, or application of appropriate herbicide; 3) Treatment of plant remainders with appropriate herbicide or treatment of herbaceous plants that cannot be manually removed; 4) Removal of plant material from the wetland and surrounding conservation area; 5) Follow-up work to prevent regrowth and the production of seed remaining in the soil; and 6) Revegetation of areas with indigenous vegetation where necessary.
Impacts of actions	The following potential impacts may result from the proposed maintenance activities: - Disturbance to aquatic habitat and vegetation and potential risk of erosion. - Disturbance to and compaction of soil resulting in erosion. - Potential increase in sedimentation of watercourses located downslope.
Severity of impacts	If all mitigation measures are implemented the severity of the impact will be Low - if revegetation with indigenous species and follow-up control takes place, a low to moderate positive impact could be expected.
Measures to mitigate the severity of the impact	• Identify alien plants to be removed. • Avoid trampling or clearing indigenous vegetation by using established paths where possible. • Clear alien vegetation according to the described alien vegetation removal methods for each invasive species as provided in the Alien Vegetation Management Plan developed for the site (PHS Consulting, March 2025). Detailed herbicides/biological control recommendations are also provided on the Working for Water website:

	http://www.dwaf.gov.za/wfw/. Kikuyu should be poisoned with a foliar herbicide (e.g. Agil) during the summer growing season (before end March). • When using herbicides, it is essential to apply the correct herbicide, in the right dose, at the right time, using the correct application method. Use only registered herbicides, follow manufacturer's instructions on the label, and wear the appropriate protective clothing during handling. • Remove cleared alien vegetation from the aquatic features and dispose of at a suitable point. • Where necessary revegetate cleared areas with suitable indigenous vegetation. Planted areas may require irrigation and care for a period following planting. The irrigation requirements will be determined by the season in which planting takes place, and the plant species planted. Planting of the new vegetation at the start of the wet season can assist in ensuring that the new vegetation is kept wet whilst establishing itself. • Ongoing monitoring and clearing of regrowth of alien plants within these areas will be required.
Remedial measures	There are no additional remedial mitigation measures other than those listed above if implemented in full.
Method of Access	Existing access roads should be utilised as far as possible.
Period of activity	The period of the maintenance management activity will vary depending on the level of infestation. The activity will be ongoing.

MS4: Maintenance of wetland offsets.

Description of activity	Routine monitoring and selective replanting of indigenous vegetation will help ensure healthy growth and prevent invasive alien plants (AIPs) from competing with native species. Regular observation of grazing impacts from resident cattle will also be useful for identifying any necessary maintenance, enabling timely adjustments to support vegetation health. Periodic checks for erosion and sedimentation within offset wetlands will allow for early intervention if needed.
Actions	The following general sequence of actions are required: 1. Conduct regular monitoring in offset wetland as outlined within the Wetland Offset and Implementation Plan (FEN, February 2025). 2. Identify areas of concern. These are areas that are affected by disturbances such as: erosion, waste dumping, alien vegetation encroachment, soil compaction, senescence of indigenous vegetation. 3. Should areas of concern be noted, identify and address the cause. 4. Clear the affected area of debris and remove excess sediment (if required) and AIPs. 5. Reshape and revegetate the disturbed/eroded area as required in line with the Wetland Offset and Implementation Plan (FEN, February 2025).
Impacts of actions	The following potential impacts may result from the proposed maintenance activities: • Proliferation of AIP species within the disturbed freshwater ecosystems. • Disturbance to and compaction of soil resulting in erosion. • Potential conveyance of sediment laden stormwater into the freshwater ecosystems
Severity of impacts	If maintenance activities are implemented in full along with all mitigation measures, a low to moderate positive impact can be expected.

Measures to mitigate the severity of the impact	• Monitor wetlands that will potentially be impacted by the proposed CWA development to ensure that the PES drivers and receptors are maintained, and where possible improved accordance with the REC and RMO. • Only existing roadways should be utilized during monitoring, maintenance and repairs to avoid indiscriminate movement of vehicles within the wetlands. • No vehicles are permitted to enter the freshwater ecosystems. Any maintenance work within wetlands must be undertaken on foot. • Any AIPs within the maintenance area must ideally be removed prior to the initiation of soil disturbing maintenance activities. This will assist in reducing the long-term AIP management requirements. • The soil within 15m of the freshwater ecosystems must be suitably loosened on completion of maintenance activities and revegetated to prevent erosion. • After sediment removal, promptly revegetate with indigenous species to reduce the spread of invasive species and prevent erosion. • Wherever possible, schedule sediment removal and erosion control activities during the dry summer months to minimize impact on aquatic life and water quality.
Remedial measures	There are no additional remedial mitigation measures other than those listed above if implemented in full.
Method of Access	Existing access roads should be utilised as far as possible.
Period of activity	The period of the maintenance management activity will vary depending on the level of maintenance required. The activity will be ongoing.

MS5: Monitoring, maintenance and repairs of stormwater infrastructure including sediment removal, litter management, erosion control etc.

Description of activity	To maintain stormwater infrastructure effectively, sediment removal will be essential to prevent accumulation that could reduce the functionality of stormwater ponds. This work will likely require using an excavator or similar equipment both within and around the ponds. Additionally, managing litter and vegetation is also necessary for optimal performance. Regular vegetation trimming will occur in channels, which may cause temporary localized habitat disturbance and potential sedimentation or increased turbidity in downstream water systems.
Actions	The following general sequence of actions are required: 1) Access stormwater ponds/channels with heavy vehicle (if required). 2) Remove silt and place on area adjacent to pond/channel. 3) Cut back vegetation from the channel/channel and place temporarily adjacent to channels on the bank area 4) Remove and dispose of vegetation and silt in suitable area 5) Rehabilitate area adjacent to pond/channel from where heavy vehicles gained accessed or where silt/vegetation was placed.
Impacts of actions	The following impacts are anticipated because of undertaking the removal activity: • Sedimentation / increased turbidity into downstream systems. • Maintenance activities within or in close proximity to stormwater ponds and channels can cause water quality impairment through operation of heavy vehicles (e.g. as result of fuel spills or leakage). • Localised habitat disturbance in the channels and potential biota loss;
Severity of impacts	If all mitigation measures are implemented the severity of the impact will be Low
Measures to mitigate the severity of the impacts	<u>Essential mitigation measures:</u> • Undertake maintenance activities during the dry summer months only. • All vehicles are to remain within existing roads or previously determined routes, no new roads should be developed without prior authorisation. No indiscriminate movement of machinery within wetlands is allowed.

	• Ensure that all excavators and other vehicles remain outside wetland systems and cross the drainage lines only on the existing road. • Dispose of sediment outside of any watercourses or other areas of ecological sensitivity, and such that it will not wash into such watercourses. • Ensure appropriate maintenance and refuelling of machinery and the appropriate containment of hazardous substances and chemicals (if required) at least 50m from the nearest watercourse, on a bunded surface. • Restrict maintenance activities to outside of bird breeding season (November to end of March). • Restrict vehicle and machinery operation to previously disturbed areas and ensure that material stockpiles are set-back from the watercourse by a minimum distance of 32m. • Cobbles must be placed on all outlet structures and indigenous vegetation established to bind the soil of the bed, to prevent erosion and assist with energy dissipation. • Prior to the onset of the winter rainy season, all stormwater infrastructure must be desilted, and any debris must be removed. • Regular inspection of the stormwater outlet structures must be undertaken (specifically prior to the winter rains and after large storm events) to ensure unobstructed flow and monitor the occurrence of erosion. If erosion has occurred, it must immediately be rehabilitated through stabilisation of the embankments and revegetation, where applicable. • All pipelines and attenuation ponds must be regularly cleaned, and all outlet structures (if any) checked to ensure there is no debris/blockages. • The likelihood of erosion at the discharge points can be reduced provided that a higher surface roughness is implemented in the area from the discharge points down to the delineated freshwater ecosystems, allowing for water to enter the seep wetland 1, CVB wetland 3 and the surrounding environment at a lower velocity. This can be achieved through the placement of cobbles and ensuring that the area surrounding each discharge point is suitably vegetated.
Remedial measures	There are no additional remedial mitigation measures other than those listed above if implemented in full.

Method of Access	Existing access roads should be utilised as far as possible.
Period of activity	The period of the maintenance management activity will vary depending on amount and frequency of siltation. The activity will be ongoing.

MS6: Upkeep and repairs of maintenance and access roads.

Description of activity	Gravel road maintenance will involve regular inspections to identify issues and grading to keep the surface even. Drainage features, such as ditches and culverts, will be cleared regularly to prevent erosion, while potholes and erosion will be promptly repaired. Vegetation along road edges will be controlled, and any flood-related damage will be repaired after storms to maintain road access and prevent further erosion.
Actions	The following general sequence of actions are required: 1. Identify maintenance activities required. 2. Clear area of debris, sediment or vegetation from the area if required. 3. Carry out necessary maintenance work. 4. Rehabilitate disturbed areas, remediate any erosion and suitably loosen any compacted soil. 5. Reshape areas and/or replant as required.
Impacts of actions	The following potential impacts may result from the proposed maintenance activities: • Proliferation of AIP species within the disturbed areas. • Potential loss of indigenous vegetation as a result of maintenance works. • Disturbance to and compaction of soil resulting in erosion. • Potential conveyance of sediment laden stormwater into the freshwater ecosystems
Severity of impacts	If all mitigation measures are implemented the severity of the impact will be Low.
Measures to mitigate the severity of the impact	• Conduct routine maintenance to minimize the risk of infrastructure failures that could necessitate more extensive work within regulated wetland areas. • Only existing roadways should be utilized during maintenance and repairs to avoid indiscriminate movement of vehicles within the wetlands.

	• No vehicles are permitted to enter the freshwater ecosystems. Any maintenance works within wetlands must be undertaken by foot, or the relevant authorizations obtained beforehand. • Any AIPs within the maintenance area must ideally be removed prior to the initiation of soil disturbing maintenance activities. This will assist in reducing the long-term AIP management requirements. • The soil within 15m of the freshwater ecosystems must be suitably loosened on completion of maintenance activities and revegetated to prevent erosion. • Stockpiling of excavated materials may only be temporary (i.e. may only be stockpiled during the period of maintenance at a particular site). Soil must be stockpiled on the upgradient side of the excavated area to avoid sedimentation of the downgradient areas. • Excavated areas must be backfilled as soon as infrastructure has been installed/repaired in any given section to reduce potential erosion of exposed soil. • Limit routine maintenance activities to the dry summer months as far as possible. • As far as possible, physical movement in the freshwater ecosystems by personnel must be limited. • Dispose of excess sediment outside of any watercourses or other areas of ecological sensitivity, and such that it will not wash into such watercourses • Regular inspection culverts and drainage structures must be undertaken (specifically prior to the onset of the winter rains and after large storm events) to ensure unobstructed flow and monitor the occurrence of erosion. If erosion has occurred, it must immediately be rehabilitated through stabilisation of the road verses and revegetation, where applicable.
Remedial measures	There are no additional remedial mitigation measures other than those listed above if implemented in full.
Method of Access	Existing access roads should be utilised as far as possible.
Period of activity	The period of the maintenance management activity will vary depending on the level of maintenance required. The activity will be ongoing.

