APPENDIX 30

WATER USE LICENCE APPLICATION SUMMARY REPORT (INCLUSIVE OF WULA PROCESS STATUS AND GEOHYDROLOGICAL REPORT)

JULY 2025

WATER USE LICENCE APPLICATION SUMMARY REPORT

APPLICATION FOR A WATER USE LICENCE IN TERMS OF SECTION 21 (A), (B), (C) & (I), (E), AND (G) ON P10/724, RE/724, P23/724, P7/942; RE/474, P3/474 and P4/474 FOR THE PROPOSED EXPANSION OF THE CAPE WINELANDS AIRPORT

DWS REF: WU33620

NAME OF APPLICANT:
CAPEWINELANDS AERO (PTY) LTD

COMPILED BY:
PHS CONSULTING

DATE: MARCH 2025

PLEASE NOTE THAT ALL CHANGES FROM THE NOVEMBER 2024 DRAFT WULA SUMMARY REPORT ARE UNDERLINED. GENERAL TEXT CHANGES ARE NOT UNDERLINED.

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Terms and Abbreviations

AIPs – Alien and Invasive Plants

ARFF - Aircraft Rescue and Firefighting

BOCMA – Breede-Olifants Catchment Management Agency

CEMP- Construction Environmental Management Programme

CESA – Critical Ecological Support Area

CGS - Council for Geoscience

CIP – Commercially Important People

CMA – Catchment Management Agency

CoCT – City of Cape Town

C&R – Comments and Responses report

CTIA - Cape Town International Airport

CVB Wetland - Channel Valley Bottom Wetland

CWA – Cape Winelands Airport

DCP - Drop-weight cone penetrometer

DEA&DP – Department of Environmental Affairs and Development Planning (Western Cape)

DWAF - Department of Water Affairs and Forestry

DWS – Department of Water and Sanitation

EAP – Environmental Assessment Practitioner

EC – Electrical Conductivity

EIR – Environmental Impact Report

ELU – Existing Lawful Use

EMF - Environmental Management Framework

FAFK - Fisantekraal Airfield

FATO - Final Approach and Take-off

FBO - Fixed Base Operations

GA – General Aviation

GN – Government Notice

GRU – Groundwater Resource Unit

GSE – Ground Support Equipment

GVA – Gross Value Add

HDI - Historically Disadvantaged Individual

HDPE - High-density polyethylene

I&AP – Interested and Affected Party

IATA - International Airport Transport Association

ICAO - International Civil Aviation Organisation

IDP - Integrated Development Plan

IUA – Integrated Unit of Analysis

kV – Kilovolt

MARS - Multi Aircraft Ramp Systems

mamsl - meters above mean sea level

mbgl – Meters Below Ground Level

MICE - Meetings, Incentives, Conferences, and Exhibitions

MRO - Maintenance, Repair and Overhaul

mS/m - milliSiemens per meter

NDP - National Development Plan

NEMA - National Environmental Management Act, Act 108 of 1998

NFEPA - National Freshwater Ecosystem Priority Area

NGA – National Groundwater Archive

NWA – National Water Act, Act 36 of 1998

OEMP – Operational Environmental Management Programme

PAL - Planning Activity Levels

PBB – Passenger Boarding Bridge

PES – Present Ecological State

PID - Photo Ionisation Detector

PTB - Passenger Terminal Building

PV – Photovoltaic

RAM – Risk Assessment Matrix

REC – Recommended Ecological Category

RESA – Runway End Safety Area

RMO – Recommended Management Objectives

RoW – Right of Way

RQO - Resource Quality Objectives

SABS - South African Bureau of Standards

SANAS - South African National Accreditation System

SANS - South African National Standards

SDF - Spatial Development Framework

SDP – Site Development Plan

SWAT - Soil and Water Assessment Tool

SWMP – Stormwater Management Plan

TBC – To Be Confirmed

TDS - Total Dissolved Solids

UST - Underground Storage Tank

VIP – Very Important Person

WARMS - Water use Authorization & Registration Management System

WMA – Water Management Area

WULA – Water Use Licence Application

WWTW – Waste Water Treatment Works

ZoR – Zone of Regulation

1. Applicant details

Name of applicant: Capewinelands Aero (Pty) Ltd (Representative: Mr Deon Cloete)

2. Person submitting application

Consultant on behalf of Applicant: Amanda Fritz-Whyte

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Qualifications: BSc Conservation Ecology

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3. Background and purpose

3.1. Background

The proposed site is located approximately 10.5km northeast of Durbanville, on the R312 and approximately 6km North of Joostenberg Vlakte, on the R304 (Figure 1). The CWA, historically known as Fisantekraal Airfield (FAFK), was initially constructed around 1943 as a South African Air Force aerodrome during World War II and has since transitioned into a general aviation (GA) airfield. The current 150ha site includes four concrete runways, each 90m wide and varying in length between 700m and 1500m. The facility supports various unscheduled operations such as recreational flying, flight training, aircraft maintenance, charter operations, crop spraying, and aerial banner towing.

The applicant, Capewinelands Aero (Pty) Ltd, proposes the expansion and upgrade of the existing airport from a general flying airfield to a commercial airport capable of facilitating long-haul, wide-body flights by airlines and unscheduled operators from across the world. A NEMA Scoping and Environmental Impact Assessment (S&EIA) process is currently underway for the proposed development and will be run as a One Environmental System Application with the WULA.

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 885ha (Figure 2). Of this area, 470ha will be allocated for airport development, including an airside precinct, terminal precinct, services precinct, general aviation precinct and associated landscaping (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, existing access roads and wetland offsets.

Apart from the existing CWA which is located on Portion 10 of Farm 724 and Portion 4 of Farm 474, the land use of the majority of the proposed development area comprises dryland grain cultivation and a clay quarry located on Portion 23 of Farm 724 extending partially onto RE of Farm 474. Several homesteads and agricultural buildings are located within the proposed development area. The clay quarry is owned by Corobrik and is in closure permit application at present, following which the sale to the Applicant will be completed. Further information on the quarry is provided in Section 10.4.4 of this report.

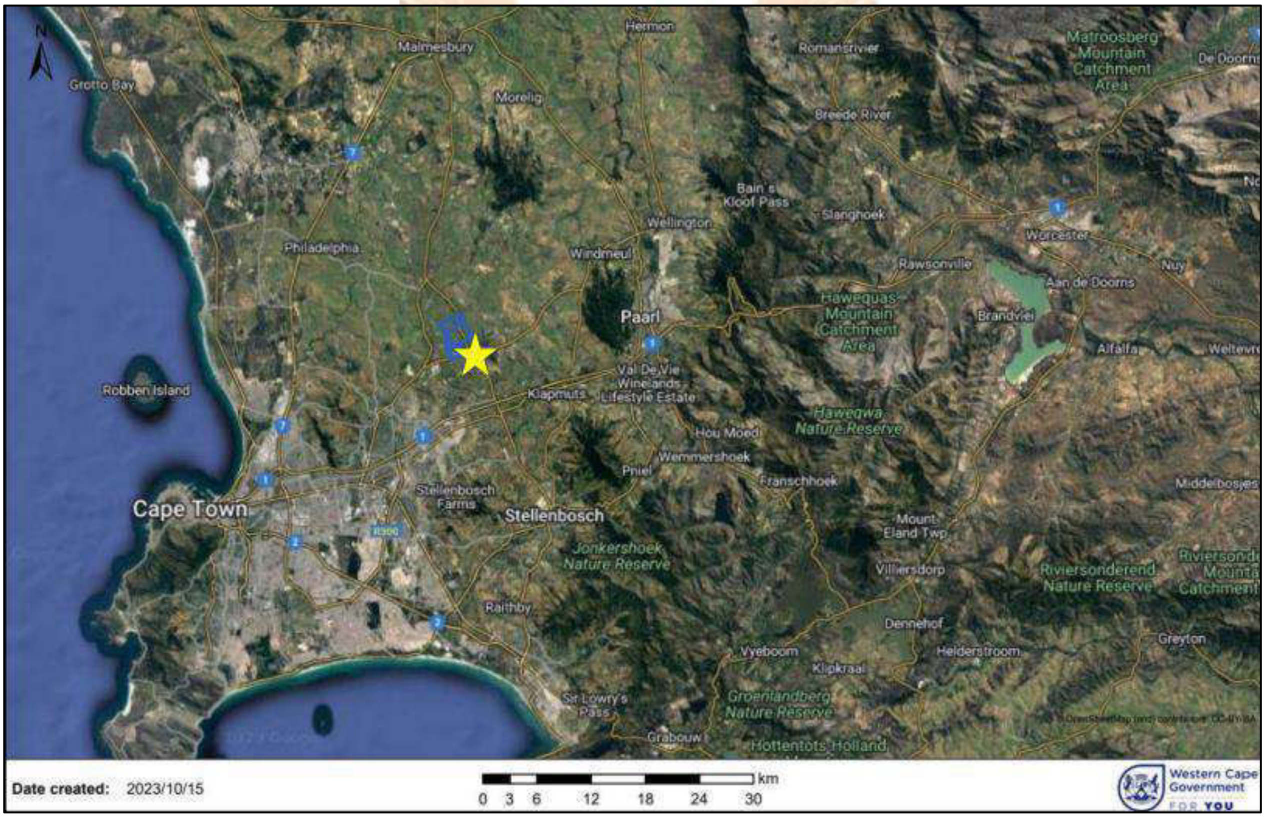


Figure 1: Regional location of current CWA indicated by yellow star. The blue lines indicate land parcels that form part of the application area (PHS Consulting, October 2023)

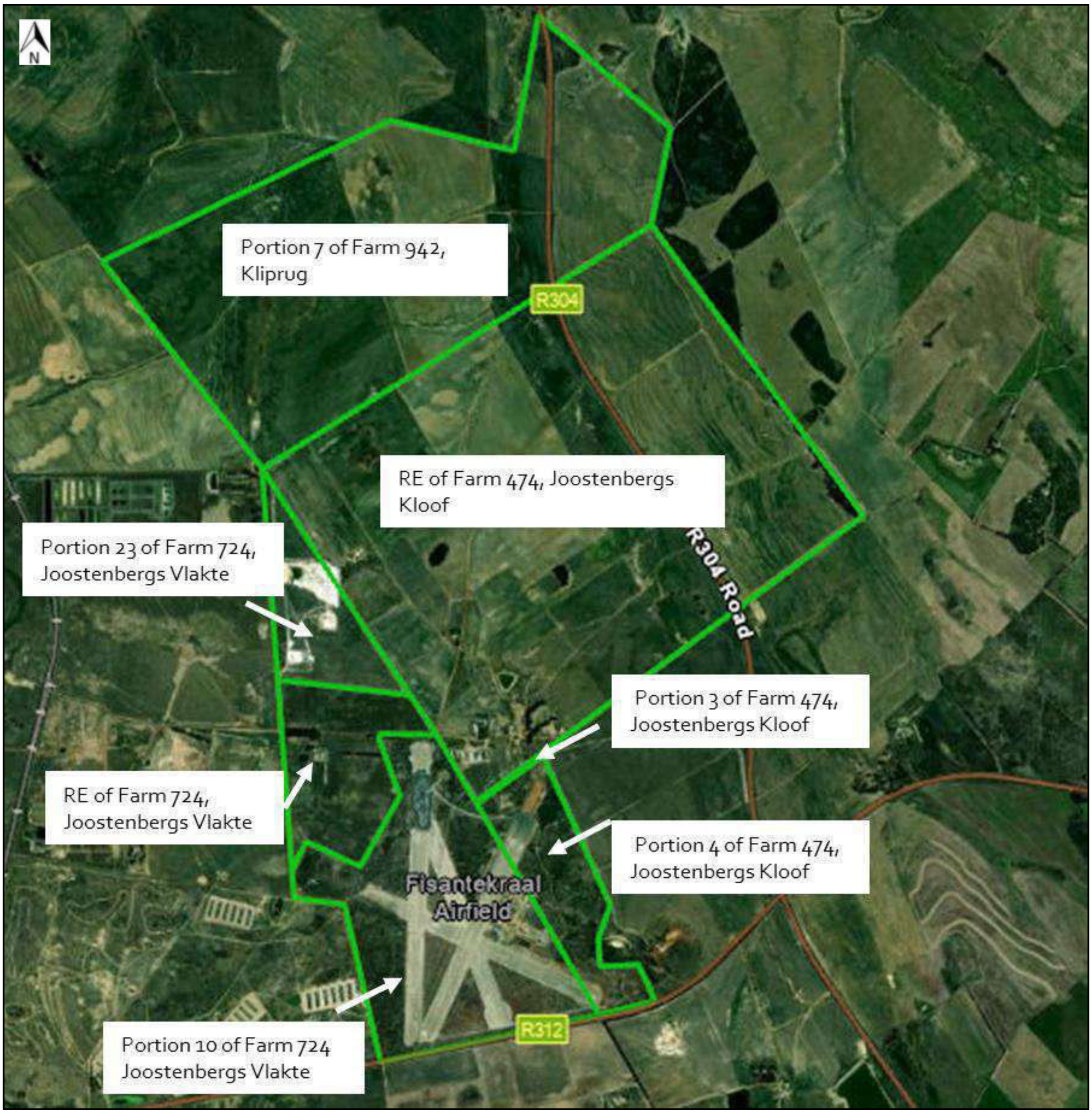


Figure 2: Cadastrals forming part of the application area indicated in green outline (PHS Consulting, February 2024)

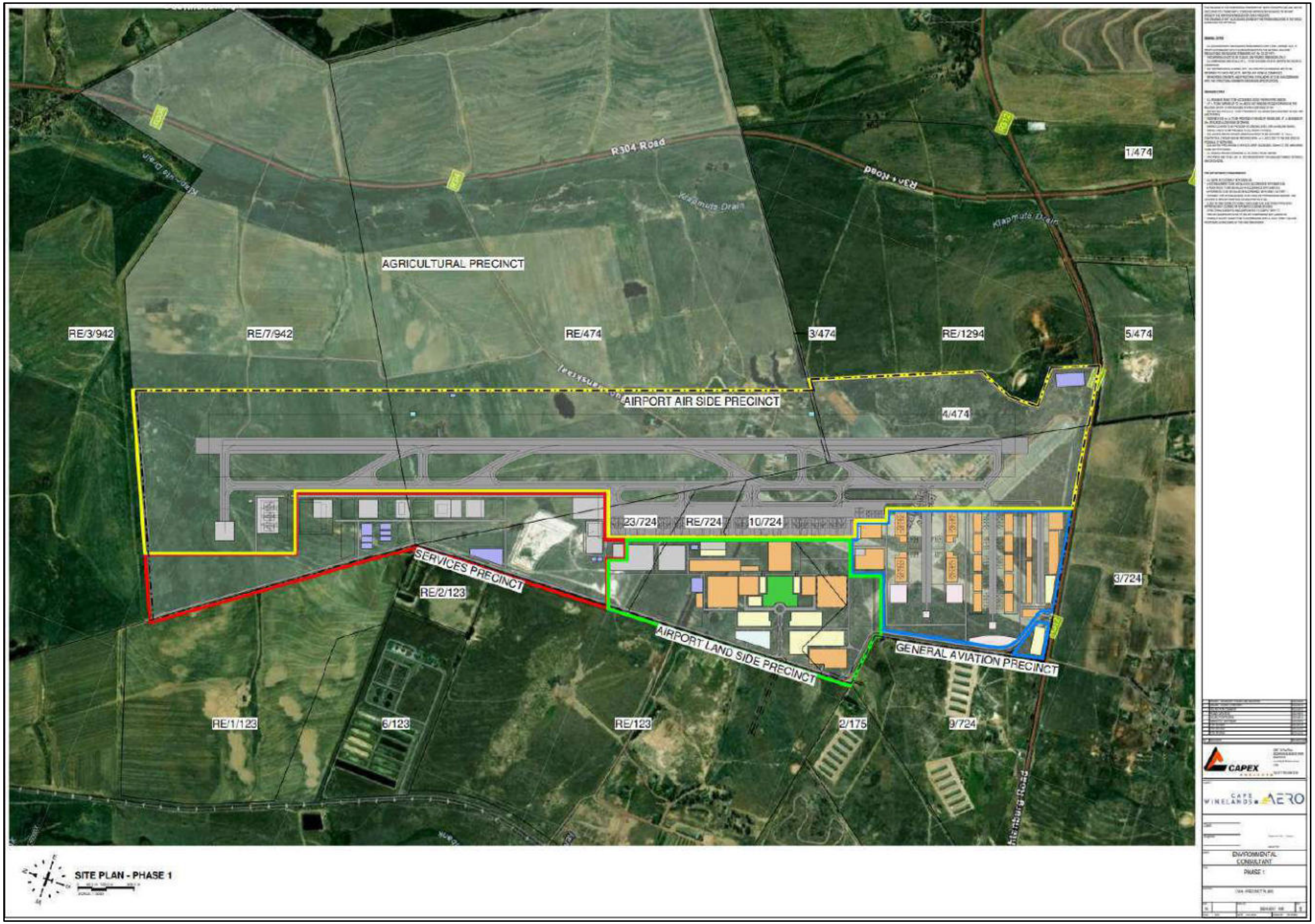


Figure 3: Phase 1 Concept SDP (Capex Projects, August 2024).

Figure 4: Phase 2 Concept SDP (Capex Projects, <u>January 2025</u>).

The proposed development area is located within the Bellville Magisterial district and within quaternary catchment G21E which forms part of what used to be the Berg-Olifants Water Management Area (WMA). The Berg-Olifants WMA was administered by the Department of Water and Sanitation (DWS). However, recently, the Breede-Olifants Catchment Management Agency (BOCMA) has been established by extending the operational boundary Breede-Gouritz WMA to include the previous Berg-Olifants WMA. As such BOCMA administers what used to be the Berg-Olifants water management area and will therefore be the authorising agent for this area on behalf of DWS.

The proposed development site has established linkages to the Cape Town City Centre, Drakenstein, Wellington, Paarl, and Stellenbosch, it is therefore strategically positioned to enable future connectivity and new tourism nodes within the region. CWA aims to fulfil numerous key roles within the aviation sector and contribute to an improved socio-economic landscape within the region.

Proposed Water Use Activities:

This WULA Application is in terms of Section 21(a), S21(b), S21(c) and (i), S21(e), and S21(g) of the National Water Act, Act 36 of 1998:

For the purposes of this Act, water use includes –

- (a) taking water from a water resource – Abstraction of water from three boreholes for potable use onsite and taking from surface water storage for use on site.
- (b) storing water – Storage of water in stormwater ponds, reservoirs, weirs and the old quarry.
- (c) Impeding or diverting the flow of water in a watercourse - Construction within the regulated area of wetlands on site; Any infrastructure/ buildings within the regulated area of or crossing underneath drainage lines / streams / wetlands.
- (e) engaging in a controlled activity identified as such in section 37(1) or declared under section38(1) - Irrigation of the landscaping on site with water containing waste, i.e., irrigation with treated effluent from the on-site sewage treatment plant.
- (g) disposing of waste in a manner which may detrimentally impact on a water resource - Storage of domestic and biodegradable industrial wastewater for the purpose of re-use or eventual disposal.
- (i) altering the bed, banks, course or characteristics of a watercourse - Construction within the regulated area of wetlands on site; Any infrastructure / buildings within the regulated area of or crossing underneath drainage lines / streams / wetlands.

Proposed Development:

The proposed development entails the phased expansion of the CWA. This will include the realignment of a primary runway with an orientation of 01-19 and a length of 3.5km. Landside and airside infrastructure will also be phased based on market demand. Landside infrastructure will include, but not be limited to, passenger and cargo terminals, hotel, aircraft hangers and services, airport facilities, bulk fuel storage facility, internal and external road infrastructure, potable water and sewage treatment infrastructure, a petrol filling station, a biodigester, solar PV, and stormwater management infrastructure. Airside infrastructure will include, but not be limited to, runways, taxiways, taxilanes, aircraft parking aprons, service roads, approach lights, airside systems such as CAT III Instrument Landing System (ILS), meteorological systems and airfield ground lighting (AGL).The runway solution also includes drainage, pavement structures, paint markings and earthworks along with considerations for aircraft tracking, jet blast impact mitigation and hydroseeding requirements.

The following reasonable and feasible development alternatives were considered during the S&EIA process:

- Alternative 1: “Do Nothing”, which implies development within current rights
- Alternative 2: “Initial preferred alternative” which entails the construction of a 3.5km main runway at orientation 01-19 and initial retention of cross runway 14-32.
- Alternative 3: “Previous preferred alternative” which entails the exclusion of the 700m cross runway 14-32
- Alternative 4: “Final preferred alternative” which entails minor refinements to Alternative 3 such as the extension of the fuel line into the GA precinct, correction of internal precinct boundaries, indication of the three production boreholes, incoming potable line indicated and the inclusion of the preferred technology and sewage treatment and management alternative.

The expansion of the CWA will take place in accordance with 4 proposed planning phases. The 4 Planning Activity Levels (PALs): 1 (A&B), 2, 3 and 4, define the timeframes for the initiation and realization of expansion projects aimed at increasing the airport's infrastructure and building facilities.

The Preferred Alternative 4 concept SDP consists of two phases - Phase 1 and Phase 2 – and is illustrated in Figure 3 & Figure 4 with the primary development activities of relevance to the NWA detailed below:

1. Airside Precinct Development:

   - **Runway 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 (Figure 5).

     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.

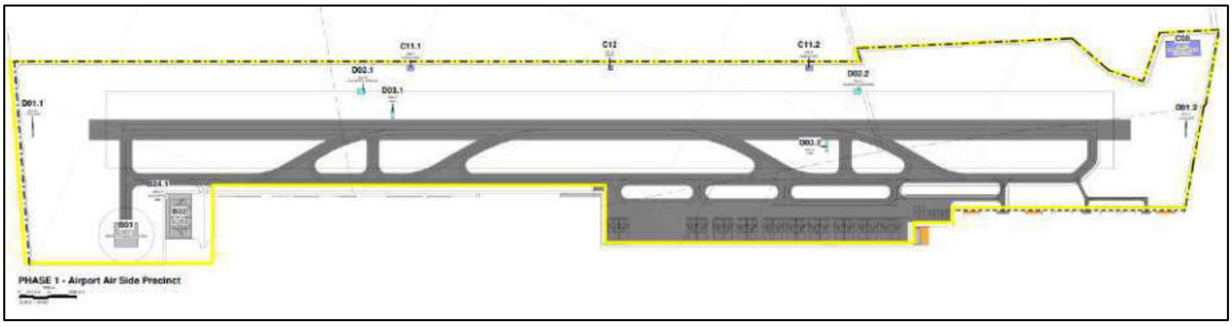


Figure 5: Planned runway layout in Phase 1 (Capex Projects, August 2024)

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.

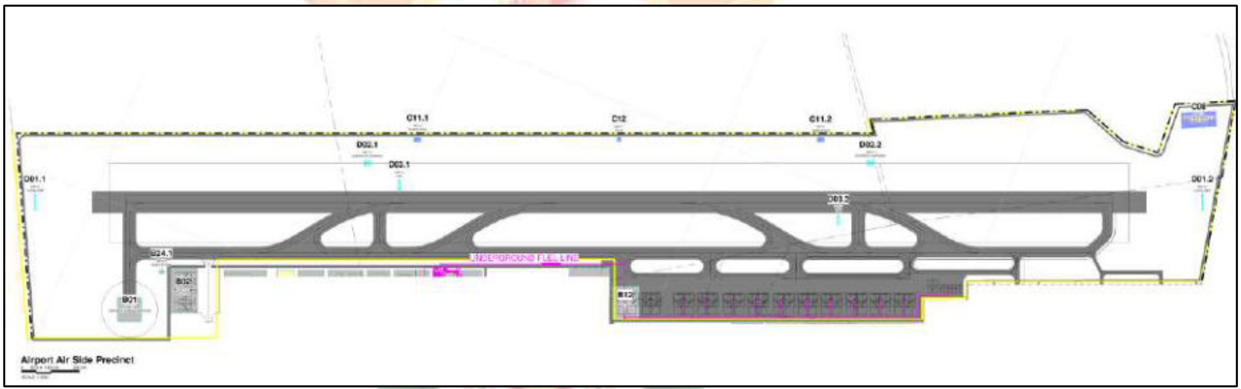


Figure 6: Planned runway layout in Phase 2 (Capex Projects, January 2025)

- **Aircraft Parking Aprons**

  The following aircraft parking aprons are included in the Development:

  - Passenger terminal apron
  - General aviation and Fixed Base Operations (FBO) aprons
  - Cargo apron
  - Maintenance, Repair and Overhaul (MRO) apron
  - Isolation pad Aircraft parking stands range from International Civil Aviation Organisation (ICAO) Code B up to ICAO Code F stands.

  As part of the Development, several Multi Aircraft Ramp Systems (MARS) stands (21 code C equivalent stands) are foreseen. Some of these will be contact MARS stands, will be equipped with passenger boarding bridges (PBBs) and will be able to accommodate up to Code F aircrafts. 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:**

  Airside service roads will be constructed to provide access to airport assets for vehicles such as buses, ground service equipment and maintenance vehicles.

- **Airport Security Fence:**

  An airport security fence will be erected in line with aviation security standards.

2. <u>Landside Precinct Development:</u>

- **Passenger Terminal Building (PTB) and Anchor Airline Terminal Building**

  The PTB will serve 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 International Airport Transport Association (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 (Figure 7). 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.

Figure 7: <u>Phase 2 Terminal Precinct</u> - Planned location of Passenger Terminal Building A01 indicated by red circle (Capex Projects, <u>January 2025</u>)

- **VIP Processing Facility**

  The VIP processing facility will have an independent access point on the landside and direct access to the airside. Government officials, VIPs and CIPs will be processed through the facility.

- **Commercial Developments**

  Included in the Development, and in addition to aeronautical development, are commercial developments. Approximately 350 000m^2 of lettable area will be provided for. The terminal precinct encompasses a terminal plaza with a landmark hotel building, aviation museum, offices, and other 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.

- **Additional Landside Developments**

  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); Drone port and vertiports; Gardens; Public transport facilities (Phase 2); Carpark/VTOL (Phase 2).

3. <u>General Aviation Precinct:</u>

- **General Aviation (GA) and Fixed Base Operations Facilities**

  The general aviation area, including business aviation, is located at the south-western end of the airport site. The FBO facilities are located along a dedicated taxi lane that provides direct access to / from the main runway via the parallel taxiway. A GA clubhouse with refuelling facilities and airside views will also be developed, with adjacent grass parking areas for visiting GA aircraft. 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.

4. <u>Services Precinct:</u>

- **Airport Support Facilities**

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:

- *Airport Fuel Facilities:* The fuel facilities consist of a bulk fuel depot, a general aviation refuelling point at the GA clubhouse and a commercial / retail service station. A fuel distribution line to the aprons has also been allowed for.
- *Aircraft Rescue and Fire Fighting:* 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 is 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.
- *Cargo Facility:* 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.
- *Airport Maintenance Facility:* The airport maintenance facilities are planned in the services precinct, with access on both airside and landside.
- *GSE Maintenance:* Facility GSE staging areas are included close to the main apron. Two areas have been reserved for GSE parking adjacent to the main apron.
- *MRO Facility:* The location of the proposed MRO facility, including apron and taxiway, is in the services precinct. This includes one widebody aircraft parking position and associated hangar. Moreover, additional space for several additional aircraft is available on the site.
- *Inflight Catering Facility:* The facility is located in the services precinct of the airport, with direct airside access and landside access via the western service entrance to the airport.
- *Solar PV and Biodigester:* Included in the Development is provision for solar PV (mostly on top of buildings) and a biodigester.

- *Airport Operations Centre:* 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 departments 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:* 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: Potable Water Reservoir; Groundwater Treatment Infrastructure; Potable Water Pump Station; Non potable Water Storage; Solid Waste Storage; WWTW; Substation; Cargo Apron (Phase 2).

Service Provision

- **Potable Water:**

The proposed development site is located on the City's urban edge and thus water services provision is limited. The current CWA site is serviced through an existing borehole on the eastern side of the site (Figure 8), and no municipal water connection exists. The nearest municipal water services are found in the Fisantekraal settlement. The tie in point is along a trunk main from the Spes Bona Reservoir, a 400mm diameter pipe located in the R312 Lichtenburg Road, which terminates just after the railway crossing, approximately 3km southwest of the current CWA site (Figure 9).

In addition, there are other proposed developments near CWA where municipal water mains are proposed (Greenville to the South and Bella Riva to the West). Both developments were considered as possible tie-in locations however, these developments are still in the planning stage and there are no firm indications that either development will have water infrastructure constructed in the short term in time to supply the proposed expansion of CWA.

An application was made to the City of Cape Town to determine if spare capacity exists in the municipal water system to supply the water requirements of the proposed CWA development. It was determined that sufficient storage capacity exists in the Spes Bona reservoir to supply the short-term water requirements of the CWA development, however the network infrastructure in the area is currently not sufficient (Zutari, Engineering Services Report, February 2025).

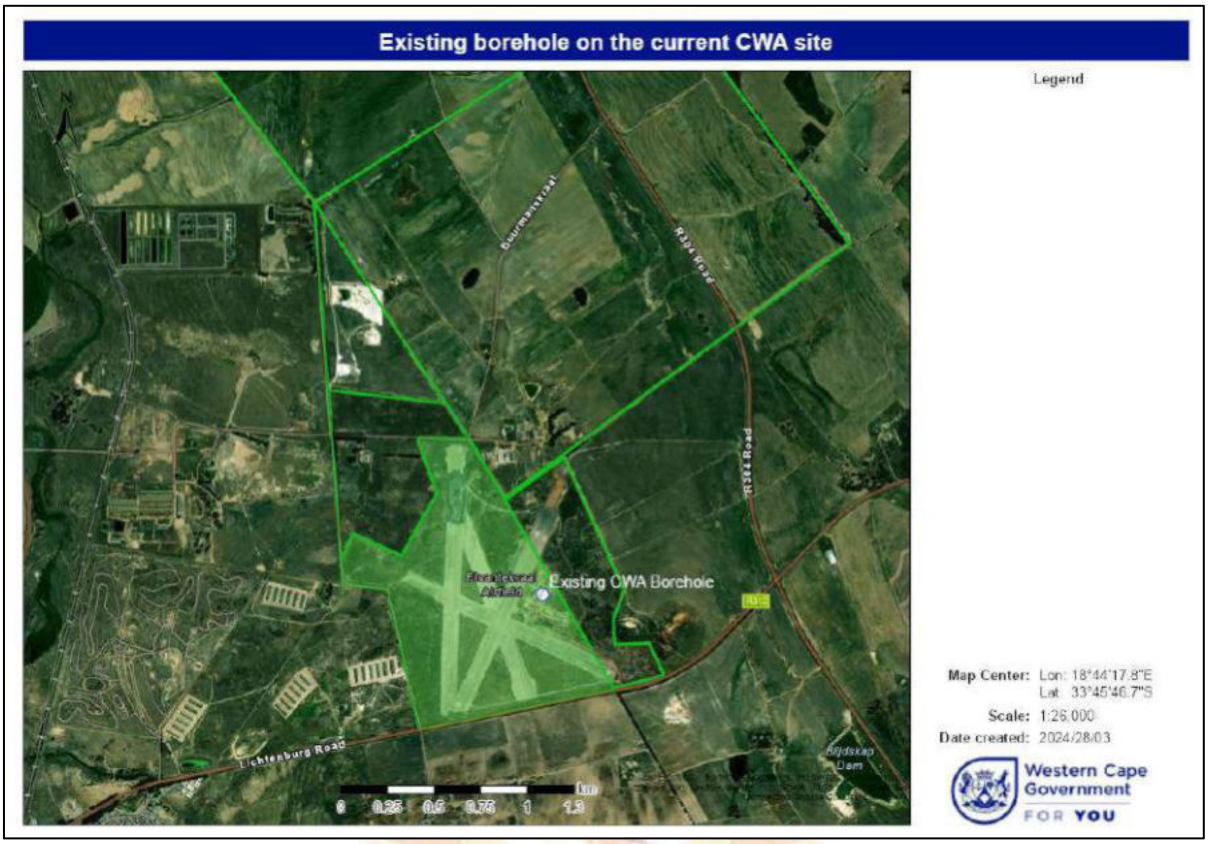


Figure 8: Existing borehole on the current CWA site (PHS Consulting, March 2024).

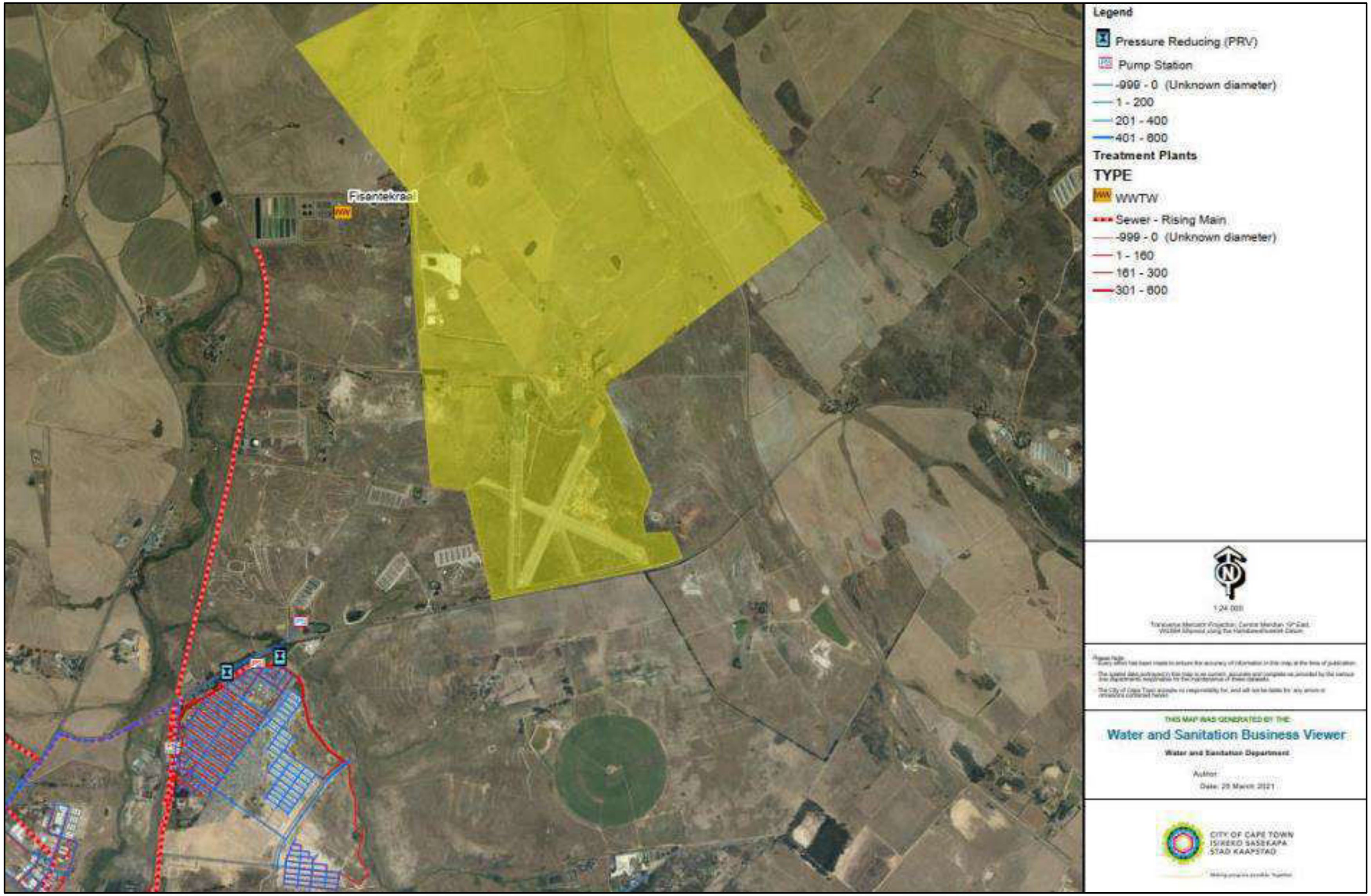


Figure 9: Existing water & Sewer Services (Zutari, Engineering Services Report, February 2025)

A proposal for bulk water supply to CWA and neighbouring developments was presented to the City of Cape Town Bulk Water and Water Reticulation on October 4, 2024. It aimed to address medium- and long-term water needs based on the city's bulk water master plan. The initial proposal included constructing a 300ML reservoir at the Spes Bona site (Spes Bona Reservoir 3) to enhance climate resilience and future supply. While an EIA approved a pipeline route from Spes Bona 3 to Mulders lei, it was recommended that CoCT Water Reticulation assess the feasibility of building the reservoir at Spes Bona 3 using this approved route. However, land acquisition for the pipeline route has not progressed. The reservoir size would be determined by CoCT Water Reticulation, with potential funding from Development Contributions (DCs) (Zutari, Engineering Services Report, February 2025). Zutari has submitted a request to CoCT Water Reticulation for support in securing the development's long-term water supply.

Due to the current constraints in the municipal system alternative potable water sources have been considered for the CWA development in the short to medium term. The current water supply strategy for CWA follows a phased approach, initially relying on groundwater as the primary source. This will continue in the short term until municipal infrastructure can either supplement or fully replace the groundwater supply as illustrated in Figure 10 below.

If a developer elects to treat groundwater to supply their development in lieu of municipal supply, then the developer is required to enter into a Water Services Intermediary agreement with the CoCT. Discussions have been held with the CoCT in this regard. The application is supported in principle and is subject to a formal application and review of the proposal by the CoCT.

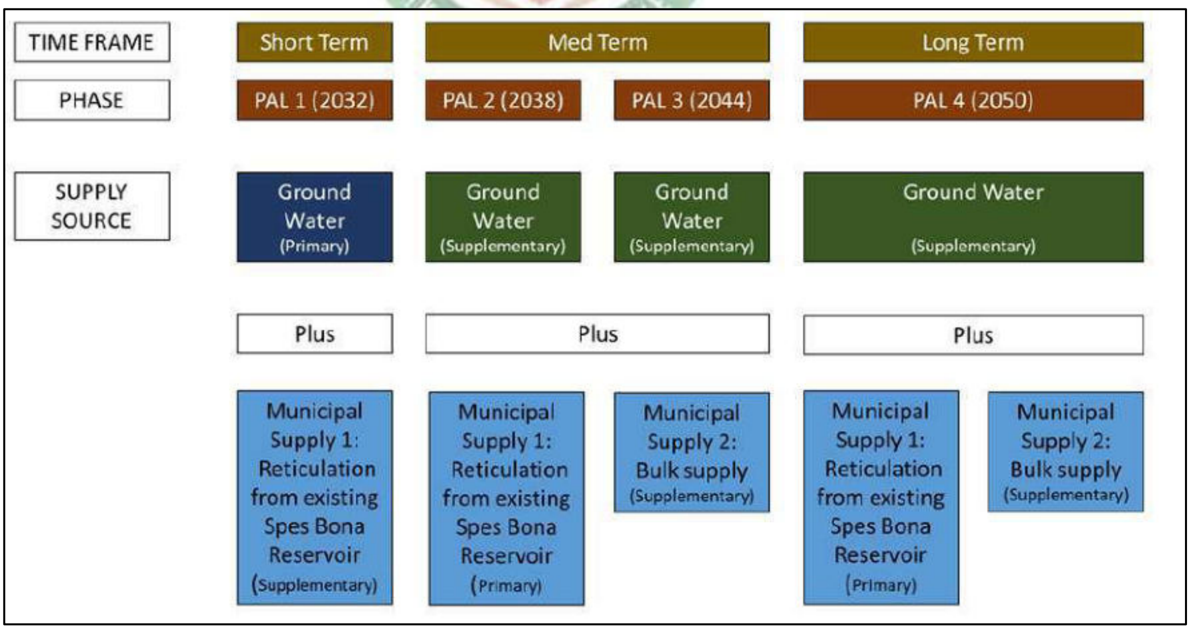


Figure 10: Potable water supply strategy (Zutari, Engineering Services Report, February 2025)

The development plan aims to provide potable water to the site by treating groundwater extracted from on-site boreholes (Figure 11), supplemented by available potable water from the City of Cape Town (CoCT) (Figure 12).Three potential production boreholes have been developed within the proposed development area (CWA_BH001, CWA_BH002 CWA_BH003) (Figure 11). The current groundwater requirement for the CWA airport facility is 155 488m^3/a. The three onsite boreholes have been yield tested and if the boreholes are pumped according to the guidelines set out in the WULA Geohydrological Assessment compiled by GEOSS (February 2025), a total volume of 163 671m^3/a can be sustainably abstracted. The onsite boreholes can therefore sustainably supply the groundwater needs during the initial phases of the proposed development activities (GEOSS, WULA Geohydrological Assessment, February 2025, Appendix B). It should however be noted that the Aquifer Firm Yield Model has confirmed that the Groundwater Resource Unit (GRU) in the region has the capacity to support the additional water extraction should it be required for future phases of development (GEOSS, WULA Geohydrological Assessment, February 2025, Appendix B).

An application under Section 21(a) of the NWA is being submitted to abstract the maximum sustainable yield of 163 671m^3/a from the three onsite production boreholes. A treatment facility will be constructed on-site to ensure the groundwater meets potable water standards. For non-potable water requirements, treated wastewater will be used, reducing reliance on groundwater abstraction and enhancing the site's resilience to drought in the short to medium term.

The proposed internal water reticulation network for CWA is proposed to be sourced from a combination of boreholes and municipal supply. These sources will feed into proposed on-site storage tanks, from which water will be distributed throughout the development. There will be no direct connection to the municipal supply line for reticulation purposes. The on-site storage tanks will be designed to provide sufficient buffering capacity to accommodate peak demand and high-demand scenarios, ensuring consistent water availability. For fire demand scenarios, a separate set of dedicated fire storage tanks is proposed. These tanks will be designed with adequate capacity to meet fire-fighting requirements without imposing additional stress on the municipal water supply system. The indicative layout of the proposed water supply to the development can be seen in Figure 13 below.

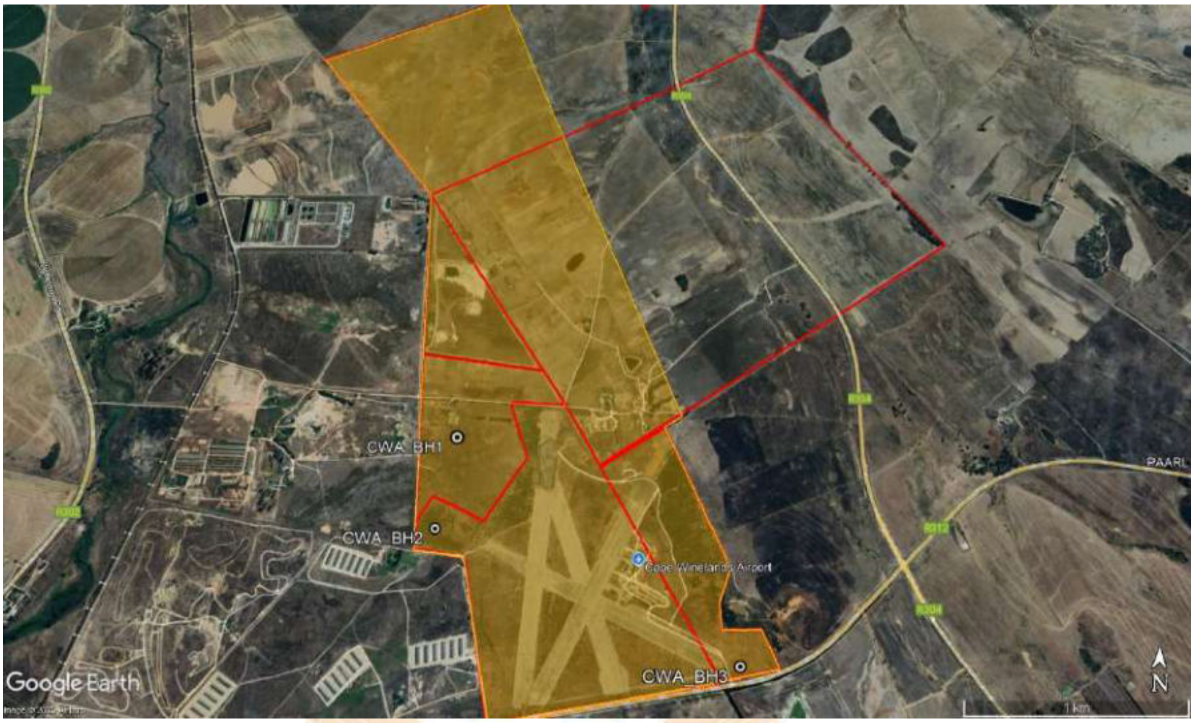
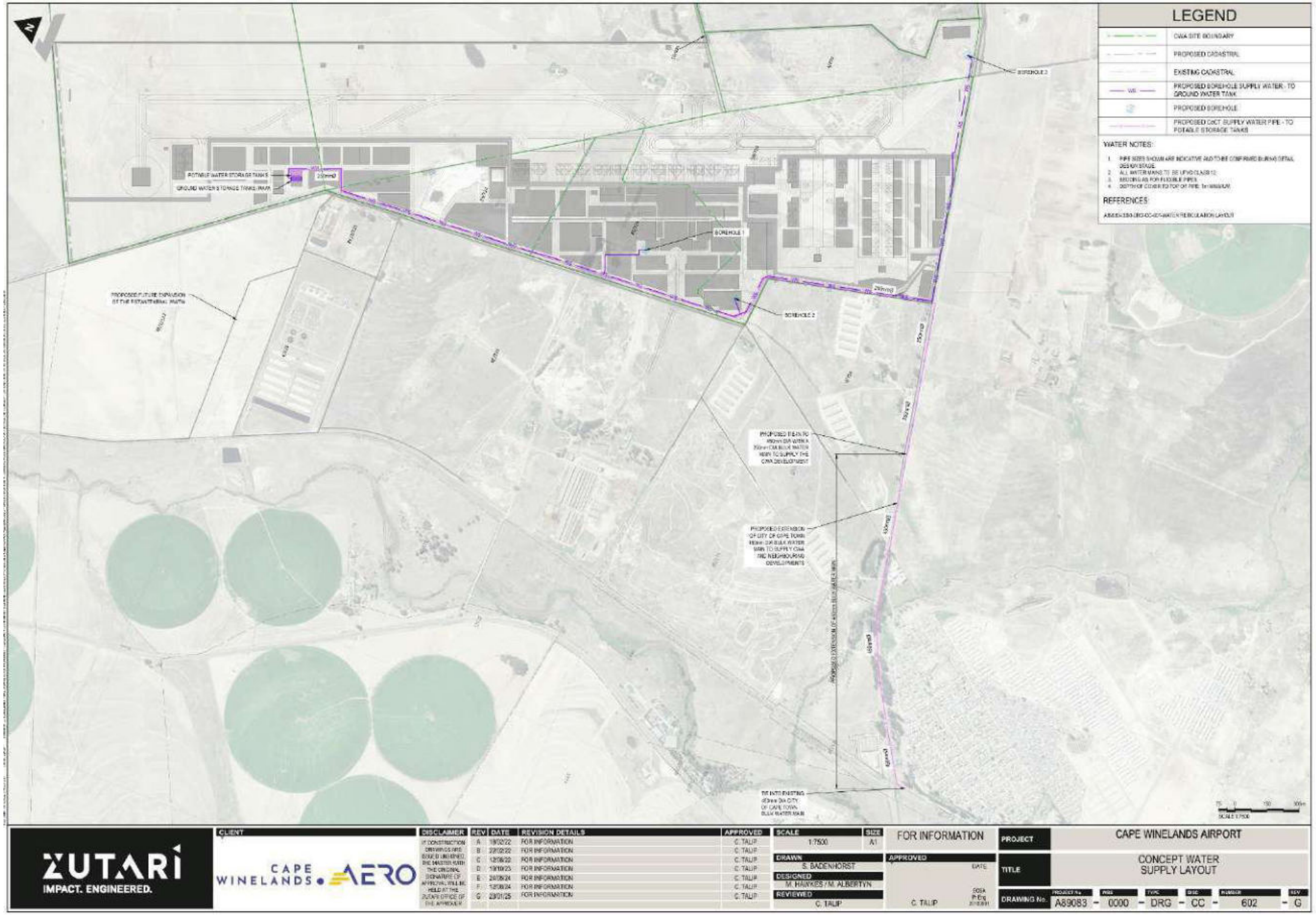


Figure 11: <u>Three</u> potential production boreholes <u>developed within the proposed development area</u> (PHS Consulting, <u>February 2025</u>).

Figure 12: Proposed potable supply line from municipal network (in yellow) (PHS Consulting, October 2024).



<u>**Figure 13: Concept water supply layout indicating the location of the three onsite production boreholes and the proposed CoCT supply line (Zutari, Engineering Services Report, January 2025)**</u>

- **Sewage Management & Treatment**

  The site is located on the urban edge and thus sewage services provision near the site is limited and existing services are located quite far. The site falls into the catchment area serviced by the Fisantekraal WWTW, but there is at present no link / service to the Fisantekraal WWTW. Existing buildings on the CWA site make use of septic tanks.

  An application was made to the City of Cape Town to determine if spare capacity exits in the municipal system to accept the sewage flows generated from the proposed CWA development. Even though capacity exists at the Fisantekraal WWTW to accept the flows, network coverage is limited and conveying the flows to the existing municipal pump station in Fisantekraal and then onward to the Fisantekraal WWTW cannot be achieved without network expansion towards the East.

  Due to the limited network coverage, conveyance infrastructure must be implemented outside of the site boundary in order to convey the sewage to the municipal wastewater treatment works. Considering this requirement, three options are contemplated:

  - Option 1: Construction of an on-site packaged Sewage Treatment Plant to treat sewage on site.
  - Option 2: Construction of pumpstation and associated rising main to pump sewage to the Fisantekraal WWTW.
  - Option 3: Option 3: Pump to Fisantekraal with extraction (Preferred option)

  A letter of intent has been submitted to the CoCT Treated Effluent Department to confirm whether the Fisantekraal WWTW would have spare capacity to receive the excess treated effluent generated by the development, should Sewer Option 1 be pursued (Zutari, Engineering Services Report, February 2025).

  The letter of intent also includes the maximum projected treated effluent required for non-potable demand, should Sewer Option 2 be pursued, to confirm whether the Fisantekraal WWTW would have the capacity to meet the development's treated effluent demands. The design will ensure that all treated effluent generated on-site will be effectively managed and disposed of in an environmentally compliant manner; and that no treated effluent will be discharged into the stormwater system (Zutari, Engineering Services Report, February 2025).

  Based on subsequent discussions with CoCT officials, support was given for a direct route from the proposed development to the Fisantekraal WWTW.

Option 1: Construction of an on-site packaged Sewage Treatment Plant (Figure 14):

This proposal entails the construction of an on-site package treatment plant to treat the sewage generated by the CWA development. The intention is that the treated sewage effluent is then re-used for irrigation and toilet flushing. The proposal for Option 1 entails the following:

- Internal sewer network to convey sewage to Package Sewage Treatment Plant
- Sludge processing area
- Emergency overflow pond
- Emergency overflow rising main to Fisantekraal WWTW

An internal sewer network will collect sewage from the various buildings and convey it to a package sewage treatment plant. The package treatment plant will treat the sewage to a quality that meets the applicable limits required for re-use. The treated effluent will then be stored and used as a non-potable water supply. The package treatment plant will be designed as a closed system with all waste generated handled in accordance with the relevant city by laws. The design will ensure that all treated effluent generated on-site will be effectively managed and disposed of in an environmentally compliant manner.

To enhance the reliability and resilience of the system, the installation of an emergency rising main to the Fisantekraal Wastewater Treatment Works (WWTW) as well as an emergency overflow pond is proposed. This additional infrastructure will provide redundancy measures for the following scenarios detailed below:

Scenario 1: Fault at the Package Wastewater Treatment Plant

- If there is a malfunction with the package wastewater treatment plant, a bypass valve will be activated, to divert flows from the treatment plant via a pump and sewer rising main to the Fisantekraal WWTW, on a temporary basis until the issue is resolved.
- This measure ensures that untreated sewage does not accumulate unnecessarily, thereby maintaining the integrity of the on-site sanitation system and mitigating against environmental contamination.

Scenario 2: Fault at the Pump Station

- If there is a malfunction with the pump station, a bypass valve will be activated to divert flows to the emergency overflow pond.
- This will prevent back-up and possible overflows in the sewer network. Once the issue is resolved, a valve will be opened to allow sewage to flow back to the pump station and subsequently to the package wastewater treatment plant.

- This approach mitigates the risk of sewage overflow and ensures continuous operation of the sewage management system.

By incorporating these emergency measures, the aim is to safeguard the functionality and efficiency of the sewage treatment process, maintaining high standards of sanitation and environmental protection.

Option 2 Pumpstation and rising main (Figure 15):

Due to the proximity of the CWA Development to the Fisantekraal WWTW it is apparent that it is advantageous to install a pumpstation and associated rising main that conveys the sewage directly to Fisantekraal WWTW to the North rather than convey the sewage to the southwest towards the municipal sewage network in Fisantekraal.

Option 3: Pump to Fisantekraal with extraction (Preferred option) (Figure 16):

The proposed solution for sewage discharge on the development integrates a dual-treatment approach to efficiently manage effluent and meet non-potable water demands. Sewage from the development will be diverted through a pump system to a proposed on-site package treatment plant. This plant will treat the sewage to a standard suitable for non-potable water use, such as irrigation or toilet flushing, thereby addressing the development's internal non-potable water requirements.

To avoid excessive effluent production and maintain compliance with wastewater discharge regulations, the remaining sewage will be directed to the nearby municipal wastewater treatment works (WWTW) for further treatment and disposal. This approach aims to optimize effluent reuse, reduce pressure on the WWTW, as well as address environmental concerns with respect to excess treated effluent generated.

The proposal for Option 3 entails the following key components:

- An internal sewer network to convey sewage.
- A lifting station to divert a portion of sewage to a package sewage treatment plant to meet the non-potable demands of the development.
- A primary sewer pump station to direct the remaining sewage to the Fisantekraal Wastewater Treatment Works (WWTW) via a pump and rising main.
- A sludge processing area.
- An emergency overflow pond.
- An emergency overflow to the primary sewer pump station from the package treatment plant, directing all development demands to the Fisantekraal WWTW in case of failure.

An internal sewer network will collect sewage from various buildings and convey it to a lifting station. From here, the required sewage volume will be diverted to the proposed package sewage treatment plant, which will treat the sewage to meet the applicable quality limits for reuse (at minimum to the cities general limits). The treated effluent will then be stored and utilized as a non-potable water supply. The package sewage treatment plant will be designed as a closed system, with all waste generated handled in compliance with relevant city by-laws.

The design ensures that all treated effluent generated on-site is effectively managed and disposed of in an environmentally compliant manner. To enhance the reliability and resilience of the system, an emergency rising main to the primary municipal pump station and an emergency pond is proposed as per Option 1. This additional infrastructure will provide redundancy measures for the same scenarios as detailed in Option 1 above.

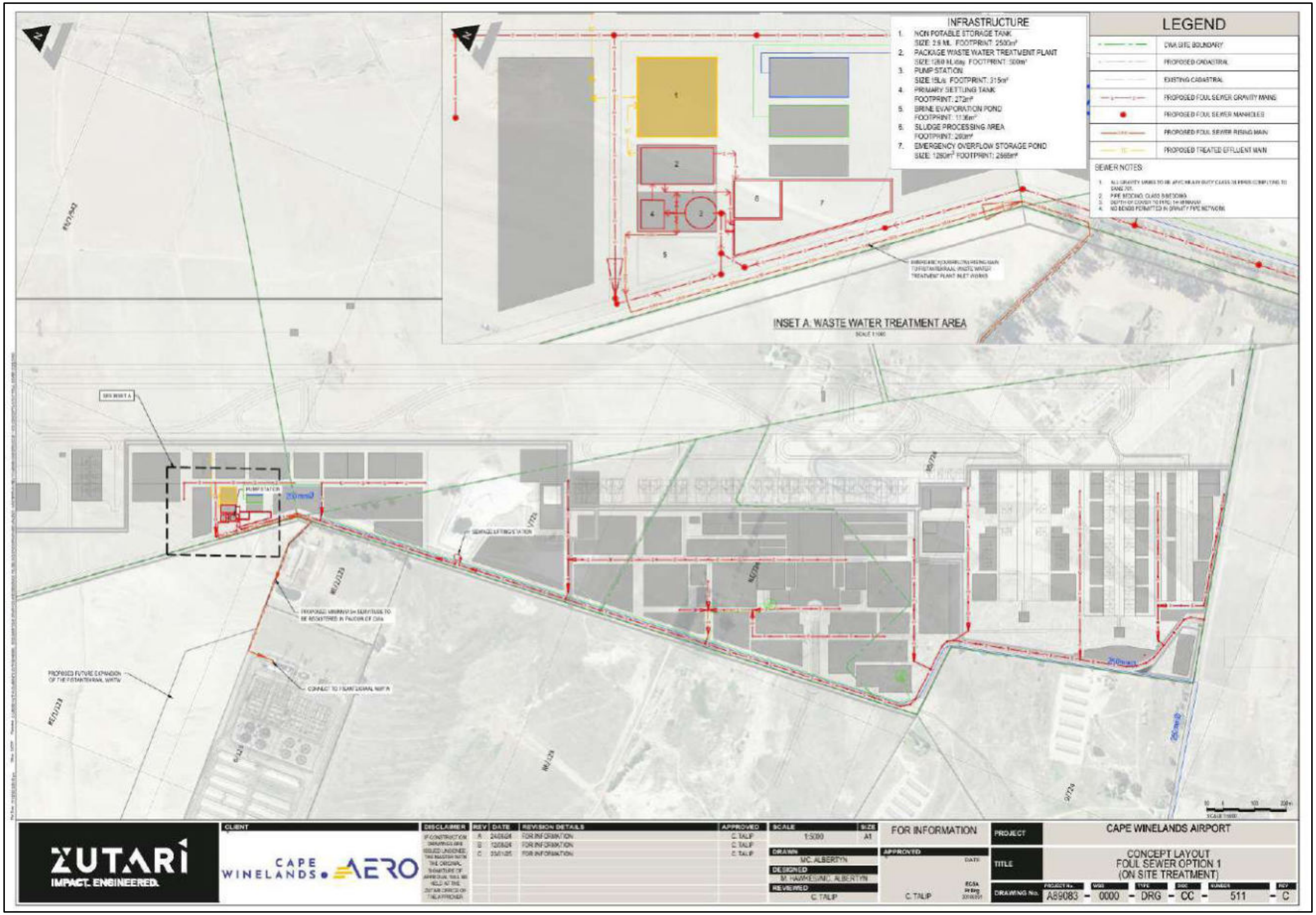


Figure 14: Foul sewer Option 1 (Onsite treatment) - Proposed route of sewage rising main (Zutari, Engineering Services Report, January 2025).

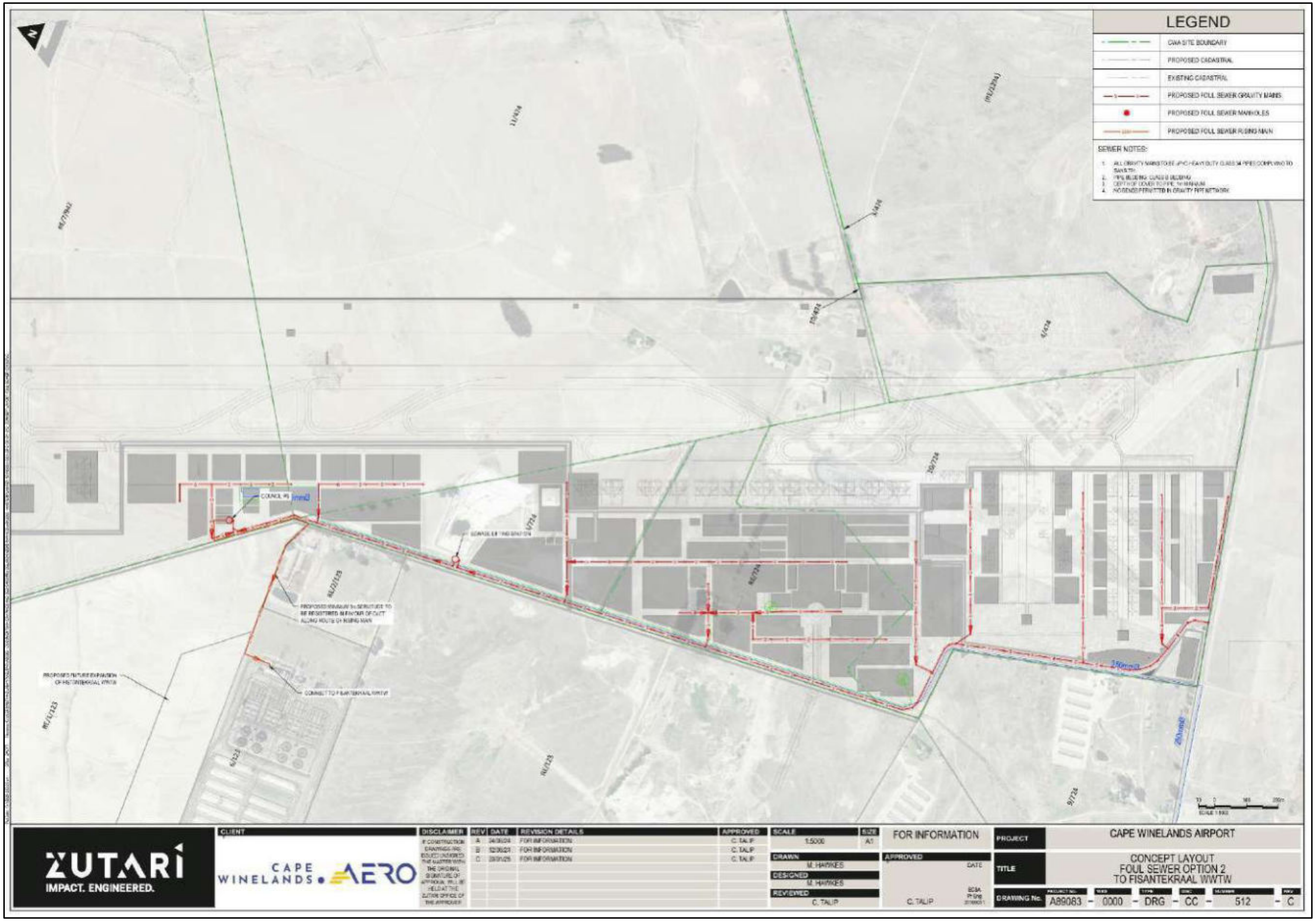


Figure 15: Foul Sewer Option 2 (To Fisantekraal WWTW) - Proposed route of sewage rising main (Zutari, Engineering Services Report, January 2025).

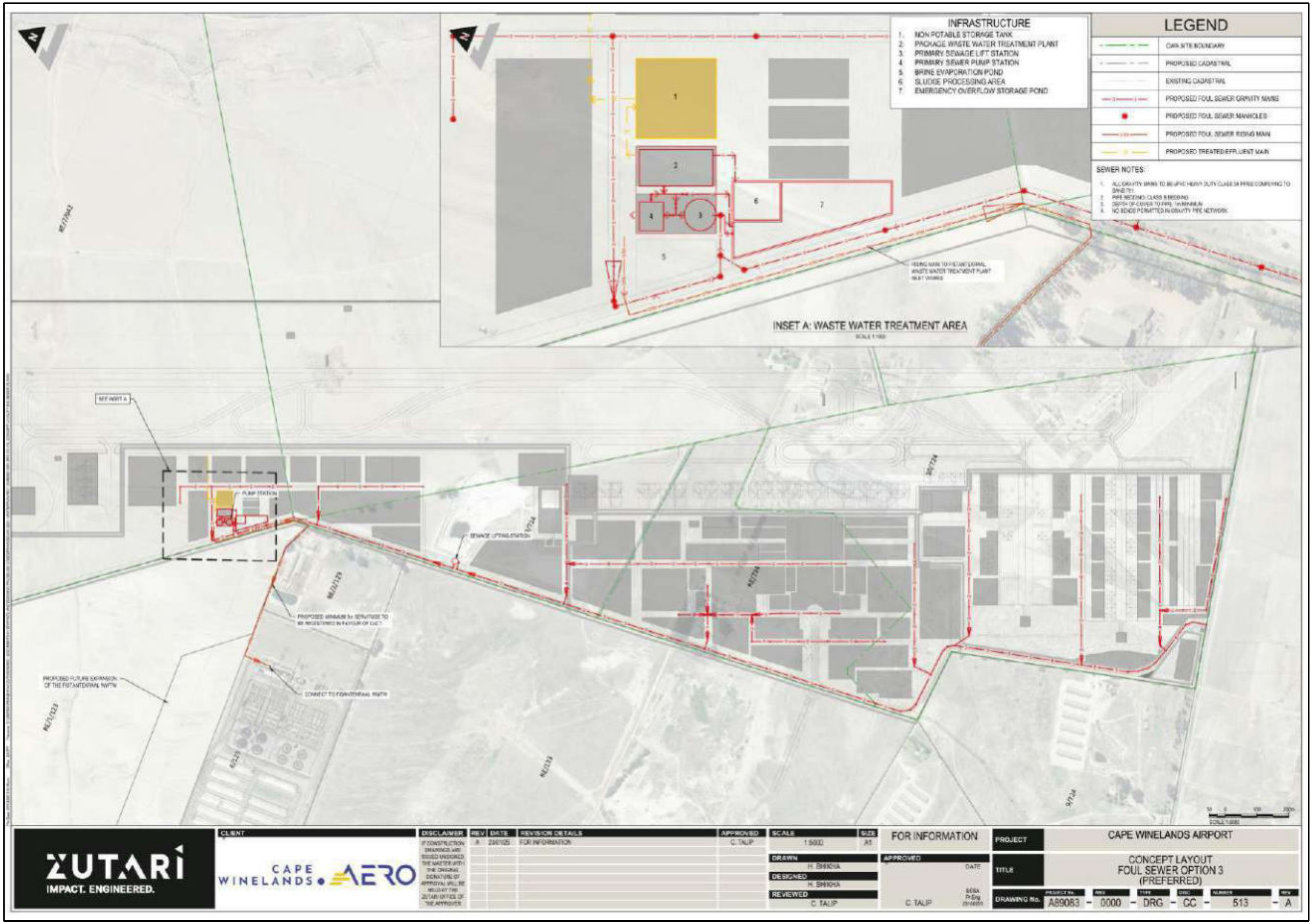


Figure 16: Foul Sewer Option 3 - Pump to Fisantekraal with extraction (Preferred option) ((Zutari, Engineering Services Report, January 2025).

- **Electricity (SANDS, Consulting Electrical Engineers Bulk Services Design Report, February 2025):**

  The site currently contains an existing 66kV Eskom supply which will have to be expanded. The bulk mains electrical supply will be connected to the Eskom Grid via the overhead 66,000-Volt three phase connection. The connection will be completed using two feeders, providing a degree of redundancy to the mains supply; this is in accordance with good engineering practice, where critical systems are connected.

  The two feeders will be connected to their Fisantekraal Substation. The feeders will be routed to the site using 66,000-Volt feeder cables, with the final routing of the Eskom connections confirmed later. The bulk electricity supply will terminate within the Cape Winelands Airport site and the connection points will comprise an Eskom high voltage substation, plus a Consumer Substation fitted with 66000:11000 Volt Step-Down Power Transformers, and Medium Voltage Power Distribution Systems.

  The Eskom supply will remain as backup supply on site; however, the intention is to minimize the reliance on Eskom supply as far as possible. The vision for the proposed development is ultimately that the site and all facilities housed should be self-sustaining in terms of renewable energy sources and resources. As such renewable energy sources in the form of (1) solar photovoltaic systems and (2) a bio-digestor plant are proposed.

  The biodigester has been sized to provide 12,000kWh/d. Biogas production will be continuous, and gas will be stored in gas bladders protected by inflated domes for consumption at night. The size of the plant can be increased should there be a higher energy demand. It must be noted that that will require a proportional increase in the daily feed to the plant.

  The biodigester was originally planned to run on chicken manure, energy crop (Napier grass) and treated effluent/water. However, due to biohazard concerns with the adjacent chicken farm, chicken manure will no longer be used as a feedstock. The feed stream will comprise treated effluent from the WWTW (200m^3/day) and cultivated biomass / energy crop (15t/day). General organic waste from the site may be used to supplement the feed. Treated biosolids from the WWTW may also be used to supplement if found to be non-hazardous.

  Energy crops as feedstock source:

  Extensive research has been done to determine the viability of growing an energy crop for the specific purpose of supplying the proposed biogas plant with feedstock. The most cited grasses for the purpose of using it to produce biogas is Napier and Vetiver.

  Based on the inherent characteristics of Napier grass, a ton of fresh grass has the potential to deliver 103m^3 of biogas, while a ton of fresh Vetiver grass processed through a hammer mill has the potential to yield 260m³ of biogas per ton. The CWA site includes 450ha of arable land where an energy crop can be farmed.

Treated Sewage Effluent as dilution feed:

The biodigester will require 3 to 5 tons of treated sewerage effluent per ton of feedstock (i.e. 200m^3/day). A significant portion of the daily water "consumption" is cycled through the plant continuously, such that the makeup water required comprises ≥ 10% ≤ 25% of the total water requirement.

The biodigester plant creates biogas which is accumulated into a (large) bladder system from which electricity is generated. The biodigester will output digestate as a liquid and a solid fraction. The liquid fraction can be used for irrigation on site and the solid fraction for fertiliser application to land.

3.2. Location of water uses

The proposed project site is located in the Western Cape Province within the Bellville Magisterial District near Fisantekraal. The water uses will take place on 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, all of which form part of the G21E Quaternary Catchment within the Breede-Olifants Water Management Area. The geographic location of the property where the water uses will take place are 33°45'20.38"S 18°44'14.81"E.

Please refer to Figure 1 and Figure 2 for location plans which show the general locality, development cadastral and the proposed development area respectively.

It should be noted that the proposed development site is located in what used to be the Berg-Olifants WMA. The Berg-Olifants WMA was administered by the Department of Water and Sanitation (DWS). However, recently, the Breede-Olifants CMA (BOCMA) has been established by extending the operational boundary of the Breede-Gouritz WMA to include the previous Berg-Olifants WMA. As such BOCMA administers what used to be the Berg-Olifants WMA and will therefore be the authorising agent for this area on behalf of DWS.

Table 1: Property Details

Property description	Title Deed number	Owner	Applicant	Agreement	SG Code	Geographic Location
Portion 23 of Farm 724, Joostenberg, Vlakte, Paarl	T13778/2009	Corobrik (Pty) Ltd	Capewinelands Aero (Pty) Ltd	POA & Cession and Delegation Agreement	C05500000000072400023	33°45'27.43"S 18°43'54.68"E
RE of Farm 724, Joostenberg Vlakte, Paarl	T14190/2022	Cape Winelands Aero (Pty) Ltd	Capewinelands Aero (Pty) Ltd	n/a	C05500000000072400000	33°45'49.16"S 18°44'0.07"E
Portion 10 of Farm 724, Joostenberg Vlakte, Paarl	T39098/2020	Cape Winelands Airport (Pty) Ltd	Capewinelands Aero (Pty) Ltd	POA	C05500000000072400010	33°46'13.90"S 18°44'21.28"E
Portion 4 of Farm 474, Joostenbergs Kloof, Paarl	T39098/2020	Cape Winelands Airport (Pty) Ltd	Capewinelands Aero (Pty) Ltd	POA	C05500000000047400004	33°46'8.83"S 18°44'41.85"E
RE of Farm 474, Joostenbergs Kloof, Paarl	T97465/2004	Buurmansk raal Boerdery (Pty) Ltd	Capewinelands Aero (Pty) Ltd	POA	C05500000000047400000	33°45'11.48"S 18°44'41.56"E
Portion 7 of Farm 942, Kliprug, Malmesbury	T97465/2004	Buurmansk raal Boerdery (Pty) Ltd	Capewinelands Aero (Pty) Ltd	POA	C04600000000094200007	33°44'30.59"S 18°44'8.08"E
Portion of Portion 3 of Farm 474, Joostenbergs-kloof, Paarl	T1986/1931	Buurmansk raal Boerdery (Pty) Ltd	Capewinelands Aero (Pty) Ltd	Acquisitive Prescription & POA	C05500000000047400003	33°45'48.21"S 18°44'37.51"E

4. Administrative documents and other technical reports submitted to support the WULA

4.1. Administrative documents

The following administrative documents will be submitted as part of the application:

- Proof of Payment of Water Use Licence Application Processing Fee.
- Certified Copy of Identity Document of Applicant's **representative.**
- Copy of Capewinelands Aero (Pty) Ltd (Applicant) company registration certificate.
- Copy of Capewinelands Airport (Pty) Ltd (Operating Company) directorship information – CIPC Director Amendments.
- Copy of RSA Aero Ltd (Holding Company) directorship information – CIPC Director Amendments.
- Power of Attorney for PHS Consulting to lodge the WULA application on behalf of the Applicant.
- Landowner information (i.e. title deeds, POA and landowner consent, Searchworks ownership reports etc.) for the following land parcels:
    - P23 of Farm 724,
    - RE of Farm 724,
    - P10 of Farm 724,
    - P4 of Farm 474,
    - P7 of Farm 942,
    - RE of Farm 474 &
    - P3 of Farm 474
- Corobrik Mining Licence for P23/724 and RE/474
- Corobrik Quarry EMPr (dated 9 July 1998)
- Mining Closure NID to DMRE
- City of Cape Town Water Supply Letter (dated 30 November 2021)
- City of Cape Town Comment on Hydraulic Water Modelling Analysis for Cape Winelands Airport (dated 16 Match 2022)

An application for a mining closure certificate for P23/724 and RE474 is in process, and an update on the process will be provided to the CA during the WULA authorisation process.

4.2. Reports and other technical documents

Table 2: List of report and other technical documents to be submitted:

Number	Report Title	Compiled by	Date of report
1.	Detailed Scoping Phase Freshwater Ecological Assessment	FEN Consulting	February 2024

2.	Detailed EIA Phase Freshwater Ecological Assessment	FEN Consulting	September 2024 Updated February 2025
3.	Water Use Licence Application Geohydrological Assessment: Cape Winelands Airport, Fisantekraal, Western Cape	GEOSS	March 2024 Updated October 2024 & February 2025
4.	Geohydrological Scoping Report for the Proposed Cape Winelands Airport, Fisantekraal, Western Cape.	GEOSS	March 2024
5.	Groundwater Impact Assessment for the Proposed Cape Winelands Airport, Fisantekraal, Western Cape	GEOSS	October 2024 Updated February 2025
6.	Socio-Economic Scoping Report for the proposed Cape Winelands Airport, Fisantekraal	Multi-purpose Business Solutions	September 2023
7.	Socio-Economic Impact Assessment for the proposed Cape Winelands Airport, Fisantekraal	Multi-purpose Business Solutions	October 2024 Updated March 2025
8.	Engineering Services Report [Inclusive of Appendices]	Zutari	February 2025 [Revision L]
9.	Concept Stormwater Management Plan Appendix A - Drawings Appendix B – Geotechnical Investigation Report Appendix C - Flood line Risk Assessment Report Appendix D - Bella Riva Stormwater Management Plan Appendix E - PCSWMM Simulation Model Output Results	Zutari	August 2024
10.	Masterplan for Aircraft Refuelling Facilities: Cape Winelands Airport	Kantey & Templer Consulting Engineers	May 2023 Updated August 2024
11.	Quantitative Risk Assessment of the Proposed Fuel Storage at CWA	RISCOM (Pty) Ltd.	August 2024
12.	Draft Environmental Management Programme for the expansion of the Cape Winelands Airport.	PHS Consulting	March 2025

13.	CWA SDP and Linear Coordinates (Also refer to Figure 3 & Figure 4 of this report for the concept SDPs)	PHS Consulting	May 2024 Updated October 2024 & March 2025
14.	S27 Motivation Report (included in this report)	PHS Consulting	March 2025
15.	Borehole Yield and Quality Testing at Cape Winelands Airport, Fisantekraal, Western Cape.	GEOSS	September 2022
16.	Borehole Yield and Quality Testing of CWA_BH002 at Cape Winelands Airport, Fisantekraal, Western Cape.	GEOSS	December 2022
17.	Yield and Quality Testing of a Quarry at the Cape Winelands Airport, Fisantekraal, Western Cape.	GEOSS	September 2022
18.	Borehole Yield and Quality Testing of CWA_BH003 at Cape Winelands Airport, Fisantekraal, Western Cape	GEOSS	December 2024
19.	Consulting Electrical Engineers Bulk Services Design Report	SANDS – Selkirk and Selkirk Engineering Solutions	April 2024 Updated August 2024 & February 2025
20.	Geotechnical Reconnaissance Investigation for Proposed Cape Winelands Airport, Fisantekraal, Western Cape.	GEOSS	September 2023
21.	Hydropedological Assessment for the proposed Cape Winelands Airport development in Fisantekraal, Western Cape province	Zimpande Research Collaborative	June 2024 Updated February 2025
22.	Draft Wetland Offset Study and Implementation Plan	FEN Consulting	September 2024 Updated January 2025
23.	Public Participation summary document (inclusive of Comments and responses report)	PHS Consulting	To be provided with final submission
24.	CWA Maintenance Management Plan	PHS Consulting	October 2024 Updated March 2025
25.	Concept Landscape Plan	Planning Partners	February 2025
26.	Final CCIA report for the proposed Cape Winelands Airport expansion	Brundtland	September 2024

			Updated February 2025

5. Project Description

The applicant proposes the expansion and upgrade of the existing CWA from a general flying airfield to a commercial airport. The proposed development will include the redevelopment of the primary runway which will have an orientation of 01-19 and length of 3.5km. Phased landside and airside development will also take place based on market demand. Landside infrastructure will include, but not be limited to, passenger and cargo terminals, hotel, aircraft hangers and services, airport facilities, bulk fuel storage facility, internal and external road infrastructure, potable water and sewage treatment infrastructure, petrol filling station, a biodigester, solar PV, and stormwater management infrastructure. Airside infrastructure will include, but not be limited to, runways, taxiways, taxi lanes, aircraft parking aprons, service roads as well as approach lights and navigational aids needed for safe operations in all weather conditions. The runway solution also includes drainage, pavement structures, paint markings and earthworks along with considerations for aircraft tracking, jet blast impact mitigation and hydroseeding requirements.

The current water supply strategy for CWA follows a phased approach, initially relying on groundwater as the primary source. This will continue in the short term until municipal infrastructure can either supplement or fully replace the groundwater supply. A treatment facility will be constructed on-site to ensure the groundwater meets potable water standards. For non-potable water requirements, treated wastewater will be used, reducing reliance on groundwater abstraction and enhancing the site's resilience to drought in the short to medium term.

The proposed development water use activities will include abstraction of groundwater, storage of water, treatment of sewage water, storage of treated effluent, and irrigation of landscaping using treated effluent. Portions of the proposed development activities will also be undertaken within the regulated area of delineated watercourses and the primary runway will intersect with a portion of Seep Wetland 1, resulting in wetland loss (Figure 17). A freshwater offset has been developed to compensate for the loss of freshwater habitat (FEN, Draft Wetland Offset Study and Implementation Plan, January 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). In addition, the agricultural drain connecting the seep wetland to the CVB wetland is also earmarked for rehabilitation (Figure 17). Offset consideration is being done in consultation with the CoCT, Cape Nature, the DEA&DP and the DWS.

The proposed project includes a series of attenuation ponds for stormwater management (Figure 18). The majority of the proposed stormwater attenuation ponds will be designed as dry attenuation ponds as detailed in Section 7 (Stormwater Management Plan) of this report, in order to deter birdlife and minimise the risk of bird strikes.

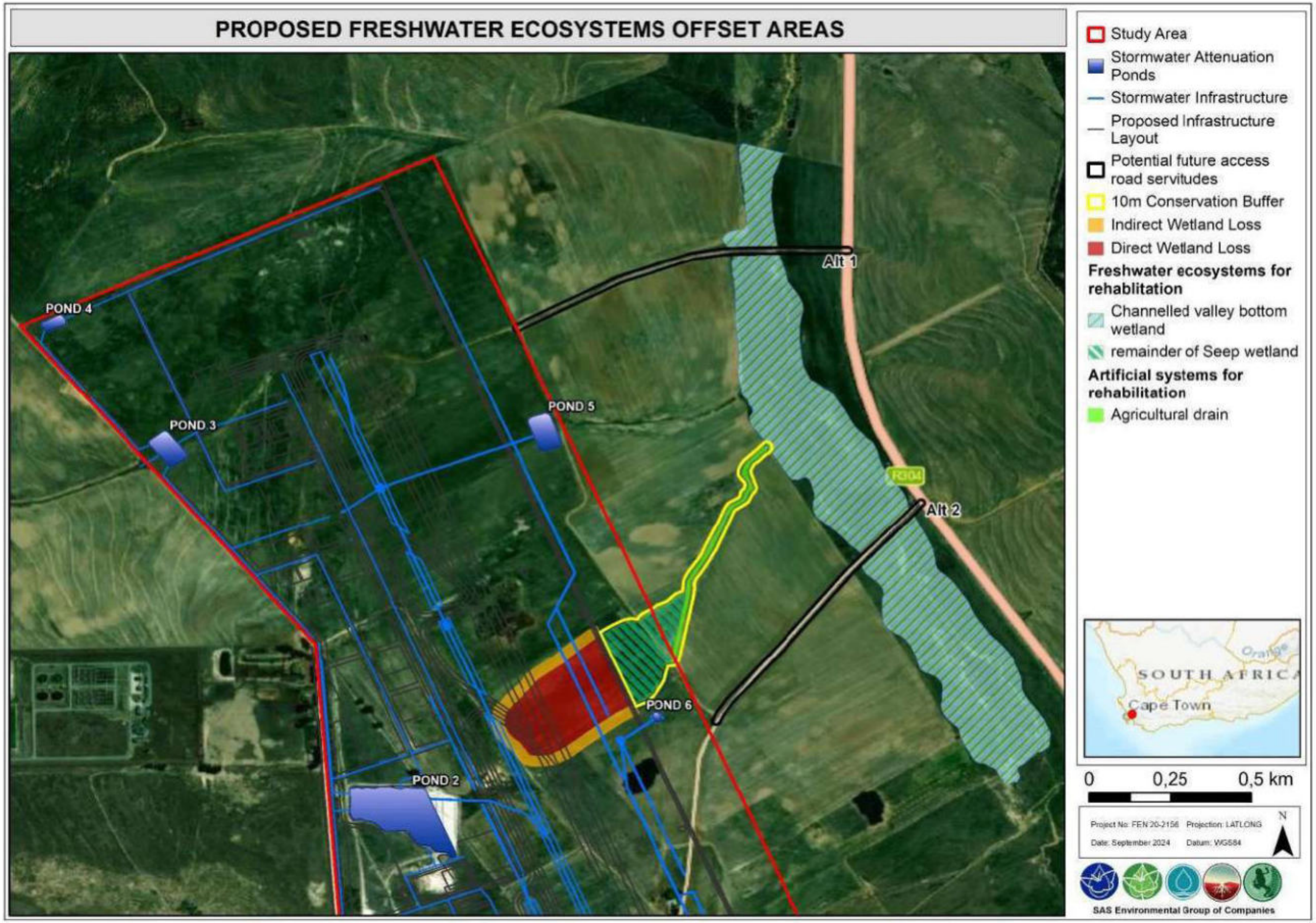


Figure 17: Extent of wetland to be lost (7.44ha) vs identified wetland areas to be rehabilitated (FEN, Draft Wetland Offset Study and Implementation Plan, January 2025)

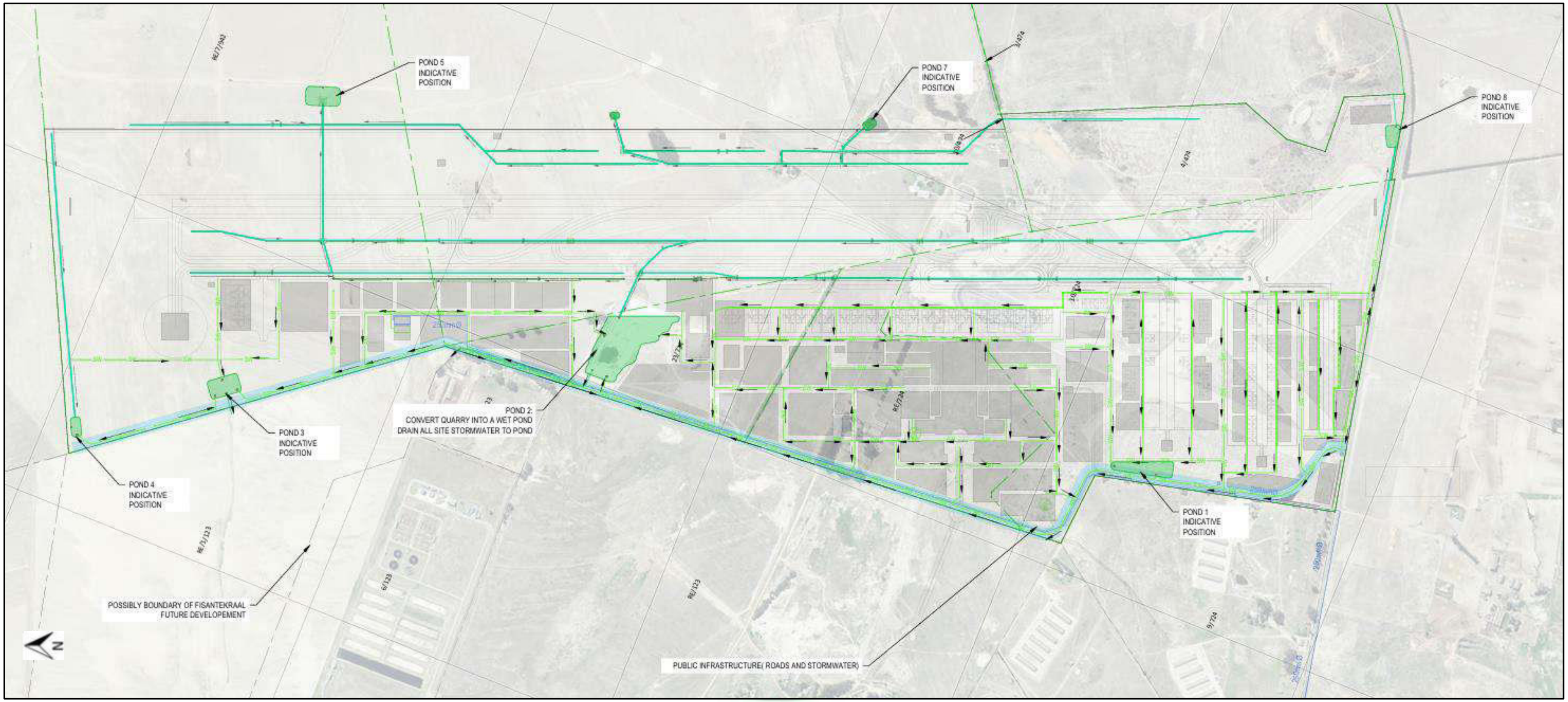


Figure 18: Proposed stormwater layout (Zutari, Engineering Services Report, January 2025)

The following activities as they relate to S21 of the NWA will be undertaken as part of the development proposal:

Table 3:Project Details

Activity	Water use to be applied for (S21 of NWA)	Description
Abstraction of water from CWA_BH001 located on RE of Farm 724, Joostenberg Vlakte, Paarl	(a)	Abstraction of a total of 31 536m^3/annum from CWA_BH001 for treatment and use as a potable source. Refer Figure 11
Abstraction of water from CWA_BH002 located on P10 of Farm 724, Joostenberg Vlakte, Paarl	(a)	Abstraction of a total of 78 840m^3/annum from CWA_BH002 for treatment and use as a potable source. Refer Figure 11
Abstraction of water from CWA_BH003 located on P4 of Farm 474, Joostenberg Kloof, Paarl	(a)	Abstraction of a total of 53 295m^3/annum from CWA_BH003 for treatment and use as a potable source. Refer Figure 11
Pond 1 - Short-term storage of stormwater within dry attenuation pond	(b)	Pond 1 has an estimated attenuation volume of 10 800m^3. Refer Figure 18.
Pond 2 - Storage of stormwater within the converted quarry – wet detention pond.	(b)	The proposed project entails the rehabilitation of the quarry located onsite for stormwater storage. The quarry stormwater pond will have an estimated attenuation volume of 95 000m^3. Refer Figure 18.
Pond 3 - Short-term storage of stormwater within dry attenuation pond.	(b)	Pond 3 has an estimated attenuation volume of 9 600m^3. Refer Figure 18.
Pond 4 - Short-term storage of stormwater within dry attenuation pond.	(b)	Pond 4 has an estimated attenuation volume of 2 100m^3. Refer Figure 18.
Pond 5 - Short-term storage of stormwater within dry attenuation pond.	(b	Pond 5 has an estimated attenuation volume of 10 800m^3. Refer Figure 18.
Pond 6 - Short-term storage of stormwater within dry attenuation pond.	(b)	Pond 6 has an estimated attenuation volume of 350m^3. Refer Figure 18.
Pond 7 - Short-term storage of stormwater within dry attenuation pond.	(b)	Pond 7 has an estimated attenuation volume of 1 550m^3. Refer Figure 18.