8. MONITORING AND REPORTING

8.1. Monitoring

Capewinelands Aero (Pty) Ltd is responsible for overseeing the monitoring of maintenance and management activities under this MMP. It is critical that all management actions outlined in the plan are strictly adhered to. Regular and thorough monitoring is essential to ensure compliance with MMP specifications, identify any issues of non-conformance, and implement corrective actions to minimize risks and prevent environmental damage.

Proactive, ongoing monitoring will address potential impacts to the ecological integrity of the associated aquatic ecosystems. Key monitoring activities include:

- **Structural Integrity Checks**: Routine inspection and maintenance of service, stormwater, and linear infrastructure associated with the CWA development to ensure structural stability and prevent potential disruptions.
- **Pollution Prevention Program**: An active monitoring system should be implemented to promptly identify and mitigate potential pollution sources that could impact soil, surface water, or groundwater quality.
- **Wetland Health Monitoring**: Regular assessments of potentially impacted wetlands to ensure ecological processes and functions are preserved or improved in line with Present Ecological State (PES) and Recommended Ecological Category (REC) goals. The Wetland Offset Study and Implementation Plan (FEN, February 2025) provides specific guidelines to maintain offset wetlands within desired ecological conditions (refer Appendix B to this report).
- **Alien Invasive Plant (AIP) Management**: Implement the Alien Vegetation Management Plan (PHS Consulting, March 2025), monitoring and removing invasive species to protect native vegetation and ecosystem balance.
- **Erosion and Sedimentation Control**: Frequent visual inspections across stormwater systems, roads, and natural areas to identify erosion or sediment buildup, with prompt corrective actions to prevent habitat degradation and downstream sedimentation impacts.

Monthly inspections should be carried out by a suitably qualified individual within the CWA Environmental Management Division (EMD) to verify the condition and functionality of critical infrastructure, including stormwater systems, service infrastructure, and fences. These checks serve as quality assurance and ensure alignment with the MMP. To facilitate effective monthly monitoring, monthly walk-through inspections should be carried out. These inspections should focus on identifying areas of concern related to:

- Erosion
- Sedimentation
- Infrastructure damage
- Waste / litter dumping
- Alien vegetation encroachment
- Soil compaction

Seasonal maintenance is essential for all stormwater infrastructure and access roads. Prior to the rainy season, thorough cleaning and inspection should be conducted, including clearing all culverts and drainage channels. Annual condition assessments should be undertaken for all infrastructure within the 32m Zone of Regulation (ZoR) and associated wetlands to identify longer-term repair needs. It should however be noted that these monitoring requirements are the minimum required to facilitate the implementation of this MMP. All service infrastructure must be maintained in accordance with manufactures' instructions and no less frequently than the manufactures statutory timeframes.

All activities undertaken **outside the scope** of the MMP, will be subject to Section 24(F) of NEMA and appropriate enforcement and compliance requirements will follow.

8.2. Reporting

Form A below must be completed by the relevant person(s) **before** maintenance activities are undertaken and Form B below **after** a maintenance activity has been completed. Form A should be completed **at least 7 working days before** the commencement of any maintenance activity and **Form B a minimum of 3 working days after** the completion of the maintenance activity(ies). At least two photographs are required from two different points of perspective (A and B) looking at the site (coordinates of these points are required). The type and reference code relates to the relevant detail within the adopted MMP.

Capewinelands Aero (Pty) Ltd is responsible to ensure a record of all maintenance activities is recorded as per Form A & B. Copies of Form A and B must also be sent to the Provincial Department of Agriculture, Directorate: Sustainable Resource Management.

DEA&DP may, within a reasonable notice period, request to evaluate the maintenance activities and assess the maintenance sites as per the adopted MMP.

FORM A REPORTING FOR INTENT TO UNDERTAKE MAINTENANCE ACTIVITIES	
Section A: Landowner Details	
Landowner Name & Surname	
Farm/Erf No	
Today's Date	
Section B: Details of proposed maintenance activity	
WUA/GA reference number:	
DEA&DP MMP reference number:	
Activity Type:	
Reference code (*make reference to MMP*):	
Footprint area (m^2):	
Volume of material (m^3):	
Equipment to be used:	
Description of method for planned activity:	
Date when work will commence:	
Date of last flood event for site:	
Note any further damage and comments regarding the state of the site:	
Section C: Photographs of activity location before maintenance	
Photo A – Before Maintenance Activities	
Coordinates:	
Photo B – After Maintenance Activities	
Coordinates:	

FORM B

REPORTING FOR COMPLETION OF MAINTENANCE ACTIVITIES

Section A: Landowner Details				
Landowner Name & Surname				
Farm/Erf No				
Today's Date				
Section B: Details of proposed maintenance activity				
WUA/GA reference number and DEA&DP reference number for MMP.	**Activity Type:**	**Reference code (*make reference to MMP*)**	**Footprint area (m^2)**	**Volume of material (m^3)**
WUA/GA reference number:				
DEA&DP MMP reference number:				
Activity Type:				
Reference code (*make reference to MMP*):				
Footprint area (m^2):				
Volume of material (m^3):				
Equipment to be used:				
Description of method for completed activity and if commence date changed:				
Date activity completed:				
Date of last flood event for site:				
Note any challenges or difficulties experienced in following the MMP method statement				
Section C: Photographs of activity location after maintenance				
Photo A – Before Maintenance Activities				
Coordinates:				
Photo B – After Maintenance Activities				
Coordinates:				

Appendix A: Detailed EIA Phase Freshwater Ecological Assessment (FEN, February 2025)

(Please refer to Appendix 7 to the Environmental Impact Assessment Report)

Appendix B: Draft Wetland Offset Study and Implementation Plan (FEN, January 2025)

(Please refer to Annexure 7 of Appendix 39 to the Environmental Impact Assessment Report)

Appendix C: MMP maintenance coordinates

Description	Coordinates		Comments
Perimeter Fence (Figure A)	Latitude	33°45'2.26"S	Start
	Longitude	18°44'13.63"E	
	Latitude	33°45'11.01"S	End
	Longitude	18°44'17.92"E	
Maintenance Road (Figure A)	Latitude	33°45'2.26"S	Start
	Longitude	18°44'13.63"E	
	Latitude	33°45'11.01"S	End
	Longitude	18°44'17.92"E	
Access Road 1 (Existing northern access road) (Figure B)	Latitude	33°44'24.37"S	Start
	Longitude	18°44'39.33"E	
	Latitude	33°44'32.66"S	End
	Longitude	18°44'6.09"E	
Access Road 2 (Existing southern access road)(Figure A)	Latitude	33°44'50.01"S	Start
	Longitude	18°44'46.38"E	
	Latitude	33°44'56.87"S	End
	Longitude	18°44'39.61"E	
Dry Attenuation Pond 5 (Figure B)	Latitude	33°44'42.23"S	Adjacent to CVB 3 (Includes associated stormwater infrastructure)
	Longitude	18°44'9.46"E	
Proposed Sprinkler Main Fire Water (Figure A)	Latitude	33°45'2.63"S	Start
	Longitude	18°44'13.44"E	
	Latitude	33°45'10.78"S	End
	Longitude	18°44'17.01"E	
Wetland Offset – RE Seep Wetland 1 (Figure A)	Latitude	33°45'3.32"S	Incl. ongoing AIP removal
	Longitude	18°44'19.67"E	
Wetland Offset – CVB Wetland 1 (Figure A)	Latitude	33°44'55.78"S	Incl. ongoing AIP removal
	Longitude	18°44'43.97"E	
Wetland Offset – Agricultural Drain Point 1 (Figure A)	Latitude	33°44'58.42"S	Rehab adjacent to Seep Wetland 1
	Longitude	18°44'23.33"E	
Wetland Offset – Agricultural Drain Point 2 (Figure A)	Latitude	33°44'44.62"S	Rehab adjacent to CVB 1
	Longitude	18°44'30.68"E	
CVB Wetland 2	Latitude	33°44'27.34"S	AIP Removal
	Longitude	18°44'15.33"E	
CVB Wetland 3	Latitude	33°44'42.19"S	AIP Removal
	Longitude	18°44'20.97"E	
Seep Wetland 2	Latitude	33°45'20.47"S	AIP Removal
	Longitude	18°44'46.87"E	