Pond 8 - Short-term storage of stormwater within dry attenuation pond.	(b)	Pond 8 has an estimated attenuation volume of 4 200m^3. Refer Figure 18.
Development of airside and landside infrastructure.	(c) & (i)	Two seep wetlands, 4 channelled valley bottom wetlands and various artificial features including several artificial drains were identified and delineated within the 500m regulated area of the proposed development. Development of infrastructure related to the SDP (Figure 3 & Figure 4) will thus be undertaken within 500m from wetlands.
Development of an incoming potable water supply line.	(c) & (i)	An incoming potable water supply line will be developed which will run from the closest municipal linkage point, located in Lichtenburg Road, to the proposed development site.
Rehabilitation activities as outlined within the Wetland Offset Study and Implementation Plan developed by FEN Consulting, January 2025.	(c) & (i)	A draft freshwater offset has been developed to compensate for the loss of Seep Wetland 1. The proposed offset involves rehabilitating the remaining seep wetland habitat along with a portion of CVB Wetland 1. In addition, the agricultural drain connecting the seep wetland to the CVB wetland is also earmarked for rehabilitation (Figure 17).
Irrigation with water containing waste from the onsite sewage treatment plant.	(e)	The proposed development activities include the potential development of an onsite sewage treatment plant. It is proposed that the treated effluent from the wastewater plant is reused for irrigation of landscaped areas around the landside development precincts. The WWTW needs to ensure that the effluent quality is within the limits of the General Authorisation for Section 21(e) water uses as outlined in point 1 of General Notice 169 of 2013. Please refer to the Overall Landscape Concept Plan developed by Planning Partners, March 2025 (Technical doc 25) for details on areas to be irrigated.
Emergency storage of sewage	(g)	In the event of an emergency, such as simultaneous malfunctions of both the packaged wastewater treatment plant and the pump station, sewage will be temporarily stored in an emergency overflow pond. Refer to Figure 14 & Figure 16
Storage of domestic and biodegradable industrial wastewater for the purpose of re-use / disposal.	(g)	Treated effluent from the WWTW may be temporarily stored onsite prior to re-use for irrigation of landscaped areas. Refer to Figure 14 & Figure 16

Storage of brine originating from the treatment of borehole water for the purpose of re-use / disposal	(g)	Onsite boreholes will be used as a potable water source. This water will require treatment, and brine will be produced as a waste product. Brine will potentially be stored onsite in brine evaporation ponds. Refer to Figure 14 & Figure 16

6. Methods statement (only for 21 (c) and (i) activities)

The following generalised guidelines apply to all works undertaken within the regulated area of a watercourse:

- 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 and operational phase of the development.
- An adequate number of waste and "spill" bins must be provided throughout the construction and operational phase of the development.
- When machinery is involved, ensure effective operation with no leaking parts and at a safe distance from any watercourses (minimum of 100m as far as feasibly possible) 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 any watercourse be blocked 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 topsoil, 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.
- The build-up of debris/sediment removed from the site may:
  - be utilised for the purpose of in-filling or other related maintenance actions;
  - not be deposited anywhere within any watercourse.

- Material that cannot be used for maintenance purposes must be removed to a suitable stockpile location or disposal site, at least 32m from a watercourse.

The following preliminary method statements have been developed for specific activities related to the S21 (c) and (i) water uses

1) Development of the primary runway through a delineated seep wetland.
2) Bulk earthworks and construction partially within regulated area of a wetland.
3) Trenching and installation of service infrastructure including water and sewer pipelines partially within the regulated area of a wetland.
4) Operation of the proposed development partially within the regulated area of a wetland.
5) Operation and maintenance of service infrastructure such as water and sewer pipelines partially within the regulated area of a wetland.
6) Operation and maintenance of a fuel farm partially within the regulated area of a wetland.
7) Development and maintenance (e.g. sediment removal) of stormwater infrastructure within the regulated area of a wetland.
8) Removal of alien invasive vegetation within the 500m regulated area of a wetland.

<u>Please note that the below method statements are only applicable to S21(c) and (i) activities. All mitigation measures as outlined in Section 11 of this report must be implemented in full to ensure all potential water related impacts associated with the proposed development are suitably managed.</u>

MS1 - The development of the primary runway through a delineated seep wetland.

Description of activity	**The proposed primary runway coincides with Seep Wetland 1. The proposed CWA development will likely result in loss of approximately 6.74ha of wetland habitat of the Seep wetland 1.**
Actions	Vegetation removal, groundbreaking, and installation of hardened infrastructure within a delineated seep wetland.
Impacts of actions	Wetland loss
Severity of impacts	Moderate
Measures to mitigate the severity of the impacts	- The seep wetland located onsite will be partially lost due to the proposed development. Wetland offset will be undertaken. An offset report has been developed (FEN, Draft Wetland Offset Study and Implementation Plan, January 2025). The proposed offset must be implemented. - All development footprint areas should remain as small as possible and should only encroach into the freshwater ecosystem if considered absolutely essential. - All construction personnel, vehicles and construction work must be confined to the boundaries of the development footprint and no edge effects must occur. - All excavation activities must be undertaken during the drier summer months as far as possible to limit surface water contamination and the need for any surface water diversion during the construction works - During excavation and trenching, any soil, sediment, or silt removed from freshwater ecosystems may be temporarily stockpiled outside these ecosystems, provided construction takes place during 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. - 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. - 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.

MS2 - Bulk earthworks and construction partially within regulated area of a wetland

Description of activity	**Development of infrastructure related to the SDP (Figure 3 & Figure 4) will be undertaken within 500m from wetlands.**
Actions	Bulk earthworks, vegetation removal, topsoil stockpiling, movement of construction equipment, machinery and personnel, installation of hardened infrastructure within the 500m ZoR for wetlands.
Impacts of actions	- Soil disturbance and compaction leading to increased runoff, erosion and alien vegetation proliferation. - Potential sedimentation of the wetlands during construction works. - Possible contamination of soil and surface water as a result of concrete works and runoff from the construction site, leading to a reduced ability to support biodiversity. - Altered runoff patterns, leading to increased erosion and sedimentation of the receiving environment.
Severity of impacts	Moderate for Seep Wetland 1 and Low for the remainder of the watercourses impacted
Measures to mitigate the severity of the impacts	• All footprint areas must remain as small as possible and vegetation clearing must be limited to what is essential. • The 15 m 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 • A designated contractor laydown area must be approved by an independent ECO prior to use. Contractor laydown areas, vehicle re-fuelling areas and material storage facilities must remain outside of the respective conservation buffers of the freshwater ecosystems and preferably the 32 m NEMA ZoR. • The delineated edge of all (remaining) watercourses must be considered a no-go area for vehicles and staff. • 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 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. • Should the periphery of the wetland(s) be impacted by development activities, suitable rehabilitation including revegetation of preferably indigenous species must be undertaken as guided by a suitable specialist. • All excavation activities must be undertaken during the drier summer months as far as possible to limit surface water contamination and the need for any surface water diversion during the construction works

	• 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. • No stockpiling may occur within 32m of a delineated watercourse. • Stockpiles should be covered with a suitable geotextile such as hessian sheeting to prevent excessive dust generation. • 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. • 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. • All exposed soils must be revegetated with preferably indigenous vegetation as soon as feasibly possible after disturbance. • Edge effects of activities including erosion and alien/ weed control need to be strictly monitored and controlled. • Unused excavated soil/sediment should be utilised as part of the open space areas or be removed from site to a registered landfill. • Dust suppression measures must be implemented throughout construction to prevent excessive dust which may smother freshwater vegetation • 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. • All soil compacted within the wetlands as a result of construction equipment must be loosened prior to revegetation with suitable indigenous species • 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. 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. Cement usage: • Concrete and cement-related mortars can be toxic to aquatic systems. Proper handling and disposal should minimize or eliminate discharges into wetlands. High alkalinity associated with cement, can dramatically affect and contaminate both soil and ground water. The following must be adhered to:

	• Fresh concrete and cement mortar should not be mixed within 32m from the delineated extent of any watercourse. Mixing of cement may be done within the construction camp, 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 shall be deposited directly onto the ground. A batter board or other suitable platform/mixing tray is to be provided onto which any mixed concrete can be deposited whilst it awaits placing. • 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 run off water be allowed into the freshwater ecosystems • Cement bags must be disposed of in the demarcated hazardous waste receptacles and the used bags must be suitably disposed of. • Spilled or excess concrete must be disposed of at a suitable landfill site. • Once construction activities are done, the surrounding area to the construction footprint must be suitably rehabilitated. Invasive plant species should be eradicated.

MS3 – Trenching and installation of service infrastructure including water and sewer pipelines partially within the regulated area of watercourses.

Description of activity	**The excavation of trenches for the installation of water and sewer pipelines.**
Actions	Groundbreaking: Installation of service infrastructure within the 500m ZoR from a delineated wetland.
Impacts of actions	- Excavation and trenching leading to stockpiling of soil, which may be transported as runoff into downgradient freshwater systems. - Movement of construction equipment adjacent to the wetland leading to damage to vegetation and exposed/compacted soils further increasing runoff, erosion and sedimentation. - Removal of vegetation leading to exposure of soil and associated soil disturbance resulting in increased runoff, erosion and sedimentation - Potential indiscriminate waste disposal and/or spillage from construction vehicles. - Proliferation of alien and / or invasive vegetation as a result of disturbances.
Severity of impacts	Moderate for Seep Wetland 1 and Low for the remainder of the watercourses impacted
Measures to mitigate the severity of the impacts	- All development footprint areas should remain as small as possible and vegetation clearing must be limited to what is considered absolutely essential. - The lengths of open trenches must be kept to a minimum to reduce risk of erosion and sedimentation as well as the development of preferential flow paths. Each 100m section of the trench must be excavated and backfilled within a period of 2 days. - All excavation activities must be undertaken during the drier summer months as far as possible to limit surface water contamination and the need for any surface water diversion during the construction works - During excavation and trenching, any soil, sediment, or silt removed from freshwater ecosystems may be temporarily stockpiled outside these ecosystems, provided construction takes place during the dry summer months. - 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. - 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. - 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 with suitable indigenous species to prevent erosion.

	- 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. - It must be ensured that the installation of al service infrastructure complies with the relevant regulations in accordance with the standards and specifications set out by the relevant control agency. - 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 - Soil may not be stockpiled within 32m of a watercourse and stockpiles may not exceed 2m in height. - Protect exposed soil and stockpiles from wind, and limit the time which soil are exposed, by covering with a suitable geotextile such as hessian sheeting during extremely windy conditions. - Proliferation of alien vegetation must be monitored and controlled. - Unused excavated soil/sediment should be utilised as part of the open space areas or be removed from site to a registered landfill. - Dust suppression techniques must be implemented throughout the construction phase. - No stormwater generated during construction may be directly released into the freshwater environment. - 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. - Under no circumstances must linear infrastructure be trenched within the CVB wetlands 2 and 3 or their conservation buffer.

MS4 - Operation of the proposed development within the regulated area of watercourses.

Description of activity	**The proposed development (including roads, primary runway, biodigester, wastewater treatment facility, fuel station etc.) will be located partially within the regulated area of several watercourses.**
Actions	During the operational phase, there is an elevated risk of pollution, sediment transport, and erosion that could adversely affect downstream watercourses.
Impacts of actions	Water quality impacts on downstream watercourses.
Severity of impacts	Low
Measures to mitigate the severity of the impacts	- Implement a monitoring programme to detect and prevent the pollution of soils, surface water and groundwater. Any spills or leaks that occur on the runway must be addressed immediately. The absorbent materials necessary for addressing spills must be readily available onsite at all times. - Monitoring and management of alien invasive plan species must be undertaken in line with the Alien Vegetation Management Plan in place for the proposed development. - Conduct monitoring as detailed in the Wetland Offset Study and Implementation Plan by FEN (January 2025). All wetlands potentially impacted by the proposed CWA development must be monitored to ensure that PES drivers and receptors are maintained, and, where possible, enhanced to align 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. 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. - 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.

MS5 - Operation and maintenance of service infrastructure such as water and sewer pipelines partially within the regulated area of a wetland.

Description of activity	**1. Maintenance or repairs of the service infrastructure could result in similar impacts as those experienced during service installation (MS3).** **2. 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.** **3. If a portion of the pipeline(s) ruptures under pressure or while carrying flows, then passage of sediment and/or sewerage might enter nearby watercourses resulting in water quality impacts.**
Actions	The following general sequence of actions are required: • Identify and demarcate area of pipeline to be repaired/ replaced; • Clear area of debris or vegetation in order to access pipeline if required; • Replace/ repair pipeline and remove old pipeline debris or materials; • 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; • Rehabilitate disturbed areas, remediate any erosion areas identified and remove siltation if required; • Reshape areas and/or plant as required.
Impacts of actions	Sedimentation, pollution of downstream environment and detrimental effects on water quality and biota.
Severity of impacts	Low
Measures to mitigate the severity of the impacts	- Implement a monitoring programme to detect and prevent the pollution of soils, surface water and groundwater. - Implement the wetland monitoring programme outlined within the FEN Draft Wetland Offset Study and Implementation Plan (January 2025). - 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. - Only existing roadways should be utilised during maintenance and repairs to avoid indiscriminate movement of vehicles within the wetlands. - Routine pipeline repairs should be confined to the dry season– this measure does not apply in the case of a sudden burst or breakage.

	- All pipes must be regularly monitored for leaks or potential damage. Any leaks and damage identified must be repaired immediately. - 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. - 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. - Following repairs / replacement, areas of physical disturbance must be rehabilitated to their pre-repair condition or better, by: o Removing all construction associated stockpiles and waste from the area, as well as removing any damaged / waste pipeline or other waste material. o Planting the disturbed area, if necessary, with appropriate indigenous vegetation to stabilize the soils and deter alien vegetation. o The disturbance area must be minimized, particularly in the vicinity of the wetland. o Excavated soil must be carefully stockpiled outside of any watercourses, and such that it will not wash / fall into a watercourse. o On completion of repairs, any excess soil must be disposed of at least 32m away from the edge of any watercourses. o If chemical additives are required for pipe cleaning, then all water 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 – in the event of uncertainty, a water quality specialist or aquatic ecologist should be consulted; o Discharges from the pipeline during routine flushing should be attenuated and sediment or other material filtered out upstream of any watercourse – slow passage of attenuated water through a length of gravel filter at least 5m in length x 1m wide or over a densely vegetated filter strip (e.g. long lawn grass) at least 10m in length x 2m in width would be recommended as guidelines; o 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 deemed necessary.

MS6 - Operation and maintenance of a fuel farm partially within the regulated area of a wetland.

Description of activity	A fuel farm is proposed within the 500m regulated proximity from the onsite seep wetland.
Actions	Development and operation of fuel farm within the 500m regulated proximity from the onsite seep wetland. All fuel will be received by road tankers. Plane refuelling will take place by means of bowser only. Plane refuelling will take place mostly outside the 500m regulated proximity from a watercourse. A fuel line from the fuel farm to the aprons has been included in the scope for future use.
Impacts of actions	Mismanagement of the fuel farm and refuelling activities could result in fuel leaks and spills which could ultimately result in water quality impacts within downstream watercourses. Leaks from fuel line.
Severity of impacts	Low
Measures to mitigate the severity of the impacts	• Implement a monitoring programme to detect and prevent the pollution of soils, surface water and groundwater. • Implement the wetland monitoring programme outlined within the FEN Draft Wetland Offset Study and Implementation Plan (January 2025). • Jet fuel and other potential hazardous chemicals must be stored in a manner that reduces the potential for spills. • All storage and refuelling infrastructure must be regularly maintained according to best practise guidelines. • All storage and refuelling infrastructure must be regularly monitored for leaks or potential damage. • All leaks and damage to infrastructure must be repaired timeously. • All refuelling activities must take place on dedicated bunded surfaces with a drip tray underneath the bowser coupling. • All fuel tanks must be located within bunded structures with the bunds capable of holding 110% of the volume of the fuel tank. • An oil-water separator must be installed within all bunded storage/containment areas. • The absorbent materials necessary for addressing spills must be readily available onsite at all times with staff suitably trained in use. • 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.

MS7 - Development and maintenance (sediment removal) of stormwater infrastructure within the regulated area of a wetland.

Description of activity	**The development of stormwater infrastructure, along with regular maintenance and sediment removal. Sediment removal is essential to prevent sediment buildup over time, which would otherwise reduce the storage capacity of stormwater ponds. The removal of sediment would likely necessitate the operation of an excavator (or similar machinery) within and alongside the stormwater ponds.**
Actions	Several dry attention ponds, a wet detention ponds and a series of swales will be developed within the regulated area of a wetland. These will need to be maintained (e.g. removal of sediment) for the duration of the operational phase. Please refer to Section 7.8 for more detail on maintenance activities that will be required. For maintenance purposes the following general sequence of actions are required: • Access stormwater pond with heavy vehicle and remove silt, • Place silt temporarily on area adjacent to stormwater pond, • Remove silt to area suitable for placement, • Rehabilitate the area adjacent to the stormwater pond from where heavy vehicles accessed the stormwater pond or where silt was placed.
Impacts of actions	Potential impacts associated with sediment removal: 1. Sedimentation of stormwater. 2. Maintenance activities within or in close proximity to stormwater ponds can cause water quality impairment through operation of heavy vehicles (e.g. as result of fuel spills or leakage). 3. Faunal mortality and floral damage due to the use of large machinery.
Severity of impacts	Low
Measures to mitigate the severity of the impacts	• 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 • 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.

	• 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 • 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 • 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. • Maintenance activities should be undertaken 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. • Sediment removed must be suitably disposed such that is does not pose a risk to any 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 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.

MS8 - Removal of alien invasive vegetation within the 500m regulated area of a wetland.

Description of activity	**Removal of alien invasive vegetation within the 500m regulated area of a wetland.**
Actions	Removal of alien invasive vegetation within the 500m regulated area of a wetland: 1. Identify alien invasive species, 2. Cutting or pulling of target plants, 3. Treatment of plant remainders with appropriate herbicide or treatment of herbaceous plants that cannot be manually removed, 4. Removal of plant material from watercourses and surrounding conservation areas, 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	• Localized habitat disturbance • Soil compaction • Increase erosion potential • Potential increase in sedimentation of watercourses located downslope
Severity of impacts	Low
Measures to mitigate the severity of the impacts	• 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 according to the methods and herbicides/biological control guidelines on the Working for Water website: http://www.dwaf.gov.za/wfw/. • 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. • 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.

	• Remove all cleared material from sensitive areas such as watercourses or areas of terrestrial biodiversity importance. No cleared material may be stockpiled within 32m from sensitive areas. All cleared material must either be removed from the site or responsibly utilized onsite.

7. Stormwater Management Plan

7.1. Contextual Information

Effective stormwater management plays a crucial role in safeguarding the ecological integrity of both onsite and nearby watercourses. Zutari (Pty) Ltd has been appointed to develop a comprehensive Stormwater Management Plan (SMP) for the proposed CWA.

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 CoCT 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.

A concept SMP, covering steps 1–3, has already been completed (Zutari, Concept Stormwater Management Plan, August 2024). This plan outlines the proposed stormwater management systems and the necessary infrastructure and interventions for the development. Moving forward, the detailed SMP will address hydrological, hydraulic, and pollution-related impacts associated with surface water runoff and ensure compliance with all applicable regulations. The plan also offers specific recommendations for mitigating environmental impacts, such as erosion, and protecting the surrounding ecosystem. Furthermore, it details the phased implementation of stormwater management measures as the project layout is finalized.

The concept SMP has been developed in consultation with the CoCT and the Freshwater Specialist for the project (Zutari, Concept Stormwater Management Plan, August 2024). This plan integrates recommendations pertaining to stormwater from both the freshwater ecologist and the environmental representatives shaping the design of the stormwater system and control measures to align with relevant requirements. As the development progresses, the detailed SMP will incorporate further feedback and input from key stakeholders, including the CoCT and relevant specialists. This collaborative approach ensures that the final plan will address all necessary considerations and align with best practices for stormwater management, environmental protection, and regulatory compliance.

A policy for the management of urban stormwater impacts has been prepared by the City of Cape Town's Catchment, Stormwater and River Management Branch to address urban stormwater impacts and ensure that new developments incorporate Water Sensitive Urban Design elements. This policy is incorporated into stormwater management planning for the proposed development.

In addition to the above-mentioned considerations, avifaunal risks linked to the establishment of a freshwater body such as a stormwater pond has been identified and must be avoided as far as possible to prevent bird strikes. The majority of the proposed stormwater ponds have therefore been designed as dry attenuation ponds to avoid attracting birds. Input from a bird strike specialist has been included in the stormwater management planning.

7.2. Concept Stormwater Management Plan Design

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 (converted quarry), positioned at strategic locations along the proposed Cape Winelands Airport development site boundary (Figure 18).

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 from 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.

7.3. Dry attenuation ponds

The proposed stormwater management plan for CWA will involve directing all stormwater into seven dry attenuation ponds and one wet detention pond, strategically placed throughout the development (Figure 18). The dry attenuation ponds are designed to manage post-development stormwater runoff, capable of attenuating up to a 1:50-year storm event. The treatment process within the dry attenuation ponds will primarily occur through the infiltration layers of the ponds, utilizing sedimentation, filtration, and plant nutrient uptake to reduce waterborne pollutants. Typical details of the dry attenuation pond engineered layer works can be seen below in Figure 19.

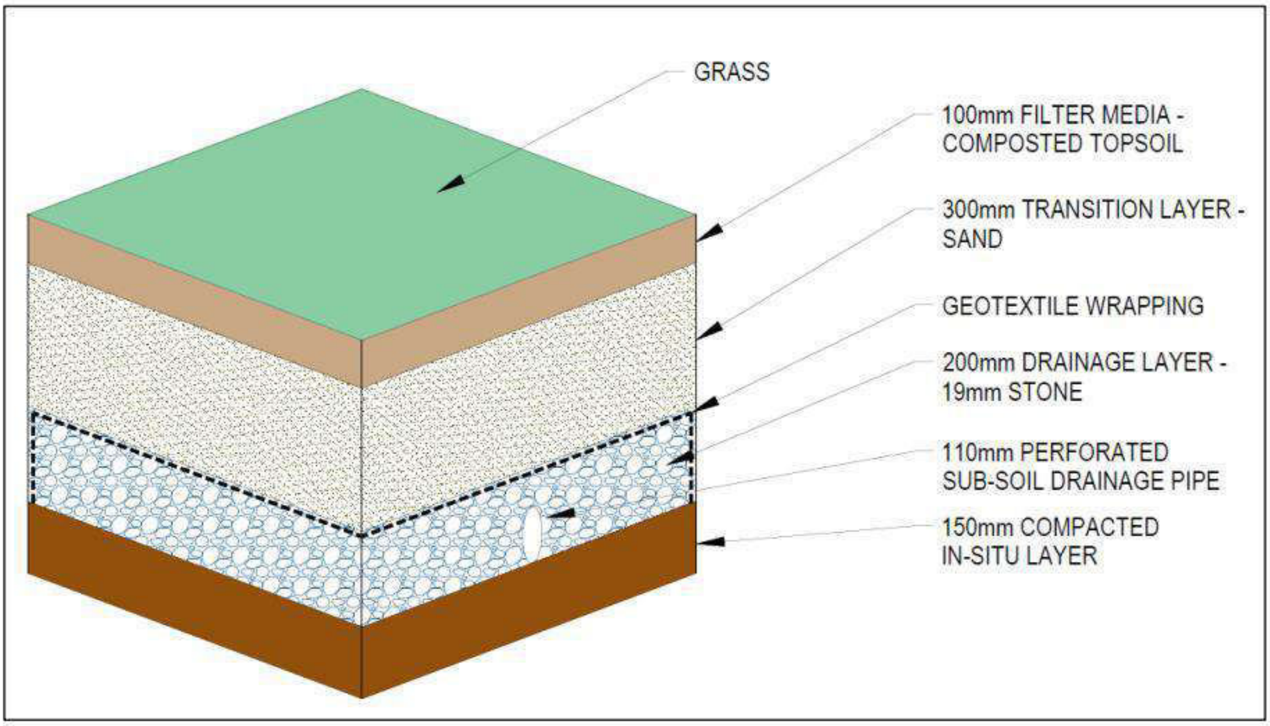


Figure 19: Typical Dry Attenuation Pond Engineered Layerworks (Zutari, Concept Stormwater Management Plan, August 2024).

7.4. Dry swales

Runoff from the CWA runway and taxiways will be directed overland to landscaped areas. As seen in Figure 18, selected landscaped areas will consist of landscaped swales which then drain towards localised detention ponds and wetland areas.

The dry 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.

Typically, the swale is underlain by a formalised piped drainage network which usually conveys stormwater from within the development to a swale outfall.

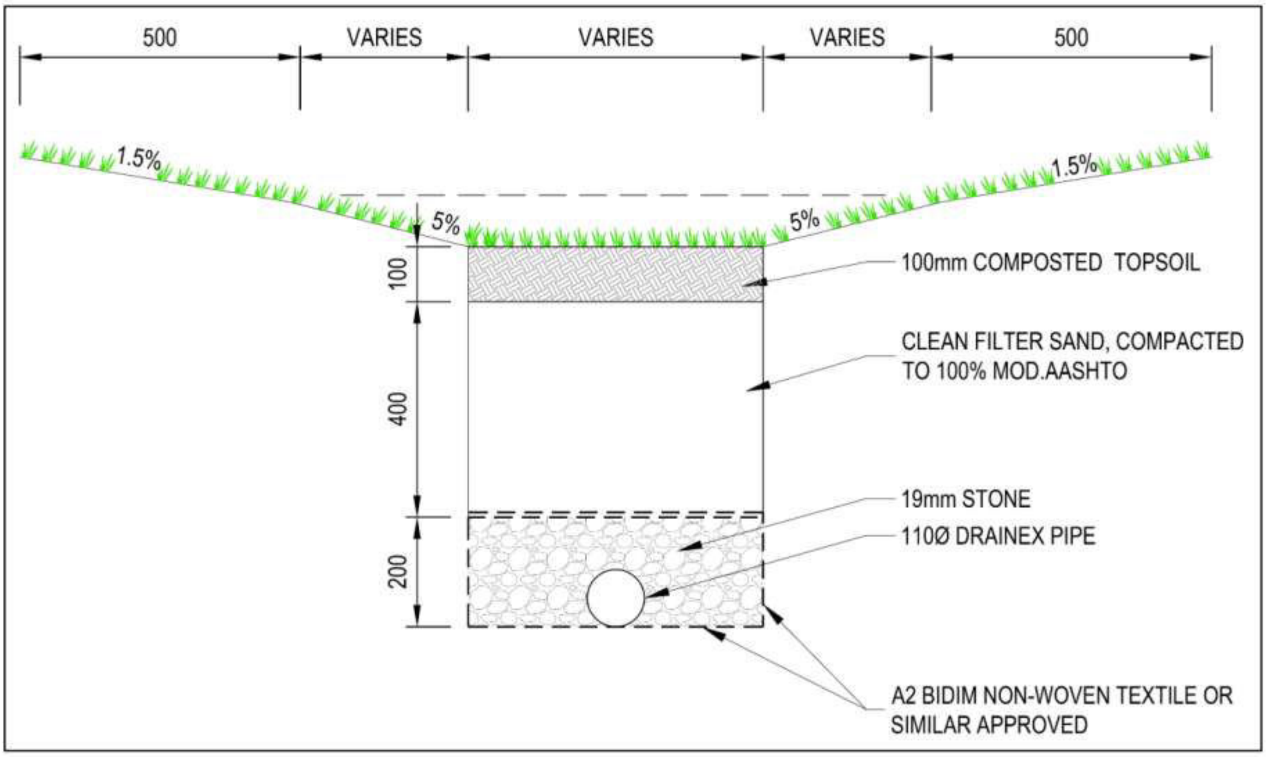


Figure 20: Typical Cross-Section of Dry Swale (Zutari, Concept Stormwater Management Plan, August 2024).

7.5. 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) which is the previous quarry site. 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. The conceptual design of the proposed wet detention pond can be seen in Figure 21.

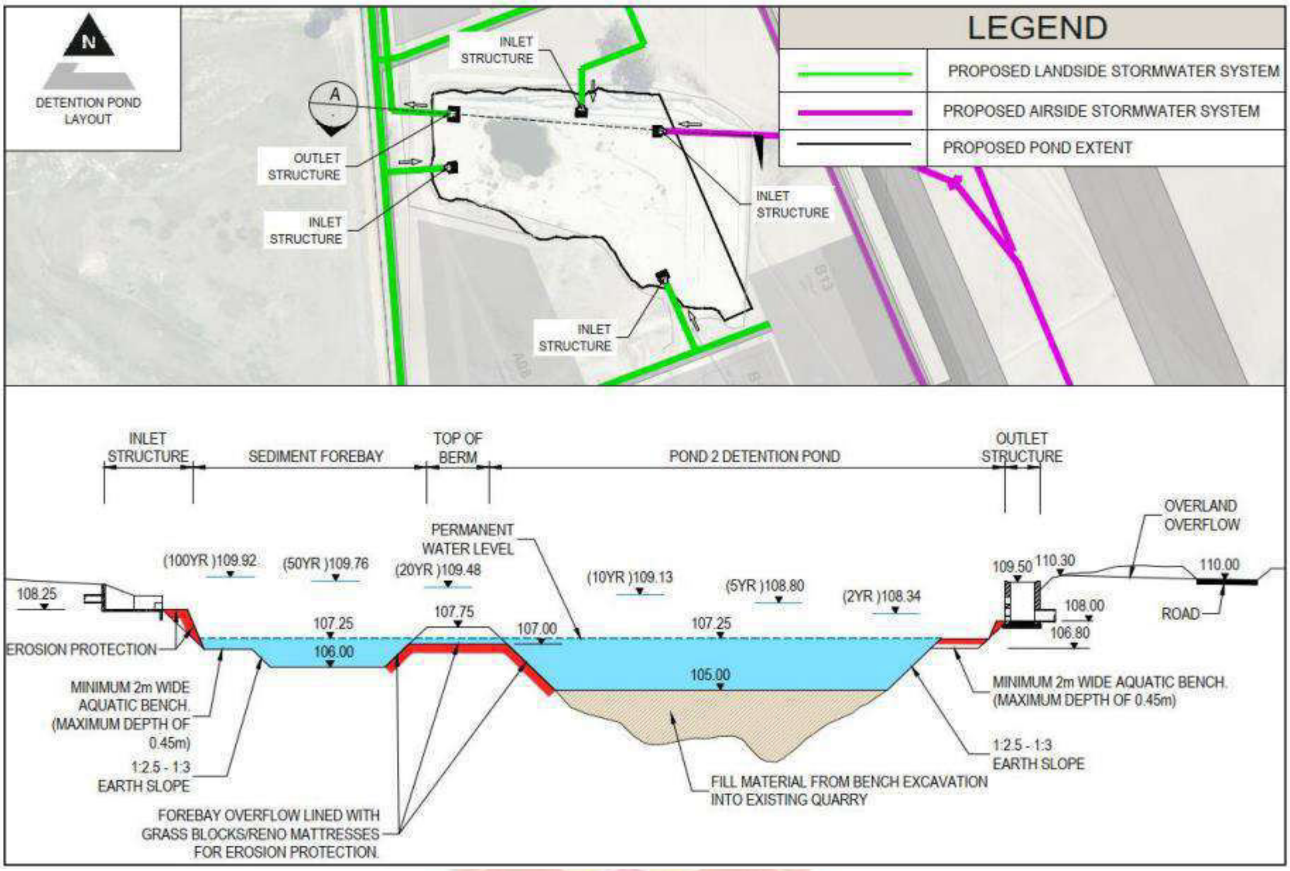


Figure 21: Typical Cross section of the Wet Detention Pond (Zutari, Concept Stormwater Management Plan, August 2024).

7.6. Storm Event Management

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 in Figure 22.

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 as can be seen detailed in Table 4.

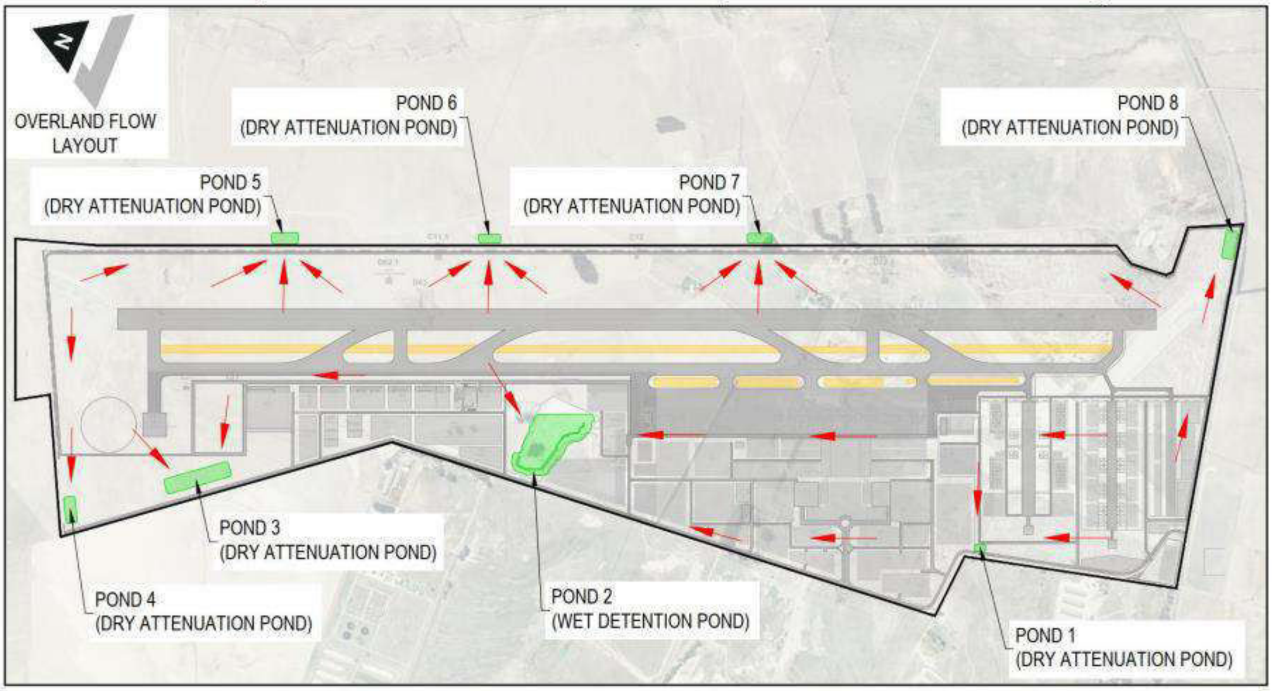


Figure 22: Overland Escape Routes (Zutari, Concept Stormwater Management Plan, August 2024) (Please note that this map is for illustration purposes only and does not convey the relative size of the stormwater ponds).

Table 4: Overland Escape Routes (Zutari, Concept Stormwater Management Plan, August 2024).

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 Rive
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

7.7. Flood Risk

A comprehensive hydraulic analysis using HEC-RAS modelling was conducted to assess the potential flood risks associated with the proposed Cape Winelands Airport development (Zutari, Flood Risk Assessment, June 2024). The study focused on the impact of a 1:100-year flood scenario after development and its effects on the surrounding environment, particularly downstream areas. The model covered key watercourses, including the Mosselbank and Klapmuts Rivers (located to the West and East of the proposed development site respectively), as well as smaller tributaries near the planned detention ponds.

The airport site itself, due to its elevated position, is not at risk of flooding from these rivers. However, the development will increase the number of impervious surfaces (such as runways and buildings), altering the natural flow of stormwater. To mitigate potential downstream flood risks, eight detention ponds are proposed. These ponds are designed to manage runoff, ensuring that the flood peaks after development are no greater than pre-development levels, even during significant storm events like the 1:100-year flood. In fact, in many cases, the flood peaks post-development is expected to be lower than before, thanks to the carefully designed stormwater management system (Zutari, Flood Risk Assessment, June 2024).

7.8. Operations and Maintenance

7.8.1. Dry Attenuation Ponds Maintenance

Typical periodic maintenance activities that will be required for the dry attenuation ponds are outlined in Table 5 below:

Table 5: Typical Operating and Maintenance activities for Dry Attenuation Ponds (Zutari, Concept Stormwater Management Plan, August 2024).

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

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

7.8.2. Dry Swale Maintenance

Typical periodic maintenance activities that will be required for the dry swales are outlined in Table 6 below:

Table 6: Typical Operating and Maintenance activities for Dry Swales (Zutari, Concept Stormwater Management Plan, August 2024).

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

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.

7.8.3. Wet Pond / Detention Basin Maintenance

Typical periodic maintenance activities that will be required for the wet attenuation pond are outlined in Table 7 below:

Table 7: Typical Operating and Maintenance activities for Detention Basins (Zutari, Concept Stormwater Management Plan, August 2024).

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

In addition to the items listed above, additional 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.

7.9. Addressing Avifauna Concerns in Stormwater Pond Design and Mitigation Measures (Zutari, Engineering Services Report, February 2025).

To address potential attraction of avifauna to the proposed stormwater ponds, all ponds, except for Pond 2 (the rehabilitated quarry which currently has a permanent water body), have been designed as dry attenuation ponds. In line with the CoCT stormwater management policy, all dry ponds are designed to provide 24-hour extended detention for the 1-year storm recurrence interval, ensuring a water retention time of no more than 24 hours. For Pond 2, excess stormwater above the permanent water level will be retained for a duration of 36 to 48 hours before receding to the permanent water level.

The dry ponds are not expected to pose a significant concern for attracting birds. For Pond 2, which currently already is a permanent water body, various mitigation measures will be investigated during the detailed design phase. The most likely approach will involve covering the exposed water surface area. In conjunction with the landscape architect additional measures will be investigated which include maintaining consistency in planting vegetation on either side of the ponds to discourage bird movement between ponds which will also be considered during detailed design (Zutari, Engineering Services Report, February 2025).

Overall, the short retention times for uncovered ponds (less than 48 hours) should effectively mitigate the risk of attracting wild birds and posing a risk to poultry biosecurity. Moreover, close monitoring as part of the proposed Bird and Wildlife Hazard Management Programme, in collaboration with the avian specialists, will provide ongoing mitigation and ensure compliance with safety and environmental requirements (Zutari, Engineering Services Report, February 2025).

8. Rehabilitation Plan

In alignment with best practice methods, a hierarchical approach has been followed for managing water resource impacts. Preventative management measures have been outlined to avoid and reduce impacts wherever possible. Where impacts do occur steps will be taken to improve the impacted system through rehabilitation. Lastly, where impacts cannot be suitably mitigated, offsets will be implemented to compensate for residual losses experienced.

Rehabilitation actions that may be required as a result of impacts during the construction and operational phase of the development are outlined in Section 11 of this report. In general, the following 'good housekeeping' measures should be implemented (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025):

- 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.

Preliminary Method Statements have been developed for construction activities related to S21 (c) and (i) water use activities with the aim of minimising impacts and remediating impacts where they do occur (Refer to Section 6 of this report). An EMPr has also been developed and includes rehabilitation measures to be implemented within the construction as well as the operational phase of the development as applicable.

8.1. Wetland Offset

The proposed development activities will result in the infill and transformation of a portion of Seep Wetland 1 located partially within the development area (Figure 17). The proposed primary runway coincides with this delineated seep wetland. The mitigation hierarchy was implemented in full in an effort to avoid this impact, however no reasonable or feasible alternative is available for the runway layout and alignment. Wetland offsets will be required to compensate for the residual loss from this system.

FEN Consulting has been appointed to undertake a freshwater offset investigation to assess suitable offset sites. During the offset investigation it was determined that the proposed development activities will result in a direct loss of approximately 6.74ha of wetland habitat. When accounting for indirect impacts, the total loss extends to 7.44ha (Figure 17). 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 (FEN Draft Wetland Offset Study and Implementation Plan, January 2025).

Through consultation with various stakeholders including the City of Cape Town, Cape Nature, the DEA&DP and the DWS it was determined that onsite offset would be most beneficial in the current context. The remainder of Seep Wetland 1 (3.68ha) in the eastern part of the study area along with a portion of Channelled Valley Bottom (CVB) Wetland 1 (36.2ha) located further East of the study area into which Seep Wetland 1 drains (via an agricultural drain), have been identified as suitable for rehabilitation and offset purposes (Figure 17). 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 (FEN Draft Wetland Offset Study and Implementation Plan, January 2025).

The key reasons of the decision to pursue the remainder of Seep Wetland 1 and CVB Wetland 1 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;
- Offsetting approximately 40ha of wetland area to compensate for the loss of 6.74ha of seep wetland is considered a meaningful conservation and restoration effort which will create awareness with the public and private sectors regarding the importance of wetland conservation; and
- The financial contribution to offset approximately 40ha of wetland area will not amount to wasteful expenditure as the CWA will manage the wetlands in perpetuity (at least for 30 years).

Furthermore, 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 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.

The offset strategy has been designed to compensate for the residual loss of wetland habitat, ensuring no net loss of wetland functionality. The selected wetland offset site encompasses approximately 40ha which is available for offset purposes (Figure 17). 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. Currently classified as category D (seep wetland) and category E (CVB wetland), these areas offer significant opportunities for improvement, reinforcing their selection for the project.

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 report will present a summary of the proposed rehabilitation actions and monitoring requirements. Comprehensive details on each phase of the rehabilitation process are provided in the FEN Draft Wetland Offset Study and Implementation Plan, dated January 2025.

The freshwater specialist recommends extensive rehabilitation work within the CVB wetland, 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 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.

Table 8 below outlines the rehabilitation requirements in a summarised format, more detailed information is provided in the FEN, Wetland Offset Study and Implementation Plan (January 2025). 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.

Table 8: Specific mitigation measures related to the freshwater ecosystems of the target offset areas to be implemented during the rehabilitation of the wetlands (FEN, Draft Wetland Offset Study, January 2025).

<table>
<tr><th colspan="5">Specific Mitigation Measures for the target offset areas</th></tr>
<tr><th colspan="5">Rehabilitation Phase</th></tr>
<tr><th colspan="5">Responsible Persons</th></tr>
<tr><th>Proponent</th><th>Project Manager</th><th>Civil Engineer</th><th>ECO</th><th>Contractor</th></tr>
<tr><th>Objective/ Requirement</th><th colspan="4">Control measures</th></tr>
<tr><td rowspan="6">Rehabilitation of impacted areas within the wetland target offset area proposed for conservation / rehabilitation.</td><td colspan="4">AIP clearing</td></tr>
<tr><td colspan="4">• 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:
○ 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
○ 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.</td></tr>
<tr><td colspan="4">Remediation of gully and headcut erosion (particularly within the CVB wetland and agricultural drain)</td></tr>
<tr><td colspan="4">• 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:
○ 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.</td></tr>
<tr><td colspan="4">Rehabilitation of natural flow patterns within the wetlands, agricultural drain and its immediate catchment</td></tr>
<tr><td colspan="4">• 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.</td></tr>
</table>

	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.

Effective monitoring of the rehabilitated wetland areas is crucial to ensure rehabilitation success. 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 the Freshwater offset 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.
- A fixed-point monitoring method should be implemented to ensure repeatability of assessments for better comparison.

Table 9 outlines the monitoring actions linked to the wetland rehabilitation plan. This monitoring program must be conducted by a qualified professional, with the findings submitted to the responsible authority for review and assessment.

Table 9: 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) (FEN, Draft Wetland Offset Study, January 2025)

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. ➢ Timetables created.
	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.				
	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.

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).	➢Baseline report compiled.
	71.	Re-record AIP densities after the initial clearing, including all methods and chemicals used.		➢After initial AIP clearing.	➢Log locations of any newly coppiced species to be treated/removed.	➢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.

<u>This monitoring plan must be implemented by a competent person who must also submit the findings to the responsible authority for evaluation.</u>

8.1.1. DWS Risk Assessment – Wetland Offset

DWS specified RAM (as promulgated in GN 4167 of 2023 as it relates to the NWA) was applied to ascertain the significance of risk associated with the rehabilitation work associated with the proposed CWA development offset.

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.

The results of the RAM are presented in Table 10 below. Please note that the impacts and mitigation measures outlined are only of relevance to the freshwater ecosystems identified for rehabilitation actions. A single set of mitigation measures has been identified for activities 1-7 as detailed in Table 10.

Table 10: Summary of the Risk Assessment outcomes for the rehabilitation work associated with the proposed CWA development offset (FEN, Draft Wetland Offset Study, January 2025)

	Activity	Impact	Freshwater Ecosystem	Mitigation Measures	Significance	Risk
Construction Phase						
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 (PES – E)	**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** ➢ Future 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	**21,6**	**L**
			Seep Wetland (PES – D)		**16**	**L**

	Activity	Impact	Freshwater Ecosystem	Mitigation Measures	Significance	Risk
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 (PES – E)	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 2m 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;	**19,8**	**L**
			Seep Wetland (PES – D)		**14,4**	**L**
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	Channelled Valley Bottom Wetland (PES – E)		**26,4**	**L**

<table>
<tr><th></th><th>Activity</th><th>Impact</th><th>Freshwater Ecosystem</th><th>Mitigation Measures</th><th>Significance</th><th>Risk</th></tr>
<tr><td></td><td></td><td>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.</td><td>Seep Wetland (PES – D)</td><td rowspan="6">➢ 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;</td><td>15,6</td><td>L</td></tr>
<tr><td rowspan="2">4</td><td rowspan="2">Rehabilitation of the CVB wetland and seep wetland</td><td rowspan="2">- Soil compaction within the wetlands;
- Potential sedimentation of the wetlands due to activities within the wetlands</td><td>Channelled Valley Bottom Wetland (PES – E)</td><td>18</td><td>L</td></tr>
<tr><td>Seep Wetland (PES – D)</td><td>12</td><td>L</td></tr>
<tr><td colspan="4">Operational Phase</td><td colspan="2"></td></tr>
<tr><td rowspan="2">5</td><td rowspan="2">Functioning of the rehabilitated wetlands</td><td rowspan="2">No perceived negative impacts</td><td>Channelled Valley Bottom Wetland (PES – E)</td><td>-33</td><td>+</td></tr>
<tr><td>Seep Wetland (PES – D)</td><td>-22</td><td>+</td></tr>
</table>

	Activity	Impact	Freshwater Ecosystem	Mitigation Measures	Significance	Risk
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	➢ 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);	**9,6**	**L**
7	Functioning of the rehabilitated wetlands post-alien and invasive vegetation removal	No perceived negative impacts	All ecosystems		**-21**	**+**

	Activity	Impact	Freshwater Ecosystem	Mitigation Measures	Significance	Risk
				➢ 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 20m downstream for any works for a length of 100m; ➢ 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: o 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; o 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; o 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; o 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.		

9. Water Uses applied for

The application includes the following water uses as detailed in Table 11.

Table 11: Water Uses Applied for

Water use(s) activities	Purpose	Capacity/ Volume (m^3, tonnes and/or m^3/annum)/ dimension (Area (ha) Length/depth, (m)),	Property Description	Co-ordinates
Section 21(a)				
Abstraction of water from CWA_BH001.	For treatment and use as a potable source	31 536m^3/ annum	RE of Farm 724, Joostenberg Vlakte, Paarl	33°45'52.27"S 18°43'57.76"E
Abstraction of water from CWA_BH002	For treatment and use as a potable source	78 840m^3/annum	P10 of Farm 724, Joostenberg Vlakte, Paarl	33°46'7.54"S 18°43'55.44"E
Abstraction of water from CWA_BH003	For treatment and use as a potable source	53 295m^3/annum	P4 of Farm 474, Joostenbergs Kloof, Paarl	33°46'26.53"S 18°44'51.87"E
Section 21(b)				
Pond 1 - Short-term storage of stormwater within dry attenuation pond.	Stormwater Management	10 800 m^3	P10 of Farm 724, Joostenberg Vlakte, Paarl	33°46'15.72"S 18°44'4.14"E
Pond 2 - Storage of stormwater within the converted quarry (wet detention pond)	Stormwater Management	95 000 m^3	P23 of Farm 724, Joostenberg Vlakte, Paarl	33°45'20.73"S 18°43'55.09"E
Pond 3 - Short-term storage of stormwater within dry attenuation pond.	Stormwater Management	9 600 m^3	P7 of Farm 942, Kliprug, Malmsbury	33°44'44.68"S 18°43'31.35"E
Pond 4 - Short-term storage of stormwater within dry attenuation pond.	Stormwater Management	2 100 m^3	P7 of Farm 942, Kliprug, Malmsbury	33°44'32.02"S 18°43'19.74"E
Pond 5 - Short-term storage of stormwater within dry attenuation pond.	Stormwater Management	10 800 m^3	P7 of Farm 942, Kliprug, Malmsbury	33°44'43.04"S 18°44'9.40"E
Pond 6 - Short-term storage of stormwater within dry attenuation pond.	Stormwater Management	350 m^3	P4 of Farm 474, Joostenbergs Kloof, Paarl	33°45'11.35"S 18°44'20.12"E
Pond 7 - Short-term storage of stormwater within dry attenuation pond.	Stormwater Management	1 550 m^3	RE of Farm 474, Joostenbergs Kloof, Paarl	33°45'36.11"S 18°44'30.77"E

Water use(s) activities	Purpose	Capacity/ Volume (m^3, tonnes and/or m^3/annum)/ dimension (Area (ha) Length/depth, (m)),	Property Description	Co-ordinates
Pond 8 – Short-term storage of stormwater within dry attenuation pond.	Stormwater Management	4 200 m^3	P4 of Farm 474, Joostenbergs Kloof, Paarl	33°46'26.25"S 18°44'56.06"E
Section 21 (c & i)				
Seep Wetland 1 - Development of airside and landside infrastructure related to the SDP (Figure 4 & Figure 5) within 500m from delineated freshwater systems & wetland rehabilitation as outlined in the FEN Wetland Offset Study	Airport Development & Operation	As per SDP Phase 1 and 2	RE of Farm 474, Joostenbergs Kloof, Paarl	33°45'6.34"S 18°44'16.11"E
Seep Wetland 2 - Development of airside and landside infrastructure related to the SDP (Figure 4 & Figure 5) within 500m from delineated freshwater systems.	Airport Development & Operation	As per SDP Phase 1 and 2	RE of Farm 474, Joostenbergs Kloof, Paarl	33°45'19.81"S 18°44'47.96"E
CVB Wetland 1 - Development of airside and landside infrastructure related to the SDP (Figure 4 & Figure 5) within 500m from delineated freshwater systems & wetland rehabilitation as outlined in the FEN Wetland Offset Study	Airport Development & Operation	As per SDP Phase 1 and 2	P7 of Farm 942, Kliprug, Malmsbury; RE of Farm 474, Joostenbergs Kloof, Paarl; P3 of Farm 474, Joostenbergs Kloof, Paarl;	33°44'41.64"S 18°44'29.72"E
CVB Wetland 2 - Development of airside and landside infrastructure related to the SDP (Figure 4 & Figure 5) within 500m from delineated freshwater systems.	Airport Development & Operation	As per SDP Phase 1 and 2	P7 of Farm 942, Kliprug, Malmsbury	33°44'26.84"S 18°44'17.16"E
CVB Wetland 3 - Development of airside and landside infrastructure related to the SDP (Figure 4 & Figure 5) within 500m from delineated freshwater systems.	Airport Development & Operation	As per SDP Phase 1 and 2	P7 of Farm 942, Kliprug, Malmsbury	33°44'42.15"S 18°44'21.15"E

Water use(s) activities	Purpose	Capacity/ Volume (m^3, tonnes and/or m^3/annum)/ dimension (Area (ha) Length/depth, (m)),	Property Description	Co-ordinates
CVB Wetland 4 - Development of airside and landside infrastructure related to the SDP (Figure 4 & Figure 5) within 500m from delineated freshwater systems.	Airport Development & Operation	As per SDP Phase 1 and 2	P7 of Farm 942, Kliprug, Malmsbury	33°44'27.35"S 18°43'28.37"E
Development of airside and landside infrastructure related to the SDP (Figure 4 & Figure 5) within 500m from agricultural drains. Agricultural drain 3 is also earmarked for rehabilitation as outlined in the FEN Wetland Offset Study.	Airport Development & Operation	As per SDP Phase 1 and 2	P7 of Farm 942, Kliprug, Malmsbury; RE of Farm 474, Joostenbergs Kloof, Paarl	1 33°44'37.31"S 18°43'41.11"E 2 33°44'59.99"S 18°44'17.56"E 3 33°45'5.77"S 18°44'21.72"E 4 33°45'34.48"S 18°44'31.53"E 5 33°45'29.32"S 18°44'53.20"E
Development of airside and landside infrastructure related to the SDP (Figure 4 & Figure 5) within 500m from existing stormwater channel	Airport Development & Operation	As per SDP Phase 1 and 2	RE of Farm 474, Joostenbergs Kloof, Paarl	33°45'34.54"S 18°44'31.33"E
Incoming potable water supply line	Potable water supply	±2.6km	Lichtenberg Road	Start: 33°47'0.39"S 18°42'44.28"E End: 33°46'33.25"S 18°44'15.11"E
Section 21 (d)				
N/A				
Section 21 (e)				
Irrigation with treated effluent from the onsite sewage treatment plant.	Re-use of non-potable water for irrigation of planted and landscaped areas.	±220ha (As per Landscaping Plan)	RE of Farm 724, Joostenberg Vlakte, Paarl	33°45'46.51"S 18°43'59.48"E
Section 21(f)				
N/A				
Section 21(g)				

Water use(s) activities	Purpose	Capacity/ Volume (m^3, tonnes and/or m^3/annum)/ dimension (Area (ha) Length/depth, (m)),	Property Description	Co-ordinates
In the event of an emergency, such as simultaneous malfunctions of both the packaged wastewater treatment plant and the pump station, sewage will be temporarily stored in an emergency overflow pond.	Emergency storage of sewage prior to treatment	1260m^3	P7 of Farm 942, Kliprug, Malmesbury	33°44'53.45"S 18°43'39.46"E
Treated effluent from the WWTW may be temporarily stored onsite prior to re-use (non-potable water).	Storage of treated effluent prior to re-use	3000m^3	P7 of Farm 942, Kliprug, Malmesbury	33°44'48.48"S 18°43'38.01"E
Onsite boreholes will be used as a potable water source. Treatment will produce brine as a waste product. Brine may be stored onsite prior to disposal.	Storage of brine prior to disposal	1136m^2	P7 of Farm 942, Kliprug, Malmesbury	33°44'49.66"S 18°43'34.50"E
Section 21(h)				
N/A				
Section 21(j)				
N/A				

10. Description of the Environment

10.1. Climate

The proposed development site has a Mediterranean Climate with mild wet winters and warm dry summers. Figure 23 shows the monthly average air temperature and Figure 24 shows the monthly median rainfall and evaporation distribution for the Fisantekraal area (GEOSS, WULA Groundwater Impact Assessment, February 2025). 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. The peak groundwater recharge period will thus be in the winter. During the summer months, groundwater assists in meeting the water requirements for the area.

However, climate change is disrupting the current climatic balance within the region. The Western Cape has been experiencing a gradual temperature increase of 0.1°C per decade, leading to more extreme temperature events and fewer cold nights. Projections suggest mean temperatures could rise by 1–1.8°C, reaching 2–2.7°C in inland areas. This will result in increased evapotranspiration, a higher likelihood of droughts, and up to 30 days annually exceeding 30°C (Brundtland, Climate Change Impact Assessment, February 2025).

The rainfall projections for the region show considerable variability, estimating minimal reduction to as much as 20%. In summer, dry periods could extend up to 20 days. The frequency of droughts is also expected to increase, current 1-in-10-year drought events could potentially occur as frequently as once every two years by the end of the century (Brundtland, Climate Change Impact Assessment, February 2025). The current Cape Winelands airport site relies heavily on groundwater, due to minimal municipal water connections being available. Effective groundwater management will be essential to maintain a sustainable water supply amid the challenges posed by climate change (Brundtland, Climate Change Impact Assessment, February 2025).

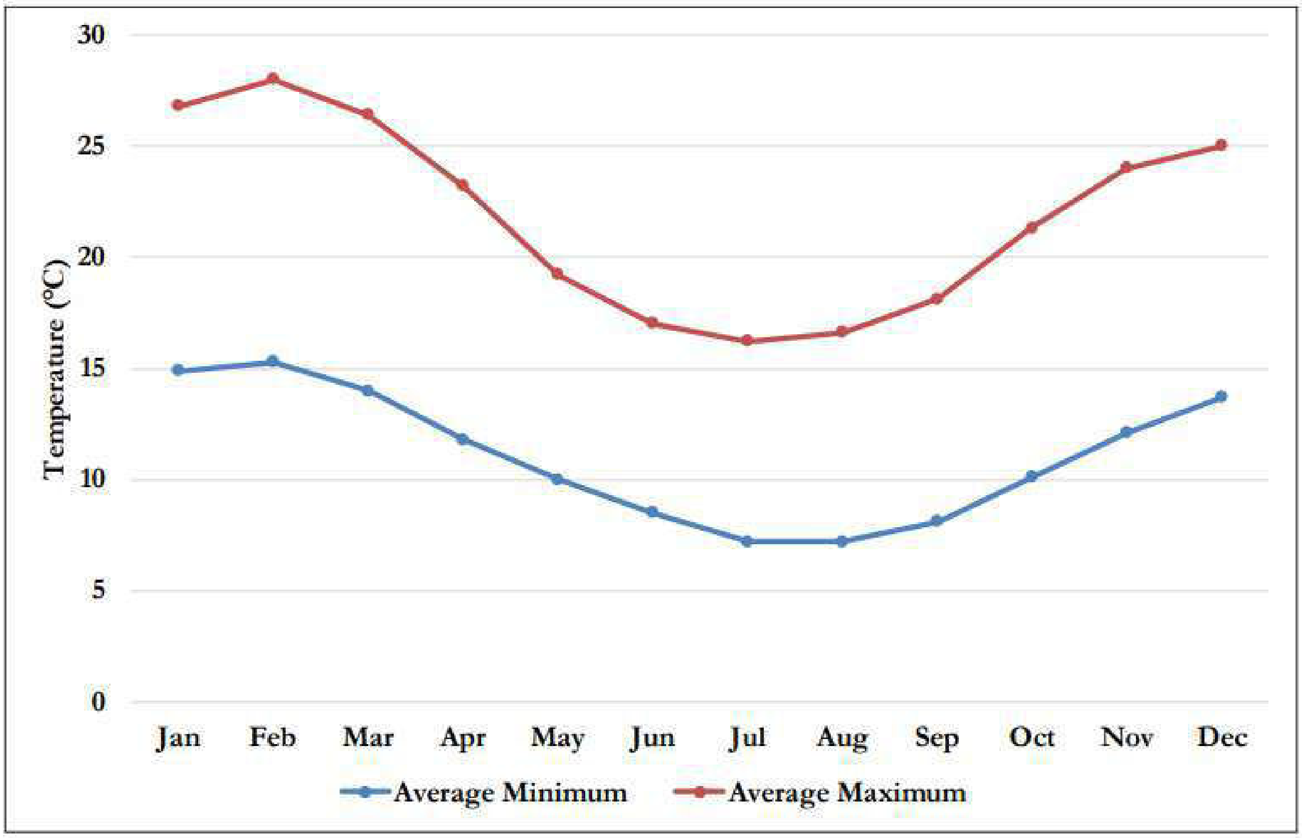


Figure 23: Monthly average air temperature distribution for the Durbanville area (GEOSS, WULA Geohydrological Assessment, February 2025, Appendix B).

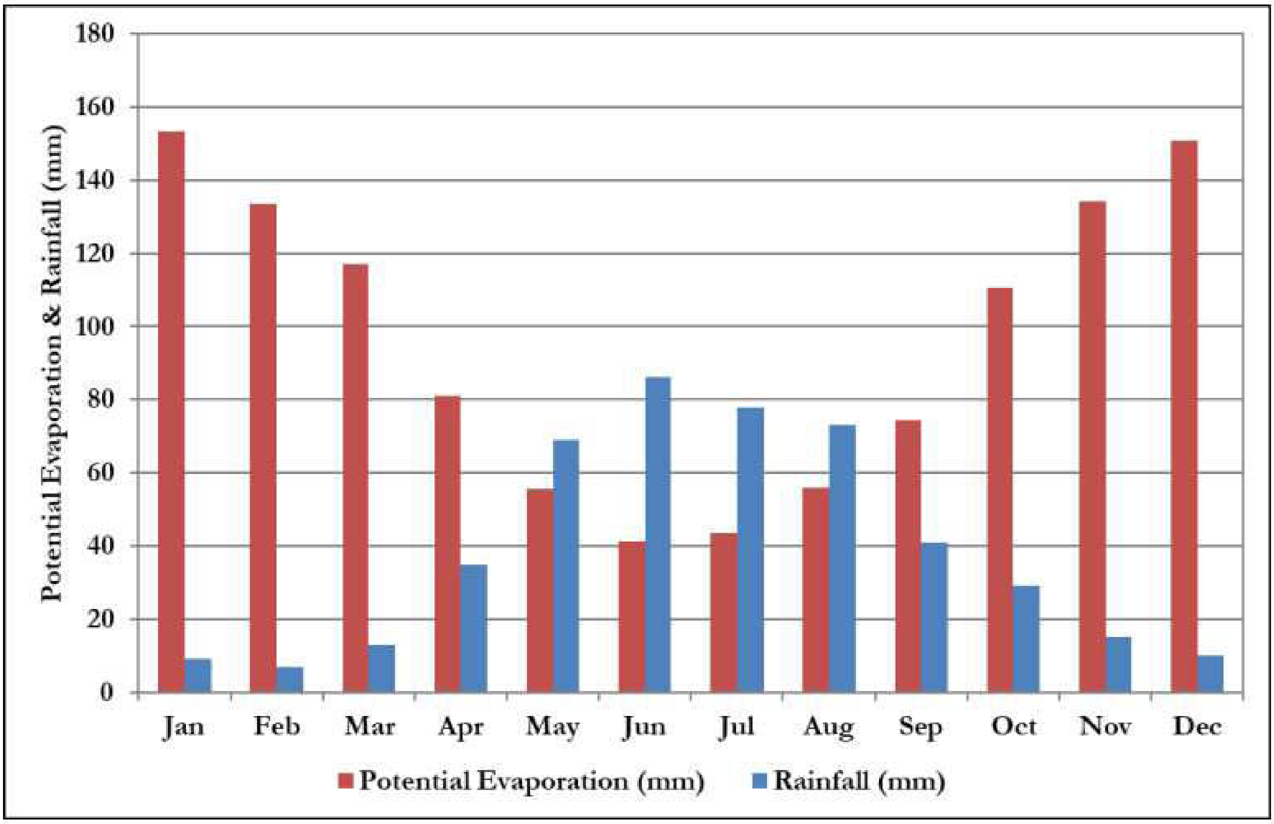


Figure 24: Monthly average rainfall and evaporation distribution for the Durbanville area (Schulze, 2009) (GEOSS, WULA Geohydrological Assessment, February 2025, Appendix B).

10.2. Topography

The topography of the site and surrounds is characterized by typical grass-covered low-relief rolling hills with a typical on-site elevation between 90 - 130m above mean sea level (mamsl). In this region, there is a low drainage density 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 characterized by generally flat terrain with little undulation, while the northern extent of the proposed expansion area is characterised by undulous terrain with rolling hills.

10.3. Surface Water

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 25). 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 Scoping Phase Freshwater Ecological Assessment, February 2024).

Various national and provincial wetland databases were also consulted to identify potential points of interest within the study and investigation area. These included the NFEPA 2011 wetlands database (Figure 26) the National Wetlands Map (Figure 27) and the CoCT 2017 wetland dataset (Figure 28).

Figure 25: Development area (hatched yellow) and cadastrals (red outline) in relation to identified rivers and drainage lines in the area (PHS Consulting, CapeFarmMapper, Oct 2023).

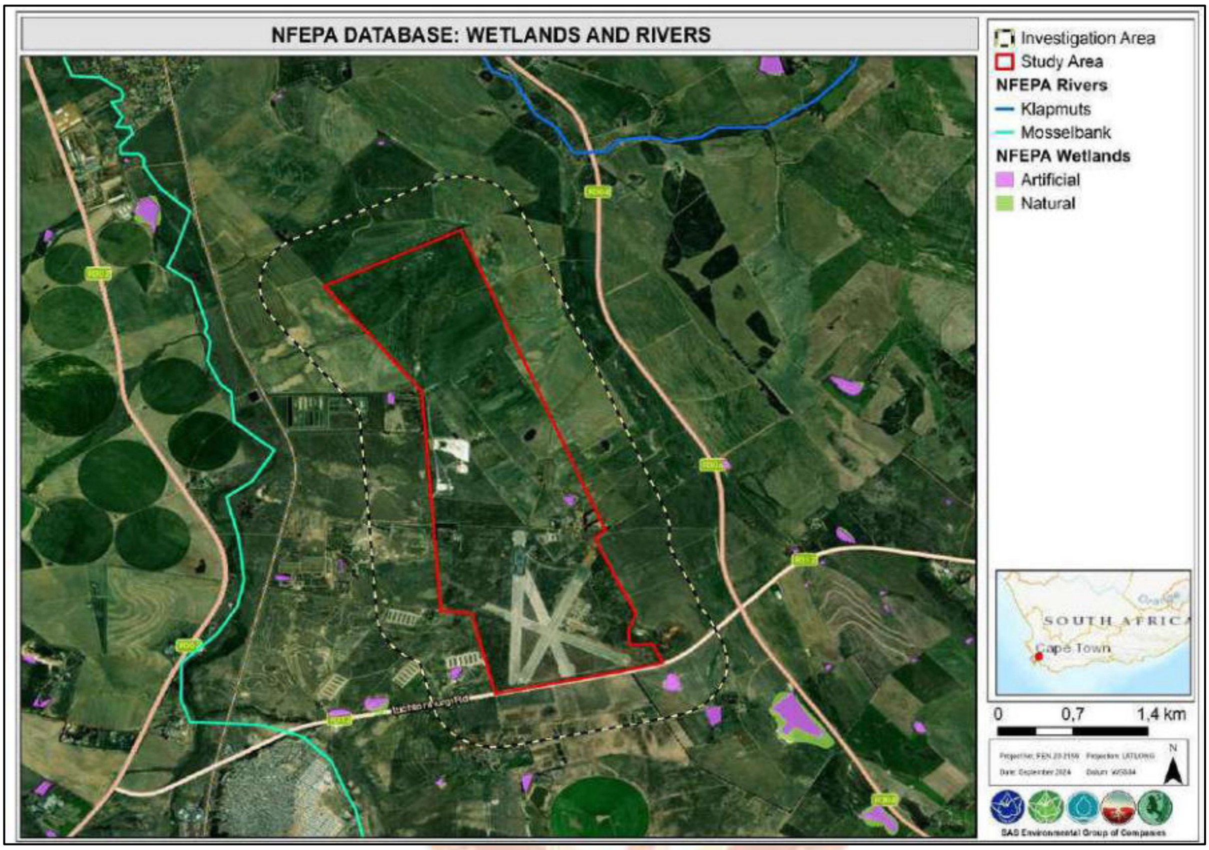


Figure 26: <u>**Rivers and natural and artificial wetlands associated with the study and investigation areas, according to the NFEPA database (2011) (FEN, Detailed EIA Phase Freshwater Ecological Assessment February 2025).**</u>

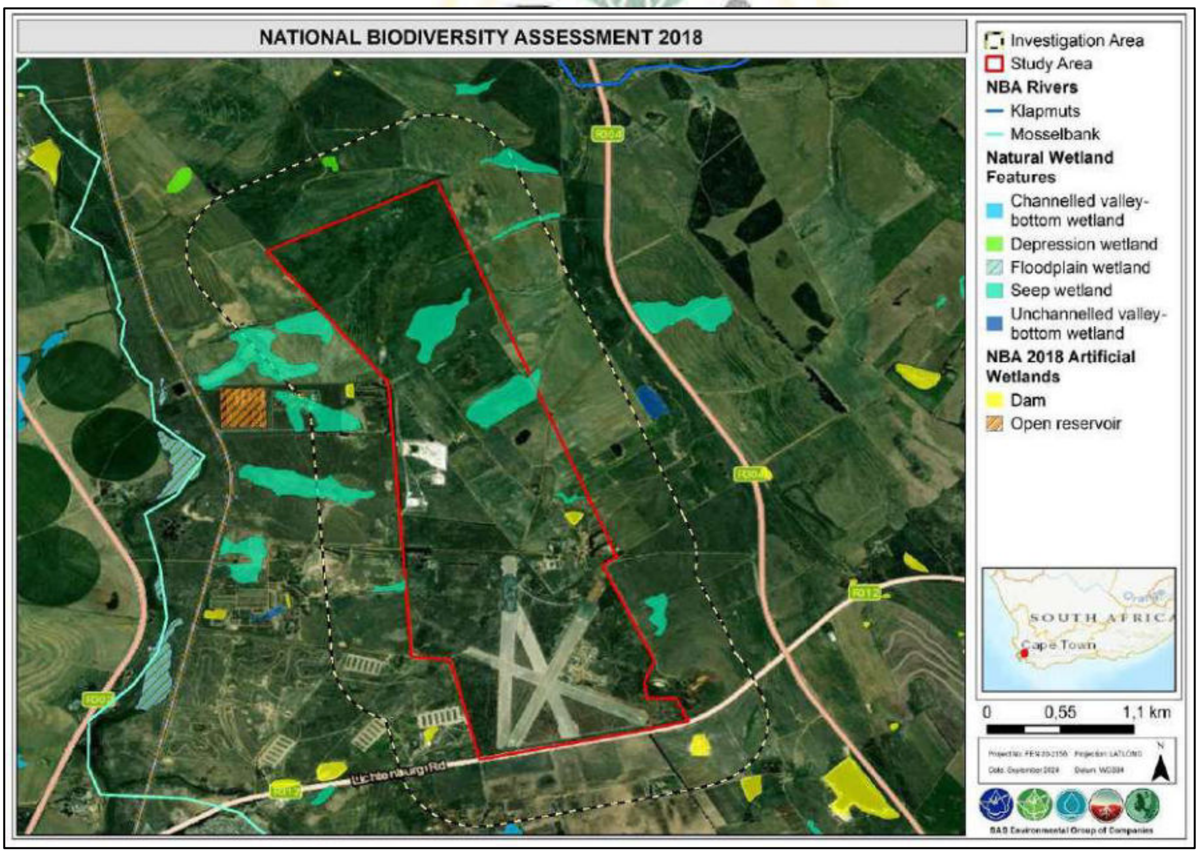


Figure 27: <u>**Wetlands and rivers associated with the study and investigation areas according to the National Biodiversity Assessment database (2018) (FEN, Detailed EIA Phase Freshwater Ecological Assessment February 2025).**</u>

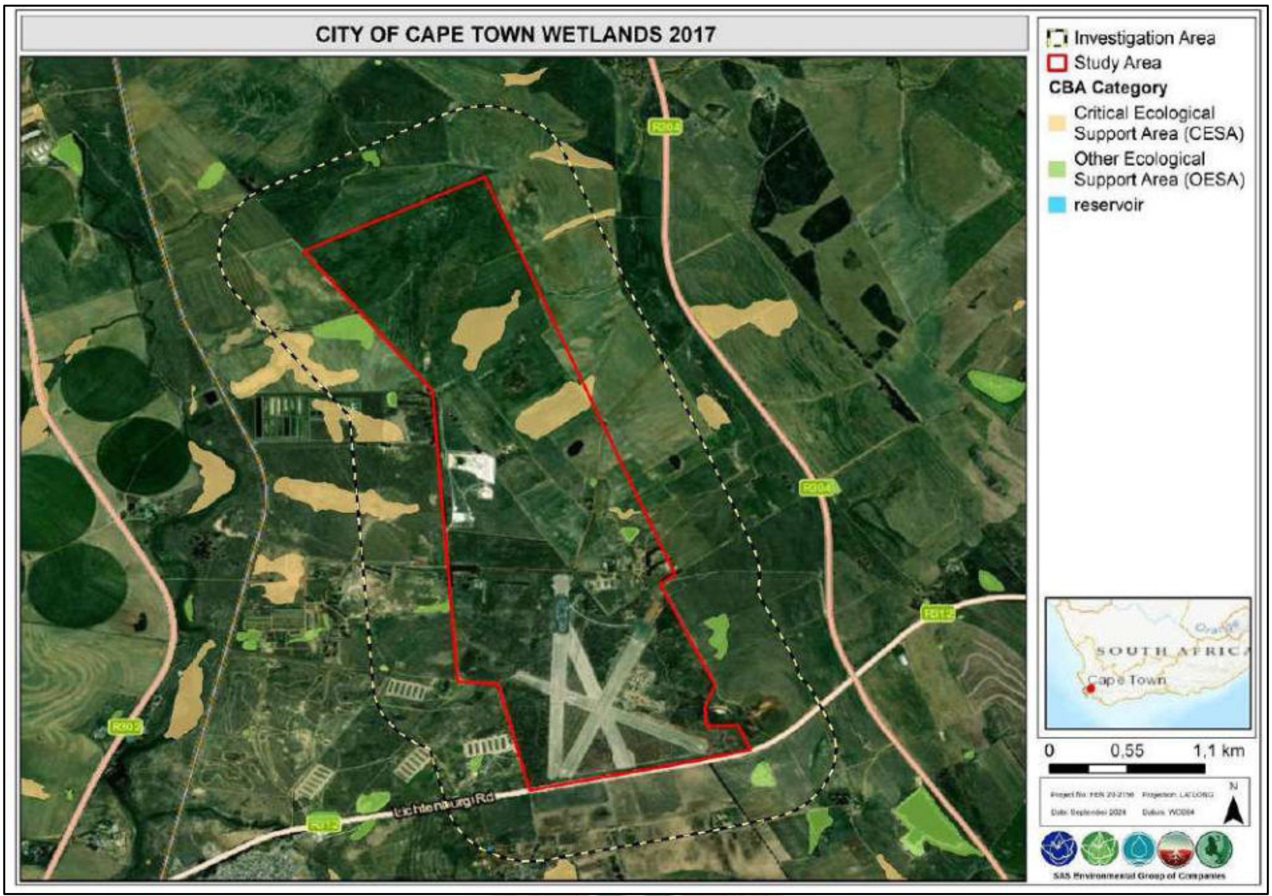


Figure 28: **<u>Wetlands identified by the City of Cape Town Wetlands Dataset (2017) to be associated with the study and investigation areas (FEN, Detailed EIA Phase Freshwater Ecological Assessment February 2025).</u>**

Field verification confirmed the presence of a single seep wetland (Seep 1) within the central portion of the proposed development area (Figure 29) (FEN, Detailed Scoping Phase Freshwater Ecological Assessment, February 2024). 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 study and investigation areas (Figure 29). In addition to the onsite wetland, the following natural freshwater features were identified within 500m from the proposed development site (investigation area) (Figure 29):

- 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.

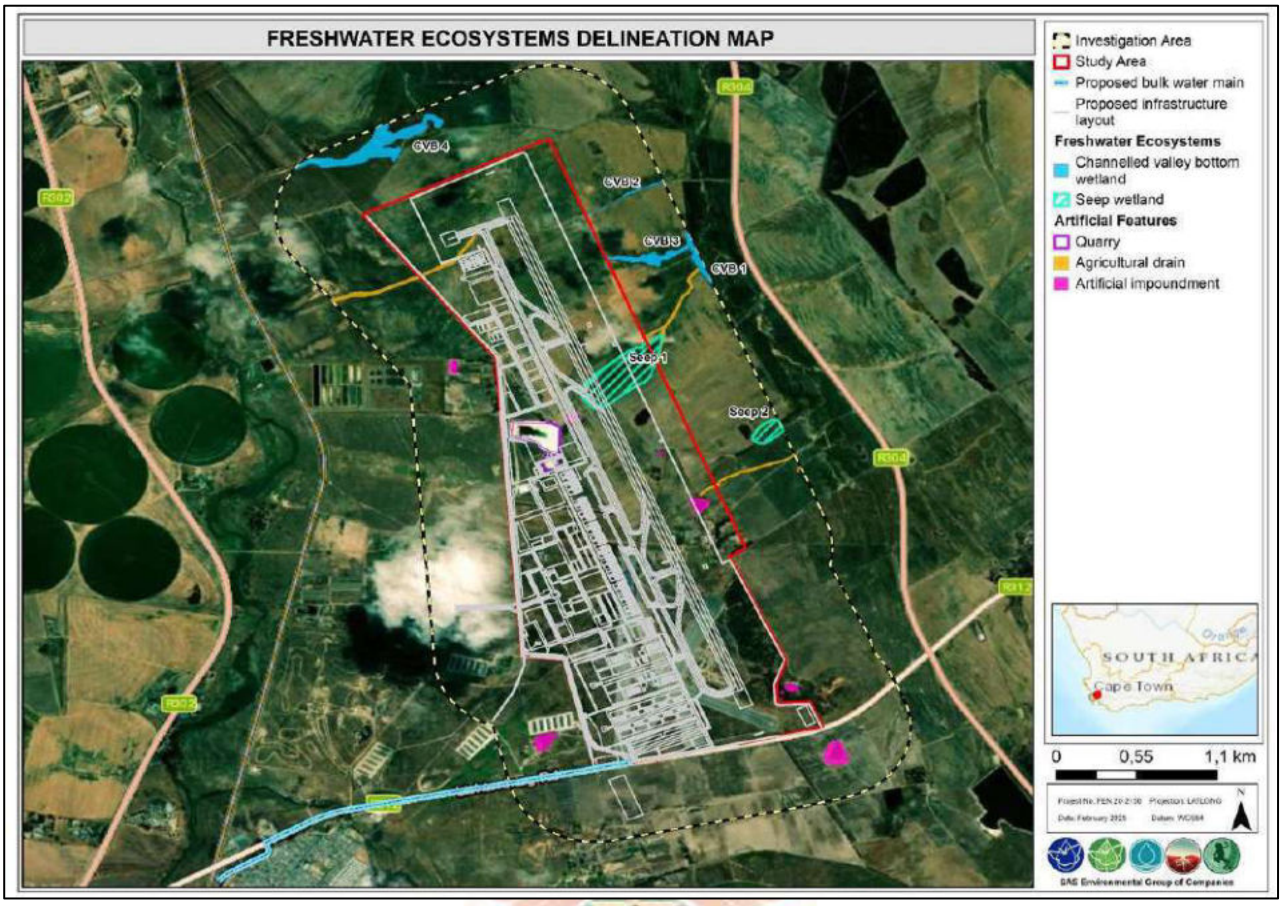


Figure 29: **<u>Map depicting the delineated extent of the freshwater ecosystems and artificial features associated with the study and investigation areas and preliminary SDP. Note that the borehole locations, PV facilities and stormwater infrastructure are not indicated on this map. (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025</u>).**

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 30). 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.

Figure 30: 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).

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.

Figure 31: 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).

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.

Figure 32: 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).

10.4. Geohydrology

10.4.1. Geology

A geohydrological assessment in support of a WULA was undertaken by GEOSS (GEOSS, WULA Geohydrological Assessment, February 2025, Appendix B). The **geology** of the proposed Cape Winelands Airport 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 (Refer Table 12).

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, 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.

A regional fault system (the Colenso Fault) is mapped along the northeastern boundary of the Cape Winelands Airport. This fault structure extends from Klapmuts in the Winelands to Langebaan on the West Coast. A geological cross section is presented in Figure 34.

Table 12: Geological formations within the study area (GEOSS, WULA Geohydrological Assessment, February 2025)

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

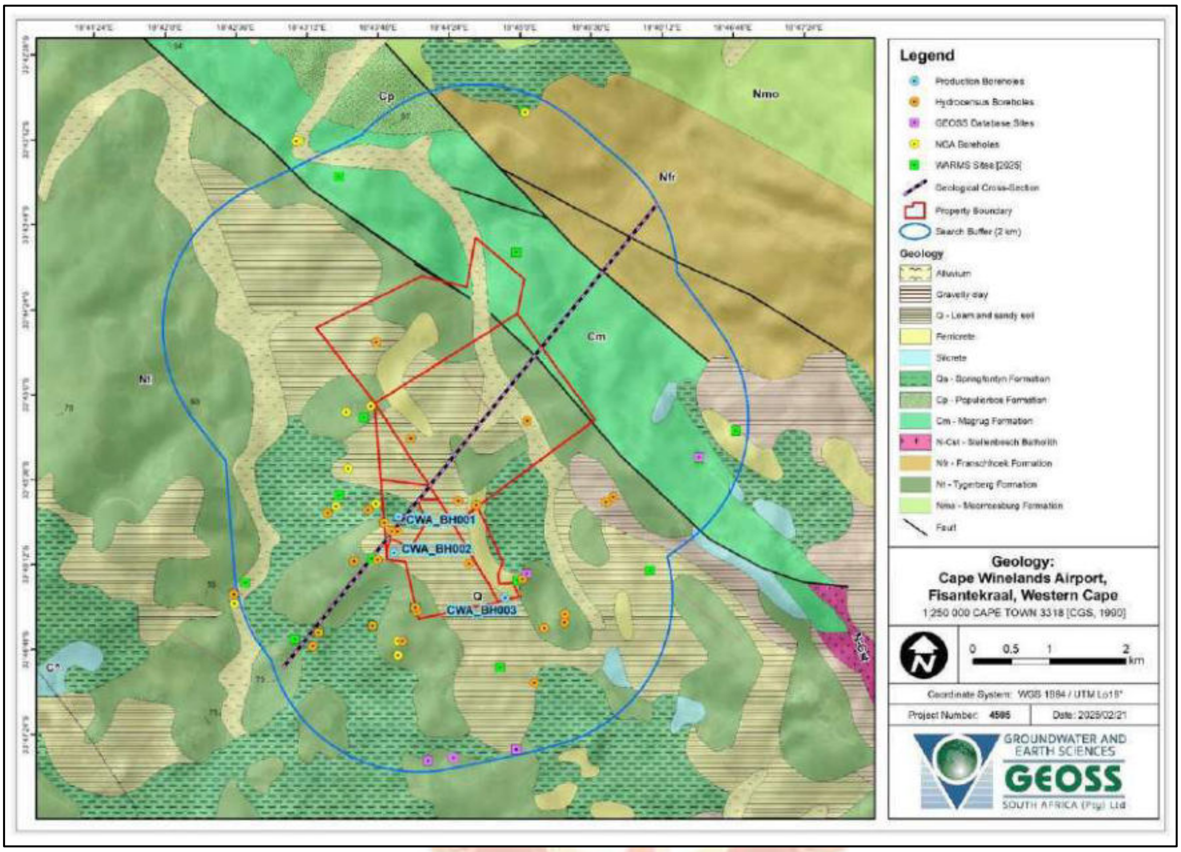


Figure 33: Geological setting of the area with the hydrocensus, NGA, WARMS borehole and cross-section line indicated (3318 – Cape Town) (GEOSS, WULA Geohydrological Assessment, February 2025, Appendix B).

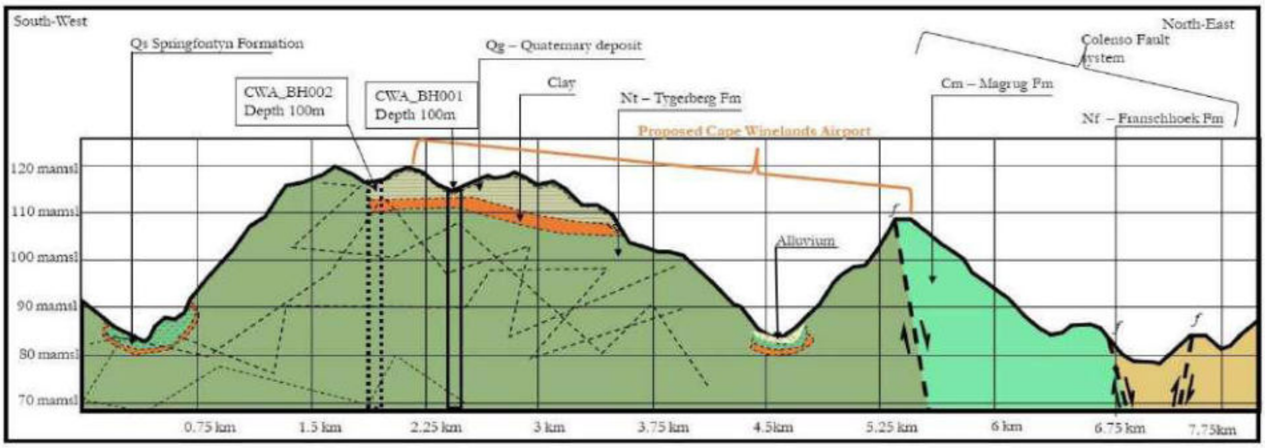


Figure 34: Schematic and conceptual south-west to north-east cross section as indicated in Figure 26 – note Colenso Fault area (GEOSS, WULA Geohydrological Assessment, February 2025, Appendix B).

10.4.2. Geohydrology

The **geogydrological** baseline study found that the site is underlain by alluvium, colluvium, and weathered bedrock of the Malmesbury Group and Cape Granite Suite (GEOSS, WULA Geohydrological Assessment, February 2025). A large geological structure, the Colenso Fault, is mapped on the north-eastern boundary of the Cape Winelands Airport.

According to the 1:1 000 000 scale groundwater map of Cape Town (3318) the area does host a fractured aquifer (i.e., the bedrock constitutes an aquifer) with the area divided into 2 yield classes. Average borehole yields of 0.5 – 2L/s are indicated across the majority of the proposed development area while average yields of 2 – 5L/s are indicated in the north-east portion of the development sites (refer Figure 35). During the hydrocensus borehole yields were found to range from 0.2 to 8.3L/s, thereby exceeding the regional yields in some areas.

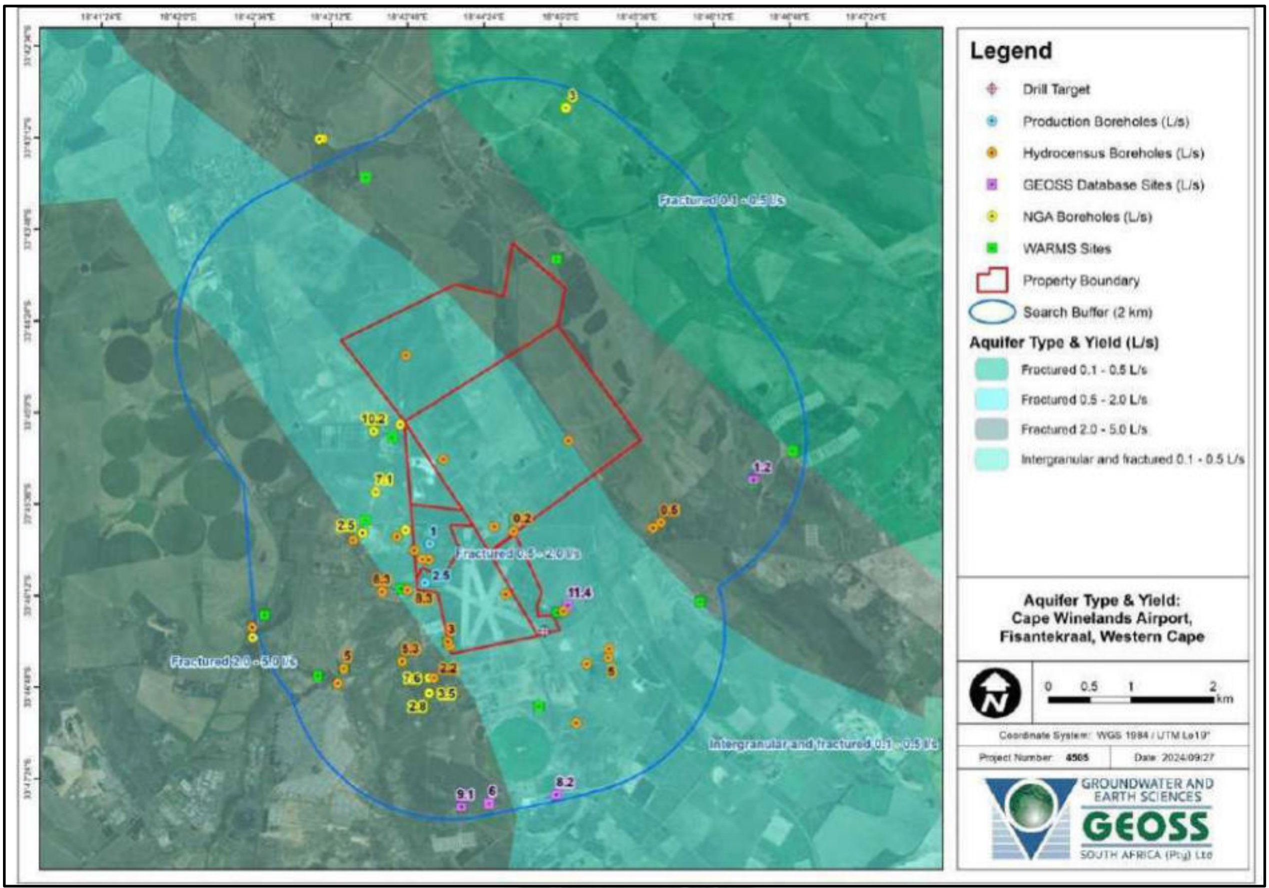


Figure 35: **Regional aquifer yield from the 1:1 000 000 scale groundwater map (3318 –Cape Town) (DWAF, 2005), of the study site with the property boundary with the production, WARMS, and NGA boreholes as well as borehole yields (L/s) (GEOSS, WULA Geohydrological Assessment, February 2025, Appendix B).**

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).