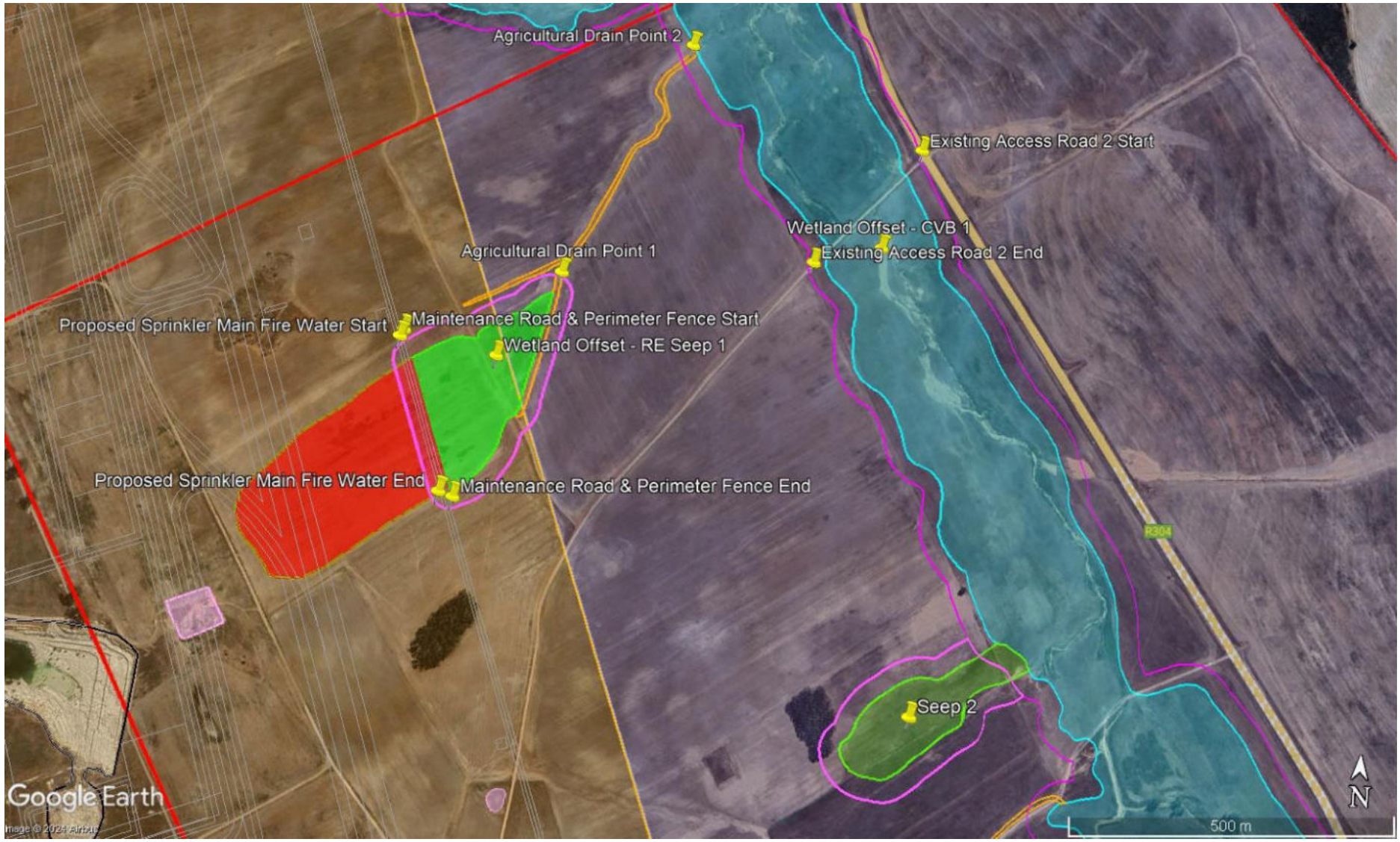


Figure A: MMP Southern Coordinates

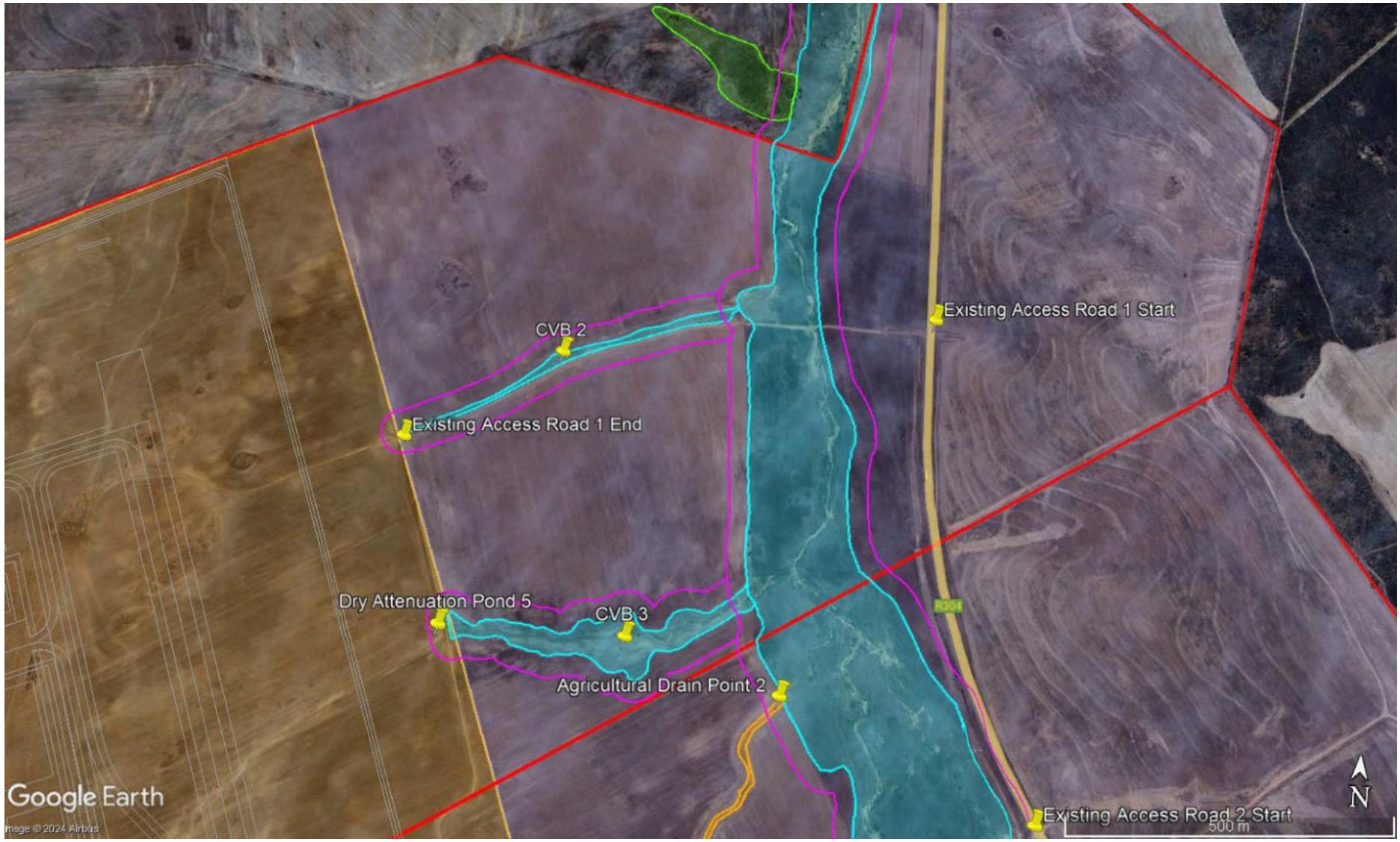


Figure B: MMP Northern Coordinates

ANNEXURE 17: GROUNDWATER MANAGEMENT PLAN

(This will be a condition of approval if Environmental Authorisation/ WULA is obtained)

ANNEXURE 18: BIODIVERSITY OFFSET REPORT

MARK BOTHA

CONSERVATION STRATEGY TACTICS & INSIGHT

Cape Winelands Airport – Biodiversity Offset Report

Compiled for: PHS Consulting, Hermanus

Client: Capewinelands Aero (Pty) Ltd.

Revision 2

20 June 2025

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EAP: PHS Consulting – Amanda Fritz-Whyte & Paul Slabbert

Declaration

I, Mark Botha, the appointed independent specialist, hereby declare that I:

• am an independent specialist service provider with experience in spatial biodiversity planning, assessing impacts and designing and negotiating biodiversity offsets for government and corporate clients since 2011 and act as independent specialist in this application;

• perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;

• regard the information contained in this report, as it relates to this offset study, to be objective, true and correct within the framework of assumptions and limitations;

• do not have and will not have any business, financial, personal or other interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations 2014, and amendments 2017, NEMA 2020 Procedures for the assessment and minimum requirements for reporting on identified environmental themes in terms of Sections 24(5) (a) and (h) and 44 of the National Environmental Management Act, 1998, when applying for environmental authorisation, and any specific environmental management act;

• declare that there are no circumstances that may compromise my objectivity in performing such work;

• have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;

• will comply with the Act, Regulations and all other applicable legislation and have no, and will not engage in, conflicting interests in the undertaking of the activity, and undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; or the objectivity of any report, plan or document to be prepared by me for submission to the competent authority;

• all the particulars furnished by us in this form are true and correct; and realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Yours truly,

Pr.Sci.Nat 20 June 2025

Acronyms and Definitions

BioNet	CCT's Biodiversity Network		MFMA	Municipal Finance Management Act
CBA	Critical Biodiversity Area		NEMBA	NEM: Biodiversity Act. Act 10 of 2004
CCT	City of Cape Town		NEMPAA	National Environmental Management: Protected Areas Act (Act 57 of 2003)
CR	Critically Endangered		PA	Protected Area
CREW	Custodians of Rare & Endangered Wildflowers		PBO	Public Benefit Organisation
CWA	Cape Winelands Airport		PFMA	Public Finance Management Act (Act 1 of 1999)
EA	Environmental Authorisation		PHS	Environmental Assessment Practitioner for CWA
EA	Environmental Assessment Practitioner		RESA	Runway End Safety Area
EN	Endangered		SANBI	SA National Biodiversity Institute
IAP	Invasive Alien Plant		SCC	Species of Conservation Concern

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1. Introduction

A consortium plans to build a new airport and associated infrastructure on the old Fisantekraal airfield (see Figure 1) and extending the runway to accommodate larger aircraft and multiple logistics and support operations. Given the size and location, there are inevitable impacts on threatened biodiversity – which already cannot meet their conservation targets. There is almost no greenfield site in the larger Cape metropole that would not impact on Critically Endangered (CR) or Endangered (EN) ecosystems – especially for an impact of this scale.

Impacts on CR ecosystems are difficult to mitigate. South Africa has adopted guidance that explores an "Ecological Compensation" approach – the mitigation of residual impacts on currently protected areas or irreplaceable biodiversity. This aspect of biodiversity offsets policy is not well developed and is best designed on a case-specific basis.

Although offsets generally and ecological compensation specifically are an important but under-utilised mitigation tool in South Africa, they are not to be used lightly. Impacts on critically endangered ecosystems have been strongly discouraged since offsets guidance first emerged in South Africa. Almost all references confirm that offsets (as a last resort mitigation measure) can only be used to attempt to remedy High or Very High significant impacts of a development IF that development is indispensable, required, and/or otherwise socially desirable. The compensation offered should not positively affect the decision to permit the impact in the first place. An inability to locate or implement a suitable offset or effective, acceptable, proportional ecological compensation can, however, have a negative impact on a decision.

However, there is little guidance on the acceptability of ecological compensation for impacts on CR ecosystems or Critical Biodiversity Areas (CBAs) where the impact itself is very small and only assessed as of Medium or Low Negative significance, and the conservation outlook for the impacted system is bleak. While these impacts could be interpreted as fatal flaws, they are also geographically very limited and on sites in rather poor condition. I take no view on the need and desirability of this Cape Winelands Airport (CWA) but assume that it is a necessary and supported development proposal for the region on its own merits.

This report confirms the scope and quantum of the biodiversity impact from the proposed CWA, provides an analysis and prioritises possible offset sites, and explores and proposes required likely implementation arrangements, should the CWA be authorised. It sets out the components of implementation arrangements that should be concluded prior to commencement.