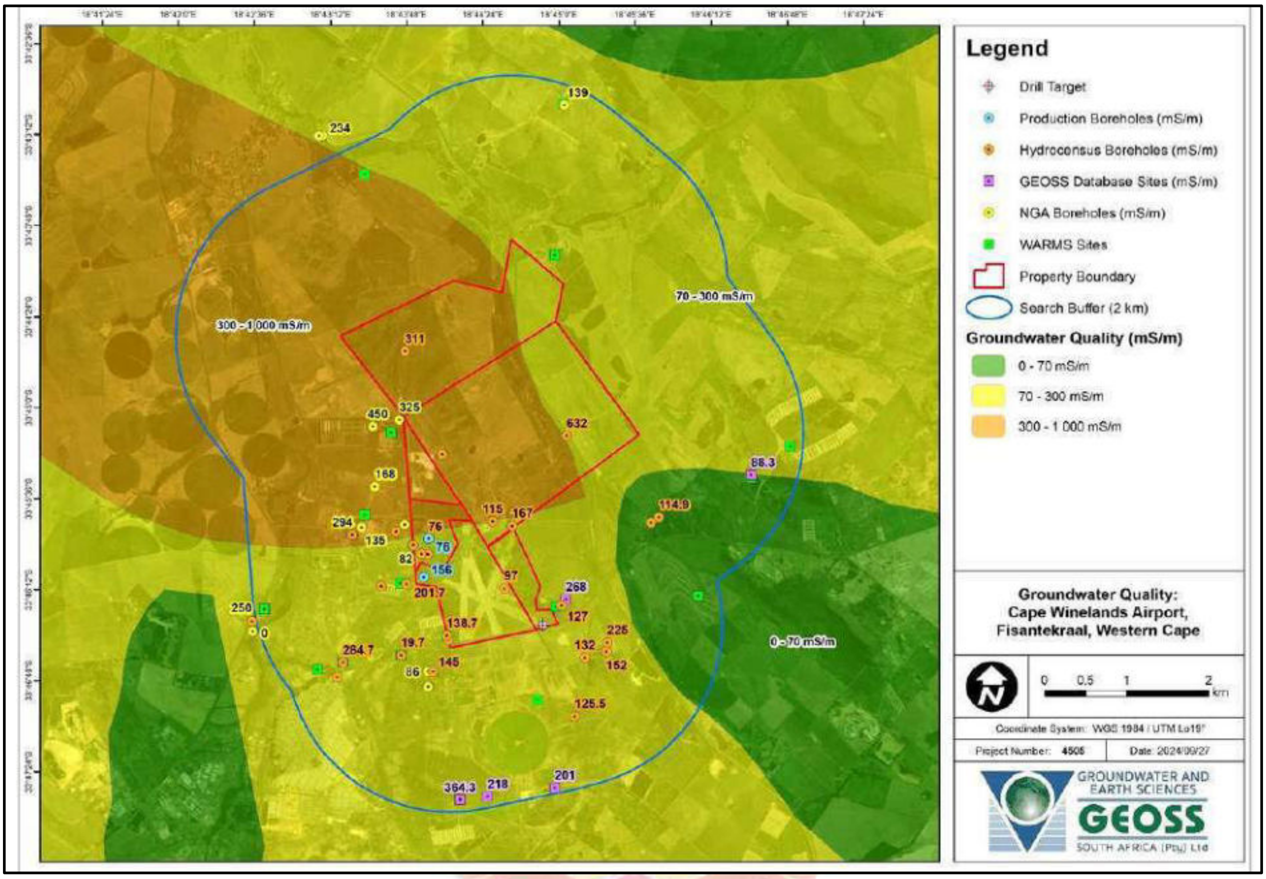


Figure 36: Regional groundwater quality (EC in mS/m) from (DWAF, 2005), of the study site with the property boundary with the production, WARMS, and NGA boreholes (GEOSS, WULA Geohydrological Assessment, February 2025, Appendix B).

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 7.881mbgl). However, the water levels that were indicated as deeper than 20mbgl all originate from the NGA database. Water levels deeper than 20mbgl do not correspond to the hand-measured resting groundwater levels during the hydrocensus which were all less than 20mbgl. It is therefore considered likely that the NGA water levels deeper than 20mbgl may represent pumping water levels.

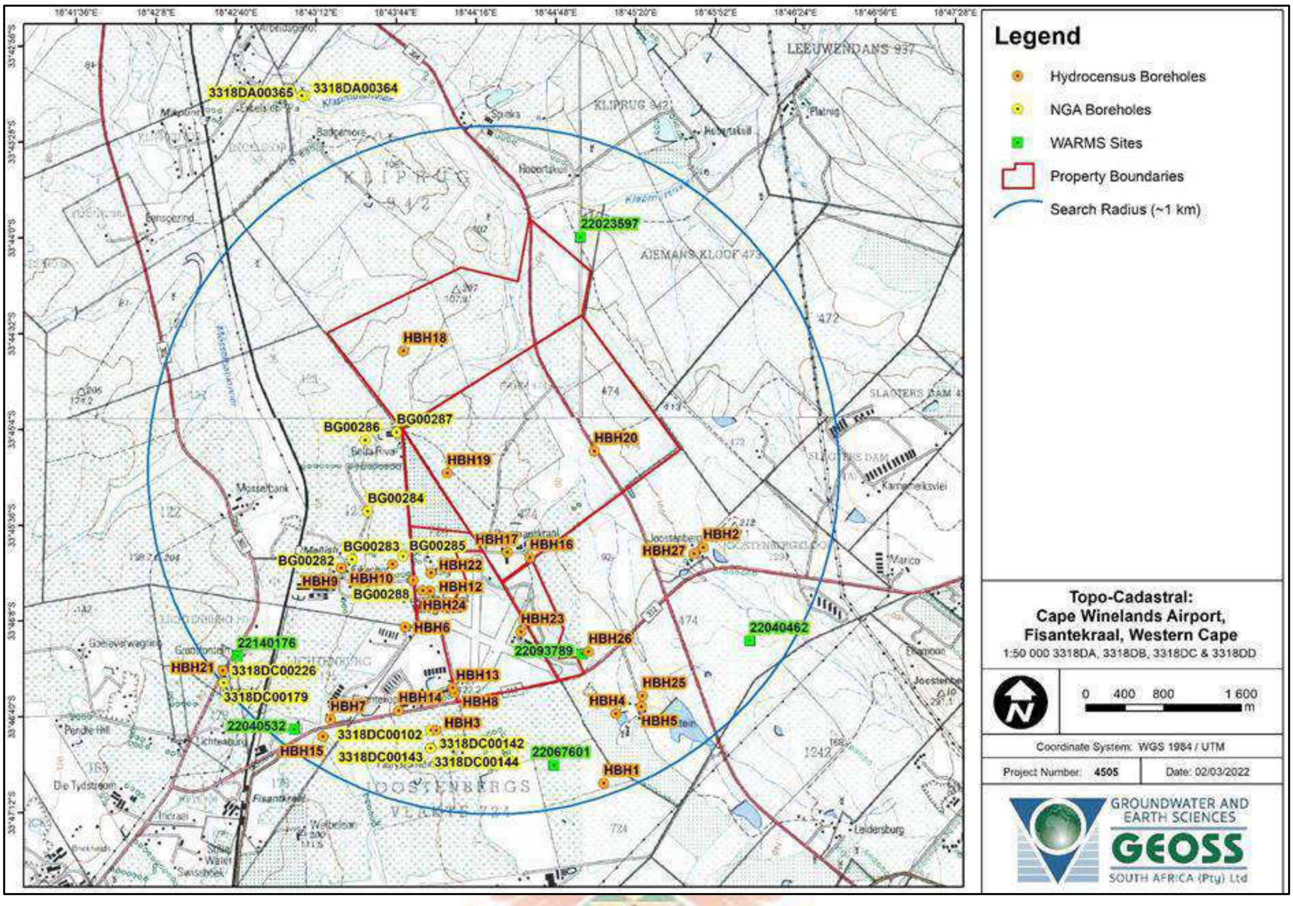


Figure 37: The study site with the property boundary, hydrocensus, NGA, and WARMS boreholes superimposed on a 1:50 000 scale topocadastral map (3318DA, 3318DB, 3318DC & 3318DD) (GEOSS, WULA Geohydrological Assessment, February 2025)

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.

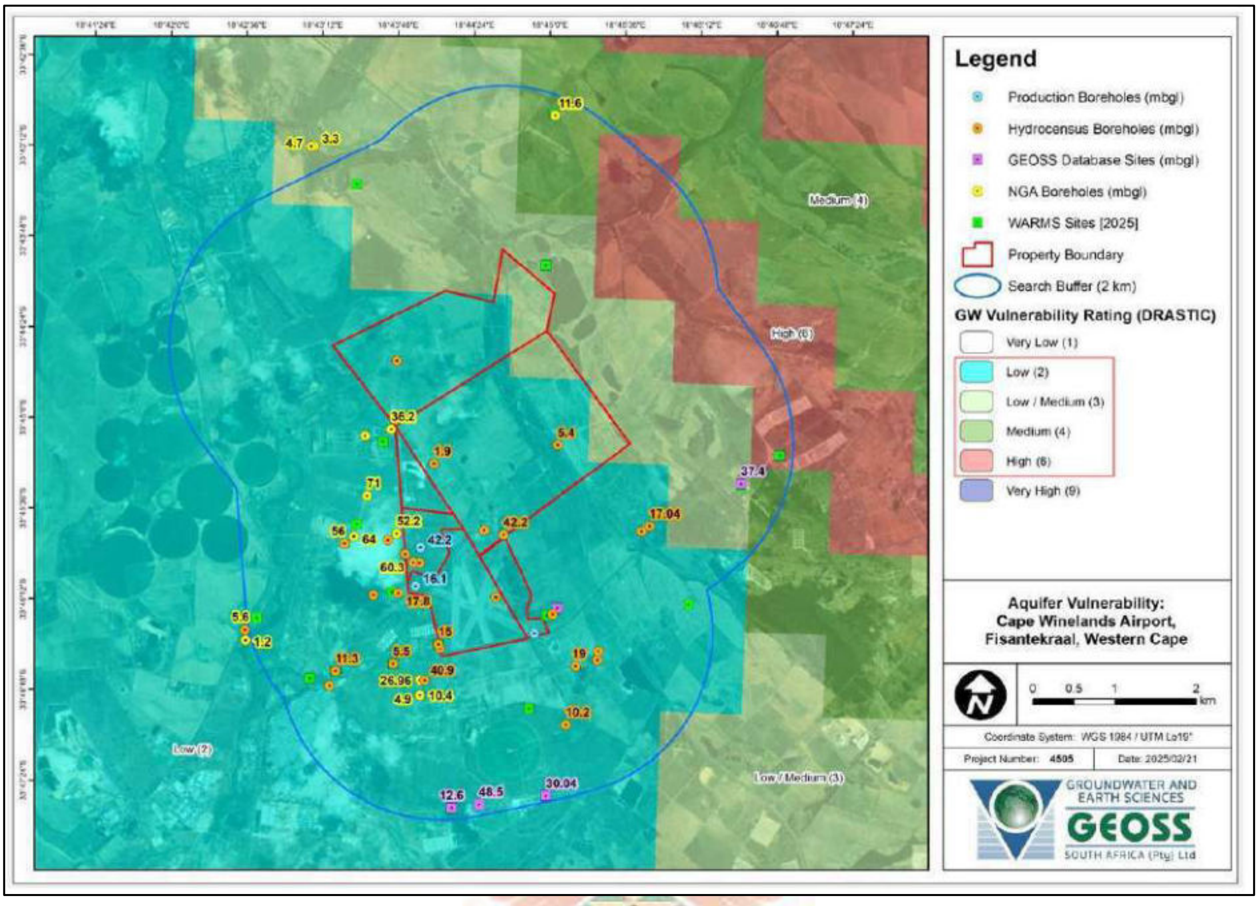


Figure 38: Vulnerability rating (DWAF, 2000) and groundwater depths (mbgl) (GEOSS, WULA Geohydrological Assessment, February 2025)

Aquifer vulnerability increases to the north-east where the Colenso Fault system is located (Figure 38). This area should be considered as a sensitive area in terms of groundwater.

Because there are other existing groundwater users and the proximity of the Colenso Fault to the CWA, a no-go area for high-risk activities is proposed for the north-eastern section of the study area, specifically for certain high-risk activities such as the aviation fuel farm, retail service station or other activities that are considered high risk to groundwater (Figure 39).

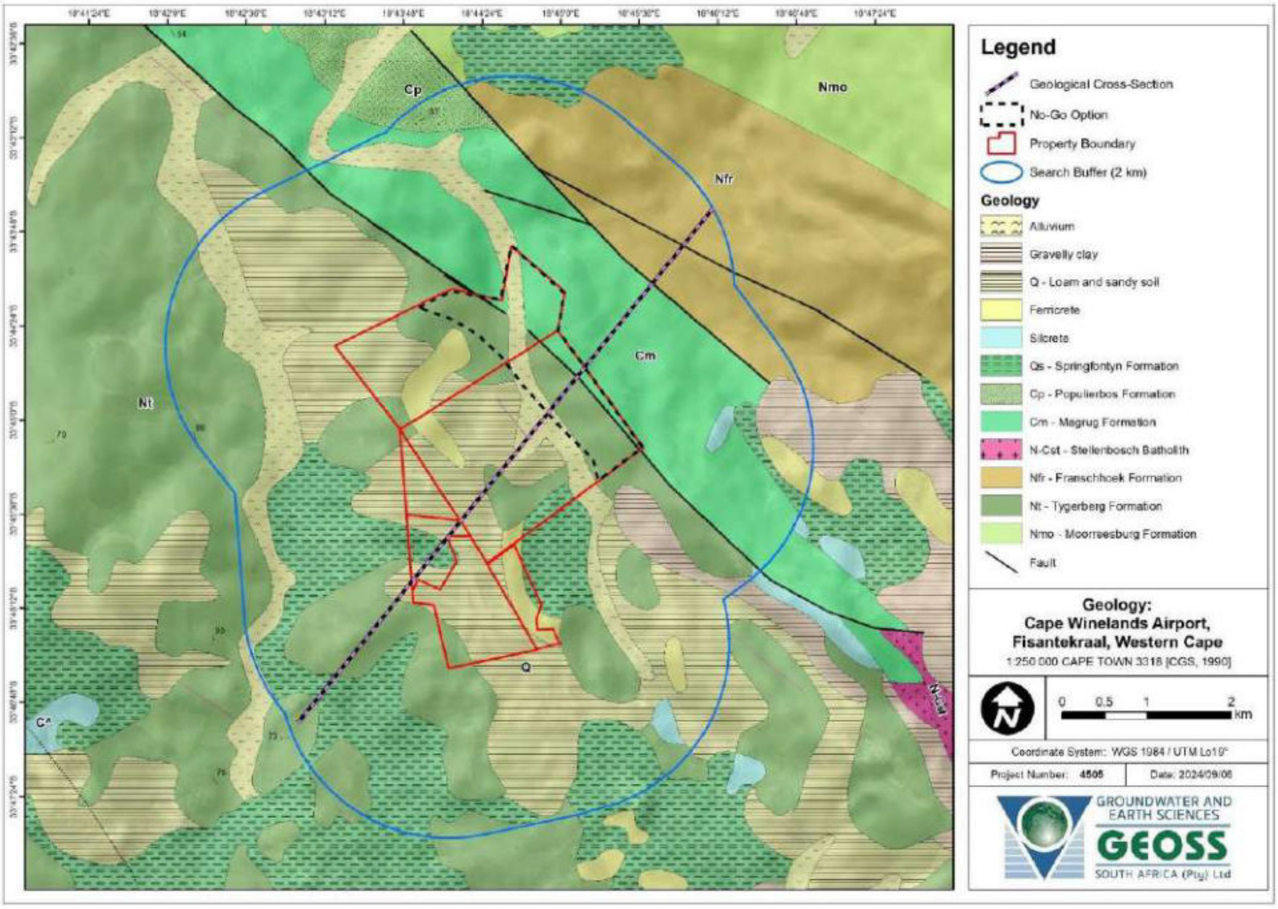


Figure 39: Geological map indication the cross section, property boundary and the no-go area proposed (GEOSS, Groundwater Impact Assessment, February 2025).

10.4.3. Geotechnical Conditions (GEOSS, Geotechnical Report, September 2023)

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 40. 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 13.

Table 13: Potential geotechnical constraints in the region of the site (after CGS, 2009) (GEOSS, Geotechnical Report, September 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

The geotechnical baseline 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. 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.

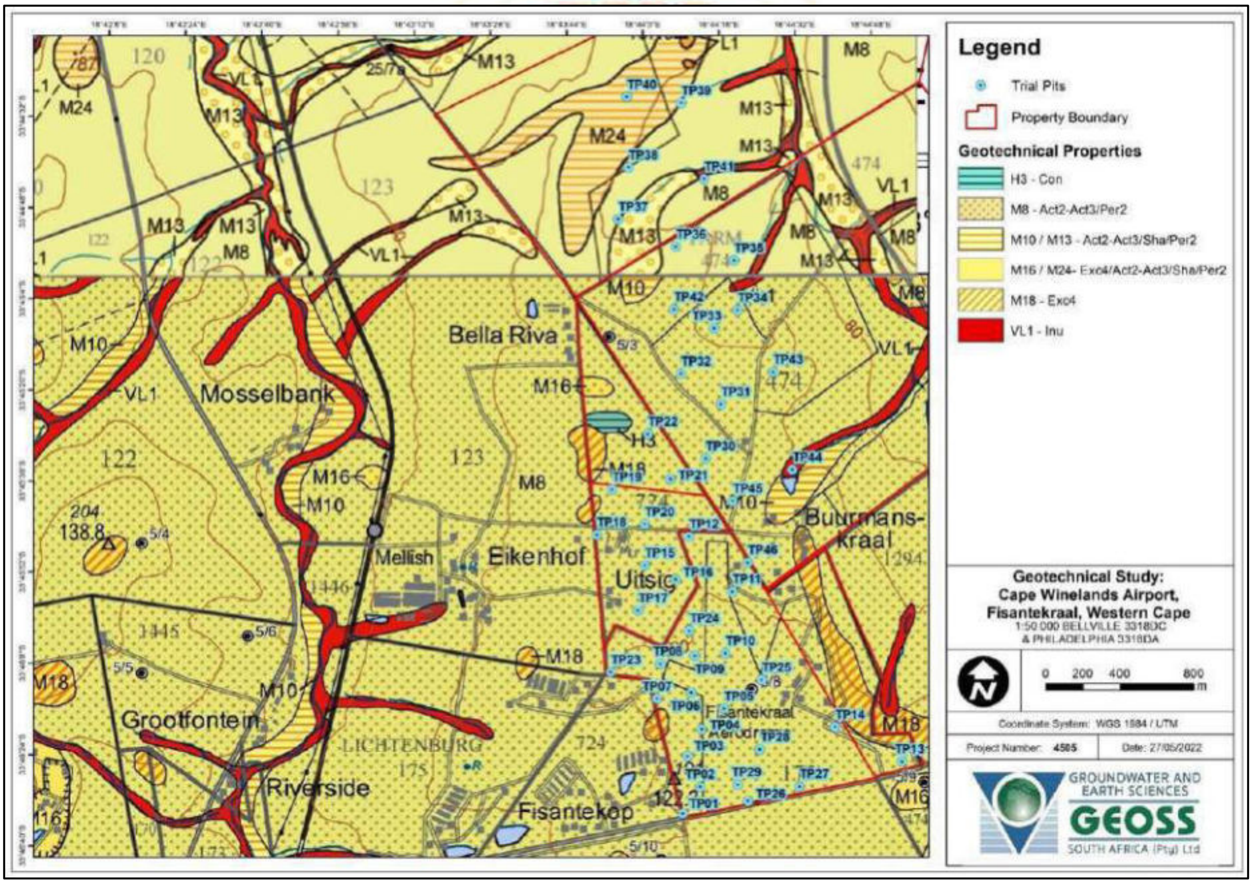


Figure 40: Large scale Geotechnical conditions of the site and surrounds showing the positions of the trial pits (3318DC – Bellville, GCS 2008) (GEOSS, Geotechnical Report, September 2023)

Five Geotechnical Zones were 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.

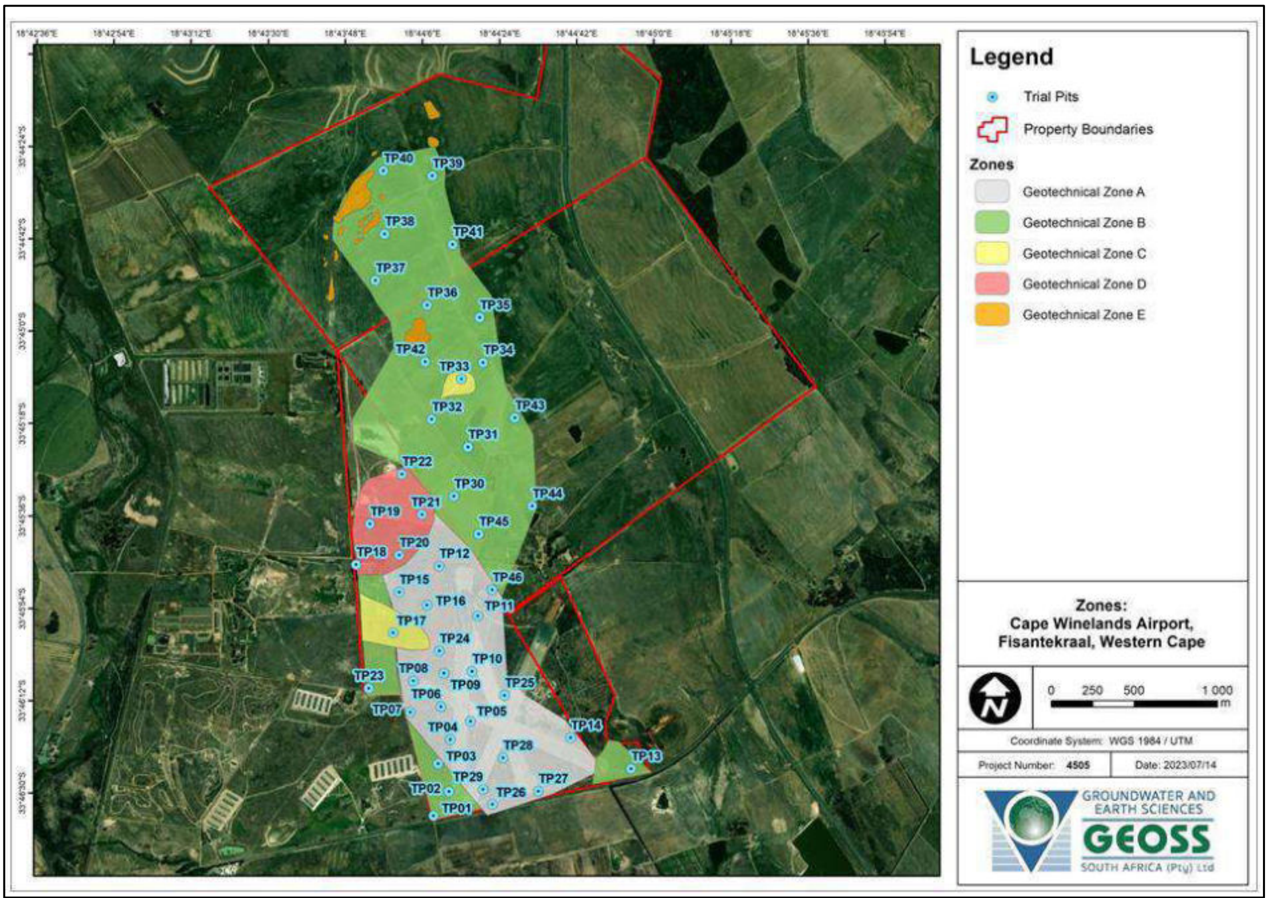


Figure 41: Aerial imagery showing interpreted Geotechnical Zone boundaries (GEOSS, Geotechnical Report, September 2023)

From a geotechnical standpoint, site development should proceed, but there are potential geotechnical challenges associated with the intended development:

- All materials encountered in the trial pits classified as soft to intermediate excavation, but 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 1.4mbgl, so excavations deeper than 1.0mbgl will require battering to ensure safe working conditions. Final designs will have to cater for aggressive and corrosive groundwater and/or soil conditions and 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.

10.4.4. Clay Quarry

The Uitsig quarry (described as Uitsig Clay Pit) (Figure 42 & Figure 43) with Mining Licence ML17/2001 has been operational since 2003. The land and the mining right / permit is owned by Corobrik (Pty) Ltd who as of the 15th of August 2022 entered into a sales agreement with Cape Winelands Airport (Pty) Ltd. As part of the acquisition of the land for the proposed CWA expansion, a mine closure application is being undertaken by Corobrik (Pty) Ltd. Once the closure is completed the sale will be effected.

Mine closure planning involves planning effectively for the after-mining landscape – all activities required before, during and after the operating life of a mine that are needed to produce an acceptable landscape economically. The most important benefit of closure planning is identification of critical activities to achieve successful reclamation, and usually also identifies areas of needed research, planning constraints and opportunities. The proposed mine closure application will be in line with the approved EMP (dated 9 July 1998) and will also incorporate the possible future use of the quarry as a stormwater retention pond.

The geological setting of the area indicates that the quarry is in ferricrete of the Bellville formation and loam and sandy loam quaternary deposits underlain by the Tygerberg Formation (Nt), however; onsite verification revealed that the quarry is located in a clay deposit of residual Tygerberg Formation (GEOSS, Yield and Quality Testing of a Quarry at the Cape Winelands Airport, Fisantekraal, Western Cape, September 2022).

Yield and water quality testing of the quarry was undertaken from the 15th of August to the 1st of September 2022 (GEOSS, Yield and Quality Testing of a Quarry at the Cape Winelands Airport, Fisantekraal, Western Cape, September 2022). The yield testing included a Constant Discharge Test and Recovery Monitoring at the Quarry and sampling of the water for chemical analysis.

Based on the information obtained from the yield test, it was concluded that **the water in the Quarry is dependent on rainfall and no groundwater influence was detected**. The laboratory results indicated that the water from the Quarry is of marginal quality for potable supply. The sodium and chloride concentrations in the quarry exceed the aesthetic limit of the SANS 241-1:2015 drinking water guidelines and result in the quarry water having a saline (salty) taste. This is most likely due to the fact that the quarry is an open body of water subject to evaporation processes. Furthermore, the clay that hosts the water body results in the elevated turbidity levels that are responsible for the murky white colour of the water. This may have been exacerbated by the pumping that took place during the yield test, as well as the very windy conditions on the day of sampling. The aluminium and lead concentrations observed can be related to the clay particles in the water sample and lower concentrations can be expected should an undisturbed sample be collected, as in the sample collected in January 2022. Based on the pH and electrical conductivity (EC) from the Quarry compared to the pH, electrical conductivity (EC), iron and manganese from Borehole 1 (CWA_BH001) (GEOSS, Yield Report for CWA_BH001, 21 September 2022) it is evident that the quarry is unrelated to the regional groundwater. The quarry will therefore not be utilised as a groundwater source but rather as a stormwater retention pond.

Figure 42: Location of quarry in relation to the proposed development area outlined as red (quarry indicated by blue arrow) (PHS Consulting, Oct 2023)

Figure 43: Photo of quarry (looking north-west) (Agri-informatics; Agro-Economical Scoping report; September 2023)

10.4.5. Onsite Boreholes

Three production boreholes have been drilled and tested onsite - CWA_BH001, CWA_BH002 and CWA_BH003. CWA_BH001 and CWA_BH002 are located along the western side of the proposed development area while CWA_BH003 is located in the south east of the proposed development area (Figure 11 & Table 14). Borehole testing included 24hr yield testing and water quality testing by a SANAS accredited laboratory.

Potential sustainable yield from CWA_BH001 (100m deep) was determined as 86.4m^3/day with an abstraction rate of 1L/s (GEOSS, Borehole Yield and Quality Testing of CWA _BH001, September 2022). Possible sustainable yield from CWA_BH002 (100.4m deep) was determined as 216m^3/day with an abstraction rate of 2.5L/s (GEOSS, Borehole Yield and Quality Testing of CWA _BH002, December 2022). Potential sustainable yield from CWA_BH003 (149.9m deep) was determined as 146.016m^3/day with an abstraction rate of 1.69L/s. (GEOSS, Borehole Yield and Quality Testing of CWA_BH003, December 2024). Therefor the total sustainable yield volume was determined as 163 671m^3/annum (GEOSS, WULA Geohydrological Assessment, February 2025, Appendix B).

Table 14: Borehole and abstraction details.

Borehole	Latitude	Longitude	Depth (m)	Abstraction Rate (L/s)	Abstraction Duration (hrs)	Possible Volume Abstraction (m^3/day)
CWA_BH001	-33.76452	18.73271	100	1	24	86.4
CWA_BH002	-33.76876	18.732067	100.4	2.5	24	216
CWA_BH003	-33.774037	18.747742	149.9	1.69	24	146.016

The water quality results obtained were classified according to the SANS241-1: 2015 standards (Table 15). The groundwater from CWA_BH001 was found to be of "marginal" water quality for human consumption, with elevated turbidity levels related to high concentrations of iron and manganese in the groundwater (Table 16 & GEOSS, Borehole Yield and Quality Testing of CWA _BH001, September 2022). Groundwater from CWA_BH002 and CWA_BH003 was found to be of poor quality with iron and manganese levels above the chronic health limit of the SANS 241-1:2015 drinking water guidelines (Table 16 & GEOSS, Borehole Yield and Quality Testing of CWA _BH002, December 2022 & GEOSS, Borehole Yield and Quality Testing of CWA_BH003, December 2024).

The precipitation of iron will result in the clogging of the boreholes as well as the abstraction infrastructure. To address this, it is recommended to maintain a constant continuous pumping schedule as much as possible. Thus, should a daily volume of less than the daily maximum sustainable yield for each borehole be required, it is recommended to decrease the pumping rate, and not the pumping duration. By pumping continuously instead of on a stop-start schedule, iron oxidation in the borehole is minimized, decreasing the amount of iron precipitation inside the boreholes and pumps. It is also recommended to pump the water into settling tanks to allow iron settling prior to use (GEOSS, Borehole Yield and Quality Testing of CWA _BH001 and GEOSS Borehole Yield and Quality Testing of CWA _BH002. Furthermore, the boreholes must be managed according to a proper, cleaning and maintenance plan (GEOSS, Borehole Yield and Quality Testing of CWA _BH001, September 2022, GEOSS, Borehole Yield and Quality Testing of CWA _BH002, December 2022 & GEOSS, Borehole Yield and Quality Testing of CWA_BH003, December 2024).

Table 15: Standard (SANS) 241:2015 classification for specific limits

Acute Health	Chronic Health	Aesthetic	Operational	Acceptable
Health risks: parameters falling outside these limits may cause acute or chronic health problems in individuals.		Parameters falling outside these limits indicate that water is visually, aromatically or palatably unacceptable.	Parameters falling outside these limits may indicate that operational procedures to ensure water quality standards are met may have failed.	

Table 16: Production borehole groundwater quality analysis classified results according to SANS 241-1:2015. (GEOSS, WULA Geohydrological Assessment, February 2025, Appendix B).

Analyses	CWA_ BH001	CWA_ BH002	CWA_ BH003	SANS 241-1:2015
Date sampled	Apr 2022	Nov 2022	December 2024	
pH (at 25 °C)	7.3	6.8	7.2	≥5 - ≤9.7 Operational
Conductivity (mS/m) (at 25 °C)	89.0	155.9	80.6	≤170 Aesthetic
Total Dissolved Solids (mg/L)	603.42	1057.00	546.47	≤1200 Aesthetic
Turbidity (NTU)	18.70	121.00	64.10	≤5 Aesthetic ≤1 Operational
Colour (mg/L as Pt)	<15	<15	<15	≤15 Aesthetic
Sodium (mg/L as Na)	130	184	149	≤200 Aesthetic
Potassium (mg/L as K)	4	4	3	N/A
Magnesium (mg/L as Mg)	16	48	19	N/A
Calcium (mg/L as Ca)	17	39	20	N/A
Chloride (mg/L as Cl)	207.57	430.19	294.37	≤300 Aesthetic
Sulphate (mg/L as SO_4)	13.89	38.04	17.39	≤250 Aesthetic ≤500 Acute Health
Combined Nitrate & Nitrite (ratio)	<1.05	<1.05	0.068	≤1 Acute Health
Nitrate Nitrogen (mg/L as N)	<1.00	<1.00	<1.00	≤11 Acute Health
Nitrite Nitrogen (mg/L as N)	<0.05	<0.05	<0.05	≤0.9 Acute Health
Ammonia Nitrogen (mg/L as N)	<0.15	<0.15	<0.15	≤1.5 Aesthetic
Total Alkalinity (mg/L as $CaCO_3$)	102.1	83.6	72.0	N/A
Total Hardness (mg/L as $CaCO_3$)	108.1	294.3	127.9	N/A
Fluoride (mg/L as F)	0.17	<0.15	<0.15	≤1.5 Chronic Health
Aluminium (mg/L as Al)	<0.008	0.016	<0.008	≤0.3 Operational
Total Chromium (mg/L as Cr)	<0.004	<0.004	<0.004	≤0.05 Chronic Health
Manganese (mg/L as Mn)	0.329	1.272	0.466	≤0.1 Aesthetic ≤0.4 Chronic Health
Iron (mg/L as Fe)	1.881	7.344	3.944	≤0.3 Aesthetic ≤2 Chronic Health
Nickel (mg/L as Ni)	<0.008	<0.008	<0.008	≤0.07 Chronic Health
Copper (mg/L as Cu)	0.010	0.010	<0.002	≤2 Chronic Health
Zinc (mg/L as Zn)	<0.008	<0.008	<0.008	≤5 Aesthetic
Arsenic (mg/L as As)	<0.010	<0.010	<0.010	≤0.01 Chronic Health
Selenium (mg/L as Se)	<0.008	<0.008	<0.008	≤0.04 Chronic Health
Cadmium (mg/L as Cd)	0.002	<0.001	0.001	≤0.003 Chronic Health
Antimony (mg/L as Sb)	<0.013	<0.013	<0.013	≤0.02 Chronic Health
Mercury (mg/L as Hg)	<0.001	<0.001	<0.001	≤0.006 Chronic Health
Lead (mg/L as Pb)	<0.008	<0.008	<0.008	≤0.01 Chronic Health
Uranium (mg/L as U)	<0.028	<0.028	<0.028	≤0.03 Chronic Health
Cyanide (mg/L as CN^-)	<0.01	<0.01	0.010	≤0.2 Acute Health
Total Organic Carbon (mg/L as C)	2.46	2.15	2.19	N/A
E.coli (cfu/100 mL)	nd	nd	-	Not Det. Acute Health-1
Total Coliform Bacteria (cfu/100 mL)	nd	nd	-	Not Det.≤10 Operational
Heterotrophic Plate Count (cfu/mL)	69	nd	-	≤1000 Operational
Charge balance %	-1.1	-1.0	4.0	≥-5 - ≤5 Acceptable

10.4.6. Future development of onsite groundwater sources

The WULA Geohydrological Assessment undertaken by GEOSS (February 2025) determined that the three onsite production boreholes can sustainably supply the short-term groundwater requirements for the proposed development. The current water supply strategy for CWA follows a phased approach, initially relying on groundwater as the primary source. This will continue in the short term until municipal infrastructure can either supplement or fully replace the groundwater supply as illustrated in Figure 10. It should however be noted that the Aquifer Firm Yield Model was used to calculate the Groundwater Resource Unit (GRU) which indicated that it can still currently support additional groundwater abstraction should additional groundwater be required for future development phases (GEOSS, WULA Geohydrological Assessment, February 2025, Appendix B).

10.5. 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 (Figure 29). The activities associated with the CWA development could potentially intercept subsurface flows and thus affect watercourse recharge. A Hydropedology Assessment was undertaken the Zimpande Research Collaborative (ZRC) (Zimpande Research Collaborative, Hydropedological Assessment, February 2025). The hydropedology study included a desktop analysis, a field survey, sampling activities, and hydrological modelling. The purpose of this hydropedology study was to investigate the recharge mechanisms of these watercourses to ensure that development planning considers hydropedologically important areas.

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 as depicted in Figure 44. The dominant soil types identified within the proposed development site were grouped according to their hydropedological responses as summarised below and illustrated in Figure 45:

- **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.

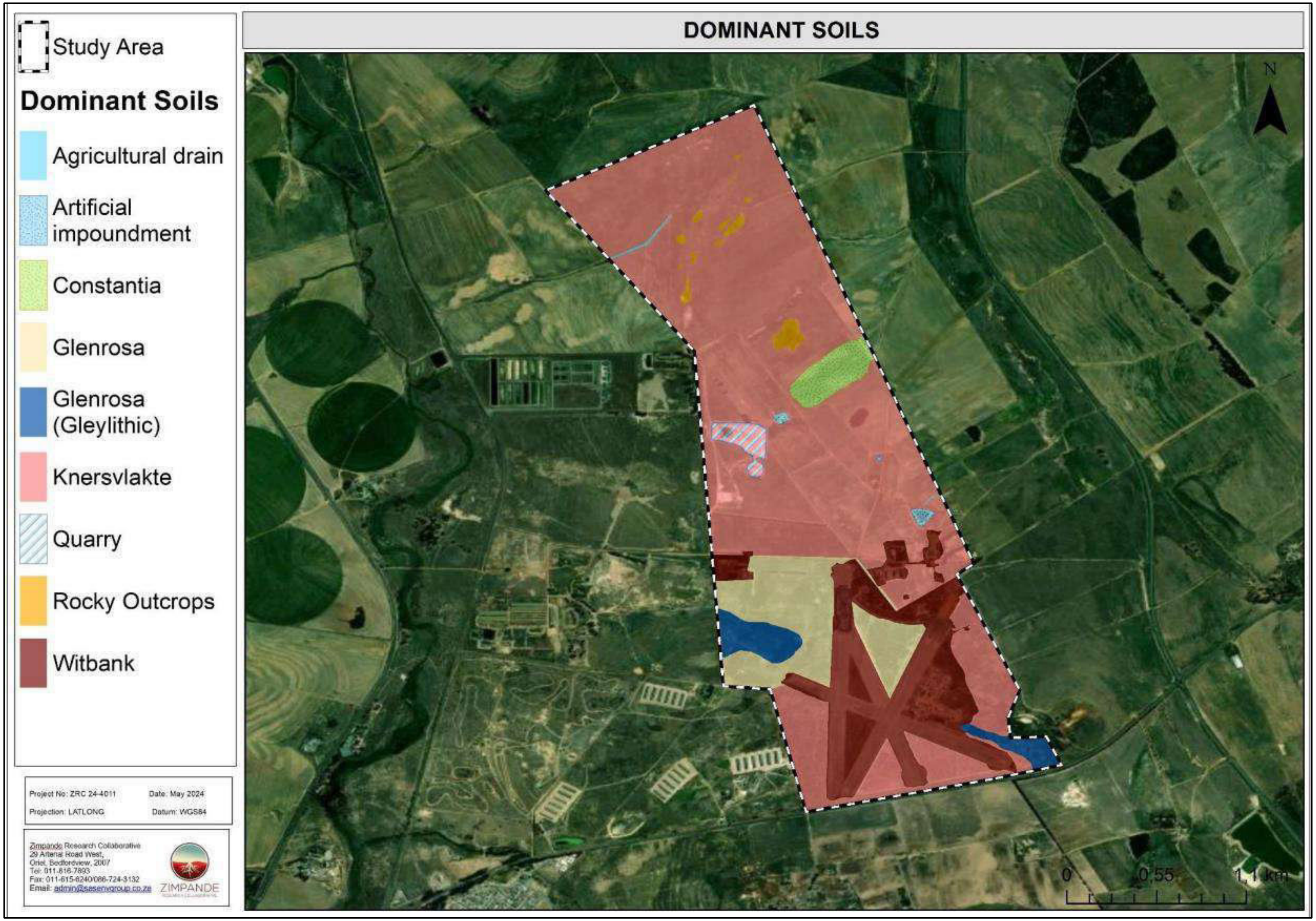


Figure 44: Map depicting spatial distribution of soils within the study area (Zimpande Research Colabirative, Hydropedological Assessment, February 2025).

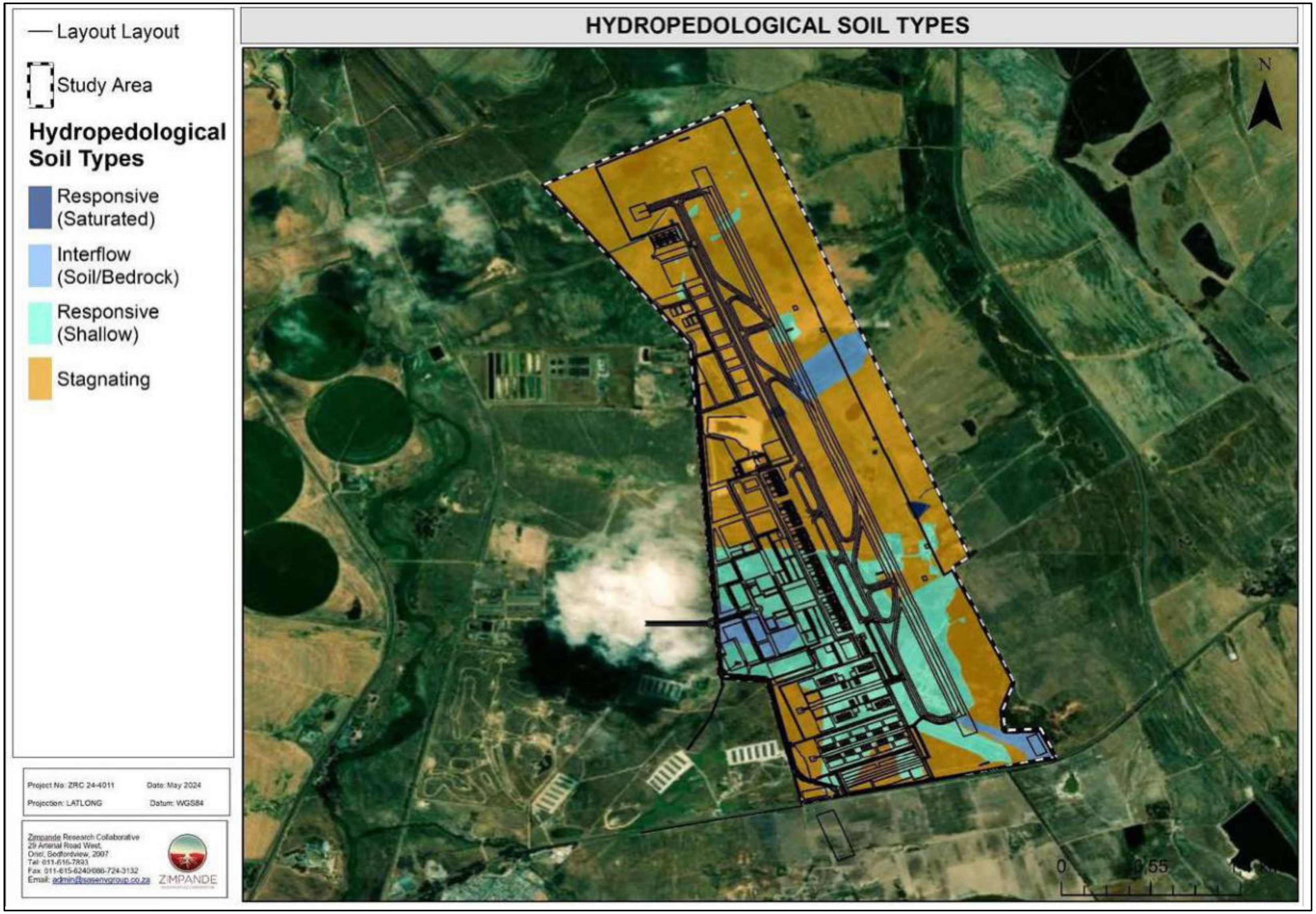


Figure 45: Map depicting hydrological soil types associated with the study area overlain by the proposed layout outline. (Zimpande Research Collaborative, Hydropedological Assessment, February 2025)

11. Impacts and mitigation measures

11.1. Potential Freshwater Impacts

FEN Consulting (Pty) Ltd was appointed to conduct a freshwater ecological impact assessment as part of the NEMA application for the proposed CWA development. This assessment aimed to identify and evaluate potential impacts on freshwater systems resulting from the development. Both the Impact Assessment method and the DWS RAM (2023) were applied to ascertain the significance of impacts on the receiving freshwater environment. The results of these assessments are outlined in the subsections below.

The impact assessment identified a moderate negative effect on the ecological integrity of freshwater ecosystems associated with the proposed development, particularly Seep Wetland 1 which will experience wetland loss. The Risk Assessment Matrix (RAM) indicates that activities from the proposed development during both construction and operational phases present a Low risk to the CVB wetlands. However, a Moderate risk is posed to Seep Wetland 1, largely due to the anticipated loss of 6.74ha of wetland habitat. Additionally, cumulative impacts from stormwater management, habitat loss, and ongoing water quality and sediment issues will further affect the freshwater systems.

As outlined in Section 8 of this report, a freshwater offset investigation is underway to address the loss of 6.74ha of Seep Wetland 1 habitat, in consultation with the DWS. This process follows the guidance and stipulations provided by DWS.

The Freshwater Ecological Assessment concluded that with strict adherence to site-specific control measures, as detailed below, the impacts associated with the proposed development activities and be effectively reduced and managed.

The Freshwater Ecological Assessment concluded that current preferred layout is considered acceptable from a freshwater ecosystem management perspective, provided that site specific mitigation measures, as detailed below are implemented. Furthermore, there must be clear evidence of a viable offset and compensation plan that ensures that there is no net loss of biodiversity (refer to Section 8 of this report). This compensation, offsetting and rehabilitation commitments as determined by the offset and rehabilitation plan (FEN, Draft Wetland Offset Study and Implementation Plan) would need to be legally binding on the applicant.

11.1.1. Freshwater Impact Assessment

Three key impacts were identified and assessed as detailed below. The results of the assessment are summarized in Table 20 and mitigation measures are included in the RAM, Table 21.

- **Impact 1: Modification of the seep wetland 1 and CVB wetland 2 and 3’s hydrological functioning and water quality**

Site clearing activities and related earthworks associated with the proposed CWA development may result in habitat loss, alteration of hydrological and geomorphological processes and water quality impacts of the wetlands through sedimentation and pollution and the loss of wetland vegetation. The increased impermeable surfaces due to the presence of hardened surfaces as a result of the proposed CWA development which will release stormwater into the seep wetland 1 and CVB wetlands 2 and 3 via stormwater attenuation ponds and surface runoff, may result in an increased catchment yield and altered flow regime, leading to changed hydrological zonation. Similarly, the construction of the maintenance road and fences which will traverse the above-mentioned wetlands may also lead to changed hydrological zonation due to the fragmentation of the wetlands. Table 17 below summarises the activities and potential impacts during the construction and operational phases.

Table 17: Construction and Operational Phase activities leading to impact on hydrology and water quality (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025)

Construction phase	Operational Phase
Site preparation prior to construction activities, involving vehicular movement (transportation of construction materials) and associated disturbances to soil.	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.
Removal of topsoil and vegetation and creation of topsoil stockpiles, and increased likelihood of dust generation due to exposed soil.	Operation of the runway and service infrastructure potentially releasing hydrocarbons from the internal road network and runway entering the wetlands through stormwater run-off.
Movement of construction equipment and personnel within the seep wetland 1 and potentially CVB wetland 3.	Operation of the maintenance road and fences through the seep wetland 1 and CVB wetlands 2 and 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.	Potential indiscriminate movement of vehicles within the wetlands for inspections/ maintenance.
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.	

- **Impact 2: Changes to the geomorphological processes (sediment balance, erosion and sedimentation)**

The activities associated with the proposed CWA development may result in the disturbance of geomorphological processes of the seep wetland 1 and CVB wetlands 2 and 3 through the removal of vegetation and topsoil during the construction phase, and earth works for the construction of service infrastructure and runway, resulting in altered runoff patterns and increased erosion and sedimentation of freshwater habitat. This in turn has the potential to impact on wetland habitat, zonation and species composition as well as goods and services provision. Table 18 below summarises the activities and potential impacts during the construction and operational phases.

Table 18: Construction and operational phase activities leading to changes to the geomorphological processes and sedimentation (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025)

Construction phase	Operational phase
Site preparation prior to construction activities, involving vehicular movement (transportation of construction materials) and associated disturbances to soil.	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.
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.	Potential indiscriminate movement of vehicles within the wetlands for inspections/ maintenance.
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 32 m NEMA ZoR of the seep wetland 1 and CVB wetlands 2 and 3.	

- **Impact 3: Wetland habitat loss, altered wetland habitat and impacts to biota**

Disturbances of soil and removal of vegetation during site preparation, and the construction phase of the proposed CWA development may result in increased AIP proliferation, and in turn to altered wetland habitat. The construction of the runway and related infrastructure including the stormwater attenuation ponds may result in the loss of 6.74ha of wetland habitat of seep wetland 1. Similarly, the construction of the maintenance road and fences which will traverse the seep and CVB wetlands may result in the fragmentation of wetland habitat. Asphalt, concrete and cement-related mortars can be toxic to aquatic / wetland life, thus asphalt and concrete works and runoff from the construction site (if unmitigated) may lead to a reduced ability of the freshwater features to support biodiversity. Table 19 below summarises the activities and potential impacts during the construction and operational phases.

Table 19: Construction and operational phase activities leading to wetland loss, changes in wetland habitat and impacts to biota (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025).

Construction Phase	Operational Phase
Site preparation prior to construction activities, involving vehicular movement (transportation of construction materials) and associated disturbances to soil.	Operation of the proposed CWA development including the related infrastructure, stormwater attenuation ponds, roads, service infrastructure and associated open space areas.
Removal of topsoil and creation of topsoil stockpiles.	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.
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 hydrocarbons from the hangars, workshops, internal road network and runway entering the wetlands through stormwater run-off.
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.	

Table 20 summarizes the outcomes of the impact assessment. All mitigation measures outlined in the RAM (Table 21) have been applied to the post-mitigation scoring. It's important to note that no additional impacts are expected for the no-go alternative of the CWA development, and therefore, it has not been included in the following discussions.

Table 20: Summary scores rated for unmitigated and mitigated phases as it relates to seep wetland 1 and CVB wetlands 2 and 3. Please note, the mitigation measures outlined in the RAM (Table 21) have been applied to obtain the post mitigation scoring (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025).

UNMANAGED								MANAGED							
Extent	Duration	Intensity	Magnitude	Probability	Status	Confidence	Significance	Extent	Duration	Intensity	Magnitude	Probability	Status	Confidence	Significance
CONSTRUCTION PHASE: Site preparation, removal of topsoil and creation of stockpiles and earthworks, groundworks and removal of vegetation associated with the construction of the proposed CWA development															
Impact on hydrological function and water quality															
Local	Short term	Low	Medium	Probable	Neg (-)	High	Moderate	Site-specific	Short term	Low	Medium	Probable	Neg (-)	High	Low
Impact to geomorphological processes (sediment balance, erosion and sedimentation)															
Site-specific	Short term	Low	Low	Probable	Neg (-)	High	Very low	Site-specific	Short term	Low	Low	Probable	Neg (-)	High	Very low
Wetland habitat loss (seep wetland 1), altered wetland habitat and impacts to biota															

UNMANAGED								MANAGED							
Extent	**Duration**	**Intensity**	**Magnitude**	**Probability**	**Status**	**Confidence**	**Significance**	**Extent**	**Duration**	**Intensity**	**Magnitude**	**Probability**	**Status**	**Confidence**	**Significance**
Local	Short term	High	High	Definite	**Neg (-)**	**High**	**Moderate**	Local	Short term	Medium	Medium	Definite	**Neg (-)**	**High**	**Moderate**
CONSTRUCTION PHASE: Earthworks and construction and installation of the maintenance road and fences															
Impact on hydrological function and water quality															
Site-specific	Short term	Low	Medium	Probable	**Neg (-)**	**High**	**Low**	Site-specific	Short term	Low	Low	Possible	**Neg (-)**	**High**	**Very low**
Impact to geomorphological processes (sediment balance, erosion and sedimentation)															
Site-specific	Short term	Low	Medium	Probable	**Neg (-)**	**High**	**Low**	Site-specific	Short term	Low	Low	Possible	**Neg (-)**	**High**	**Very low**
Altered wetland habitat and impacts to biota															
Site-specific	Short term	Low	Medium	Probable	**Neg (-)**	**High**	**Low**	Site-specific	Short term	Low	Low	Possible	**Neg (-)**	**High**	**Very low**
CONSTRUCTION PHASE: Potential mixing and casting of concrete/ asphalt for runway within the 32 m NEMA ZoR of the seep wetland 1															
Impact on hydrological function and water quality															
Site-specific	Short term	Medium	Medium	Probable	**Neg (-)**	**High**	**Low**	Site-specific	Short term	Medium	Low	Im-probable	**Neg (-)**	**High**	**Very low**
Altered wetland habitat and impacts to biota															
Site-specific	Short term	Medium	Medium	Probable	**Neg (-)**	**High**	**Low**	Site-specific	Short term	Medium	Low	Im-probable	**Neg (-)**	**High**	**Very low**
CONSTRUCTION PHASE: Loss (6.74 ha) of seep wetland 1 habitat and ecoservices as a result of the construction of the proposed CWA development.															
Altered wetland habitat and impacts to biota															
Local	Long term	High	High	Definite	**Neg (-)**	**High**	**High**	Site-specific	Long term	High	High	Definite	**Neg (-)**	**High**	**Moderate**
OPERATIONAL PHASE: Operation of the runway and related infrastructure (including stormwater attenuation ponds)															
Impact on hydrological function and water quality (on seep wetland 1)															
Site-specific	Long term	High	Medium	Probable	**Neg (-)**	**High**	**Moderate**	Site-specific	Long term	Medium	Medium	Probable	**Neg (-)**	**High**	**Moderate**
Impact to geomorphological processes (sediment balance, erosion and sedimentation) (on seep wetland 1)															
Site-specific	Long term	High	Medium	Probable	**Neg (-)**	**High**	**Moderate**	Site-specific	Long term	Medium	Medium	Probable	**Neg (-)**	**High**	**Moderate**
Wetland habitat loss, altered wetland habitat and impacts to biota (on seep wetland 1)															
Local	Long term	High	High	Definite	**Neg (-)**	**High**	**High**	Local	Long term	Medium	Medium	Definite	**Neg (-)**	**High**	**Moderate**
Impact on hydrological function and water quality (on CVB wetlands 2 and 3)															
Site-specific	Long term	Low	Low	Probable	**Neg (-)**	**High**	**Low**	Site-specific	Long term	Low	Very Low	Probable	**Neg (-)**	**High**	**Very low**
Impact to geomorphological processes (sediment balance, erosion and sedimentation) (on CVB wetlands 2 and 3)															
Site-specific	Long term	Low	Low	Probable	**Neg (-)**	**High**	**Low**	Site-specific	Long term	Low	Very Low	Probable	**Neg (-)**	**High**	**Very low**
Altered wetland habitat and impacts to biota (to CVB wetlands 2 and 3)															
Site-specific	Long term	Low	Low	Probable	**Neg (-)**	**High**	**Low**	Site-specific	Long term	Low	Very Low	Possible	**Neg (-)**	**High**	**Very low**
OPERATIONAL PHASE: Operation of the maintenance road and fences and maintenance of service infrastructure															
Impact on hydrological function and water quality															
Site-specific	Long term	Low	Low	Definite	**Neg (-)**	**High**	**Low**	Site-specific	Long term	Low	Very Low	Probable	**Neg (-)**	**High**	**Very low**
Altered wetland habitat and impacts to biota															
Site-specific	Long term	Low	Low	Definite	**Neg (-)**	**High**	**Low**	Site-specific	Long term	Low	Very Low	Possible	**Neg (-)**	**High**	**Very low**

UNMANAGED								MANAGED							
Extent	Duration	Intensity	Magnitude	Probability	Status	Confidence	Significance	Extent	Duration	Intensity	Magnitude	Probability	Status	Confidence	Significance
OPERATIONAL PHASE: Operation of the stormwater attenuation ponds and release of hydrocarbons into the wetlands from attenuation ponds and surrounding landscape															
Impact on hydrological function and water quality															
Local	Long term	Low	Medium	Definite	Neg (-)	High	Moderate	Local	Long term	Low	Low	Probable	Neg (-)	High	Low
Impact to geomorphological processes (sediment balance, erosion and sedimentation)															
Local	Long term	Low	Medium	Definite	Neg (-)	High	Moderate	Local	Long term	Low	Very Low	Probable	Neg (-)	High	Very low
Altered wetland habitat and impacts to biota															
Local	Long term	Low	Medium	Definite	Neg (-)	High	Moderate	Local	Long term	Low	Low	Probable	Neg (-)	High	Low
OPERATIONAL PHASE: 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															
Altered wetland habitat and impacts to biota															
Site-specific	Long term	Low	Low	Definite	Neg (-)	High	Low	Site-specific	Long term	Low	Very Low	Probable	Neg (-)	High	Very low

11.1.2. DWS Risk Assessment – Proposed Development

DWS specified RAM (as promulgated in GN 4167 of 2023 as it relates to the NWA) was applied to ascertain the significance of risk associated with the proposed development on the key drivers and receptors (hydrology, water quality, geomorphology, habitat and biota) of the wetlands associated with the proposed CWA development.

The following potential ecological risks on the freshwater ecosystems were considered as part of this assessment:

- Changes to the socio-cultural and service provision;
- Impacts on the hydrology and sediment balance of the wetlands;
- Impacts on water quality;
- Associated indirect impacts to biota; and
- Proliferation of alien and invasive plant (AIP) species.

The results of the risk assessment are summarised in Table 21 below, including key control measures for each activity that must be implemented.

Table 21: Summary of the results of the DWS risk assessment applied to the freshwater ecosystems at potential risk from the proposed CWA development.

<table>
<tr><th></th><th>Activity</th><th>Impact</th><th>Freshwater Ecosystem</th><th>Mitigation Measures</th><th>Significance</th><th>Risk Rating</th></tr>
<tr><td colspan="7">Construction Phase</td></tr>
<tr><td rowspan="3">1</td><td rowspan="3">Site access, clearing and preparation for civil works which involves:
• 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.</td><td rowspan="3">• Removal of vegetation leading to exposure of soil.
• Increased likelihood of dust generation due to exposed soil.
• Increased runoff and erosion due to exposed soil and soil disturbance, leading to sedimentation of the freshwater ecosystems.
• Soil and stormwater contamination from oil and hydrocarbons originating from vehicles; and
• Proliferation of AIP as a result of disturbances.</td><td>Seep wetland 1</td><td rowspan="3">1. Access to the site must be from existing access roads as far as feasible to avoid indiscriminate driving through the freshwater ecosystems.
2. 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 (e.g. Figure A) 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 A: Example of a barrier fence used to demarcate the no-go area around the freshwater ecosystems and the 15m construction conservation buffer.
3. 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 32 m NEMA ZoR. A designated contractor laydown area must be approved by an independent ECO prior to use.
4. Stockpiles must be placed outside the delineated freshwater ecosystems and 32m thereof.</td><td>30</td><td>M</td></tr>
<tr><td>CVB wetland 2 and 3</td><td>14,4</td><td>L</td></tr>
<tr><td>CVB wetland 4</td><td>8,4</td><td>L</td></tr>
</table>

	Activity	Impact	Freshwater Ecosystem	Mitigation Measures	Significance	Risk Rating
				5. 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. 6. Avoid unnecessary trampling of vegetation irrespective of the vegetation being associated with the freshwater ecosystems or the surrounding terrestrial area. 7. Retain as much indigenous vegetation as possible (wetland and terrestrial). 8. Dust suppression measures must be implemented throughout construction to prevent excessive dust which may smother freshwater vegetation. 9. 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. 10. 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. 11. 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 12. 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.		

	Activity	Impact	Freshwater Ecosystem	Mitigation Measures	Significance	Risk Rating
2	Ground-breaking, excavation of foundations and other construction related earthworks upgradient of / within the catchment of the freshwater ecosystems, and particularly within seep wetland 1.	• Disturbances of soil leading to increased AIP proliferation, and in turn to altered freshwater ecosystem habitat. • Altered runoff patterns within the landscape, leading to increased erosion and sedimentation of freshwater ecosystem habitat. • Potential for deteriorated water quality, including increased likelihood of dust generation, turbidity and sedimentation within the freshwater ecosystems. In the case of Seep wetland 1: • Loss of habitat for wetland biota. • Loss of ecoservice provision associated with the wetland portion that will be transformed. • Alteration of hydrological processes of the downstream (eastern) portion of the seep wetland. • Increased habitat fragmentation and reduction in ecological connectivity.	Seep wetland 1 CVB wetland 2 and 3 CVB wetland 4	1. 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. 2. 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. 3. 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. 4. 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. 5. 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. 6. 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. 7. 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. 8. With the exception of the infrastructure as described in this report (the potable water 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 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. 9. 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.	**32** **14,4** **5,6**	**M** **L** **L**

	Activity	Impact	Freshwater Ecosystem	Mitigation Measures	Significance	Risk Rating
3	Earthworks involved in the construction of the maintenance road along the eastern boundary of the study area, 2 perimeter fences and linear infrastructure associated with the proposed CWA development.	• Earthworks could be potential sources of sediment, which may be transported as runoff into the freshwater ecosystems. • Disturbances of soil leading to potential indirect impacts to the freshwater ecosystems and increased sediment runoff from the construction site to the freshwater ecosystems, in turn potentially leading to altered freshwater ecosystem habitat. • Loss of freshwater habitat (in the case of seep wetland 1). • Altered runoff patterns, leading to increased erosion and sedimentation of the receiving environment. • Proliferation of AIPs as a result of disturbances; and • Possible contamination of soil and surface water as a result of concrete works and runoff from the construction site, leading to a reduced ability to support biodiversity; • Fragmentation of the freshwater ecosystems as a result of the	Seep wetland 1 CVB wetland 2 and 3 CVB wetland 4	10. 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 area of the freshwater ecosystems: 11. 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 B); 12. Trenches must be backfilled as soon as the infrastructure has been installed in any given section to reduce potential erosion of exposed soil. 13. 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. 14. No stormwater may be directly released into the freshwater environment.  **Figure B: Excavation for trenching with stockpiles alongside.** 15. 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). 16. Construction activities are only allowed in the development footprint. Refer to Activity 1 control measure 2. As far as possible, physical movement in the freshwater ecosystems by personnel must be limited; and	**16** **12** **3,2**	**L** **L** **L**

	Activity	Impact	Freshwater Ecosystem	Mitigation Measures	Significance	Risk Rating
		proposed linear infrastructure		17. Under no circumstances must linear infrastructure be trenched within the CVB wetlands 2 and 3 or their conservation buffer. Design plans must reconsider the layout of the water pipelines to avoid these wetlands.		
4	Construction activities related to the proposed development - construction of CWA, industrial buildings, water treatment facilities, WWTW, bio-digester, stormwater infrastructure and installation of service infrastructure (including bulk water pipeline and substations) in the study area and GN 4167 ZoR.	• Potential conveyance of sediment laden stormwater into the freshwater ecosystems; • Disturbance to vegetation and habitat ecoservice provision; • Potential disturbance to hydrological functioning and activity of the freshwater ecosystems; • Disturbances of soils potentially leading to increased alien vegetation proliferation, and in turn to altered habitat; • Altered runoff patterns, leading to increased erosion and sedimentation of the freshwater ecosystems; • Compaction of soil and loss of habitat as a result of ongoing disturbance from vehicles and equipment.	Seep wetland 1	1. Refer to control measure 1 Activity 2 and 3. 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. 2. Refer to control measures of Activities 2 and 3 related to stockpiling and trenching. Control measures specific to asphalt / concrete works: 3. 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: 3.1. 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. 3.2. 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. 3.3. 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. 3.4. 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.	**32**	**M**
			CVB wetland 2 and 3		**12,8**	**L**
			CVB wetland 4		**8,4**	**L**
5	Construction of one of the fences, the maintenance road along the eastern perimeter of the		Seep wetland 1		**7,2**	**L**

	Activity	Impact	Freshwater Ecosystem	Mitigation Measures	Significance	Risk Rating
	study area and over the CVB wetlands and adjacent to the seep wetland 1 and the water irrigation pipeline through seep wetland 1 and adjacent to CVB wetlands 2 and 3		CVB wetland 2 and 3	3.5. 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 3.6. Spilled or excess concrete must be disposed of at a suitable landfill site. Chain of custody documentation must be provided. <u>Control measures specific to the construction of stormwater infrastructure:</u> 4. 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 (Figure C). 5. Attenuation ponds must be vegetated with indigenous obligate and facultative species suitable for seasonal saturation. 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 C: Examples of swales utilised for conveyance of stormwater.** 6. 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 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	**7,2**	**L**

	Activity	Impact	Freshwater Ecosystem	Mitigation Measures	Significance	Risk Rating
				potentially reduce the extent and functionality of the wetland systems in the long-term; 7. Refer to control measure 9 of Activity 1. 8. All materials used to construct the attenuation ponds must not generate toxic leachates or lead to significant changes in pH or dissolved salt concentrations. 9. No plastic lining may be used as part of the attenuation pond construction as this has various ecological impacts. 10. 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. 11. 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 of Activity 4 and 5 above. These must ideally be constructed during the drier summer months to reduce the impact on water quality of the seep wetland 1. 12. Refer to control measures of Activity 2 and 3 regarding soil stockpiles. 13. Litter traps must be installed at all the outlet structures to prevent any litter from entering the freshwater ecosystems. 14. 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. 15. All soil compacted within the wetlands as a result of construction equipment must be loosened prior to revegetation with suitable indigenous species. 16. Suitable dust management practices must be implemented for the duration of construction. 17. 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. 18. Refer to control measure 1 of Activity 1 regarding movement in the freshwater ecosystems. Careful planning of all construction equipment must be undertaken beforehand to ensure that the minimum impact on the freshwater ecosystems occur. 19. Any fences that are to traverse the CVB wetlands 2 and 3 must be installed in such a way that hydropedological processes are not		

	Activity	Impact	Freshwater Ecosystem	Mitigation Measures	Significance	Risk Rating
				impeded within these systems. It is recommended that the erection of fence posts within the CVB wetlands 2 and 3 are avoided; and 20. 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 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. 21. 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.		
				Operational Phase		
6	Operation of the CWA development, roads, and internal service infrastructure (excluding the stormwater attenuation ponds, but including <u>bulk water pipeline,</u> sewer and water treatment plants, bio-digester and fuel stations).	• Increased risk of pollution of surface water resulting from seepage/runoff from impermeable surfaces such as the runway, access road, passenger parking, terminal buildings, fuel stations, etc., potentially affecting the downgradient freshwater ecosystems, leading to impaired water quality and salination of soils. • Increased risk of sediment transport in surface runoff from impermeable surfaces into the freshwater ecosystems leading to altered water quality,	Seep wetland 1	1. Implement a monitoring programme to detect and prevent the pollution of soils, surface water and groundwater. 2. Monitor wetlands that will 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. An offset plan is being compiled by FEN Consulting which will outline an appropriate monitoring approach. 3. A Service Infrastructure Management Plan should be compiled which details the frequency in which service infrastructure, particularly the sewer and water treatment plants 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; 4. 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. 5. Jet fuel and other potential hazardous chemicals must be stored in a manner that reduces the potential for spills; and 6. 6. An emergency spill protocol must be compiled and is to be maintained for the CWA, especially for potential spills on the runways,	**24**	**L**
			CVB wetland 2 and 3		**13,2**	**L**

	Activity	Impact	Freshwater Ecosystem	Mitigation Measures	Significance	Risk Rating
		smothering of biota and altered vegetation community composition; and • Increased risk of erosion, leading to further altered topography/geomorphology, in turn resulting in altered runoff patterns and formation of preferential flow paths.	CVB wetland 4	aprons, roads, etc. to prevent the pollutants from being transported via stormwater infrastructure into the downgradient wetlands	**8,8**	**L**
7	Operation of the stormwater infrastructure within the study area	• Potential pollutants and toxicants entering into the seep wetland 1 and CVB wetland 3; • Potential changes to the water retention pattern, timing and flows within downgradient wetlands, especially the seep wetland 1 and CVB wetland 3; • Potential erosion and sedimentation within the seep wetland 1 and CVB wetland 3 as a result of the increased stormwater discharge causing increased scour and velocity.	Seep wetland 1	1. 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. All pipelines and attenuation ponds must be regularly cleaned, and all outlet structures (if any) checked to ensure there is no debris/blockages. 3. 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 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. 4. 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; and 5. The proposed stormwater infrastructure must be incorporated into a suitable and site-specific Stormwater Management Plan (e.g. (Zutari, Concept Stormwater Management Plan, August 2024) and the stormwater infrastructure are to be maintained as per the requirements of the Concept Stormwater Management Plan (Zutari, Concept Stormwater Management Plan, August 2024).	**19,2**	**L**
			CVB wetland 2		**7,2**	**Low**
			CVB wetland 3		**24**	**L**

	Activity	Impact	Freshwater Ecosystem	Mitigation Measures	Significance	Risk Rating
8	Operation and maintenance of the maintenance road and fences.	• Potential eutrophication of water as a result of enriched water draining into the freshwater ecosystems. • Potential fragmentation of the freshwater ecosystems caused by the property fences. • Proliferation of AIP species within the freshwater ecosystems. • Potential loss of indigenous vegetation as a result of maintenance works. • Disturbance to and compaction of soil resulting in erosion.	Seep wetland 1	1. It must be ensured that regular maintenance takes place to prevent failure of any infrastructure associated with the proposed CWA development. 2. Only existing roadways should be utilised during maintenance and repairs to avoid indiscriminate movement of vehicles within the wetlands. 3. 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. <u>With regards to maintenance activities</u> 4. Refer to control measure 6, and 10 to 12 of Activity 2 and 3, and control measure 3 of Activity 4 and 5; and 5. Refer to control measures Activity 2 and 3 regarding trenching and stockpiling; and 6. No vehicles are permitted to enter the freshwater ecosystems. Any maintenance works must be undertaken by foot, or the relevant authorisations obtained beforehand	**6,4**	**L**
			CVB wetland 2 and 3		**6,4**	**L**
9	Monitoring and maintenance of structural integrity of the service infrastructure and stormwater and linear infrastructure associated with the proposed CWA development		Seep wetland 1		**4,8**	**L**
			CVB wetland 2 and 3		**4,8**	**L**
			CVB wetland 4		**2**	**L**

The activities and the associated risks posed by the proposed activities are all highly site-specific, not of a significant extent relative to the area of the freshwater ecosystems assessed and therefore have a limited spatial extent (within the investigation area). With the implementation of the above-mentioned control measures, the proposed CWA development poses a Low-risk significance to the CVB wetlands 2 and 3 and are thus considered acceptable. The construction and operation of the CWA however poses a Moderate risk significance to the seep wetland 1 due to the anticipated 6.74ha wetland habitat loss. Key control measures that must be implemented include:

- 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 (Zutari, Concept Stormwater Management Plan, August 2024) 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 (Zutari, Concept Stormwater Management Plan, August 2024).
- 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;
- A monitoring programme must be implemented to detect and prevent the pollution of soils, surface water and groundwater;
- Wetlands that will potentially be impacted by the proposed CWA development must be monitored to ensure that the PES drivers and receptors are maintained, and where possible improved, in accordance with the REC and RMO. An offset plan is being compiled by FEN Consulting which will outline an appropriate monitoring approach (FEN, Draft Wetland Offset Study, January 2025);
- 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;
- A Service Infrastructure Management Plan is to 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. This will assist in the prevention of leakages and bursting of the sewer infrastructure; and
- 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.

It should be noted that although the impact on the wetland hydrology of seep wetland 1 and CVB wetland 3 is considered negative, the release of treated stormwater into these wetlands can contribute to the recharge of the systems, resulting in a net positive impact if the recommended control measures outlined in Table 21 and the management measures outlined in the Concept Stormwater Management Plan (Zutari, Concept Stormwater Management Plan, August 2024, also refer to Section 7 of this report) are implemented (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025).

With strict enforcement of the site-specific control measures, the significance of impacts arising from the construction and operational phase of the proposed CWA development can be effectively reduced and managed (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025). Additional "good practice" control measures applicable to a project of this nature are provided in Appendix G of the FEN EIA Phase Freshwater Ecological Assessment (February 2025).

11.1.3. Cumulative Freshwater Impacts

Freshwater ecosystems within the Cape Town region and the broader Western Cape region are under continued and increasing threat due to a variety of factors primarily related to changes in land use which, in the long term, may prove to be unsustainable. The predominant land use and economic activity in the wider area is commercial agriculture. This has resulted in degradation of freshwater features due to land transformation and resultant disturbance to surrounding freshwater features through proliferation of AIPs, as well as physical transformation of freshwater ecosystems, primarily in the form of impoundments and other artificial structures (such as stormwater drains) that have been developed along most of the drainage lines in the area. Increasing urbanisation and continued urban sprawl, including within the greater area in which the CWA development is proposed to be located, are further contributing to the cumulative impacts to freshwater ecosystems in the area (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025).

The stormwater impoundments exert various types of impacts, including freshwater habitat transformation, hydrological impacts, as well as hydromorphological impacts. Other factors such as existing linear infrastructure (roads and railways), urban expansion as well as climate change also exert impacts on the freshwater ecosystems in the wider area. The development of the CWA will impact freshwater ecosystems located on the development site (i.e. resulting in the loss of 6.74ha of wetland habitat of seep wetland 1), and potentially those located downgradient of, and adjacent to the study area, thereby potentially resulting in a cumulative impact on the freshwater ecosystems and associated biodiversity it supports. The operation of the CWA and stormwater related impacts associated with the proposed development will cumulatively add to the existing water quality and sediment issues currently experienced by the freshwater ecosystems. The implementation of control measures to avoid impacts where possible will either reduce the scale and intensity of such a cumulative impact, or under a best-case scenario will negate the creation of a cumulative impact (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025). A freshwater offset is being investigated for the 6.74ha loss of freshwater habitat associated with the seep wetland 1, as per consultation between the proponent and the DWS, and guidance and stipulations provided by the DWS in this regard (Refer to Section 8 of this report). The offset investigation will assist in the positive cumulative impacts on the freshwater ecosystems within the broader region of the proposed CWA development.

The loss of an area of wetland in the study area, if not offset, will contribute to the cumulative loss of wetland habitat within a local catchment context. Although not regionally significant and limited in extent in a regional context, any loss of wetland habitat is significant and accordingly the loss of wetland habitat of the western portion of the seep wetland 1 in the study area needs to be offset according to the relevant hectare equivalents to ensure that no nett loss of wetland habitat and functionality occurs (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025). For the remainder of the seep wetland 1 and the CVB wetlands 2 and 3 within the investigation area, the impacts associated with the proposed CWA development are unlikely to contribute significantly to the cumulative effect on the loss of wetland habitat within the local catchment or the region provided that cognisant, well-planned design is implemented. The PES and ecoservice provision of the freshwater ecosystems has to be maintained or improved were feasibly possible, as per the REC and RMO.

While the development of an airport may bring economic benefits, the significance of climate change impacts on wetland ecology should not be overlooked, as these ecosystems provide ecological services such as flood regulation, water purification, and biodiversity support, which are important for maintaining overall environmental health and resilience (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025). Climate change is anticipated to have several impacts on wetland ecology in the Western Cape, South Africa, including in the local region of the proposed CWA development. These impacts may include:

- Changes in precipitation patterns: Climate change could alter precipitation patterns, leading to changes in water availability in wetlands. Some areas may experience increased rainfall, leading to flooding and changes in hydrology, while others may face drought conditions, resulting in reduced water levels;
- Temperature increases: Rising temperatures could affect wetland ecosystems by altering the physiology and behaviour of species that inhabit them. Increased temperatures can also lead to changes in water temperature, affecting aquatic species' breeding, migration patterns, and overall health;
- Extreme weather events: Climate change is expected to increase the frequency and intensity of extreme weather events such as storms, hurricanes, and heatwaves. These events can cause physical damage to wetland habitats, disrupt ecosystem functions, and lead to loss of biodiversity; and
- Changes in vegetation composition: Altered environmental conditions may result in shifts in vegetation composition within wetlands. Some species may thrive under new conditions, while others may struggle to adapt or face local extinction.

While the above potential impact associated with climate change are acknowledged, it is considered unlikely that the proposed CWA development will contribute significantly to impacts of climate change on the ecology of the freshwater ecosystems identified to be associated with the CWA development. Therefore, an impact assessment of cumulative effects is not included in the Freshwater Ecological Impact Assessment report (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025). Nevertheless, control measures that could be implemented to address these climate change impacts include:

- Wetland restoration and conservation: Protecting and restoring wetland habitats can help mitigate the effects of climate change by preserving ecosystem services, enhancing biodiversity, and providing natural buffers against extreme weather events; and

- Water management: Implementing sustainable water management practices can help maintain water levels in wetlands, particularly during periods of drought. This may include water conservation measures, watershed management, and the restoration of natural hydrological processes to as close as possible mimic the natural pattern, flow and timing of water in the landscape, where possible.

Incorporating wetlands and biodiversity resource management considerations into development planning can bolster climate change resilience by fostering natural buffers and enhancing ecosystem services. By implementing these mitigation measures, stakeholders can work to minimize the adverse effects of climate change on wetland ecology and promote the long-term sustainability of these ecosystems.

11.1.4. Monitoring Requirements: Potential Freshwater Ecological Impacts

The FEN Detailed EIA Phase Freshwater Ecological Assessment (February 2025) included the following monitoring requirements:

- A monitoring programme must be implemented to detect and prevent the pollution of soils, surface water and groundwater;
- 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.

11.2. Potential Groundwater Impacts

GEOSS South Africa (Pty) was appointed to conduct a groundwater impact assessment as part of the NEMA application for the proposed CWA development. The assessment aims to determine the hydrogeological conditions of the site and the potential impacts that the development may have on the groundwater resources. For a risk to groundwater to exist there must be a source (s), pathway(s) and receptor(s). All three are present in the case of the proposed development of the CWA.

Potential sources of contamination associated with the proposed development are outlined in Table 22. Contamination originating from the various potential sources as outlined in Table 22 could infiltrate the subsurface soils and groundwater due to the existence of preferential flow paths. Preferential flow paths include boreholes, edges of buildings and/or conduits constructed for stormwater management and or reticulation of services that extend deeper into the ground. These contaminates may reach receptors such as the underlying aquifer and groundwater users, as well as on site workers through dermal contact with contaminated soils or water.

Table 22: Origins, locations, and operations of potential groundwater impact sources at Civil airports sources (GEOSS, Groundwater Impact Assessment, February 2025)

Origin	Location	Operations
Surface runoff	Runways, taxiways, aprons, roadways, maintenance areas, vehicle parking areas, hangars, workshops, and other paved areas	Refuelling, handling, parking of vehicles, maintenance of aircraft, vehicles and other equipment, drained by rainwater, pavement cleaning
Leaks from fuel storage and distribution	Fuel Farm	Refuelling on fuel farms and storage of other chemical substances (pesticides, lubricants, solvents, etc.)
Leaks from fuel storage and distribution	AVGAS storage area	Refuelling (hydrant systems) and storage of other chemical substances (solvents, antioxidants, etc.)
Leaks from fuel storage and distribution	Retail service station (petrol station)	Refuelling and storage of other chemical substances (lubricants and solvents)
Leaks from bulk fuel storage	Construction laydown areas, fuel farms, refuelling stations, fuel storage areas	Storage and refuelling on and around construction laydown areas, storage of large amounts of fuel.
Atmospheric deposition	Unpaved areas	Aircraft operations (engine starting, run-ups, testing, ground manoeuvring, take-off, and landing), handling vehicles and equipment, heating systems, and winter operations
Direct release	Unpaved areas, fire-fighting training areas, and storage facilities	Weed control, fire-fighting training, storage/ deposition of substances in unpaved/pervious areas
Accidental contamination (other origins)	Electrical substations, green areas, hangars, workshops, cargo terminal, and storage facilities	Leaks during operation or servicing of electrical substations, spills of pesticides, spills of chemical substances used in cleaning and maintenance of aircraft, handling vehicles and other equipment, spills from cargo

In addition to the potential pollution sources noted above, pollution sources associated with wastewater treatment were considered. These potential contamination sources include:

- storage of wastewater before treatment,
- storage of brine from treated potable water,
- storage of chemicals associated with WWTW, and

- irrigation of the landscape with treated wastewater.

The final potential pollution source that was considered is the biodigester. It was initially proposed that the biodigester would use chicken manure as a feedstock, however, concerns arose regarding "digestate" from biodigester potentially leading to nutrient pollution of surface and groundwater bodies if not properly managed (GEOSS, Groundwater Impact Assessment, February 2025). Subsequently, the design of the biodigester has been altered whereby the feed stream will be comprised of treated effluent from the WWTW (200m^3/day) and cultivated biomass/energy crop (15t/day). Further, organic waste from the site may be used to supplement the feed. Treated biosolids from the WWTW may also be used to supplement the feed stream on the condition that they are not tested to be hazardous. Potential for groundwater contamination exists during the operation of the biodigester as digestate may leak and be transported to the groundwater. Some elements in the digestate have the potential to contaminate groundwater however some studies have concluded that a relatively low potential for groundwater contamination exists for digestate used as fertilizer compared to inorganic fertilisers (GEOSS, Groundwater Impact Assessment, February 2025).

11.2.3. Groundwater Impact Assessment – No-Go Option

The No-Go option would entail the preservation of the site as is and no further development. The risks associated with the existing development onsite are outlined in Table 24 to Table 27.

Table 23: Impact table for contamination of groundwater as a result of surface run-off (GEOSS, Groundwater Impact Assessment, February 2025).

Potential impact on groundwater quality deterioration because of surface runoff.		
Impact	**Description**	
Nature of Impact	Contamination of groundwater and surrounding environment due to contaminated stormwater emanating from the facility infiltrating into the groundwater, leading to a decrease in groundwater quality.	
Status of Impact	Negative	
Recommended mitigation measures	**Description**	
Impact avoidance/ Prevention/ Mitigation	Ensure that the current stormwater management systems are equipped with catch pits to isolate fuel and other contaminants. Properly designed stormwater management systems are required. 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 discharging 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 (for a more detailed description the reader is referred to CEDR, 2016). Petrol interceptors might be considered to mitigate the risks of contaminants draining into the environment.	
Assessment of impact	**Rating before mitigation**	**Rating after mitigation**
Extent of impact	Local (L)	Site Specific (SS)
Duration of impact	Long term (L)	Short term (S)
Magnitude of negative impact	Medium (M)	Low (L)
Magnitude of positive impact	Zero (Z)	Zero (Z)
Intensity of impact	Destructive – Medium (M)	Destructive – Low (L)
Probability of occurrence	Possible (Po)	Improbable (Im)
Significance	**Low (L)**	**Very Low (VL)**
Confidence	Sure (S)	Sure (S)

Table 24: Impact table for contamination of groundwater as a result of leaks from fuel storage and distribution GEOSS, Groundwater Impact Assessment, February 2025).

Potential impact on groundwater quality deterioration because of leaks from fuel storage and distribution.	
Impact	**Description**
Nature of Impact	Containment, distribution and storage of fuel and other chemical substances (e.g. cleaning agents for apparatus associated with airport equipment used for operation/pesticides for vegetated areas).
Status of Impact	Negative
Recommended mitigation measures	**Description**
Impact avoidance/ Prevention/ Mitigation	Necessary levels of protection and monitoring will need to be installed on site to reduce the risk of contamination. Here we list some general recommendations for the storage and containment of petrol and diesel. Similar approaches may be required for different types of fuel required at the airport refuelling depot; however, this should be guided by relevant industry practises and international airport development guidelines. The mitigation measures listed below must be employed to ensure no contamination of the aquifer takes place. 1. 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; 2. Fuel lines and sumps must be secondary contained where lines are joined. 3. The filling station must include the following design measures: • **<u>Fuel Containment Area</u>** 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. • **<u>Forecourt Area</u>** 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 4. All containment manholes must be regularly inspected as part of the normal management procedures at the service station. 5. 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 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) (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 500 L.** 6. The installation of the UST's and associated pipework must comply with the National Building Regulations and Standards Act No. 103 of 1977; 7. 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); 8. 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 BAR and to all required SABS / SANS standards and applicable legislation. A report thereafter, based on the engineer's findings, it to be submitted to the DEA & DP Land Management and Pollution Directorates for inspection and the City of Cape Town Municipality. 9. 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** 10. 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; 11. Construction of a reinforced concrete slab over the USTs, its thickness and strength are to be determined by a qualified Engineer; 12. 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; and

	13. The USTs are to be fitted with a tank containment sump, fitted on top of the tank and a dispenser containment sump must be provided, fitted underneath the dispenser as containment. A Filler spill containment must also be provided for remote filler containment purposes; 14. 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; **15. 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);** 16. The UST is to be inspected before installation for damage, including factures or damage to coating work. 17. 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. 18. The UST must be buried 750mm below finished ground level in accordance with SANS 10089-3; 19. 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** 20. 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. 21. 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; 22. 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; 23. 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 24. 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: 25. 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; 26. When ownership of the UST and associated underground pipework changes; 27. 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; 28. 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. 29. USTs are to be fitted with a monitoring tube to allow for the monitoring of leaks through the tank surface; 30. Leak detectors are to be installed to the submersible pumps within UST manholes to ensure that there are no line leaks; 31. 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. 32. 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 16 mm diameter monitoring pipe over portion of this depth 33. The Groundwater Monitoring Action Plan must be included as an Annexure to the approved EMP. **34. Observation wells must be installed in the sand fill surrounding the underground storage tanks for regular monitoring purposes** 35. All containment manholes must be regularly inspected as part of the normal management procedures at the service station 36. 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. **37. 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 38. Installation of pump islands in the forecourt area. The pumps are to be fitted with a Spill Containment Chamber; 39. 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.	
Assessment of impact	**Rating before mitigation**	**Rating after mitigation**
Extent of impact	Local (L)	Site Specific (SS)
Duration of impact	Long term (L)	Short term (S)
Magnitude of negative impact	Medium (M)	Low (L)
Magnitude of positive impact	Zero (Z)	Zero (Z)
Intensity of impact	Destructive – Medium (M)	Destructive – Low (L)
Probability of occurrence	Possible (Po)	Improbable (Im)
Significance	**Medium (M)**	**Very Low (VL)**
Confidence	Sure (S)	Sure (S)

Table 25: Impact table for contamination of groundwater as a result of atmospheric deposition GEOSS, Groundwater Impact Assessment, February 2025).

Potential impact on groundwater quality deterioration because of atmospheric deposition.		
Impact	**Description**	
Nature of Impact	Aircraft operations (engine starting, run-ups, testing, ground manoeuvring, take-off, and landing), handling vehicles and equipment, and heating and/or cooling systems.	
Status of Impact	Negative	
Recommended mitigation measures	**Description**	
Impact avoidance/ Prevention/ Mitigation	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. Ensure vehicles are well-maintained and always parked on paved surfaces.	
Assessment of impact	**Rating before mitigation**	**Rating after mitigation**
Extent of impact	Local (L)	Site Specific (SS)
Duration of impact	Long term (L)	Short term (S)
Magnitude of negative impact	Low (L)	Low (L)
Magnitude of positive impact	Zero (Z)	Zero (Z)
Intensity of impact	Destructive – Low (L)	Destructive – Low (L)
Probability of occurrence	Possible (Po)	Improbable (Im)
Significance	**Low (L)**	**Very Low (VL)**
Confidence	Sure (S)	Sure (S)

Table 26: Impact table for contamination of groundwater as a result of Direct Release GEOSS, Groundwater Impact Assessment, February 2025).

Potential impact on groundwater quality deterioration because of direct release.		
Impact	**Description**	
Nature of Impact	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 (Cheng et. al., 2009). 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.	
Status of Impact	Negative	
Recommended mitigation measures	**Description**	
Impact avoidance/ Prevention/ Mitigation	For routine burns and training purposes, make use of biodegradable fuels, which once burned minimises the impact on the groundwater. Mitigation will include outlawing the use of PFC substances 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 should be monitored and analysed for several chemical parameters (to be established once the composition of the extinguishing agents used on site are known) and must be disposed of or stored appropriately in accordance with the National Water Act (DWS, 1998) (and relevant amendments).	
Assessment of impact	**Rating before mitigation**	**Rating after mitigation**
Extent of impact	Local (L)	Site Specific (SS)
Duration of impact	Long term (L)	Long term (L)
Magnitude of negative impact	Low (L)	Low (L)
Magnitude of positive impact	Zero (Z)	Zero (Z)
Intensity of impact	Destructive – Medium (M)	Destructive – Low (L)
Probability of occurrence	Probable (Pr)	Improbable (Im)
Significance	**Low (L)**	**Low (L)**
Confidence	Sure (S)	Sure (S)

Table 27: Impact table for contamination of groundwater as a result of Accidental Release GEOSS, Groundwater Impact Assessment, February 2025).

Potential impact on groundwater quality deterioration because of Accidental Release.		
Impact	**Description**	
Nature of Impact	The origins of accidental releases of contaminants to the environment are electrical infrastructure (substations) and spillages by chemical storage facilities (Nunes, 2011).	
Status of Impact	Negative	
Recommended mitigation measures	**Description**	
Impact avoidance/ Prevention/ Mitigation	Ensure that the construction and design of the bunding for storage of chemical substances that are stored on site is appropriate. Ensure that existing electrical infrastructure (where risk of contamination exists, i.e. substations) is located 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.	
Assessment of impact	**Rating before mitigation**	**Rating after mitigation**
Extent of impact	Local (L)	Site Specific (SS)
Duration of impact	Long term (L)	Long term (L)
Magnitude of negative impact	Medium (M)	Low (L)
Magnitude of positive impact	Zero (Z)	Zero (Z)
Intensity of impact	Destructive – Medium (M)	Destructive – Low (L)
Probability of occurrence	Possible (Po)	Improbable (Im)
Significance	**Low (L)**	**Very Low (VL)**
Confidence	Sure (S)	Sure (S)

11.2.3. Groundwater Impact Assessment – Proposed development

Several risks have been identified for the proposed development. During the construction and operational phase of the proposed development soil and groundwater contamination could result due to several potential contaminate sources detailed as detailed in Table 22. Each source of potential contamination has been qualitatively assessed and impact tables inclusive of mitigation measures has been presented in Table 28 to Table 41 below (GEOSS, Groundwater Impact Assessment, February 2025).

It is anticipated that some subsurface structures will be required, e.g., for basement parking lots. Since the groundwater in the region is typically well below 30mbgl, it is anticipated that dewatering will not be required during construction. However, based on the information collected during the preliminary geotechnical assessment there are areas of local perched water tables across the site. Such areas may require some dewatering activities during construction.

Table 28: Impact table for contamination of groundwater as a result of construction of the facility (GEOSS, Groundwater Impact Assessment, February 2025)

Potential impact on groundwater quality deterioration because of contamination by construction of the facility.		
Impact	**Description**	
Nature of Impact	Contamination of groundwater and surrounding environment due to the construction processes of the facility such as concrete batching, leading to a decrease in groundwater quality.	
Status of Impact	Negative	
Recommended mitigation measures	**Description**	
Impact avoidance/ Prevention/ Mitigation	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. Fuel spillages are deal with in more detail in subsequent tables, the mitigation measures should also be adopted here. 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.	
Assessment of impact	**Rating before mitigation**	**Rating after mitigation**
Extent of impact	Site Specific (SS)	Site Specific (SS)
Duration of impact	Short term (S)	Short term (S)
Magnitude of negative impact	Low (L)	Low (L)
Magnitude of positive impact	Zero (Z)	Zero (Z)
Intensity of impact	Destructive – Low (L)	Destructive – Low (L)
Probability of occurrence	Possible (Po)	Improbable (Im)
Significance	**Very Low (VL)**	**Very Low (VL)**
Confidence	Sure (S)	Sure (S)

Table 29: Impact table for contamination of groundwater as a result of surface runoff (GEOSS, Groundwater Impact Assessment, February 2025).