2. Assumptions and limitations

- The direct and indirect impacts are adequately mapped and assessed by the specialists, and that no cryptic species worthy of separate offset measures will be impacted.
- As with most major complex, highly contingent infrastructure projects, there have been numerous changes to layouts and footprints. This includes minor elements (such as perimeter security roads) that may marginally impact on sensitive features. I must assume that the final layout plan and clearing accords with the Spatial Development Plan version 13 as of 22 August 2024 and that no material impacts eventualise. Please note that some maps in this report may be derived from earlier iterations of layouts, although the actual impact figures are accurate.
- There is no realistic chance for restoration of the renosterveld and sand plain fynbos ecosystems adjacent to the runway, the RESA and other operational features of the airport. While some individuals of CR species may persist, the ecosystem that supports their populations in the long term will be lost. This is a risk averse and precautionary approach to offset calculation.
- This study only investigates the terrestrial ecosystem impacts – the wetland impacts and offset are subject to a separate analysis and proposal (FEN 2024). Where possible and prudent, the two offset processes have been developed in cognisance of each other.
- No faunal impacts were assessed or proposed to require offset-type mitigation.
- As with most offset studies, the final choice of site and securing of an implementation partner is out of my control, and subject to multiple contingent factors, including successful authorisation and surviving of any legal challenge. While the site options and implementation arrangements proposed here have already been largely secured and financial arrangements are in process of being concluded, they cannot be guaranteed. For this and other reasons, it is strongly advised that any authorisation include carefully crafted conditions to ensure the ultimate success of offset mitigation – regardless of the proposals herein. Guidance is provided as to what this might look like.

3. Context

The receiving environment is typical of the Cape Lowlands, with highly fragmented remnant ecosystems in various stages of neglect and moderate to poor ecological condition. Offsets are difficult to make work in this context – but the corollary is that the long-term prognosis for effective ecological function and persistence of species of conservation concern is very low without dedicated offset (or other conservation) interventions and budgets.

As the impacted ecosystems are nominally designated as CR (Swartland Silcrete Renosterveld, Swartland Shale Renosterveld or EN (Swartland Granite Renosterveld), the Biodiversity Offset Guideline (DFFE 2022) indicates that the appropriate mitigation is technically 'Ecological Compensation' –

although the modality is identical to a biodiversity offset. These terms will therefore be used interchangeably in this report.

The primary objective of "Ecological Compensation" should be to secure and improve management of the closest analogue to the impacted biodiversity in a way that contributes maximally to the persistence of important biotic features in the landscape. In South Africa, this implies a focus on securing CBA areas within Protected Area (PA) expansion priority focus areas, or other local priorities identified and mapped by specialists and conservation authorities. The CWA is located in the Klipheuwel Corridor of the CCT's BioNet[1]. There is some misalignment between the BioNet's mapping and designation of CBAs and priority remnant habitats and those identified by the Botanical and Freshwater Specialists' report – this report adopts the specialists' recommendations and has ground-truthed the impacted (and offset) sites.

It is not likely to be able to defensibly "trade up" for impacts on two of the most CR ecosystems in South Africa. Other sites 16km to the North do not conserve the same vegetation or SCC component, although have substantial numbers of other SCC and unique and very rare habitats which are demonstrably under greater threat of imminent extirpation. It is conceivable to propose offsets in these sites, but this would require authorities' approval and intricate management and protection arrangements.

Species mitigation for many fynbos species relying on tight mutualisms or specific ecological processes (e.g. suitable return interval and intensity fire regimes) is difficult. Where possible, search and rescue of propagation material for all listed species by trained professionals is encouraged. Where prudent, this material can be reestablished in or near the offset sites on suitably protected and managed portions to improve the species chance of persistence. Offset site selection, design and management regime should incorporate management actions to improve survival of these species.

No faunal impacts were assessed or proposed to require offset-type mitigation.

Wetland impacts were moderate and are the subject of a separate specialist report and offset process. Although coordination and alignment between the terrestrial and wetland specialists has been pursued, it has been agreed with all parties that there is little utility in co-locating these offset measures.

[1] An updated version of the BioNet was released for comment after this report was submitted. There is no fundamental change to the status of the impact and receiving environment and the botanical specialist report findings still hold.

4. Impact & Offset metrics

Two patches of Very High botanical sensitivity were identified in the study area, each of about 1.6ha in extent. The northern one (Swartland Silcrete Renosterveld) is located within the proposed development area (just over 50% of it is within the runway alignment which unfortunately cannot be altered due to civil aviation constraints, the remainder in the Runway End Safety Area (RESA) which must have all rocks and woody plants removed), whilst the southern one (Swartland Shale Renosterveld) is just outside the development area (Helme 2023). It's unclear how much will finally be impacted, so this offset report assumes complete loss given the likely adjacent disturbance associated with airport operations, mowing, lack of burning etc.

The Botanical Impact Assessment Report (Helme March 2024) found: "*any mapped areas of remnant habitat that are lost to development should be offset by formalised conservation of high conservation priority examples of the same habitat in the region, at minimum ratios of 20:1 (for non-pristine habitat) and 30:1 (for better quality examples; as per Dept. of Forestry, Fisheries & Environment offset guidelines, 2022). Preliminary estimates suggest that 1.0ha of Very High sensitivity vegetation (partly degraded; exact extent to be confirmed) will need to be offset at a ratio of at least 20:1, and 2.3ha of Medium sensitivity at a ratio of about 10:1, and the 1.3ha of High sensitivity vegetation at about 15:1. This means that a total offset of at least 63ha (plus ongoing environmental management budget for this) will be required..*"

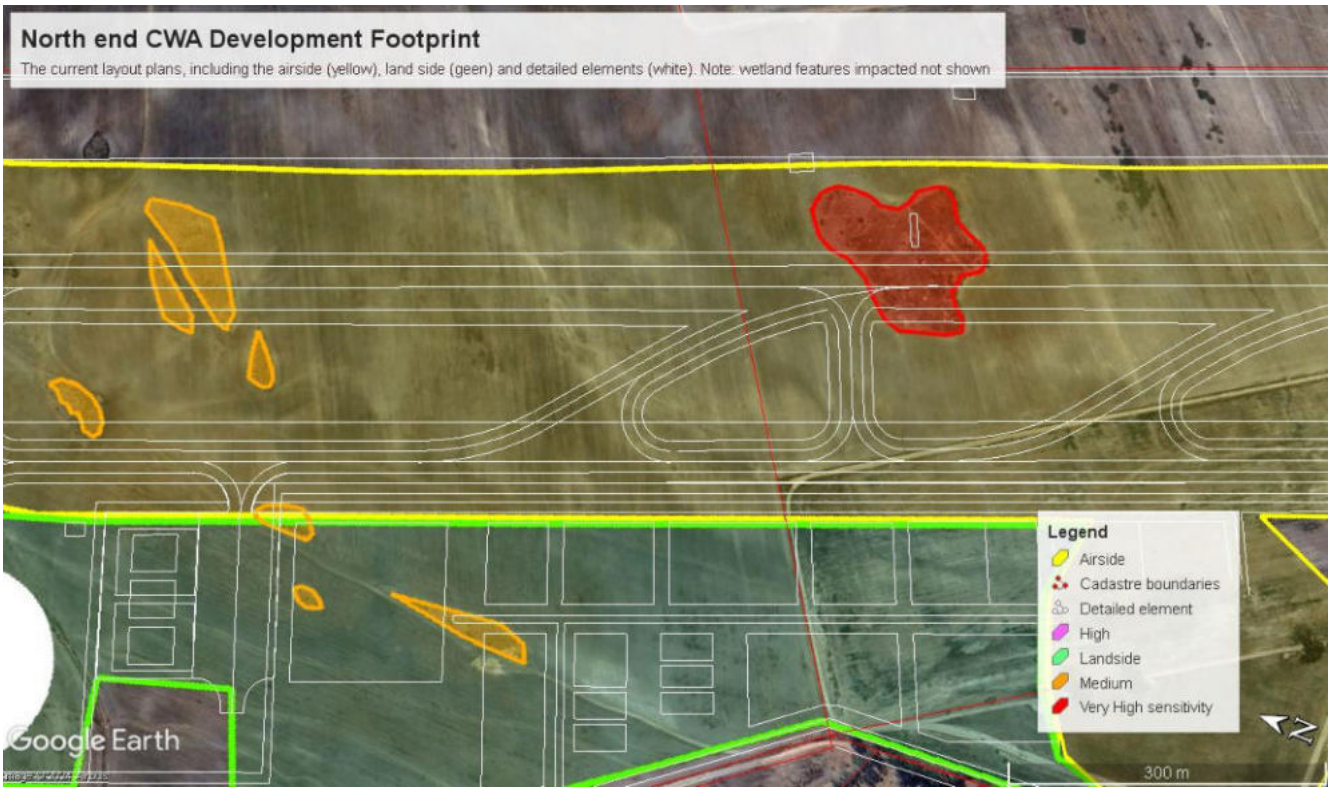


Figure 1. Botanical sensitivity map for the northern part of the study area, with airside layout and detailed elements superimposed. From Helme (2023). New layouts (August 2024) do not affect the major impact calculation metrics. Note North Arrow indicator to the left. The removal of rock and other incompatible material from the RESA is assumed to cause complete loss of biodiversity features in the yellow airside area. Replanting

some of the species of conservation concern within this zone is possible if mowing can be avoided. Rescue to other habitat analogues is likely better, more dependable mitigation.

The impact sites were visited on 4 May 2024, and I concur with the Botanical Specialist's findings. Although some of the northern Silcrete remnant may be left in the RESA, this report assumes its entire loss for offset calculation purposes. The condition of the impacted areas and their likely persistence (even if the CWA development does not proceed) is low, and the offset metrics of impact area, condition, and thus the ultimate offset liability is conservative, cautious and risk aversely calculated. Note that the impacted, highly degraded Renosterveld seep wetland is subject to a separate Specialist Report and Offset Process conducted by FEN (2024).