Potential impact on groundwater quality deterioration because of surface runoff.		
Impact	**Description**	
Nature of Impact	Contamination of groundwater and surrounding environment due to the construction processes of the facility such as concrete batching, leading to a decrease in groundwater quality.	
Status of Impact	Negative	
Recommended mitigation measures	**Description**	
Impact avoidance/ Prevention/ Mitigation	Installation of appropriate stormwater systems with catch pits to isolate fuel and other contaminants. Properly designed stormwater management systems and is required. 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 (for a more detailed description the reader is referred to CEDR, 2016). Petrol interceptors might be considered to mitigate the risks of contaminants draining into the environment.	
Assessment of impact	**Rating before mitigation**	**Rating after mitigation**
Extent of impact	Local (L)	Site Specific (SS)
Duration of impact	Long term (L)	Short term (S)
Magnitude of negative impact	Medium (M)	Low (L)
Magnitude of positive impact	Zero (Z)	Zero (Z)
Intensity of impact	Destructive – Medium (M)	Destructive – Low (L)
Probability of occurrence	Possible (Po)	Improbable (Im)
Significance	**Medium (M)**	**Very Low (VL)**
Confidence	Sure (S)	Sure (S)

Table 30: Impact table for contamination of groundwater as a result of leaks from fuel storage and distribution (GEOSS, Groundwater Impact Assessment, February 2025).

Potential impact on groundwater quality deterioration because of leaks from fuel storage and distribution.	
Impact	**Description**
Nature of Impact	Containment, distribution and storage of fuel and other chemical substances (e.g. cleaning agents for apparatus associated with airport equipment used for operation/pesticides for vegetated areas).
Status of Impact	Negative
Recommended mitigation measures	**Description**
Impact avoidance/ Prevention/ Mitigation	Necessary levels of protection and monitoring will need to be installed on site to reduce the risk of contamination. Here we list some general recommendations for the storage and containment of petrol and diesel. Similar approaches may be required for different types of fuel required at the airport refuelling depot; however, this should be guided by relevant industry practises and international airport development guidelines. The mitigation measures listed below must be employed to ensure no contamination of the aquifer takes place. 40. 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; 41. Fuel lines and sumps must be secondary contained where lines are joined. 42. The filling station must include the following design measures: • **<u>Fuel Containment Area</u>** 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. • **<u>Forecourt Area</u>** 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 43. All containment manholes must be regularly inspected as part of the normal management procedures at the service station. 44. 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: **d) 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 stations and consumer installations.** **e) SANS 10 400TT (Fire Protection) 53 Sections 1-6 (The application of the National Building Regulations-Installation of Liquid Fuel Dispensing Pumps and Tanks);** **f) 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 500 L.** 45. The installation of the UST's and associated pipework must comply with the National Building Regulations and Standards Act No. 103 of 1977; 46. 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); 47. 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 BAR and to all required SABS / SANS standards and applicable legislation. A report thereafter, based on the engineer's findings, it to be submitted to the DEA & DP Land Management and Pollution Directorates for inspection and the City of Cape Town Municipality. 48. 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** 49. 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; 50. Construction of a reinforced concrete slab over the USTs, its thickness and strength are to be determined by a qualified Engineer; 51. 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; and

52. The USTs are to be fitted with a tank containment sump, fitted on top of the tank and a dispenser containment sump must be provided, fitted underneath the dispenser as containment. A Filler spill containment must also be provided for remote filler containment purposes;
53. 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;
54. **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);**
55. The UST is to be inspected before installation for damage, including factures or damage to coating work.
56. 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.
57. The UST must be buried 750mm below finished ground level in accordance with SANS 10089-3;
58. The local Fire Department must be informed two (2) working days before installation commences and to be called for inspection at the following stages:

d) Installation of tank on clean sand bed before backfilling
e) Witness pressure test (delivery lines 1000kPa, tank 35kPa); and
f) Inspection of slab over tank before concreting;

Pipework

59. 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.
60. 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;
61. 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;
62. 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 63. 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: 64. 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; 65. When ownership of the UST and associated underground pipework changes; 66. 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; 67. 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. 68. USTs are to be fitted with a monitoring tube to allow for the monitoring of leaks through the tank surface; 69. Leak detectors are to be installed to the submersible pumps within UST manholes to ensure that there are no line leaks; 70. 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. 71. 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 16 mm diameter monitoring pipe over portion of this depth 72. The Groundwater Monitoring Action Plan must be included as an Annexure to the approved EMP. **73. Observation wells must be installed in the sand fill surrounding the underground storage tanks for regular monitoring purposes** 74. All containment manholes must be regularly inspected as part of the normal management procedures at the service station 75. 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. **76. 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 77. Installation of pump islands in the forecourt area. The pumps are to be fitted with a Spill Containment Chamber; 78. 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.	
Assessment of impact	**Rating before mitigation**	**Rating after mitigation**
Extent of impact	Local (L)	Site Specific (SS)
Duration of impact	Long term (L)	Short term (S)
Magnitude of negative impact	Medium (M)	Low (L)
Magnitude of positive impact	Zero (Z)	Zero (Z)
Intensity of impact	Destructive – Medium (M)	Destructive – Low (L)
Probability of occurrence	Possible (Po)	Improbable (Im)
Significance	**Medium (M)**	**Very Low (VL)**
Confidence	Sure (S)	Sure (S)

Table 31: Impact table for contamination of groundwater as a result of atmospheric deposition (GEOSS, Groundwater Impact Assessment, February 2025).

Potential impact on groundwater quality deterioration because of atmospheric deposition.		
Impact	**Description**	
Nature of Impact	Aircraft operations (engine starting, run-ups, testing, ground manoeuvring, take-off, and landing), handling vehicles and equipment, and heating and/or cooling systems.	
Status of Impact	Negative	
Recommended mitigation measures	**Description**	
Impact avoidance/ Prevention/ Mitigation	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. Ensure vehicles are well-maintained and always parked on paved surfaces.	
Assessment of impact	**Rating before mitigation**	**Rating after mitigation**
Extent of impact	Local (L)	Site Specific (SS)
Duration of impact	Long term (L)	Short term (S)
Magnitude of negative impact	Low (L)	Low (L)
Magnitude of positive impact	Zero (Z)	Zero (Z)
Intensity of impact	Destructive – Low (L)	Destructive – Low (L)
Probability of occurrence	Possible (Po)	Improbable (Im)
Significance	**Low (L)**	**Very Low (VL)**
Confidence	Sure (S)	Sure (S)

Table 32: Impact table for contamination of groundwater as a result of Direct Release (GEOSS, Groundwater Impact Assessment, February 2025).

Potential impact on groundwater quality deterioration because of direct release.		
Impact	**Description**	
Nature of Impact	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 (Cheng et. al., 2009). 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.	
Status of Impact	Negative	
Recommended mitigation measures	**Description**	
Impact avoidance/ Prevention/ Mitigation	For routine burns and training purposes, make use of biodegradable fuels, which once burned minimises 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.	
Assessment of impact	**Rating before mitigation**	**Rating after mitigation**
Extent of impact	Local (L)	Site Specific (SS)
Duration of impact	Long term (L)	Long term (L)
Magnitude of negative impact	Low (L)	Low (L)
Magnitude of positive impact	Zero (Z)	Zero (Z)
Intensity of impact	Destructive – Medium (M)	Destructive – Low (L)
Probability of occurrence	Probable (Pr)	Improbable (Im)
Significance	**Low (L)**	**Low (L)**
Confidence	Sure (S)	Sure (S)

Table 33: Impact table for contamination of groundwater as a result of Accidental Release (GEOSS, Groundwater Impact Assessment, February 2025).

Potential impact on groundwater quality deterioration because of Accidental Release.		
Impact	**Description**	
Nature of Impact	The origins of accidental releases of contaminants to the environment are electrical infrastructure (substations) and spillages by chemical storage facilities (Nunes, 2011).	
Status of Impact	Negative	
Recommended mitigation measures	**Description**	
Impact avoidance/ Prevention/ Mitigation	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.	
Assessment of impact	**Rating before mitigation**	**Rating after mitigation**
Extent of impact	Local (L)	Site Specific (SS)
Duration of impact	Long term (L)	Long term (L)
Magnitude of negative impact	Medium (M)	Low (L)
Magnitude of positive impact	Zero (Z)	Zero (Z)
Intensity of impact	Destructive – Medium (M)	Destructive – Low (L)
Probability of occurrence	Possible (Po)	Improbable (Im)
Significance	**Medium (M)**	**Low (L)**
Confidence	Sure (S)	Sure (S)

Table 34: Impact table for contamination of groundwater because of biodigester facilities for energy generation (GEOSS, Groundwater Impact Assessment, February 2025).

Potential impact on groundwater quality deterioration because of bio-digestor facilities for energy generation.		
Impact	**Description**	
Nature of Impact	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.	
Status of Impact	Negative	
Recommended mitigation measures	**Description**	
Impact avoidance/ Prevention/ Mitigation	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.	
Assessment of impact	**Rating before mitigation**	**Rating after mitigation**
Extent of impact	Local (L)	Site Specific (SS)
Duration of impact	Long term (L)	Short term (S)
Magnitude of negative impact	Medium (M)	Very low (VL)
Magnitude of positive impact	Zero (Z)	Zero (Z)
Intensity of impact	Destructive – Medium (M)	Destructive – Low (L)
Probability of occurrence	Possible (Po)	Improbable (Im)
Significance	**Medium (M)**	**Very low (VL)**
Confidence	Sure (S)	Sure (S)

Table 35: Impact table for contamination of groundwater as a result of operation of photovoltaic solar facilities (GEOSS, Groundwater Impact Assessment, February 2025).

Potential impact on groundwater quality deterioration because of the operation of photovoltaic solar facilities.		
Impact	**Description**	
Nature of Impact	Use of cleaning agents to ensure maximal power generation from solar panels.	
Status of Impact	Negative	
Recommended mitigation measures	**Description**	
Impact avoidance/ Prevention/ Mitigation	Make use of biodegradable cleaning agents to ensure little to no impact on the quality of the groundwater is experienced.	
Assessment of impact	**Rating before mitigation**	**Rating after mitigation**
Extent of impact	Local (L)	Site Specific (SS)
Duration of impact	Long term (L)	Short term (S)
Magnitude of negative impact	Low (L)	Very Low (VL)
Magnitude of positive impact	Zero (Z)	Zero (Z)
Intensity of impact	Destructive – Low (L)	Destructive – Very Low (VL)
Probability of occurrence	Possible (Po)	Improbable (Im)
Significance	**Low (L)**	**Very low (VL)**
Confidence	Sure (S)	Sure (S)

Table 36: Impact table for depletion of the groundwater resource as a result of over-abstraction (GEOSS, Groundwater Impact Assessment, February 2025).

Potential impact due to the depletion of groundwater resources as a result of over-abstraction.		
Impact	**Description**	
Nature of Impact	Over-abstraction from the borehole would drop the regional groundwater level.	
Status of Impact	Negative	
Recommended mitigation measures	**Description**	
Impact avoidance/ Prevention/ Mitigation	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. 72 mbgl for CWA_BH001, 40 mbgl for CWA_BH002, and 61 mbgl 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. 85 mgbl for CWA_BH001, 61 mbgl 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. A formal groundwater management plan needs to be designed and implemented.	
Assessment of impact	**Rating before mitigation**	**Rating after mitigation**
Extent of impact	Local (L)	Site Specific (SS)
Duration of impact	Long term (L)	Short term (S)
Magnitude of negative impact	Medium (M)	Low (L)
Magnitude of positive impact	Zero (Z)	Zero (Z)
Intensity of impact	Destructive – Medium (M)	Destructive –Low (L)
Probability of occurrence	Definite (D)	Possible (Po)
Significance	**Medium (M)**	**Very Low (VL)**
Confidence	Sure (S)	Sure (S)

Table 37: Impact table for groundwater quality deterioration as a result of over-abstraction (GEOSS, Groundwater Impact Assessment, February 2025).

Potential impact on groundwater quality deterioration as a result of over-abstraction		
Impact	**Description**	
Nature of Impact	Exposure and oxidation of minerals through the lowering of the water table, with potential water quality impacts when water levels recover.	
Status of Impact	Negative	
Recommended mitigation measures	**Description**	
Impact avoidance/ Prevention/ Mitigation	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.	
Assessment of impact	**Rating before mitigation**	**Rating after mitigation**
Extent of impact	Local (L)	Site Specific (SS)
Duration of impact	Long term (L)	Short term (S)
Magnitude of negative impact	Medium (M)	Low (L)
Magnitude of positive impact	Zero (Z)	Zero (Z)
Intensity of impact	Destructive – Medium (M)	Destructive –Low (L)
Probability of occurrence	Improbable (Im)	Improbable (Im)
Significance	**Medium (M)**	**Very Low (VL)**
Confidence	Sure (S)	Sure (S)

Table 38: Impact table for groundwater quality deterioration as a result of wastewater storage (GEOSS, Groundwater Impact Assessment, February 2025).

Potential impact on groundwater quality deterioration as a result waste water storage before treatment		
Impact	**Description**	
Nature of Impact	Contamination of groundwater due to the cracking, leaking or overflow of the concrete ponds and/or pipelines within the WWTW and to and from inflow and outflow points, allowing the seepage of contaminants into the groundwater.	
Status of Impact	Negative	
Recommended mitigation measures	**Description**	
Impact avoidance/ Prevention/ Mitigation	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.	
Assessment of impact	**Rating before mitigation**	**Rating after mitigation**
Extent of impact	Site Specific (L)	Site Specific (SS)
Duration of impact	Long term (L)	Short term (S)
Magnitude of negative impact	Medium (M)	Low (L)
Magnitude of positive impact	Zero (Z)	Zero (Z)
Intensity of impact	Destructive – Medium (M)	Destructive –Low (L)
Probability of occurrence	Possible (Po)	Improbable (Im)
Significance	**Medium (M)**	**Very Low (VL)**
Confidence	Sure (S)	Sure (S)

Table 39: Impact table for groundwater quality deterioration as a result of brine storage (GEOSS, Groundwater Impact Assessment, February 2025).

Potential impact on groundwater quality deterioration as a result waste water storage before treatment		
Impact	**Description**	
Nature of Impact	Contamination of groundwater due to the cracking, leaking or overflow of the concrete ponds and/or pipelines containing brine from treated potable water, allowing the seepage of contaminants into the groundwater.	
Status of Impact	Negative	
Recommended mitigation measures	**Description**	
Impact avoidance/ Prevention/ Mitigation	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 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.	
Assessment of impact	**Rating before mitigation**	**Rating after mitigation**
Extent of impact	Site Specific (L)	Site Specific (SS)
Duration of impact	Long term (L)	Short term (S)
Magnitude of negative impact	Medium (M)	Low (L)
Magnitude of positive impact	Zero (Z)	Zero (Z)
Intensity of impact	Destructive – Medium (M)	Destructive –Low (L)
Probability of occurrence	Possible (Po)	Improbable (Im)
Significance	**Medium (M)**	**Very Low (VL)**
Confidence	Sure (S)	Sure (S)

Table 40: Impact table for groundwater quality deterioration as a result of chemical storage associated with WWTW (GEOSS, Groundwater Impact Assessment, February 2025).

Potential impact on groundwater quality deterioration as a result waste water storage before treatment		
Impact	**Description**	
Nature of Impact	Contamination of groundwater due to the leaking or spilling of containers storing chemicals associated with the WWTW, allowing the seepage of contaminants into the groundwater.	
Status of Impact	Negative	
Recommended mitigation measures	**Description**	
Impact avoidance/ Prevention/ Mitigation	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. 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.	
Assessment of impact	**Rating before mitigation**	**Rating after mitigation**
Extent of impact	Site Specific (L)	Site Specific (SS)
Duration of impact	Long term (L)	Short term (S)
Magnitude of negative impact	Medium (M)	Low (L)
Magnitude of positive impact	Zero (Z)	Zero (Z)
Intensity of impact	Destructive – Medium (M)	Destructive –Low (L)
Probability of occurrence	Possible (Po)	Improbable (Im)
Significance	**Medium (M)**	**Very Low (VL)**
Confidence	Sure (S)	Sure (S)

Table 41: Impact table for groundwater quality deterioration as a result of result of irrigation with the treated sewage effluent (GEOSS, Groundwater Impact Assessment, February 2025)

Potential impact on groundwater quality deterioration as a result waste water storage before treatment		
Impact	**Description**	
Nature of Impact	Contamination of groundwater due to irrigation with poorly treated waste water effluent (TSE)	
Status of Impact	Negative	
Recommended mitigation measures	**Description**	
Impact avoidance/ Prevention/ Mitigation	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. It is recommended that Groundwater Management Plan be implemented to ensure the groundwater quality is not negatively affected by the irrigation with treated effluent.	
Assessment of impact	**Rating before mitigation**	**Rating after mitigation**
Extent of impact	Local (L)	Site Specific (SS)
Duration of impact	Long term (L)	Short term (S)
Magnitude of negative impact	Medium (M)	Low (L)
Magnitude of positive impact	Zero (Z)	Zero (Z)
Intensity of impact	Destructive – Medium (M)	Destructive –Low (L)
Probability of occurrence	Possible (Po)	Improbable (Im)
Significance	**Medium (M)**	**Very Low (VL)**
Confidence	Sure (S)	Sure (S)

11.2.4. Cumulative Assessment

During the course of the hydrocensus it became apparent that the majority of water users in the area utilise the underlying groundwater resource for agricultural purposes. Further to this, no developments similar to the CWA are present within the region (GEOSS, Groundwater Impact Assessment, February 2025). The developments of interest that were noted include the County Fair chicken farm and the Fisantekraal Wastewater Treatment Works. Each individual impact was assessed with regards to its potential cumulative impact when considered along with the other developments. These are presented in Table 42.

Table 42: Cumulative impacts in relation to other regional developments (GEOSS, Groundwater Impact assessment, February 2025).

Type of cumulative impact	Significance rating before mitigation	Significance rating after mitigation
Construction and Development	Very Low (VL)	Very Low (VL)
Surface Run-off	Medium (M)	Medium (M)
Leaks Storage and Distribution	Medium (M)	Medium (M)
Atmospheric Deposition	Low (L)	Very Low (VL)
Direct/Surface Release	Low (L)	Low (L)
Accidental Release	Medium (M)	Low (L)
Energy Supply	Medium (M)	Very Low (VL)
Groundwater resource depletion as a result of over-abstraction	High (H)	Low (L)
Groundwater quality deterioration as a result of over-abstraction	High (H)	Low (L)
Storage of wastewater before treatment	Medium (M)	Very Low (VL)
Storage of brine from treated potable water	Medium (M)	Very Low (VL)
Storage of chemicals associated with WWTW	Medium (M)	Very Low (VL)
Irrigation of the landscape with treated wastewater	Medium (M)	Very Low (VL)

Overall, 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 (GEOSS, Groundwater Impact Assessment, February 2025). The clay found underlying the site does provide some degree of protection to the underlying fractured rock aquifer. However, it must be noted that the vulnerability does increase to the northeast where the Colenso Fault system is located. This area should be considered as a sensitive area in terms of groundwater (GEOSS, Groundwater Impact Assessment, February 2025).

Given the fact that there are groundwater users and the proximity of the Colenso Fault to the CWA, a no-go area for high-risk activities is proposed for the northeastern section of the study area (Figure 39) (GEOSS, Groundwater Impact Assessment, February 2025). This no-go area is in terms of certain high-risk activities such as the aviation fuel farm, retail service station or other activities that are considered high risk to groundwater.

Groundwater monitoring is important to ensure that any potential contamination caused as a result of the construction and/or operation of the CWA is identified and suitable managed. It is therefore recommended that the development design includes a groundwater monitoring plan (GEOSS, Groundwater Impact Assessment, February 2025). Monitoring requirements should be revised annually to ensure that monitoring actions remain aligned with the activities onsite. Monitoring should begin prior to construction to help establish a baseline condition of the groundwater quality and availability onsite.

The Groundwater Impact Assessment indicated that the development can proceed, provided that appropriate mitigation, protection, and monitoring measures are implemented so as to not impact on groundwater and associated groundwater users (Table 28 and Table 41).

11.3. Potential Geohydrological Impacts

A geohydrological assessment in support of a WULA, was undertaken by GEOSS (GEOSS, WULA Geohydrological Assessment, February 2025, Appendix B). To date, three production boreholes have been drilled on the site. During the construction and operational phase of the proposed development, soil and groundwater contamination could result due to several potential contaminant sources detailed in Table 22. Each source/origin of contamination and impacts associated with groundwater abstraction has been qualitatively assessed within the Groundwater Impact Assessment undertaken by GEOSS (GEOSS, Groundwater Impact Assessment, February 2025). The impacts and mitigation measures presented in Table 28 to Table 41 are also of relevance to the WULA Geohydrological Assessment.

11.3.1. Groundwater Management Plan

In addition to the mitigation measures outlined in Table 28 to Table 41, the geohydrological assessment in support of a WULA (GEOSS, WULA Geohydrological Assessment, February 2025,

Appendix B) includes the following recommendations for the management of onsite groundwater abstraction:

Proposed Groundwater Monitoring Plan for Production Boreholes (GEOSS, WULA Geohydrological Assessment, February 2025, Appendix B) – Monitoring Infrastructure:

1) An “observation pipe” needs to be installed (32mm inner diameter, class 10 as shown in Appendix G to the GEOSS, WULA Geohyrological Assessment, February 2025 attached to this report as Appendix B) from the pump depth to the surface, closed at the bottom and slotted for the bottom 5 – 10m, for each production borehole. This allows for a ‘window’ of access down the borehole which enables manual water level monitoring and can house an electronic water level logger.
2) Care has been taken to equip the borehole in such a way that contaminants cannot easily enter the borehole, but due to the high vulnerability of the primary aquifer, it is also advised that due diligence is followed when storing fuel and other contaminants, such as pesticides on the site. Over-fertilization should also be avoided as these nutrients could leach into the groundwater.
3) Continuous monitoring of groundwater levels using a pressure transducer in the borehole is ideal. The water level in the borehole may not drop below the critical water level as shown in Table 43. If the water level in the borehole drops below the critical water level, abstraction must be immediately reduced by 10%. Monitoring must continue and after 30 days, if the water level in the borehole does not recover to above the crucial water level, abstraction must be reduced by a further 10%. This process must continue until the water level in the borehole is stable. If the low levels persist for more than 60 days, abstraction must be stopped until the levels have been restored.
4) Water quality monitoring which includes sampling and analysis of the groundwater at an accredited laboratory is important. A sampling interval of quarterly is recommended for the first year of monitoring, thereafter, the water quality monitoring should be reviewed and can potentially be reduced to bi-annual or annually as seen in Table 44.
5) The monitoring data should be reviewed on a quarterly basis for the first 2 years and can then be scaled down to bi-annually.
6) Installation of a sampling tap at the production borehole (to monitor water quality) is essential.
7) Installation of a flow volume meter at the production borehole (to monitor abstraction rates and volumes) is also important. External flow (e.g., mag-flow) meters are recommended.
8) Abstraction volumes must be monitored and recorded by a designated person onsite. Depending on the frequency of use, daily, weekly or monthly abstraction should be recorded.
9) The appropriate borehole pump must be installed, i.e., not an over-sized pump that is chocked with a gate valve. If the monitoring shows that more water can be abstracted, then the duration of pumping time can be increased (not the flow rate).
10) If required, the pump and borehole casing (and associated infrastructure) can be serviced annually and cleaned.

11) A geohydrologist should review the above information at least annually to ensure optimal groundwater abstraction and management occurs.

12) The relevant DWS monitoring officer (as specified in the Water Use Licence) should be informed if water levels are dropping to critical level in Table 43 or if any parameters, as specified in Table 44, changes by 20%.

The groundwater abstraction should be reviewed to ensure that it is sustainable based on the monitoring data obtained.

Table 43: Borehole Abstraction Recommendations (GEOSS, WULA Geohydrological Assessment, February 2025).

Borehole Details				
Borehole Name	**Latitude (DD)**	**Longitude (DD)**	**Borehole Depth (m)**	**Inner Diameter (mm)**
CWA_BH001	-33.84071	18.53738	100	158
CWA_BH002	-33.76876	18.732067	100.4	203
CWA_BH003	-33.774037	18.747742	149.9	170
Abstraction Recommendations				
Borehole Name	**Abstraction rate (L/s)**	**Abstraction Duration (hrs)**	**Recovery Duration (hrs)**	**Possible Volume Abstracted (L/d)**
CWA_BH001	1.0	24	0	86 400
CWA_BH002	2.5	24	0	216 000
CWA_BH003	1.69	24	0	146.016
Pump Installation Details				
Borehole Name	**Pump Installation Depth (mbgl)**	**Critical Water Level (mbgl)**	**Dynamic Water Level (mbgl)***	**Rest Water Level (mbgl)**
CWA_BH001	93	85	72	42.22
CWA_BH002	65	61	40	16.13
CWA_BH003	107	101	61	18.89

* Typical water level expected during long-term production

Table 44: Proposed groundwater monitoring parameters for production boreholes (GEOSS, WULA Geohydrological Assessment, February 2025, Appendix B).

Parameter	Frequency
Groundwater Level	Ideally every 15 minutes with a data logger
Chemical parameters	
pH (at 25 ºC)	Quarterly (Field Chemistry)
Conductivity (mS/m) (at 25 ºC)	Quarterly (Field Chemistry)
Total Dissolved Solids (mg/L)	Quarterly (Field Chemistry)
Turbidity (NTU)	Quarterly*
Colour (mg/L as Pt)	Quarterly*
Sodium (mg/L as Na)	Quarterly*
Potassium (mg/L as K)	Quarterly*
Magnesium (mg/L as Mg)	Quarterly*
Calcium (mg/L as Ca)	Quarterly*
Chloride (mg/L as Cl)	Quarterly*
Sulphate (mg/L as SO_4)	Quarterly*
Nitrate & Nitrite Nitrogen (mg/L as N)	Quarterly*
Nitrate Nitrogen (mg/L as N)	Quarterly*
Nitrite Nitrogen (mg/L as N)	Quarterly*
Ammonia Nitrogen (mg/L as N)	Quarterly*
Total Alkalinity (mg/L as $CaCO_3$)	Quarterly*
Total Hardness (mg/L as $CaCO_3$)	Quarterly*
Fluoride (mg/L as F)	Quarterly*
Aluminium (mg/L as Al)	Quarterly*
Total Chromium (mg/L as Cr)	Quarterly*
Manganese (mg/L as Mn)	Quarterly*
Iron (mg/L as Fe)	Quarterly*
Nickel (mg/L as Ni)	Quarterly*
Copper (mg/L as Cu)	Quarterly*
Zinc (mg/L as Zn)	Quarterly*
Arsenic (mg/L as As)	Quarterly*
Selenium (mg/L as Se)	Quarterly*
Cadmium (mg/L as Cd)	Quarterly*
Antimony (mg/L as Sb)	Quarterly*
Mercury (mg/L as Hg)	Quarterly*
Lead (mg/L as Pb)	Quarterly*
Uranium (mg/L as U)	Quarterly*
Cyanide (mg/L as CN-)	Quarterly*
Total Organic Carbon (mg/L as C) *E.coli* (count per 100 ml)	Quarterly* Quarterly*
Total Coliform Bacteria (count per 100 ml)	Quarterly*
Heterotrophic Plate Count (count per ml)	Quarterly*
Total Petroleum Hydrocarbons (TPH)	Quarterly*
*Can be reduced to bi-annually or annually if reviewed and deemed appropriate	

Proposed Groundwater Monitoring Plan for Monitoring Boreholes (GEOSS, Groundwater Impact Assessment, February 2025):

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 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 and illustrated in Table 45 and Figure 46.

Table 45: Details for the proposed monitoring sites (GEOSS, Groundwater Impact Assessment, & WULA Geohydrological Assessment, February 2025)

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

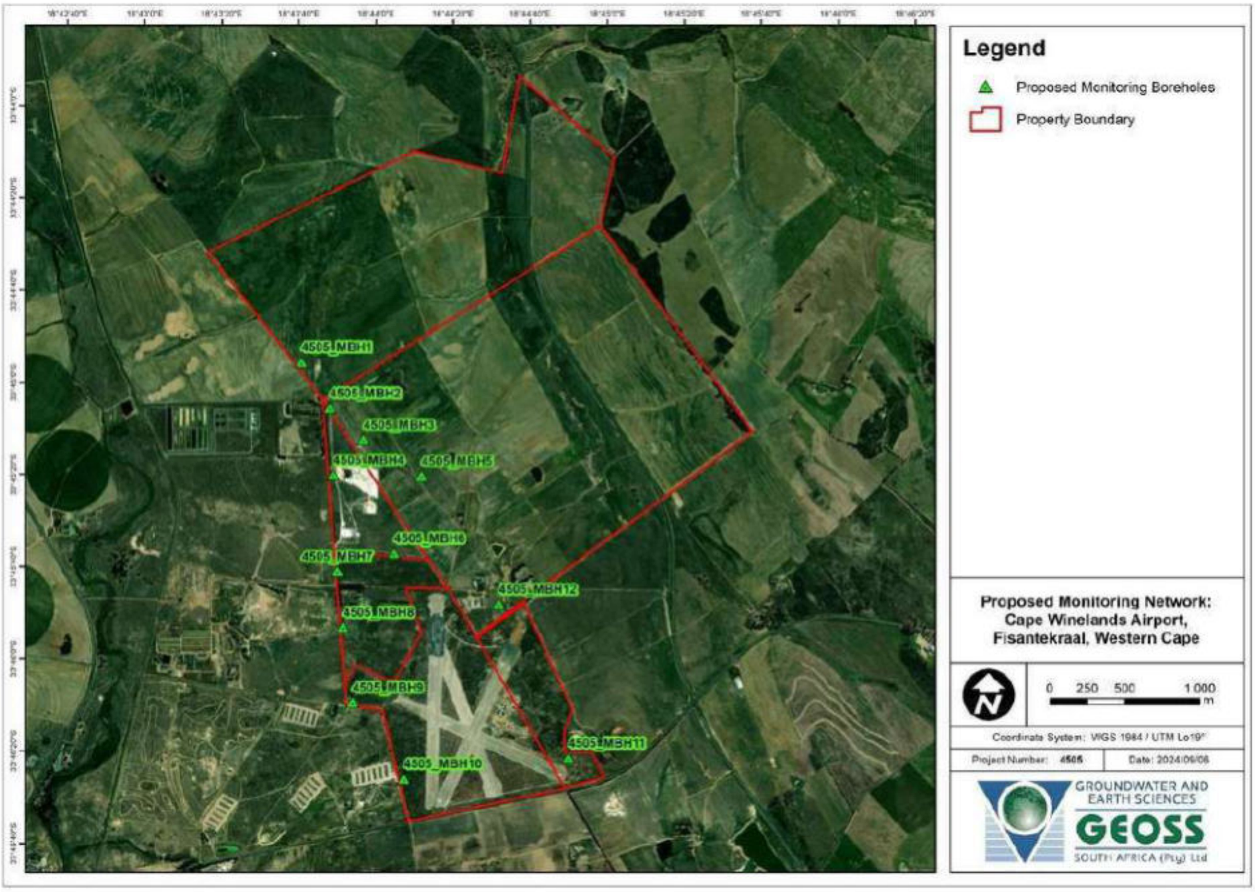


Figure 46: Proposed groundwater monitoring locations across the Cape Winelands Airport development (GEOSS, WULA Geohydrological Assessment, February 2025).

Borehole Construction Specifications (GEOSS, Groundwater Impact Assessment, February 20254).

The drilling of boreholes should be supervised by a hydrologist and drill samples should be collected every 1m and logged. Additional information should also be collected such as the depth of water strikes associated water strike yields and groundwater quality. The driller should be supervised to ensure all site requirements are met.

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 if 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 areas. Each borehole must also have 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.

Groundwater Level Monitoring (GEOSS, Groundwater Impact Assessment, February 2025).

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 heigh must then also be measured (m). The water level (mbgl) can then be calculated by subtracting the collar/casing height from the water level. The value must be recorded along with the date and time of the measurement.

Groundwater Quality Monitoring (GEOSS, Groundwater Impact Assessment, February 2025). 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 (GEOSS, Groundwater Impact Assessment, February 2025).

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 (GEOSS, Groundwater Impact Assessment, February 2025).

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 developed and the intricate details of the services are made available, a more detailed, standalone monitoring programme report will need to be developed. Table 46 indicates the potential parameters for ongoing monitoring, this will be revised upon approval and development of the CWA

Table 46: Proposed groundwater monitoring parameters for groundwater monitoring locations and their recommended frequency (GEOSS, Groundwater Impact Assessment, February 2025).

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.*

11.4. Potential Hydropedological Impacts

The Hydropedological Assessment undertaken by the Zimpande Research Collaborative included a desktop analysis, a field survey, sampling activities, and hydrological modelling. Soil samples were taken from various representative points to understand the wetland recharge mechanisms and predict the hydropedological impact of the proposed development. Data collected from the field and lab were used in hydrological models to quantify key hydrological processes and assess the effects of the planned developments.

11.4.1. Conceptual Models and Implications (Zimpande Research Collaborative, Hydropedological Assessment, February 2025)

Conceptual models were developed to analyse the flow paths of water and how the project might disrupt these paths in the landscape, affecting recharge mechanisms.

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 surface may necessitate the channelisation of water into stormwater structures and discharge into downstream watercourse 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.

11.4.2. Quantification of Hydropedological Fluxes (Zimpande Research Collaborative, Hydropedological Assessment, February 2025)

The SWAT+ (v 1.2.3) model was used to model and quantify the hydropedological changes expected due to the proposed development, focusing particularly on lateral flow. This quantification was conducted at three different scales: basin scale, landscape unit scale, and hydrological response unit scale (Table 47 - Table 49):

- The hydropedological analysis at the **basin scale** shows a slight increase in streamflow and surface runoff, each by 10.55% and 10.99% respectively, although these constitute less than 15% of the water balance. This change is not expected to significantly alter the timing or pattern of water flow, minimizing impacts on instream functionality. Simulations also indicate decreases in lateral flow and percolation by 2.21% and 5.62% respectively, largely due to flow path disruptions and sealed surfaces from proposed development. Evapotranspiration remains the largest water loss, accounting for over 79% of the water balance, highlighting its critical role in local water dynamics. While there is a slight increase in profile water at this scale, changes in hydropedological processes are predicted to have minimal impact on wetland conditions, with no more than one PES class change expected (Table 47).

- At the **landscape unit (hillslope) scale**, streamflow and surface runoff show a modest increase of 6.17% and 6.52% respectively, comprising only 13% of the water balance, attributed to new impervious surfaces and redirected water flow through stormwater channels due to proposed development. Lateral flow and percolation decrease by approximately 2.8% and 3.7% respectively, with minimal impact on the water balance due to the absence of interflow soils. Evapotranspiration remains the dominant water loss at 78.53%, with local rainfall crucial for wetland dynamics. While there is a slight decrease in profile water at this scale, changes in hydropedological processes are predicted to have minimal impact on wetland conditions, with no more than one PES class change expected (Table 48).
- At the **hydrological response unit scale**, site clearing, and surface infrastructure establishment are expected to reduce evapotranspiration and increase direct evaporation from bare soil. Evapotranspiration is the dominant water outflow mechanism, accounting for approximately 78.71% of the water balance. Post-development, streamflow and surface runoff are projected to increase by approximately 13.62% and 14.26% respectively, due to impervious surfaces and low soil storage capacity. Effective management through a Stormwater Management Plan can mitigate altered water movement patterns. Lateral flow shows minimal change with a loss of about 0.4%, while percolation decreases by 4.35%. Post-development, there is a slight increase in available profile water, indicating higher moisture levels. 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 (Table 49).

Table 47: Summary of the water balance pre- and post-development at Basin scale (Zimpande Research Collaborative, Hydropedological Assessment, February 2025).

	Before	% of WB	After	% of WB	Change	Weighted Loss	Anticipated PES/EIS Change
Rainfall	623,2843		623,2842				Limited with no more than one PES class change predicted.
Streamflow	79,9027	12,8196	88,2567	14,1599	10,4551	1,4804	
Surface runoff	76,6931	12,3047	85,1181	13,6564	10,9853	1,5002	
Lateral flow	3,2097	0,5150	3,1386	0,5036	-2,2148	-0,0112	
Percolation	6,2647	1,0051	5,9124	0,9486	-5,6230	-0,0533	
ET	504,1576	80,8873	494,5141	79,3401	-1,9128	-1,5176	
eCanopy	5,7670	7,2176	5,7557	6,5215	-0,1968	-0,0128	
Transpiration	44,0300	7,0642	43,9645	7,0537	-0,1488	-0,0105	
Evaporation	454,3605	72,8978	444,7939	71,3629	-2,1055	-1,5025	
ET0	1576,6309		1611,1848				
Profile available water	1,1765		1,0837		-7,8899		
Topsoil available water	9,8895		9,4766		-4,1748		

Table 48: Summary of the water balance pre- and post-development at Landscape Unit scale (Zimpande Research Collaborative, Hydropedological Assessment, February 2025).

	Before	% of WB	After	% of WB	Change	Weighted Loss	Anticipated PES/EIS Change
Rainfall	623,2850		623,2838				Limited with no more than one PES class change predicted.
Streamflow	81,2817	13,0409	86,3035	13,8466	6,1783	0,8555	
Surface runoff	78,3146	12,5648	83,4218	13,3842	6,5213	0,8728	
Lateral flow	2,9670	0,4760	2,8817	0,4623	-2,8767	-0,0133	
Percolation	5,8488	0,9384	5,6287	0,9031	-3,7628	-0,0340	
ET	497,4307	79,8079	489,4732	78,5314	-1,5997	-1,2563	
eCanopy	5,2834	6,5001	5,3189	6,1630	0,6719	0,0414	
Transpiration	37,9979	6,0964	38,2837	6,1423	0,7523	0,0462	
Evaporation	454,1495	72,8639	445,8706	71,5357	-1,8229	-1,3041	
ET0	1576,6309		1611,1848				
Profile available water	1,1293		1,0550		-6,5771		
Topsoil available water	9,5294		9,2791		-2,6265		

Table 49: Summary of the water balance pre- and post-development at HRU scale (Zimpande Research Collaborative, Hydropedological Assessment, February 2025).

	Before (mm)	% of WB	After (mm)	% of WB	Change	% Weighted Loss	Anticipated PES/EIS Change
Rainfall	623,2841		623,2841				No Change anticipated.
Streamflow	67,3854	10,8113	76,5647	12,2841	13,6220	1,6733	
Surface runoff	64,2743	10,3122	73,4410	11,7829	14,2618	1,6805	
Lateral flow	3,1111	0,4991	3,1237	0,5012	0,4049	0,0020	
Percolation	5,6349	0,9041	5,3896	0,8647	-4,3519	-0,0376	
ET	502,2760	80,5854	477,0062	76,5311	-5,0311	-3,8503	
eCanopy	5,9388	8,8132	6,5827	8,5975	10,8422	0,9322	
Transpiration	35,6774	5,7241	42,8946	6,8820	20,2289	1,3922	
Evaporation	460,6597	73,9085	427,5289	68,5929	-7,1920	-4,9332	
ET0	1576,6309		1576,6309				
Profile available water	1,2272		1,2425		1,2470		
Topsoil available water	9,1629		8,9367		-2,4678		

11.4.3. Mitigation Measures (Zimpande Research Collaborative, Hydropedological Assessment, February 2025)

A scientifically derived buffer was initially developed to ensure that appropriate consideration of the potential impact on the interflow soils (Constantia) associated with the Seep Wetland 1. However, given the geometric requirements of the airport and associated runway complex, complete avoidance of Seep Wetland 1, the associated interflow soils and the scientific buffer is not practical. A wetland offset has been developed for the wetland loss and forms part of the WULA application.

Although the overall hydropedological impacts identified are anticipated to be minimal, mitigation measures and recommendations have been compiled and these include but are not limited to (Zimpande Research Collaborative, Hydropedological Assessment, February 2025):

- 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; and
- 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;

The results of the Hydropedology Assessment undertaken by the Zimpande Research Collaborative indicate that the proposed project can be considered for authorisation from a hydropedological perspective as it is not anticipated to cause an unacceptable impact of the wetland recharge mechanisms based on the type of soils identified as well as the quantification of hydropedological losses (Zimpande Research Collaborative, Hydropedological Assessment, February 2025). The PES/EIS and functionality will likely remain unchanged once mitigations have been implemented.

11.5. Potential Climate Change Impacts

Brundtland Consulting (Pty) Ltd was appointed to undertake a Climate Change Impact Assessment of the proposed CWA expansion. The CCIA involves assessing the contribution of the project to climate change through the emission of greenhouse gases (GHG's) such as carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) as well as determining the physical risks faced by the project due to climate change.

To assess the impact of the Cape Winelands Airport project on climate change, a carbon footprint analysis was conducted using the GHG Protocol's Corporate and Accounting Reporting Standard and the Department of Forestry, Fisheries and Environment's guidelines. This analysis covered Scope 1 direct emissions, Scope 2 indirect emissions, and Scope 3 value chain emissions. The carbon footprint was evaluated against South Africa's carbon budget aligned with the Nationally Determined Contributions (NDC) for limiting global warming to 1.5˚C. The overall significance of these emissions was determined by assessing the project's duration, magnitude, and probability of climate change impacts (Brundtland, Climate Change Impact Assessment, February 2025).

A physical risk assessment was conducted to evaluate how climate change might impact the Cape Winelands Airport project. Historical climate data and future projections for temperature, precipitation, and extreme weather events in the Western Cape were analyzed. Identified climate hazards were assessed for potential impacts on health and safety, operations, and the project's value chain.

11.5.1. Impact of the Project on Climate Change (Brundtland, Climate Change Impact Assessment, February 2025).

The current airport site is undeveloped with minimal activity occurring. The current site has an estimated carbon footprint of 647 tCO_2e each year (Brundtland, Climate Change Impact Assessment, February 2025).

Construction Phase Emissions

Construction emissions were estimated at a high level, capturing the most significant material emission sources. It is estimated that the construction phase will produce approximately 326 662 tCO2e. A breakdown of these emissions is provided in Table 50 below. All construction emissions have been categorised under various relevant categories in Scope 3.

Table 50: GHG emissions breakdown for the construction phase (Brundtland, Climate Change Impact Assessment, February 2025).

Emission Source	Category	Emissions (tCO_2e)
Scope 3 - Category 1	Bulk earthworks	106 430
	Steel	912
	Plastic	1 790
	Asphalt	8 246
	Concrete	2 880
Scope 3 – Category 2	Buildings	191 883
	Substation	1 311
	Solar PV Farm	114
	Biodigester	428
Scope 3 – Category 5	Construction waste	2 649
Scope 3 – Category 7	Employee Commuting	10 019
Total construction emissions		**326 662**

Scope 3 Category 1 - Purchased Goods contains the most significant GHG emissions, including the usage of cement, steel, asphalt, and plastic for the development of roads, runways, and stormwater infrastructure. These emissions arise from the fuel and energy use of on-site machinery, such as cranes, bulldozers, rollers, excavators, tractors, and dumpers. Emissions from building construction were estimated based on the embedded material emissions from common construction materials like cement, steel, and glass. This estimate also included fuel and energy-related emissions per

square meter, accounting for material transport and earthworks, sourced from the CO_2 Database. Emissions related to electrical infrastructure were estimated using spend-based information. Employee commuting emissions for construction workers have been determined based on the estimated number of direct jobs the construction is expected to create.

Operational Phase Emissions

Emissions for the operational phase have been determined per PAL to project emissions up to 2050 (Table 51). The assumption is that by 2050, CWA will have fully implemented renewable technologies and mitigated any hard-to-abate emissions through offsetting.

In relation to electricity needs CWA will still be reliant on grid electricity of up to 5MVA of the total electrical requirements despite the implementation of renewable energy initiatives (Solar PV, Biodigester, wind energy), so the project will not be optimally running off the grid. The biodigester uses renewable biomass (e.g., energy crops), making its emissions climate-neutral.

For direct emissions, it is assumed that ground servicing equipment and on-site vehicles use combustion engines, but with the potential investment in electric vehicles, which could further reduce Scope 1 emissions by 8% (5350 tCO_2e).

Additional Scope 1 emissions arise from the operation of the wastewater treatment plant. Over 60% of emissions from wastewater treatment plants are direct process emissions, with the remainder related to energy use. Methane (CH_4) and nitrous oxide (N_2O) are the primary GHG's emitted during treatment depending on the process type.