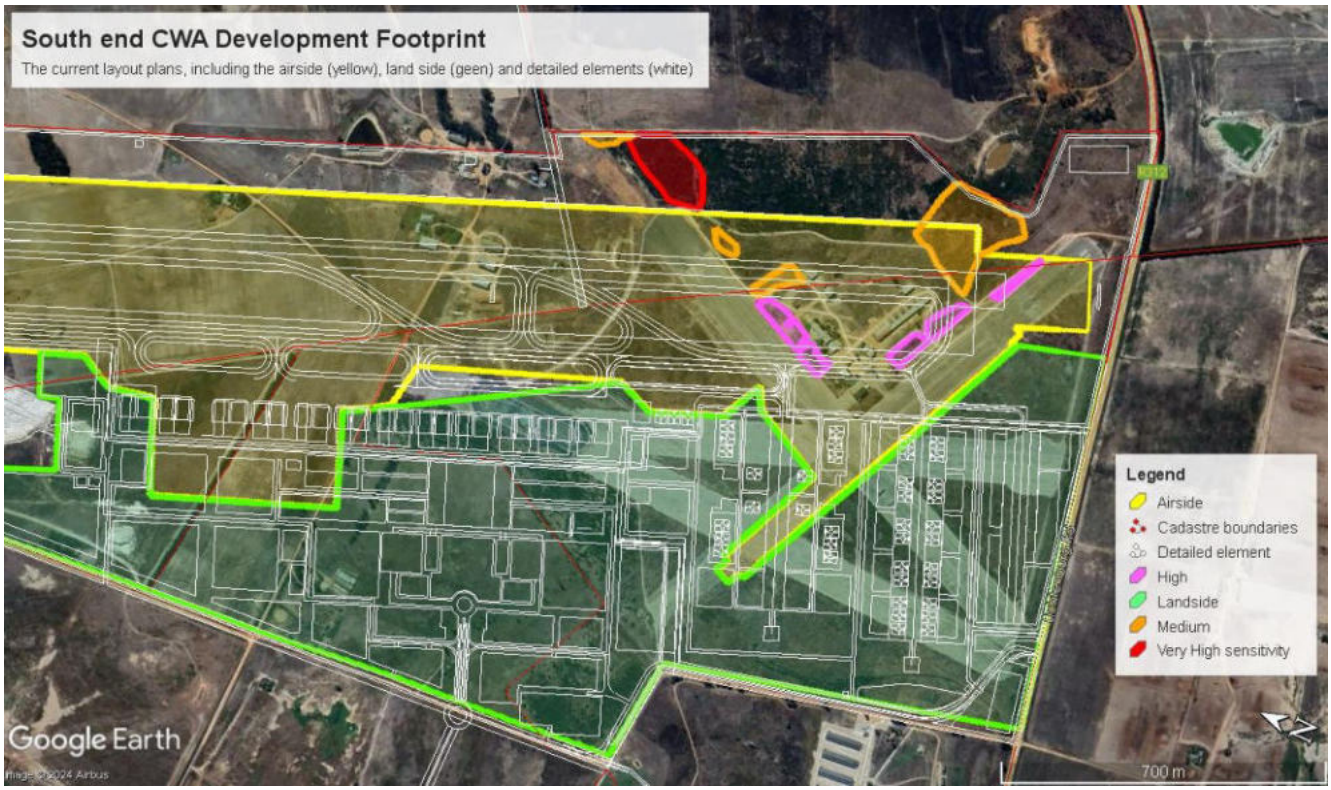


Figure 2. Botanical sensitivity map for the southern part of the study area. All unshaded areas within the study area indicated are of Low sensitivity. From Helme (2023) and layout from Aug 2024. The offset calculation assumes the Very High Botanical Sensitivity area is avoided by all infrastructure, access road and firebreak development. New layouts and site development must ensure that these sensitivities are avoided. Note North Arrow indicator to the left

Given the very fine grain transitions between the underlying ecosystems, veld age and the poor condition of the vegetation it is difficult to accurately ascribe the loss to a specific vegetation type with any precision. Vegetation type mapping is less accurate at mapped scale. However, for the purposes of this offset report, I concur with the botanical specialist that given SCC occurrence and soil observation, Swartland Silcrete Renosterveld and Swartland Shale Renosterveld are the primary types requiring ecological compensation. The High Sensitivity impacted areas adjacent to the existing Fisantekraal airport may, however, have been more closely related to Swartland Granite Renosterveld. Regardless, the primary determinant of candidate offset sites should be representations

of these three types. No other biodiversity priority area or planning features were identified as requiring offsets.

Choice of suitable offset ratios is informed by the underlying Ecosystem Status (in this case all CR, with one (Granite) possibly EN), Protection Level (in this case Not Protected – Skowno et al 2019), and condition of the impacted site. Starting ratios for all impacts must thus be 30:1. This ratio is moderated down by the condition of the impacted sites – according to the table below. The justification for the condition modifiers is predominantly based on either the very poor condition (modified down to 33%) or moderate condition of the impacted sites (modified down by 50%). The Silcrete remnant patch is in moderate condition, although heavily invaded and grazed, and is completely isolated from any substantial surrounding patch – thus the ratio is modified down to 66% of the starting ratio provided for in guidance.

Feature (all in Swartland Silcrete, Shale & possibly Granite Renosterveld)	***Size (ha)***	***Gazette Ratio***	***Condition modifier***	***Final Ratio***	***Offset Required***
Northern Silcrete Remnant. Moderate condition, V high significance	1,7	30:1	66%	20	34
Mown grassy meadows along existing runways, poor to moderate, High significance	1,33	30:1	50%	15	20
Remnant Renosterveld patches within or overlapping airside layout, Medium significance, poor to v poor condition	2,3	30:1	33%	10	23
Total Terrestrial Offset required (ha)	**5.3**				**77**

Table 1. Specific biodiversity features impacted, affected area, starting gazetted ratio, habitat condition modifier, and final offset ratio and area calculation. Note that Helme's (2024) calculations exclude around 0,7 ha of the Northern Silcrete remnant which is outside the runway footprint – this is included in these calculations.

Comprehensive floral species impacts in these CR ecosystems are difficult to quantify given the cryptic nature of some, the absence of primary ecological drivers from the ecosystem which triggers life cycles (especially underlying burning regime) and invasion by woody trees. However, I have no reason to doubt the Botanical specialist's findings and assessment. Search and Rescue type mitigation must be informed by SANBI's guidance for experts in this regard, as well as professional implementation.

My guidance is that the following species mitigation should be incorporated in any ecological compensation type interventions if not catered for in the botanical specialist's recommendations:

Species of Conservation concern	***Status***	***Required Intervention (From Helme 2024; this Report)***

Leucadendron verticillatum; About 60 plants NE of old runway	Critically Endangered	Secure population on site on southern very high sensitivity site, regularly remove all threatening IAP and increase habitat protection and condition offsite for known occurrences
Podalyria microphylla	Critically Endangered	Search & Rescue to a habitat analogue from very high sensitivity area at northern end of runway. If deemed feasible by specialist, replant on ferricrete/silcrete area (even if surface rock removed for RESA), and increase habitat protection and condition offsite for known occurrences
Ficinia sp nov Rare in ferricrete patch in northern area	Not yet assessed	Search & Rescue from northern end of site to habitat analogue. If deemed feasible by specialist, replant on ferricrete/silcrete area (even if surface rock removed for RESA), and increase habitat protection and condition offsite for known occurrences
Babiana odorata; About 10 plants close to entrance gate;	Endangered	increase habitat protection and condition offsite for known occurrences
Leucospermum grandiflorum Two dead plants	Endangered	Granite species. Required mitigation unclear
Restio rigoratus	Endangered	Search & Rescue to habitat analogue. increase habitat protection and condition offsite for known occurrences
Lampranthus leptaleon; Only 3 plants in SE area;	Endangered	Search & Rescue to habitat analogue. increase habitat protection and condition offsite for known occurrences
Drosanthemum hispifolium About 10 plants on northern edge;	Vulnerable	Search & Rescue to habitat analogue. increase habitat protection and condition offsite for known occurrences
Xiphotheca lanceolata	Vulnerable	Increase habitat protection offsite for known occurrences
Metalasia octoflora	Vulnerable	Increase habitat protection offsite for known occurrences
Muraltia macropetala	Vulnerable	Increase habitat protection offsite for known occurrences
Gladiolus watsonius About 30 plants in SE area;	Near Threatened	Search & Rescue to habitat analogue

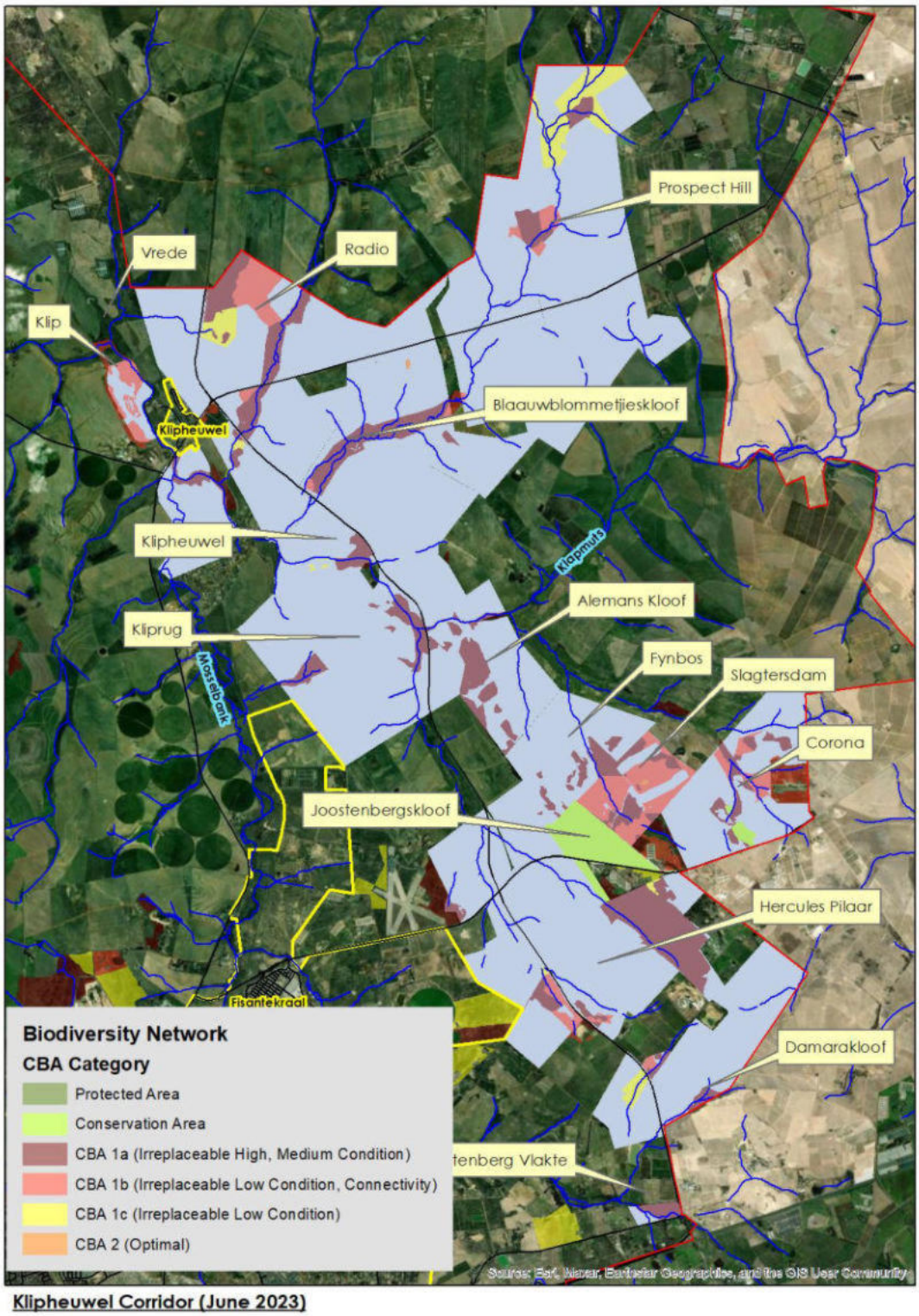
Table 2. Species of conservation concern likely to be impacted, their status and proposed mitigation measures. Adapted from Helme (2024)

Summary of the criteria for the biodiversity offset is that the site(s) need to:

- secure at least 77 ha of Swartland Renosterveld, on shale, or granite or silcrete.
- include options for rehabilitation of degraded ecosystems and be able to receive species from Search and Rescue operations.
- create corridors or expand existing conserved areas where at all possible
- house viable populations of *Leucadendron verticilatum, Podalyria microphylla, Ficinia* sp nov., and preferably as many of the other EN species impacted.
- Be able to be declared as a protected area in perpetuity and be effectively managed.

However, given the geographical layout and biodiversity patterns and noting that many of the otherwise potential offset site landowners may not be willing to consider offsets on their properties, it may be difficult to secure an offset site that meets all the above criteria perfectly.

5. Candidate site selection



Klipheuwel Corridor (June 2023)

Figure 3. The Klipheuwel corridor node of the Biodiversity Network of the City of Cape Town. Stewardship efforts have been active here for decades, with only 1 site (Joostenbergkloof) effectively being secured on the lowest tier. Acquisition attempts for conservation have been unsuccessful. Long term prognosis for many flat sites, especially with accessible resources under them, is not good. Options do exist to secure offset sites >70 ha.

Several sites were assessed for suitability for the CWA offset on recommendation by the proponent, EAP, regional flora specialists, and authorities. These included:

Table 3. A shortlist of possible offset candidate properties, their size and biodiversity features, and sufficiency to offset CWA impacts in the mode of Ecological Compensation.

Site	***Size***	***Comments***	***Suitability***
Renosterkop Nature Reserve 1334 Paarl	158 ha Natural ptn	Boland granite – not analogous, already protected	No
Ruitevallei RE 483 Paarl	<140 ha natural	Boland granite – not analogous. Impacted by trails	No
Woodlands 874 ptn 19 Paardeberg	460 ha	Boland granite – not analogous. Has L. grandiflora	No
Kliprug & Klipheuwel Farms	<50 ha	Interesting vegetation, dissimilar to impact site but contains other SCC. Subject to other Offset	Insufficient by itself but could contribute
Stonehaven "Rockridge" on Zanddam Re/ 479	≈140 ha. Poor condition remnant	Little IAP, but much weedy, grassy invasion. Has SCC and rehabilitation promise	Insufficient by itself but could contribute
Blaauwblommetjieskloof RE of 941	68 ha	Very dissimilar to impact site. Interesting for other reasons	Insufficient by itself
Alemanskloof (RE/ 473) and Fynbos Farm (RE/ 472 and ptn 2/472	64 ha combined all remnants	Closest analogue to impact site. Not big enough. Would need substantial rehabilitation and connectivity to qualify	Insufficient by itself, but an option
Hercules Pilaar (1242)	108 ha (North), 3 ha 15ha (West) remnants	Large enough, opportunity for restoration and connectivity. Main remnant doesn't contain all SCC	Yes, requires remnants for sufficiency

Two additional sites proposed by regional Botanical Specialists (Ismail Ebrahim (SANBI) and Rupert Koopman (Pvt)) were considered but are provisionally rejected unless authorities approve trading up for threat mitigation:

1- "Vlakfontein" - being ptn 1 of 881 (Morganwagt) and the northern and extreme eastern ptn of Woodlands (RE/874). This is a well-known CREW flora site on granitic sands and under pressure from sand mining. Lots of SCC are known and monitored on this site but it remains among the most precarious in the Swartland.

2- "Doornkraal" being the koppies with remnant Swartland Granite Fynbos on Doornkraal RE/832 and Morgenwagt 3/881. These sites are potentially floristically more related to Malmesbury than Fisantekraal. Latter is possibly under less threat than others closer to CWA.

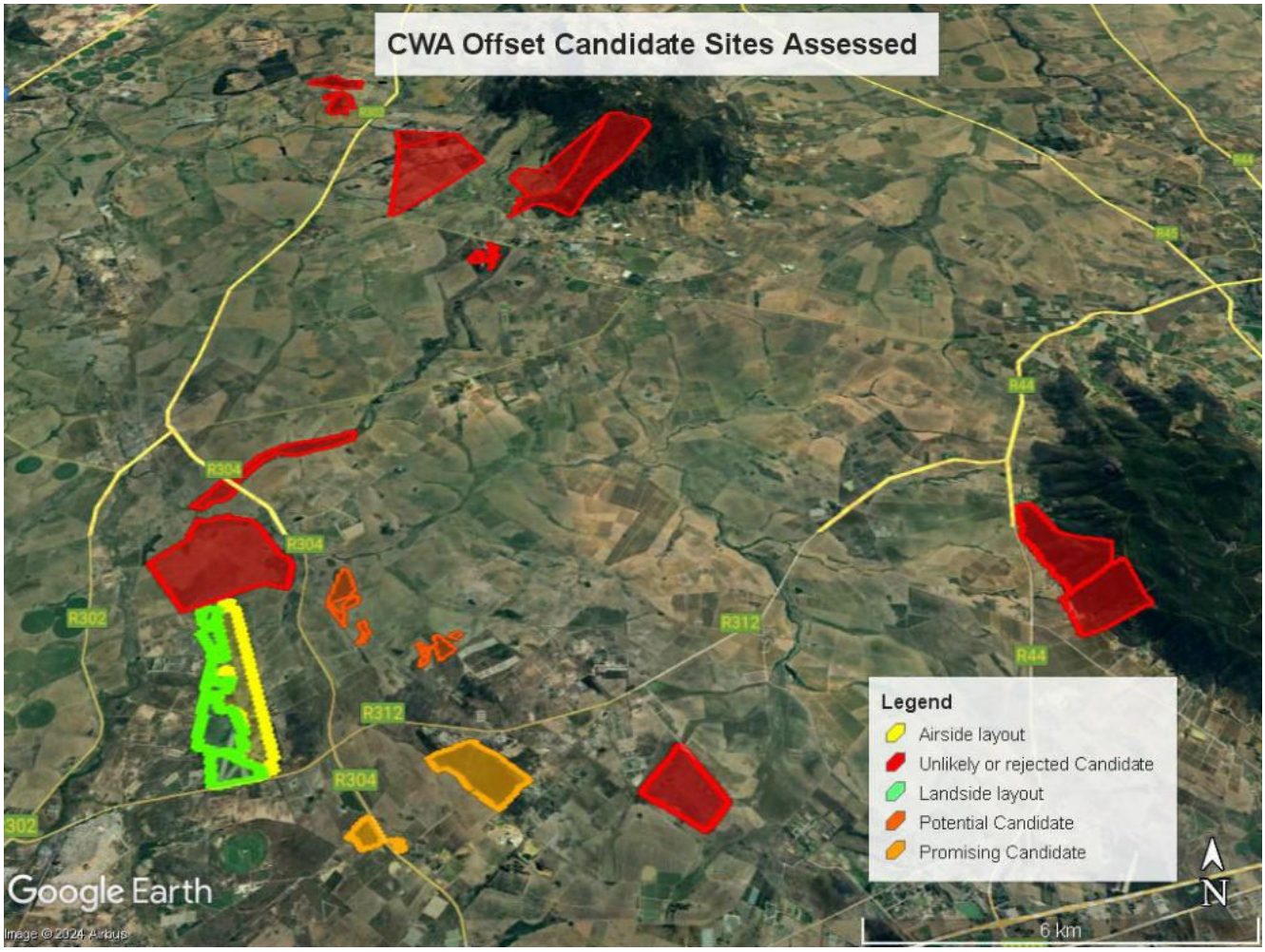


Figure 4. The suite of possible candidate sites assessed to offset the impacts of the CWA. Most were rejected on grounds of floral dissimilarity, some were already deemed to be conserved, or in poor condition with little opportunity for recovery. Two sites remain as priorities for further investigation/development.

6. Prioritising candidate sites

After the initial screening and consultation with authorities, a short list was prepared based on potential biodiversity contribution. These sites were visited to establish the similarity with the impact site, presence of the impacted SCC (or of other CR & EN SCC that require conservation action), as well as a perspective on their possible ecological management outlook and persistence. This removed several of the proposed candidates as they were insufficiently analogous to the CWA site, or suffered from external threats or were already effectively conserved.

A final scan of options, as well as discussions with CCT biodiversity management staff and two local botanical specialists not involved in the CWA assessment yielded two candidates for shortlisting. The prioritisation was based on landowner willingness and implementation feasibility.

The priority candidate site of Hercules Pilaar has sufficient available land with Swartland Renosterveld (primarily shale with some silcrete) and has around 30 ha of degraded Renosterveld which was last ploughed >30 years ago. It would meet all the offset requirements, within reason, provided for in the National Guideline. The site also contains two smaller remnants with significant concentrations of the

impacted CR & EN SCC, excepting the *Ficinia*. The property is under threat from development, especially from neighbouring industrial operations and the expanding urban areas. Conservation Stewardship efforts have been effectively stalled since 2012. The applicant has secured an agreement with the owner to use this site as an offset.

A second candidate site has almost sufficient habitat and supports most of the impacted SCC, with options to restore small patches in between remnants. There is good reason to be confident that if the first candidate site, for some unforeseen reason, cannot be secured, then this one would be an adequate replacement, provided rehabilitation of corridors between the remnants was undertaken. Both candidates would increase the currently conserved area and create ecological corridors for long term species movement and adaption, as well as facilitating improved fire management.

If for some reason these two candidates are not acceptable to CapeNature, CCT and DEA&DP, then further alternatives will need to be proposed by the authorities which would satisfy the 'Ecological Compensation' considerations.

7. Implementation arrangements

The proposed model for offset implementation was developed around current conservation action in the Klipheuwel Corridor in the City's BioNet. Given the extreme threat to the remnant vegetation and the nascent BioNet protection node developing, it appears prudent to pursue outright acquisition and declaration of the site as a Nature Reserve (or possibly Protected Environment) if possible in the long term. A binding Letter of Intent commitment has been concluded between the applicant and the owner of Hercules Pilaar covering a long-term lease agreement/conservation servitude with an accompanying management agreement. This would require the landowner to declare the site as a nature reserve if the listed activities of the CWA are authorised. This is seen as the only mechanism to secure the biodiversity features until acquisition and declaration becomes possible. Agreements have been developed in draft format to execute the intent on receipt of successful authorisation.

Regarding management for the site, the CCT is currently the only active conservation agency managing sites or looking to extend the PA network, and coordination with them is important for synergy and long-term efficacy. However, there are numerous challenges in funding the city team directly. These include: i) the constraints and inflexibility of the MFMA and procurement frameworks to meet the nimble response required in conservation management; and ii) the CCT Biodiversity Branch does not have the capacity or desire to manage site-based endowments.
As management negotiations with landowners are being finalised, it is unclear what roles they would wish to play if they elect to eventually subdivide or sell sections of their properties to be declared. Professional and capacitated service providers are often better placed to handle management of remnants with intricate management (such as prescribed burning regimes and invasive species control) and will need to assist the owners.

The applicant will have a large environmental management responsibility around the airport site – including almost all the kinds of interventions that need to be carried out on the offset site (Fencing and security, controlled burns, invasive plant control, erosion and rehabilitation etc). They have elected to include offset site management under the purview of their environmental management team, and thus the EMPr can be updated to include the relevant offset site interventions and timelines set out in this report. This enables an ECO to asses compliance with offset site management requirements, and to update the site management plan as circumstances dictate.

The EMPr will effectively become the Biodiversity Offset Management Plan for the site, until such time as it is declared a Nature Reserve, and a compliant Management Plan is submitted to the MEC for approval.

The specific management requirements, the level of effort required and return frequency, have been set out in a more detailed budget and are summarised in Table 4). The projected 30 yr costing of this budget was used to determine the Net Present Value of any penalty required to be paid by the applicant to ensure site management for the duration of the liability period. This is calculated in Table 5 in the annex.

As an extra means of security, a PBO (the Endangered Wildlife Trust) has agreed to play the role of site manager in the instance that the applicant fails or is unable to meet its offset obligations. The mechanism to achieve this security is two-fold:

1. By suspending the authorisation for the Airport (as the EA would be valid for a substantial period to cover certain operational aspects of the listed activities)
2. To include as a condition of authorisation, a penalty provision outlining the requirement for the applicant to lodge an endowment with the PBO for this site's management equivalent. This penalty could be equivalent to the Net Present Value of the remaining management costs and would be in addition to any other administrative penalty that the competent authority deems necessary.

The PBO would be required manage this endowment fund efficiently to build a non-sinking fund that can cover management interventions on site or in the adjacent Klipheuwel Corridor post the 30-yr period for the CWA.

A detailed budget has been drawn up for the priority candidate site using accurate and current actual unit costs incurred by the CCT for specific management actions as well as some additional staff capacity to undertake specific tasks. If required, this can then be applied to the second site with minor, non-substantive tweaks to input metrics. The following management interventions are catered for, and were considered to be satisfactory for maintaining and improving site condition. These form the basis for the Biodiversity Offset Management Plan when the site is declared:

Table 4. Proposed management interventions on the priority candidate site, their metrics, costs and frequency

7%	Inflation	length	width				
#	***Intervention***	***Unit / Dist***	***Unit/ Dist***	***Cost/ unit***	Est. 2025 cost	***Repeats in 30yr***	***Assumptions***
1	Firebelt brush cut	3000m	6m	3,8 *R/m²*	R73 188	annually	annual bush-cutter & tractor for accessible portions, Teams & brush cutters for steeper slopes. Team costs = R3,80 sqm
2	Prescribed burn	1150m	800m	R1 957	R192 600	four X	burn half site every 8 years. ~~Assumes CoCT covers 40- 50% costs~~
3	FPA membership	107 ha			R2 301	annually	required for risk / liability management
4	IAP clearing	108 ha	5%	R200/ha	R23 112	three X	clear large seeding trees, at least every 10 yrs
5	IAP follow up	108 ha	1%	R100/ha	R11 556	15 X	clear seedlings and saplings every other yr
6	Fence Maintenance	4000m		R2/m	R8 560	annually	annual fence fixing
7	Head cut /erosion control	40sqm		R80/sqm	R3 424	three X	decadal check and erosion control, especially at dams / after heavy rain
8	Audit	108 ha		R100/ha	R11 556	annually	required for risk / liability management
9	Field Ranger	2/5time			R160 000		Employed by CWA, report to ECO
10	Management fee	9%			R40 787	annually	If this must be executed by an PBO and not the applicant
11	Contingency	5%			R22 671	annually	
	Total				R516 060		For FY 2025. Each yr differs

The applicant will submit the signed Landowner agreement to secure the priority site with the Final EIR. As executing these agreements is beyond my control and fine scale management responsibilities for the site must still evolve, it is impossible to commit to time frames for final arrangements. Therefore, a suspensive condition of authorisation is proposed binding the applicant to achieve certain outcomes to satisfy the attainment of offset outcomes and thus compliance with the National Guideline. This is proposed below.

8. Offset condition

The following condition of authorisation is proposed for consideration by the competent authority. It is assumed that the EA will have a relatively long validity period (as it covers certain operational aspects of the activity), and thus the offset condition could be enforced relatively easily:

1- Prior to commencement, the applicant must conclude an offset implementation agreement(s) with a suitable person or organisation that secures in perpetuity, through suitable legal protection mechanisms, an area (or areas) meeting the following criteria:

- be within the Klipheuwel Corridor region of the City of Cape Town's Biodiversity Network, or if proof of no such site being available is provided, then another priority area acceptable to the City's Biodiversity Management branch and CapeNature,
- contain in aggregate not less than 77 ha of Swartland Renosterveld (or closely related ecosystems) in good ecological condition,
- host populations of at least 50% of the impacted species of conservation concern, as evidenced by a suitable botanical or protected area site assessment,
- be rezoned to open space for conservation or equivalent zoning
- if not able to be declared as a protected area for any reason, then the site must have a servitude registered over it in favour of the applicant and/or City of Cape Town reserving for them the rights of ownership that may otherwise impact negatively on the persistence of biodiversity on the site.

2- The applicant must include in its EMPr for the listed activities, the required interventions to protect, rehabilitate and manage the biodiversity offset site, including but not limited to the following:

- Management plans and costs for invasive alien plant control, firebelt establishment, prescribed burns, ecological rehabilitation, ecological auditing and other matters that may be necessary for the proper management of the offset site as a nature reserve.
- Oversight responsibility for site management for the entire 30 yr duration of the offset management liability.
- Sufficient provision to ensure that these costs are catered for over a minimum of thirty years, and ideally in perpetuity.

3- Should the applicant fail to execute such an implementation agreement prior to commencement with the activities, or fail to effectively manage the site through compliance with the applicable management plan, then:

- This authorisation is immediately suspended, and the applicant may be liable for administrative penalties and/or other sanction under NEMA in addition to compliance with this offset condition; and
- In addition to any other administrative penalties that may be determined, a sum of R8 million becomes immediately payable to the Endangered Wildlife Trust, to establish a, or augment an existing, fund for the management of the offset site and adjacent priority conserved areas in the Klipheuwel Corridor not currently in City ownership. The priorities for deploying the funds must be determined in consultation with the DEA&DP and CoCT Biodiversity Management Branch.

9. Conclusion

The Cape Winelands Airport has modest impacts on Critically Endangered biodiversity which cannot be effectively mitigated through any means other than a biodiversity offset. This report has explored the terrestrial biodiversity component and is augmented by a parallel process for wetland offsets. Through the onsite delineation provided by the specialist and application of ratios provided in the relevant Guideline, the offset is determined to be not less than 77 hectares of Swartland Renosterveld on Shale, Silcrete/Ferricrete or Granite. Where possible, the offset site should support those impacted species of conservation concern and provide opportunities for restoration and establishment/reinforcement of existing populations of at least the CR species. Site contribution to improved ecosystem function is desirable where design and other constraints allow.

At least two candidate sites were located that substantially satisfy the offset requirements, and negotiations with landowners are concluded for the priority site. Only once the agreement is executed can the ultimate protection mechanism be implemented. However, this report provides minimum requirements that must be met to ensure alignment with good practice and reigning regulatory guidance. A preliminary costing exercise, based on management interventions and likely intervention unit costs, has been developed to inform the requisite implementation arrangements.
At least one PBO has indicated a willingness to host and administer an endowment to manage the site and surrounding priority areas for the minimum 30-year liability period, and to disburse funds to City of Cape Town or other partners to undertake site management.

A proposed condition of authorisation is presented for consideration by the competent authority, which stipulates the offset outcomes to be achieved, indicators or sufficient performance, possible parameters of implementation arrangements, as well as penalties for non-compliance with the offset requirements.

10. References

City of Cape Town (2023). *Spatial Trends & Implementation Tracking.* Dept Urban Planning & Design. Publication 1.0 June 2023. https://resource.capetown.gov.za/documentcentre/Documents/City%20research%20reports%20and%20review/UPD_Spatial_Trends_Report.pdf

DFFE (2023). *National Biodiversity Offset Guideline*. Government Gazette 23 June 2023. No. 48841.

FEN (2024). *Detailed EIA phase Freshwater Ecological Assessment.* Submitted as part of the EIA and WUL authorisations for the Cape Winelands Airport. Report Reference FEN 20-2156. March 2024

Helme N (2023). *Botanical Scoping Study For Proposed Cape Winelands Airport, Fisantekraal, Western Cape*. Submitted to PHS Consulting, 23 October 2023.

Helme N (2024). *Botanical Impact Assessment For Proposed Cape Winelands Airport, Fisantekraal, Western Cape*. Submitted to PHS Consulting, version of March 2024. (final version not available at time of writing)

Skowno, A.L., Raimondo, D.C., Poole, C.J., Fizzotti, B. & Slingsby, J.A. (eds.). 2019. *South African National Biodiversity Assessment 2018 Technical Report Volume 1: Terrestrial Realm*. South African National Biodiversity Institute, Pretoria.

11. Record of Consultations and Meetings

- 15 May 2024. CCT Biodiversity Management Branch. On Site – Farm 1242, Klipheuwel Corridor sites
- 24 May 2024. CCT Biodiversity Management Branch. Meeting on Management options for key candidate offset sites.
- 7 June 2024. CapeNature, DEA&DP, CCT. Online meeting to provide an overview of offset process, outcomes to date, landowner and implementation agreements, and next steps prior to Report submission.
- 22 August 2024. CCT, Client, Offset Candidate Landowner. In person meeting to negotiate the terms of a letter of intent to secure (purchase or lease) a prospective offset area, and the required terms of a lease agreement to be concluded.
- Several meetings were held online in July and August 2024 between the Client and various PBO offset management fund service providers. As at time of writing, funding agreements were being drafted.

12. Annex 1. Curriculum Vitae Extract

SELECTED PROJECT SPECIFIC REFERENCES:

1. **Offset Specialist Consultant – UNDP & DFFE BIOFIN Offset Banking Modality for Expansion of PAs. Sept 2022 – Current.** Provide leadership and specialist support to SANParks and other management authorities to set up proactive offset schemes, price offset credits appropriately, provide training and input into the Offset technical community of practice, and policy and operational procedures guidance. Contact: Jeff Manuel SANParks Jeffrey.manuel@sanparks.org.za; Pam Kershaw DFFE PKershaw@dffe.gov.za ; Nokutula Mhene UNDP BIOFIN Project Management nokutula.mhene@undp.org

2. **Offset Specialist – Hermanus CBD Bypass Feb 2021 – Current.** Assess and determine offset requirements for impacts on the protected area, advise and align national, provincial and local government officials on the options and policy principles of offsetting around protected areas. Quantify offset/ecological compensation cost, opportunities to facilitate transfers in line with the PFMA and MFMA, and imperatives for managing offset site in terms of GIAMA, and NEMPA, and related operational matters. Contact: Willem Moolman Willem.Moolman@westerncape.gov.za. Or Dr Coral Birss, CapeNature 087 087 3197

3. **Strategic Biodiversity Offset – Namakwa SEZ, Namaqualand & Richtersveld 2020-22.** Manage specialist consultant, review existing baseline information, liaise with relevant taxa and regional/subject specialists. Compile offset report, present risk analysis and strategic offset implications to NCEDA and partners. Clarify PFMA constraints and opportunities for securing offset site. Contact: Hendrik Louw, Acting CEO NCEDA. 081 3232533

4. **Ecological Compensation advisor – TGME Underground Mine Project, Pilgrims Rest 2019 – 22**. Coordinate various consultants and EAP. Develop Ecological compensation framework and budgets, and present to regulators and I&APs. Compile Compensation Report. Negotiate acceptability of compensation package with DFFE and DWS, MTPA. Contact. Jacques de Triou, TGME COO. 082 9268898.

5. **Offset Specialist – Net Positive Impact Strategy: Anglo Platinum. March 2022 – March 2023.** Quantify Anglo Platinum's mine portfolio residual impact, determine appropriate offset and additional conservation action strategies, identify candidate sites and alternative management implementing entities. Liaison between specialist providers, Anglo Group and Platinum leads. Contact: Jurie Human (Platinum) or Warwick Mostert (Group) Warwick.Mostert@angloamerican.com .

6. **Offset Specialist – Black Rock Mine Operations. May 2021 – Current.** Assess and determine offset requirements for impacts (current and forecast) from BRMO's operations at Hotazel. Locate suitable offset sites, manage the team engaging with landowners. Conclude purchase agreements with landowners and Management arrangements with implementing party. Contact: Wilhemina Ngcobo: Black Rock Mine General Manager. Or Botshelo Moses (Environment Manager) Assmang.

7. **Offset Specialist – Komas/Gromis WEF, Namaqualand 2020 -2021.** Manage offset assessment, compile report, negotiate with DAEARDLR, DFFE, SANParks on suitable parameters, sites etc. Contact: Elsabe Swart – Environmental Research, DAEARDLR, Kimberly: Mercia Grimbeek, Enertrag SA. Mercia.Grimbeek@enertrag.co.za

8. **Lead consultant - Streamlining Biodiversity Offset implementation in the Northern Cape. 2017-2020.** Project for DENC and Wilderness Foundation Africa. Highlighted spatial aggregation possibilities and decision-making support protocols to simplify offsets and improve predictability. Contact: Kerry Purnell Kerry@wfa.africa

9. **Offset Specialist – Kap Vley Wind Farm.** Juwi Energy and DENC. **February 2018 –Feb 2020.** Review offset proposals, confirm adequacy and accuracy of original Offset report. Expert Opinion on alternative implementation mechanisms and additionality. Facilitate negotiations between juwi, DENC, SANParks and WWF-SA, and develop a proactive implementation model to reduce risk for energy developers. Contact Steyn de Vos for Reference. Steyn.devos@juwi.co.za 082 388 4738

10. **Offset Specialist and lead Negotiator –** Zirco Roodeheuwel Mine**. Jan 2016 – Dec 2017**. Review previous specialists' offset studies, submit a professional perspective on their accuracy and veracity. Develop and

conclude an implementation agreement between the parties, implementing agencies and commenting authorities. Contact Mark McKinney for reference. 082 900 5640 or m.mckinney@aeolus-resources.com

11. **Team leader – Biodiversity Offset for the N2 Wild Coast Toll Highway**. CCA and SANRAL **Jan 2014 – May 2016.** Conceptualise the work programme; oversee external specialists, resource economists; Locate and quantify candidate offset sites and attendant rehabilitation and management plans and Budgets; Integrate terrestrial and freshwater/wetland offset requirements. Compile Offset statement and Specialist Report. Lead offset component of the Authorities Reference Group. Lead negotiations and budgeting with implementing agencies, SANRAL and National Treasury. Concluded an implementation plan and offset agreement between the parties. **September 2018- January 2022** appointed as specialist advisor to the implementation team for the Offset. Contact Fuad Fredericks for Reference ffredericks@slrconsulting.com

12. **Team leader – Gamsberg Biodiversity Offset.** Vedanta Zinc International and Black Mountain Mine. **Oct 2012 – Nov 2014 and 2019 - 2020.** Conceptualise the work programme; oversee external specialists, financial specialist; Quantify candidate offset sites and notional management plans and Budgets; Compile Offset statement and Specialist Report. Lead negotiations and budgeting with implementing agencies, DENC and Black Mountain Mine. Concluded an offset agreement between the parties.

13. **Offset Specialist – Booysendal Platinum Mine S24G and additional EMPR activities.** Northam Platinum**. April 2017 – 2020.** Review and understand the full suite of impacts from the mine, including separating historical from current impacts and liabilities. Finalise offset parameters and costs. Understand, align and synthesize various specialists' recommendations into an offset report, and draft appropriate conditions of authorisation. Provide guidance to client and legal specialists on appropriate models for implementation and concluding agreements with authorities. Negotiations between Northam and MTPA on finalising offset agreement and implementation plan.

13. Annex 2. Submitted Plan of Study

Week	Task	Output	Submitted
1	Review draft Impact Assessments, desktop review receiving environment. Review authorities' SR comments and other correspondence.	Plan of Study	25 Apr
2	Site visit, confirm impact areas, remnant vegetation, assess Botanical specialist calculations. Create possible candidate offset site shortlist. Visit two or more candidate sites. Solicit input from CREW project and field staff with local knowledge.	Candidate Site Shortlist	3 May
3	Develop Offset statement, solicit input and further comment/constraints from CN, CCT Biodiversity Branch, DEA&DP (if required). Develop draft Offset Report and prepare for DEIR. Get no objections to min 2 and max 3 candidate sites.	Draft Report	17-30 May
4	Compile minimum requirements for Offset Implementation Agreement for leading candidate sites. Advise client on options and Heads of Implementation Agreement for leading candidates, including potential management arrangements. Anonymise candidate sites if prejudicial to implementation.	Draft Implementation arrangements, Draft Offset Submission EIR	Aim for 14 June
5	Incorporate authorities & I&AP comments.	Final report, input into CRR	13 June – 29 June
6	Finalise Offset Report, and draft condition of Authorisation for consideration. Finalise input into Implementation Agreement – if required	Final Report, Implementation agreement for negotiation	Weeks of 8 – 19 July

14. Determination of management liabilities in succeeding years

Table 5. The yearly forecast management costs, the NPV of the remaining liability period of management costs, in case of failure by the applicant to secure or safeguard the management of the offset site.

Discount rate	8,9%	National Treasury
Inflation	6%	Ave CPIX 2023/4

2024 Baseline

Year	Management costs	NPV remaining fees	Year	Tax Year
2025	R 516 060	R 7 897 362	1	2026
2026	R 311 786	R 8 038 238	2	2027
2027	R 558 176	R 8 414 106	3	2028
2028	R 356 964	R 8 555 107	4	2029
2029	R 399 220	R 8 927 778	5	2030
2030	R 408 688	R 9 287 599	6	2031
2031	R 457 067	R 9 669 134	7	2032
2032	R 467 907	R 10 031 941	8	2033
2033	R 523 296	R 10 415 233	9	2034
2034	R 535 707	R 10 772 319	10	2035
2035	R 655 239	R 11 147 671	11	2036
2036	R 613 331	R 11 426 258	12	2037
2037	R 685 934	R 11 775 278	13	2038
2038	R 702 203	R 12 076 295	14	2039
2039	R 785 326	R 12 386 387	15	2040
2040	R 1 381 920	R 12 633 555	16	2041
2041	R 899 120	R 12 253 030	17	2042
2042	R 920 444	R 12 364 409	18	2043
2043	R 1 737 438	R 12 462 477	19	2044
2044	R 1 053 817	R 11 679 567	20	2045
2045	R 1 288 954	R 11 571 442	21	2046
2046	R 1 206 515	R 11 197 629	22	2047
2047	R 1 349 336	R 10 880 323	23	2048
2048	R 1 381 339	R 10 379 245	24	2049
2049	R 1 544 855	R 9 798 720	25	2050
2050	R 1 581 495	R 8 988 459	26	2051
2051	R 1 768 705	R 8 066 183	27	2052
2052	R 1 810 653	R 6 857 954	28	2053
2053	R 2 024 990	R 5 496 511	29	2054
2054	R 3 780 486	R 7 252 007	30	2055

ANNEXURE 19: NOISE MITIGATION AND MANAGEMENT PLAN

(This will be a condition of approval if Environmental Authorisation is obtained)

ANNEXURE 20: PERMITS AND LICENSES

(This section is updated as permits and licences are issued e.g. the Environmental Authorisation is included here, should it be granted.)