The majority of emissions during the operational phase result from downstream (Scope 3) emissions, with Scope 3 Category 11 – Use of Sold Products as the largest contributor, estimated at 3.8 million tCO_2e. This category includes emissions related to passenger movement, cargo movement, and aircraft operations. The primary source of Scope 3 emissions is aeroplane movements, projected to reach 3.15million tCO_2e by 2050, representing 79% of total Scope 3 emissions. Only domestic aviation emissions of 1.5million tCO_2e will be accounted for in the GHG impact assessment on the South African national inventory, in accordance with the determination of sectoral emissions in South Africa. Category 7 – Employee Commuting accounts for 4% of Scope 3 emissions, followed by Category 5 – Waste Generated in Operations.

Mitigating Scope 3 emissions is challenging due to their source from activities outside the airport's direct control. However, the project should focus on reducing emissions from waste management, travel, and operational inefficiencies. This can be done by implementing recycling programs, on-site composting, promoting electric vehicles, improving public transport links, supporting sustainable aviation fuel development, and offsetting unavoidable emissions through carbon offset programs.

Table 51: Emissions breakdown per PAL for the operational phase (Brundtland, Climate Change Impact Assessment, February 2025).

Emission Source	Category	Emissions per PAL (tCO_2e)					Total Emissions (tCO_2e)
		PAL 1A	PAL 1B	PAL 2	PAL 3	PAL 4	
Scope 1 – Direct emissions	Mobile diesel	437	964	1 350	1 697	344	4 792
	Stationary diesel	17	36	51	64	13	181
	Wastewater treatment	35	77	105	133	27	377
Total Scope 1 emissions		***488***	***1 077***	***1 506***	***1 894***	***385***	***5 350***
Total Scope 2 emissions	***Grid Electricity Usage***	***176 952***	***265 428***	***265 428***	***265 428***	***44 238***	***1 017 474***
Scope 3 – Category 2	Passenger busses	5.7	0.9	0.6	1.4	0.6	9.2
	Mobile stairs	1.7	0.3	0.1	0.4	0.3	2.9
	Tractors	1.7	0.3	0.1	0.6	0.6	3.3
	Aviation Fuel Handling	0.7	0	0	0	0	0.7
	Conveyors	0.7	0.7	0.8	1.1	1.2	4.5
Scope 3 – Category 3	Diesel	99	214	299	376	76	1 063
	Energy Crops Transport	468	703	703	703	117	2694
Scope 3 – Category 5	Commercial and industrial waste	1 429	3 152	4 413	5 548	1 126	15 669
Scope 3 – Category 6	Business travel	7	16	23	30	6	82
Scope 3 – Category 7	Bus	942	2 055	2 953	3 724	728	10 401
	Minibus Taxi	3 425	7 473	10 742	13 544	2 647	37 831
	Private car	8 449	18 434	26 499	33 411	6 529	93 321
	Motor/scooter	524	1 143	1 643	2 072	405	5 787
Scope 3 – Category 11	Passenger movement	63 665	140 438	190 051	234 582	46 635	675 371
	Cargo movement	70	104	104	104	17	400
	Domestic aviation combustion	130 053	273 133	423 876	551 054	106 592	1 484 709
	International aviation combustion	137 333	369 746	450 358	585 450	113 245	1 656 133
Total Scope 3 emissions		***346 473***	***816 613***	***1 111 668***	***1 430 602***	***278 125***	***3 983 104***
TOTAL EMISSIONS OPERATIONAL PHASE		**523 913**	**1 083 118**	**1 378 601**	**1 697 924**	**322 748**	**5 005 928**

Overall Carbon Footprint of the CWA Expansion Project

The carbon footprint of the CWA expansion project is determined by calculating the direct and indirect emissions associated with the construction and future operation (Brundtland, Climate Change Impact Assessment, February 2025). The carbon footprint is presented in Table 52. It is expected that the Project Scope 1 emissions produced up to 2050 is 5350 tCO_2e. Due to the design plans indicating self-sufficiency using a solar plant, biogas to electricity facility and a battery system, no Scope 2 emissions have been included. The total footprint of the project (construction and operation) is approximately 4.3million tCO_2e. Scope 1 emissions for the operations phase contribute 0.12% and the value chain emissions from construction contribute approximately 8%, and from the operational phase 92% (Brundtland, Climate Change Impact Assessment, February 2025).

Table 52: Carbon Footprint of CWA Expansion Project up to 2050 (Brundtland, Climate Change Impact Assessment, February 2025).

Project Phase	Direct Scope 1 & 2 Emissions (tCO_2e)	Indirect Scope 3 Emissions (tCO_2e)	Total Emission (tCO_2e)
Construction Phase	0	326 662	326 662
Operation Phase	1 022 824	3 983 104	**5 005 929**
Total	**1 022 824**	**4 309 766**	**5 332 590**

The emissions trajectory for the operations of the airport is shown in Figure 47. In terms of the impact on South Africa the carbon footprint would be 3.35 million tCO_2e as emissions from international aviation are excluded from the National Inventory. 1.7million tCO_2e emissions is associated with international aviation flights. The average annual impact from the operation of the CWA expansion project is estimated to be 217 649 tCO2e per annum.

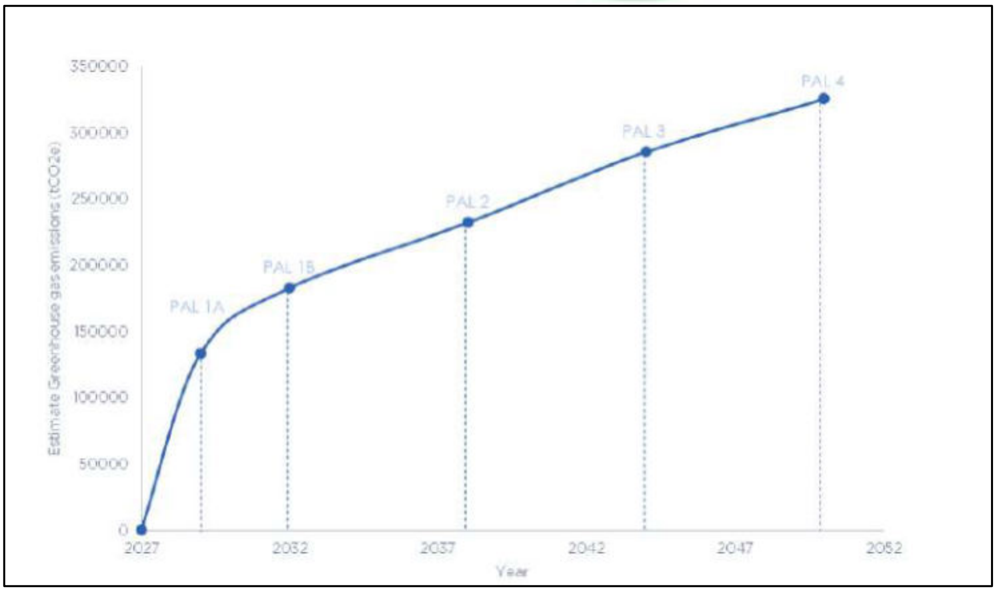


Figure 47: GHG emissions trajectory for the CWA expansion project (Brundtland, Climate Change Impact Assessment, February 2025).

Impact of the project on both South African and Global Investors

To contextualize the estimated GHG emissions they should be compared to the national GHG emissions budget. It's important to note where emissions occur, as it is assumed that the production of construction materials and operational emissions will happen within South Africa. Indirect emissions from international aviation, which are monitored by ICAO and excluded from the national inventory, are not included. As a result, the total emissions for the expansion project, including only domestic aviation, amount to 3.68million tCO_2e (Brundtland, Climate Change Impact Assessment, February 2025). Table 53 presents the CWA emissions inventory as a portion of the global budget.

Table 53: Impact of Project emissions on national carbon budget (Brundtland, Climate Change Impact Assessment, February 2025)

	Contribution to National Carbon Budget (%)	Impact on National Carbon Budget
Total Scope 1+2 emissions (up to 2050)	0.027	Low-Medium
Cape Winelands Expansion Project Total emissions (up to 2050)	0.097	Medium

The direct operation of the CWA would have a **low-medium impact** due to the planned sustainability measures of the Project. The total project emissions including value chain emissions would have a **medium impact** on the National Carbon budget due to the significant contribution of Scope 3 emissions to the Project's overall footprint (Brundtland, Climate Change Impact Assessment, February 2025).

The major contributor to Scope 3 emissions, are emissions from domestic aviation, representing 40% of total emissions. The impact of emissions from domestic aviation should be considered considering the regulatory and legislative instruments in place or under development to deal with emissions from domestic aviation, namely the Carbon Tax and the mandatory carbon budgets allocation under the Climate Change Act. As the regulatory environment and framework is designed to deal with these Scope 3 emissions from domestic aviation, a reduction in emissions can be expected as the year 2050 approaches. It should also be considered that approximately 88% of the Scope 3 emissions are expected to occur regardless of the expansion, due to the projected growth in the aviation and tourism industries.

The CWA project has the potential to mitigate some future growth-related emissions by improving infrastructure for more efficient operations and implementing sustainability practices. This could reduce energy consumption per passenger and limit the growth of Scope 3 emissions, which are largely driven by domestic and international aviation. A distinction is made between airport and airline operators in terms of emissions, based on IPCC Guidelines and the National Greenhouse Gas Emission Reporting (NGER) regulations. Domestic aviation, classified under IPCC code 1A3a, is subject to carbon taxes and future carbon budget regulations, regardless of airline nationality or aircraft registration. However, domestic law mandates that entities conducting domestic aviation must have a significant legal presence in the Republic, and aircraft used for domestic flights must be registered within the Republic. This ensures that all domestic aviation activities comply with national regulations controlling emissions.

Under ICAO regulations, all flights must carry reserve fuel for potential diversions, which adds weight and increases both emissions and operational costs. Currently, flights may divert to OR Tambo (1,270km away) or Port Elizabeth (747km away). In contrast, Cape Winelands Airport (CWA) is only 25km from Cape Town International Airport (CTIA), making it a much closer alternative. This proximity could reduce the excess fuel required for diversions, cutting GHG emissions by 3-5% (CWA Diversion Airport Analysis Summary Report, 2022). Using CWA as an alternative would also help airlines optimize operations by reducing fuel loads, lowering operating costs, and potentially decreasing airfare while increasing cargo capacity, aligning with sustainable aviation goals.

Overall Impact of the Project on Climate Change

The CWA expansion project will impact climate change from a construction and operational perspective. However, the expected changes in global climate cannot be specifically linked to the GHG emissions of a specific emission source or individual emitter. Emissions will result from fuel combustion, wastewater treatment, and various indirect sources like waste generation, employee and passenger commutes, and aviation. Only emissions within South Africa's boundaries are considered, excluding international aviation. The estimated emissions from the airport are 3.68 million tCO_2e, which represents about 0.097% of South Africa's national GHG budget of 3,380 $MtCO_2e$, a notable contribution. Evaluation criteria for climate change impacts are presented in Table 54. Climate change impacts are classified as global and long-term, as the impacts could potentially be reversed. The project's emissions were assessed with a medium magnitude and the overall environmental impact significance was also determined to be medium.

Table 54: Evaluation of environmental impact criteria

	1	2	3	4	5
Extent (E)	Local	Regional	National	International	Global
Duration (D)	Very Short (0 – 1 years)	Short (2 – 5 years)	Medium (5 – 15 years)	Long (>15 years)	Permanent
Magnitude (M)	Very low	low	Medium	High	Very High
Probability (P)	Very Improbable	Improbable	Probable	Highly Probable	Definite

11.5.2. Impact of Climate Change on the Project (Brundtland, Climate Change Impact Assessment, February 2025).

When considering climate change, risks typically originate from interactions between climate-related hazards and the exposure or vulnerability of the affected systems, whether human or ecological. The Cape Winelands District Municipality (CWDM), where the CWA site is located, is vulnerable to hazards such as wildfires, landslides, water scarcity, extreme heat, river floods, and urban floods (GFDRR, 2019). According to the CWA expansion's baseline air quality report (DDA Environmental Engineers, 2022), the air quality around CWA is good, with low levels of pollutants from airport operations. Therefore, air quality is not expected to be a significant climate hazard. However, hazards like wildfires and heatwaves could impact air quality and are considered acute physical climate risks.

Climate projections for the Western Cape were obtained from The World Bank Group (2021) (Figure 48 and Figure 49). Five shared socioeconomic pathways (SSPs) were considered. SSPs are various climate change scenarios of anticipated global socioeconomic changes up to the year 2100. They are used to derive different greenhouse gas emission scenarios under various climate policies. SSP1-1.9 represents a stringent mitigation scenario, while SSP5-8.5 represents a very high warming scenario. As current climate tools in South Africa only provide data at the provincial level, the Western Cape projections are considered relevant to the proposed site.

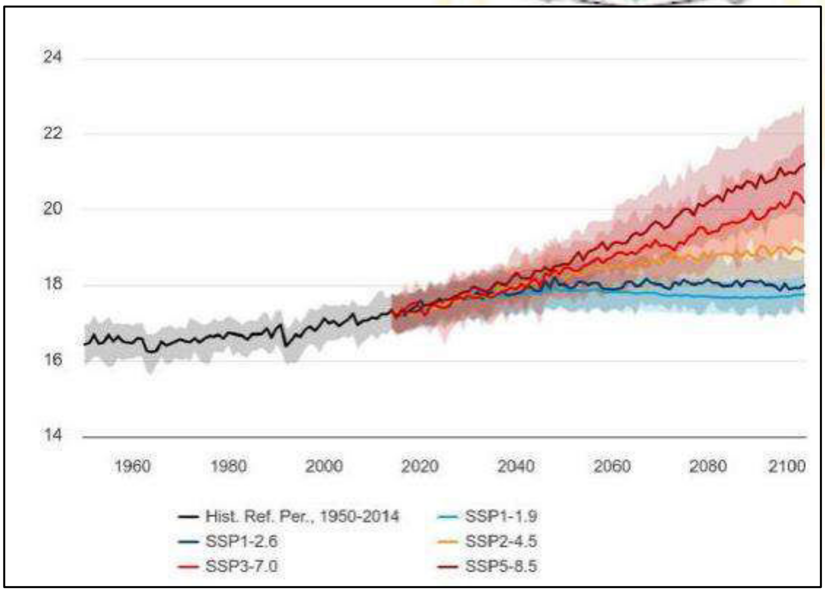


Figure 48: Projected mean temperature for the Western Cape (reference period 1995 - 2014) (Brundtland, Climate Change Impact Assessment, February 2025).

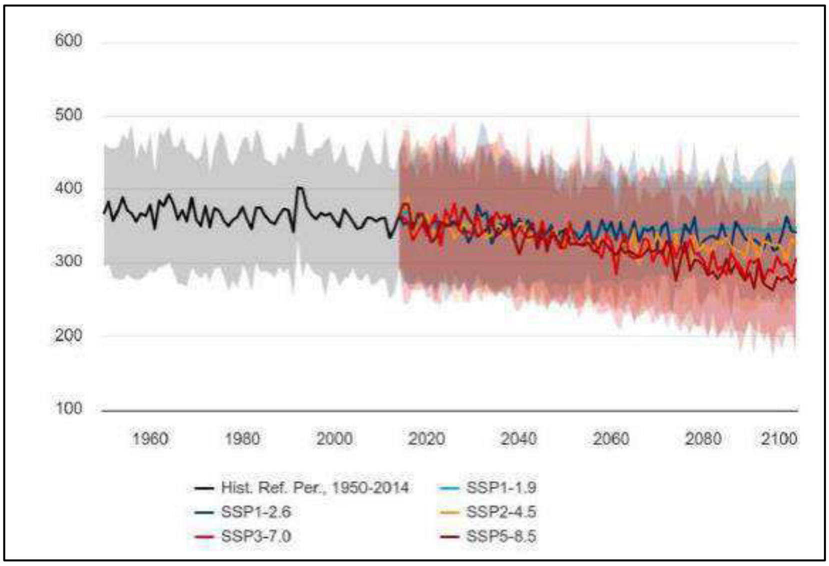


Figure 49: Projected precipitation for the Western Cape (reference period 1995 - 2014) (Brundtland, Climate Change Impact Assessment, February 2025).

According to Figure 48, mean annual temperatures in the Western Cape are projected to increase under all SSPs. Increased temperatures are expected in all seasons. Based on Figure 49, a slight decreasing trend for future precipitation in the Western Cape is apparent, however substantial multiyear fluctuations are predicted for future scenarios.

Several potential impacts of climate change on the proposed project were identified:

1. Risk of Wildfires

   The CWA site is situated in a region where climate and fire prone vegetation (fynbos and renosterveld) increase the risk of fires, linked to increased temperatures and greater rainfall variability expected for the area.

Table 55: Risk of Wildfires (Brundtland, Climate Change Impact Assessment, February 2025)

Impact	Description of hazard
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 (Fann et al., 2016).

Impact	Description of hazard
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. 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 to meet electricity requirements above 5 MVA. 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.

2. Risk of Landslides

Due to rainfall patterns, terrain slope, geology, soil and land cover, the site locality is considered susceptible to landslides, however this hazard does not occur often and is more common in areas with steep slopes.

Table 56: Risks of Landslides (Brundtland, Climate Change Impact Assessment, February 2025)

Impact	Description of hazard
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.
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.

3. Risk of Water Security

The risk of water scarcity to the region is considered medium by the GFDRR (2019). This is due to the potential increase in "drought tendency", and "physical area of drought" projected for the region, which will impact water scarcity. According to the GFDRR (2019), there is up to a 20% chance that droughts will occur in the next 10 years. Thus, droughts can be expected in the short to medium term. The risk of water stress in the region, defined as "the ratio of total water demand to available renewable surface water and ground water supplies" by WRI (2019), is considered extremely high. The CWA plans to make use of groundwater at site. According to WRI (2019), groundwater decline in the region is expected to be 0 – 1cm/year and is rated as a low-medium risk.

Table 57: Risk of water scarcity (Brundtland, Climate Change Impact Assessment, February 2025)

Impact	Description of hazard
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.
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.

4. Risk of Extreme Heat

The Western Cape is projected to experience increased temperatures and greater numbers of hot days where temperatures exceed 30°C (CSAG, 2022). The risk of extreme heat to the CWDM is considered medium, meaning that there is a 25% chance that at least a period of prolonged exposure to extreme heat, causing heat stress, will take place in the following five years (GFDRR, 2019).

Table 58: Risk of extreme heat (Brundtland, Climate Change Impact Assessment, February 2025)

Impact	Description of hazard
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.
Impact	Description of hazard
	• 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 (Fann et al., 2016).
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.

5. Risk of Flooding Events

There are no rivers located within the CWA area, however, the Mosselbank River is located about 1km West of the site and the Klapmuts River is located about 1.1km northeast of the site. According to the flood risk assessment conducted for the CWA expansion (Zutari, Flood Risk Assessment, June 2024), the airport itself is at zero risk of flooding from surrounding rivers due to its elevated position. However, runoff from the site will change with the airport development, and slopes and drainage patterns will change. Thus, flood risks for catchments downstream of the CWA will change. The CWA plans to construct detention ponds as a mitigation measure. According to both the GFDRR (2019) and WRI (2019), the site region is at low risk of both urban and riverine floods. This is consistent with modelled predictions for the Western Cape, which show that an increase in temperature and decrease in rainfall can be expected in the future (CSAG, 2022). There is a greater than 1% chance of floods occurring in the coming 10 years (GFDRR, 2019).

Table 59: Risk of flooding events (Brundtland, Climate Change Impact Assessment, February 2025)

Impact	Description of hazard
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.
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.

11.5.3. Mitigation Measures to reduce the impact of the project on Climate Change (Brundtland, Climate Change Impact Assessment, February 2025).

- Additional Scope 1 emissions arise from the operation of the wastewater treatment plant. These emissions were determined using a DEFRA default value, as the plant's design is not yet finalised. Over 60% of emissions from wastewater treatment plants are direct process emissions, with the remainder related to energy use. Methane (CH_4) and nitrous oxide (N_2O) are the primary GHG's emitted during treatment depending on the process type.
- Mitigation strategies include energy production from methane in anaerobic systems to reduce fugitive methane emissions and energy consumption and optimising nutrient recovery and control strategies in bioreactors to minimise N_2O emissions.
- CWA aims to be self-sustainable and off-grid in meeting its electricity needs. Consequently, the bulk electrical services report proposes investing in a Solar PV farm with a 20-100MW capacity, incorporating a 1MW biogas generation plant, and planning a lithium-ion backup battery system. The proposed backup diesel generators have a capacity of 8MW. Implementing these developments will reduce reliance on grid electricity. However, CWA will still be reliant on grid electricity of up to 5MVA of the total electrical requirements, the project will not be optimally running off the grid. While emissions from the biodigester have been calculated and included in the operational emissions, it's important to note that the biodigester

uses renewable biomass (e.g., energy crops), making its emissions climate-neutral. For direct emissions, it is assumed that ground servicing equipment and on-site vehicles use combustion engines. However, CWA's commitment to sustainability suggests a potential investment in electric vehicles, which could further reduce Scope 1 emissions by 8% (5350 tCO_2e).

- Mitigating Scope 3 emissions is challenging, as a significant portion of these emissions are produced by operations outside the control of the airport. However, the project should consider the options to reduce emissions from Category 5, 6, 7 and 11. 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. 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. 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.
- Further investment in renewable energy to make the project completely self-sustainable, with minimal reliance on grid electricity.
- Collaboration with airline partners to facilitate the development and use of sustainable aviation fuels.
- Collaboration with local authorities to optimise public transport to and from the airport.
- 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
- Incorporating mitigation measures, appropriate to the chosen design of the wastewater treatment plant.

11.5.4. Mitigation Measures to reduce the vulnerability of the CWA to identified climate-related risks (Brundtland, Climate Change Impact Assessment, February 2025).

Mitigation and adaptation measures have been developed to reduce the vulnerability of the CWA to identified climate-related risks. Recommendations for consideration in project design, planning, construction and operation are outlined in Table 60.

Table 60: Recommended mitigation and adaptation measure (Brundtland, Climate Change Impact Assessment, February 2025)

Risk	Adaption and Mitigation measures
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 the health and safety of employees, site evacuation and emergency response plans for wildfire events should be implemented. • Ensure backup power systems are available, should the 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.
Risk	**Adaption and Mitigation measures**
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.

In addition to the mitigation proposed in Table 60, CWA has also included a variety of climate change adaptation mitigation measures which are aligned with the City of Cape Town Climate Change Strategy (2021):

Urban cooling and heat responsiveness – The CWA aims to develop buildings appropriate for the local climate that reduce the need for cooling/heating in summer/winter.

Water scarcity and drought readiness – The CWA expansion aims to utilise treated groundwater abstracted from boreholes on site as a short to medium term solution to potable water supply. In the medium to long term, potable water supplied by the City of Cape Town will be added. To treat the ground water to a potable standard, a water treatment facility will be established on site. Non-potable water needs will be met using treated sewage water. Water saving technologies such as rainwater harvesting, water reuse and recycling, efficient irrigation and drought resisted landscaping will be implemented.

Water sensitivity, flood-readiness and storm management – The CWA expansion plans to develop a full stormwater design to accommodate the increase in hardened surfaces and additional stormwater runoff anticipated from buildings. The stormwater design will focus on the prevention of flooding.

Managing fire risk and responsiveness – The CWA expansion plans to implement the placement of fire water tanks on site and include fire protection measures in its building designs. A fire response plan will also be developed. Fire response vehicles and trained fire fighters will be present on site, to ensure fast emergency response times. Fire breaks will also be constructed along the site perimeter and alien vegetation removal will be prioritized to decrease the likelihood of veld fires crossing the site.

Zero emissions buildings - Two sustainable energy options are being considered, including a biodigester plant and photo-voltaic power supplies (solar PV) with optional storage batteries. Ideally, diesel generators will serve as a back-up option in case of unfavourable weather conditions, plant failure or maintenance operations. As mentioned above, the CWA expansion plans to construct buildings that minimise the need to heating and cooling, which will subsequently reduce electricity needs and associated emissions.

Waste generation, management and disposal – waste is expected to be generated from the biodigester, the wastewater treatment plant and from the daily operation of the airport. 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. When drafting the waste management plan, should include aspects such as recycling and composting.

12. Water demand and water supply Analysis

12.1 Water demand

The expansion of the CWA will take place in accordance with 4 proposed Planning Activity Levels (PALs) – PAL 1 (A and B), 2, 3 and 4. The water demands for the proposed CWA development have been determined for each of these planning phases and are based on the following applicable design guidelines (Zutari, Engineering Services Report, February 2025):

- Guidelines for Human Settlement Planning and Design (‘The Red Book 2019’), published by the CSIR.
- Minimum Standards for Civil Engineering Services in Townships (July 2013).
- City of Cape Town: Treated Effluent By-Law, 28 October 2009, promulgated 30 June 2010
- SANS 1200: Standardised Specification for Civil Engineering Construction.
- SANS 241 of 2015

The water demand will be used for a variety of uses such as business/commercial uses, yard connections, warehouses, hotels, parks, wash facilities, club house buildings, industrial uses, parking areas, a garage and filling station, the terminal building and the biodigester. For land uses not defined in the abovementioned guidelines, such as water demand for airport hangars, Zutari applied a process to rationalize an equivalent or combination of land uses, with adjustments made where necessary to determine water requirements (Zutari, Engineering Services Report, February 2025).

The water demand for each use category was broken down into potable and non-potable demands based on the CSIR Guidelines for Human Settlement Planning and Design (‘The Red Book 2019’). The split between non-potable and potable will be further refined during the detailed design process once the landscaping and et services designs are developed.

The water demands for each of the planning phases (PAL 1, 2, 3 and 4) are summarized in Table 61 - Table 64 below.

Table 61: **PAL 1 Water Demand Calculations (Zutari, Water Balance Revision 11, February 2025).**

	PAL 1 Water Demand Calculations					
Water Use	**Potable Use (m^3/a)**	**Non-Potable Use - Toilets (m^3/a)**	**Non-Potable Use - Irrigation (m^3/a)**	**Non-Potable Use - Semi Treated Effluent (m^3/a)**	**Total Potable Requirement (m^3/a)**	**Total Non-Potable Requirement (m^3/a)**
Business/Commercial	76736	25579	11368	n/a	76736	36947
Yard Connection	2523	841	374	n/a	2523	1215
Warehousing	14070	4690	2084	n/a	14070	6774
Hotel	10469	3490	1551	n/a	10469	5041
Park – Grounds Only	0	0	79901	n/a	0	79901
Wash Facility	0	0	0	n/a	0	0
Club – Buildings Only	0	0	0	n/a	0	0
Industrial	7106	2369	1053	n/a	7106	3422
Parking Grounds	0	0	0	n/a	0	0
Garage and Filling Station	2683	894	397	n/a	2683	1291
Terminal Building	47797	15932	7081	n/a	47797	23013
Biodigester	n/a	n/a	n/a	12775	n/a	12775
Total PAL 1 (m^3/annum)					161382	170378
AADD PAL 1 (m^3/day)					442	467

Table 62: PAL 2 Water Demand Calculations (Zutari, Water Balance Revision 11, February 2025).

	PAL 2 Water Demand Calculations					
Water Use	**Potable Use (m^3/a)**	**Non-Potable Use - Toilets (m^3/a)**	**Non-Potable Use - Irrigation (m^3/a)**	**Non-Potable Use - Semi Treated Effluent (m^3/a)**	**Total Potable Requirement (m^3/a)**	**Total Non-Potable Requirement (m^3/a)**
Business/Commercial	118919	39640	17618	n/a	118919	57258
Yard Connection	2678	893	397	n/a	2678	1290
Warehousing	44704	14901	6623	n/a	44704	21524
Hotel	20938	6979	3102	n/a	20938	10080
Park – Grounds Only	0	0	79901	n/a	0	79901
Wash Facility	0	0	0	n/a	0	0
Club – Buildings Only	0	0	0	n/a	0	0
Industrial	7039	2346	1043	n/a	7039	3389
Parking Grounds	0	0	0	n/a	0	0
Garage and Filling Station	2658	886	394	n/a	2658	1280
Terminal Building	64797	21599	9600	n/a	64797	31199
Biodigester	n/a	n/a	n/a	73000	n/a	73000
Total PAL 2 (m^3/annum)					261732	278920
AADD PAL 2 (m^3 /day)					717	764

Table 63: PAL 3 Water Demand Calculations (Zutari, Water Balance Revision 11, February 2025).

	PAL 3 Water Demand Calculations					
Water Use	**Potable Use (m^3/a)**	**Non-Potable Use - Toilets (m^3/a)**	**Non-Potable Use - Irrigation (m^3/a)**	**Non-Potable Use - Semi Treated Effluent (m^3/a)**	**Total Potable Requirement (m^3/a)**	**Total Non-Potable Requirement (m^3/a)**
Business/Commercial	135655	45218	20097	n/a	135655	65315
Yard Connection	2936	979	435	n/a	2936	1414
Warehousing	48950	16317	7252	n/a	48950	23569
Hotel	20938	6979	3102	n/a	20938	10081
Park – Grounds Only	0	0	79901	n/a	0	79901
Wash Facility	0	0	0	n/a	0	0
Club – Buildings Only	0	0	0	n/a	0	0
Industrial	7039	2346	1043	n/a	7039	3389
Parking Grounds	0	0	0	n/a	0	0
Garage and Filling Station	2658	886	394	n/a	2658	1280
Terminal Building	81304	27101	12045	n/a	81304	39146
Biodigester	n/a	n/a	n/a	80300	n/a	80300
Total PAL 3 (m^3/annum)					299481	304395
AADD PAL 3 (m^3 /day)					820	834

Table 64: PAL 4 Water Demand Calculations (Zutari, Water Balance Revision 11, February 2025).

	PAL 4 Water Demand Calculations					
Water Use	**Potable Use (m^3/a)**	**Non-Potable Use - Toilets (m^3/a)**	**Non-Potable Use - Irrigation (m^3/a)**	**Non-Potable Use - Semi Treated Effluent (m^3/a)**	**Total Potable Requirement (m^3/a)**	**Total Non-Potable Requirement (m^3/a)**
Business/Commercial	135 655	45 218	20 097	n/a	135 655	65 315
Yard Connection	3 074	1 025	455	n/a	3 074	1 480
Warehousing	48 950	16 317	7 252	n/a	48 950	23 569
Hotel	20 938	6 979	3 102	n/a	20 938	10 081
Park – Grounds Only	0	0	100 635	n/a	0	100 635
Wash Facility	0	0	0	n/a	0	0
Club – Buildings Only	0	0	0	n/a	0	0
Industrial	7 106	2 369	1 053	n/a	7 106	3 422
Parking Grounds	0	0	0	n/a	0	0
Garage and Filling Station	2 683	894	397	n/a	2 683	1 291
Terminal Building	96 086	32 029	14 235	n/a	96 086	46 264
Biodigester	n/a	n/a	n/a	80 300	n/a	80300
Total PAL 4 (m^3/annum)					314 493	332 358
AADD PAL 4 (m^3 /day)					862	911

12.2. Water supply analysis

The current CWA site is serviced through an existing borehole on the eastern side of the site (Figure 8), and no municipal water connection exists. Water quality in the existing borehole is poor with high Fe and Mn levels and yield is minimal. This borehole is the only source of water on site for the current CWA and is only used for non-potable needs.

The nearest municipal water services are found in the Fisantekraal settlement. The tie in point is along a trunk main from the Spes Bona Reservoir, a 400mm diameter pipe located in the R312 Lichtenburg Road, which terminates just after the railway crossing, approximately 3km southwest of the current CWA site (Figure 9).

There are additional proposed developments near CWA where municipal water mains are proposed (Greenville to the South and Bella Riva to the East). Both developments were considered as possible tie-in locations however, these developments are still in the planning stage and there are no firm indications that either development will have water infrastructure constructed in the short term in time to supply CWA.

A proposal for bulk water supply to CWA and neighbouring developments was presented to the City of Cape Town Bulk Water and Water Reticulation on October 4, 2024. It aimed to address medium- and long-term water needs based on the city's bulk water master plan. The initial proposal included constructing a 300 ML reservoir at the Spes Bona site (Spes Bona Reservoir 3) to enhance climate resilience and future supply. While an EIA approved a pipeline route from Spes Bona 3 to Mulders lei, it was recommended that CoCT Water Reticulation assess the feasibility of building the reservoir at Spes Bona 3 using this approved route. However, land acquisition for the pipeline route has not progressed. The reservoir size would be determined by CoCT Water Reticulation, with potential funding from Development Contributions (DCs)(Zutari, Engineering Services Report, February 2025). Zutari has submitted a request to CoCT Water Reticulation for support in securing the development's long-term water supply.

Due to the current constraints in the municipal system alternative potable water sources have been considered for the CWA development in the short to medium term. The current water supply strategy for CWA follows a phased approach, initially relying on groundwater as the primary source. This will continue in the short term until municipal infrastructure can either supplement or fully replace the groundwater supply as illustrated in Figure 10. A treatment facility will be constructed on-site to ensure the groundwater meets potable water standards. For non-potable water requirements, treated wastewater will be used, reducing reliance on groundwater abstraction and enhancing the site's resilience to drought in the short to medium term.

Borehole Supply

To date, three production boreholes, CWA_BH001, CWA_BH002, and CWA_BH003 have been drilled on-site to supply groundwater for the initial phases of the CWA development (GEOSS, WULA

Geohydrological Assessment, February 2025, Appendix B). Yield testing has confirmed that CWA_BH001, drilled to a depth of 100m, can sustainably provide 86.4m³/day, while CWA_BH002, at a depth of 100.4m, can supply 216m³/day and CWA_BH003 at a depth of 149.9m can supply 146.016m³/day. The combined conservative estimate of groundwater available from all three boreholes is 163 671m³ per annum. These yields are sufficient to meet the short-term groundwater demand. An application under Section 21(a) of the NWA is being submitted to abstract the maximum sustainable yield from the three production boreholes. It should however be noted that the Aquifer Firm Yield Model has confirmed that the Groundwater Resource Unit (GRU) in the region has the capacity to support the **additional water extraction** should it be required for future phases of development (GEOSS, WULA Geohydrological Assessment, February 2025, Appendix B).

Water quality assessments reveal that CWA_BH001 contains "marginal" quality water for human consumption due to elevated levels of iron (Fe) and manganese (Mn), leading to high turbidity. Groundwater from CWA_BH002 and CWA_BH003 has even poorer quality, with elevated concentrations of the same contaminants. To address this, a water treatment facility will be constructed on-site to treat the borehole water to a potable standard.

To supply potable water within the City of Cape Town metro area, the supplier (developer) needs to obtain a Water Supply Intermediary (WSI) agreement from the CoCT. Discussions have been held with the CoCT in this regard. The application is supported in principle and is subject to a formal application and review of the proposal by the CoCT. The elements proposed for this solution are included in the table below.

Table 65: Phase 1 Borehole Supply Requirements (Zutari, Engineering Services Report, February 2025).

ID	Element	Description	Asset Owner
1	Boreholes	Several boreholes will be sunk to meet the demand of the CWA development.	CWA
2	Water Treatment Plant	A water treatment plant will be provided to treat the water to meet SANS 241 (2015) standard.	CWA
3	Storage Tanks	Storage tanks will be provided to provide a buffer against peaks flows and as emergency storage if the boreholes or WTP experience down time.	CWA
4	Booster Pumpstation	To supply water at the required flow and pressure.	CWA
5	Brine Evaporation ponds	If required brine evaporation ponds to deal with the brine as a byproduct of the water treatment process.	CWA

Phase 2: Municipal Supply

Phase 2 involves primary supply via the proposed connection to the municipal supply in Lichtenberg Rd. Once the bulk supply is available then the connection will be made directly onto the network.

12.3. Water Balance

Detailed water balances outlining the potable and non-potable water supply and demand for each of the planning phases (PAL 1, 2, 3 and 4) will be included in final submissions. A high-level summary is provided below.

Table 66: Potable Water Balance Summary (Zutari, Water Balance Revision 11, February 2025)

	Total Groundwater Supply (m³/a) Treated to potable levels	Total Municipal Supply (Potable) (m³/a)	Total Potable Requirement (m³/a)	Balance: Total Potable Supply VS Demand (m³/a)
PAL 1	152 912	168 670	161 382	160 200
PAL 2	155488	168670	261 732	62 426
PAL 3	155488	168670	299 481	24 678
PAL 4	155488	168 670	314 493	9665

Table 67: Non-Potable Water Balance Summary (Zutari, Water Balance Revision 11, February 2025)

	Total Non-Potable Supply (m³/a) (On Site Treated Sewer Effluent)	Total Non-Potable Requirement (m³/a)	Balance: Total Non-Potable Supply VS Demand (m³/a)
PAL 1	170378	170378	0
PAL 2	278920	278920	0
PAL 3	304395	304395	0
PAL 4	332 358	332 358	0

13. Water quality

13.1. Groundwater Quality

According to the DWAF 2005 database, regional groundwater quality ranges from “ideal” to “poor” (in terms of EC) (Figure 36). Three production boreholes have been drilled and tested onsite - CWA_BH001, CWA_BH002 and CWA_BH003. CWA_BH001 and CWA_BH002 are located along the western side of the proposed development area while CWA_BH003 is located in the south east of the proposed development area (Figure 11 & Table 14). Borehole testing included 24hr yield testing as well as water quality testing by a SANAS accredited laboratory.

The water quality results obtained were classified according to the SANS 241-1: 2015 standards (Table 15). The groundwater from CWA_BH001 was found to be of “marginal” water quality for human consumption, with elevated turbidity levels related to high concentrations of Fe and Mn in the groundwater (Table 16 & GEOSS, Borehole Yield and Quality Testing of CWA _BH001, Sept 2022). Groundwater from CWA_BH002 and CWA_BH003 was found to be of poor quality with Fe and Mn levels above the chronic health limit of the SANS 241-1:2015 drinking water guidelines (Table 16 &

GEOSS, Borehole Yield and Quality Testing of CWA _BH002, Dec 2022 ;GEOSS, Borehole Yield and Quality Testing of CWA_BH003, December 2024). A water treatment plant will be developed to treat the borehole water to a potable water standard.

13.2. Water Treatment Plant

A water treatment plant will be provided to treat the groundwater to meet SANS 241 (2015) standard. Treatment of groundwater to potable standards will result in the production of brine. Brine will be stored in a brine evaporation pond for final disposal (Zutari, Engineering Services Report, February 2025).

13.3. Wastewater Treatment Plant

The preferred development proposal includes the construction of an on-site treatment plant to treat a portion of the sewage generated by the CWA development. The treatment plant will treat the sewage to a quality that meets the applicable limits. The treated effluent will then be reused on the site as non-potable water supply. To avoid excessive effluent production and maintain compliance with wastewater discharge regulations, the remaining sewage will be directed to the nearby municipal WWTW for further treatment and disposal. This approach aims to optimize effluent reuse, reduce pressure on the WWTW, as well as environmental concerns with respect to excess treated effluent generated (Zutari, Engineering Services Report, February 2025).

The package sewage treatment plant will be designed as a closed system, with all waste generated handled in compliance with relevant city by-laws (Zutari, Engineering Services Report, February 2025). The key infrastructure elements for the preferred sewage management approach are summarized in Table 68. The key design parameters that will inform the design of the sewer networks are summarized in Table 69.

Table 68: Required Sewage Infrastructure Elements (Zutari, Engineering Services Report, February 2025).

ID	Element	Description	Asset Owner
1	Internal Sewer Gravity Network	Gravity mains to convey sewage within the development to the primary sewage pumpstation.	CWA
2	Minor Sewage Lifting Stations	If required lifting stations will be placed inside the CWA property to pump/lift the sewer in areas where the pipes become too deep in order to assist conveying sewage to the main sewage station.	CWA
3	Primary Sewage Lift Stationing	This pumpstation will collect and then lift the sewage into the package treatment plant and divert the remainder to the Pump Station.	CWA
4	Package Sewage Treatment Plant	The Package Sewage Treatment will treat the sewage emanating from the CWA development for re-use	CWA
5	Emergency Storage Pond	In the event that there is a malfunction with the primary lifting station or sewage treatment plant flows will be diverted to the emergency overflow pond.	CWA
6	Primary Sewer Pumpstation	A Primary Sewage pump station to pump all sewage flows from the CWA Development to the Fisantekraal WWTW.	CoCT
7	Rising Main	A sewage rising main from the municipal pumpstation to the Fisantekraal WWTW.	CoCT
8	Servitude	A servitude registered across the Bella Riva property in favour of CoCT is required in order accommodate the sewer rising main.	n/a
9	Additional inlet chamber	An additional chamber is required at the inlet works to receive the sewage from the lifting station. The inlet works at WWTW is of the above ground type as it was designed to received pumped flows only.	CoCT

Table 69: Key Sewage Design Criteria (Zutari, Engineering Services Report, February 2025).

Criteria	Value
Pipe Positioning	• Sewer pipes to be installed in the centre of the road with 1m offset from C/L • Exceptions to avoid acute angles in the pipe.
Material	• GRAVITY pipes range from 160 mm dia. to 250mm dia shall be uPVC Class 34 heavy duty on Class B bedding. • FORCED MAIN pipes to be uPVC Class 12 rising main pipe required or HDPE depending on working pressure. • Sewer manholes to be precast ring manholes with a diameter of 1.2m concrete lockable covers and frames to be used.
Pipe Slope	• Pipe slopes to be designed to maintain self-cleansing flow velocities between 0.6m/s and 2.5m/s.
Depth of Cover	• 1m from crown of pipe to finished road level. • Soil improvement for pipes with a depth of cover less than 1m will be considered. • Such improvements will consist of cement stabilised material (4% cement) on top of the required pipes.

14. Public participation

In accordance with the One Environmental System, combined PPP will be undertaken for the Scoping and Environmental Impact Assessment and the WULA application. The required 60-day public commenting period under the National Water Act was divided into two 30-day phases. The first 30-day public participation period for the WULA took place during the NEMA in-process Scoping phase PPP, while the second 30-day period occurred during the first round of the NEMA in-process Environmental Impact Assessment phase PPP. An additional round of public consultation will now be conducted during the NEMA Impact Assessment phase, during which the WULA application will also be made available for public review. This final round will provide stakeholders with an additional 45-day period to submit comments.

PPP consisted of three main components: i) Notification, ii) Engagement, and iii) Comments and Response, as elaborated below:

PPP for the first 30-day public participation period included the following:

- The draft WULA Technical Report was made available for a 30-day commenting period on the PHS Consulting website www.phsconsulting.co.za along with the Scoping EIA documentation. Public participation ran from 24 July 2024 up to and inclusive of 26 August 2024.
- Notification letters were sent to all identified I&APs (including organs of state and adjacent landowners) via email or WhatsApp as relevant, informing them of the activity and the opportunity to comment.
- Additional municipalities namely, the Cape Winelands District Municipality, the Swartland Municipality and the West Coast District Municipality were notified via direct emails as requested by DEA&DP
- An advertisement in English was placed in the Tygerburger on the 24th of July 2024 with detail on and how to comment on the draft Scoping Report and the Water Use Licence application.
- Three site Notices in English were placed on or near the site along various roads adjacent to the site with detail on and how to comment on the draft Scoping Report and the Water Use Licence application during the 30-day commenting period. These site notices remained in place for the entire PPP period
- A hard copy of the report was lodged at the Fisantekraal Public Library for public viewing for the duration of the 30-day commenting period. A site notice was pinned on the library notice board for the same time period.
- I&APs were encouraged to submit any comments via email, fax, post or Whatsapp.

- I&APs who are unable to read or write or who otherwise need special assistance to state their views on the proposal, could request assistance in recording their comments or objections. These I&APs could send their comments using the voicenote option on Whatsapp.
- All comments received from I&APs were recorded and an I&AP register compiled and updated as required.
- All comments received were responded to in the Comments and Response (C&R) report which was included in the final Scoping Report.
- All comments received during the 30-day comment period were considered in the final Scoping Report and specialist reports and where required and specialist reports were amended. Where comments required amendment to the WULA technical summary report it was included and also included in the Geohydrological report.

PPP for the second 30-day public participation period included the following:

- The draft WULA Technical Report was made available for a 30-day commenting period on the PHS Consulting website www.phsconsulting.co.za along with the draft Environmental Impact Assessment Report documentation. Public participation ran from 13 November 2024 up to and inclusive of 13 December 2024. Where extensions were requested by I&APs, they were granted until the 13th of January 2025.
- Notification letters were sent to all identified I&APs (including organs of state and adjacent landowners) via email or WhatsApp as relevant, informing them of the activity and the opportunity to comment.
- Additional municipalities namely, the Cape Winelands District Municipality, the Swartland Municipality and the West Coast District Municipality were notified via direct emails as requested by DEA&DP
- An advertisement in English was placed in the Tygerburger on the 13th of November with detail on and how to comment on the draft Environmental Impact Assessment Report, the Water Use Licence application and the Maintenance Management Plan. This advert also informed the public of a Public Open Day that was held on 20 November 2024.
- Three site Notices in English were placed on or near the site along various roads adjacent to the site with detail on and how to comment on the draft Environmental Impact Assessment Report, the Water Use Licence application and the Maintenance Management Plan during the 30-day commenting period.
- A hard copy of the report was lodged at the Fisantekraal Public Library for public viewing for the duration of the 30-day commenting period. A site notice was pinned on the library notice board for the same time period.
- I&APs were encouraged to submit any comments via email, fax, post or Whatsapp.

- I&APs who are unable to read or write or who otherwise need special assistance to state their views on the proposal, could request assistance in recording their comments or objections. These I&APs could send their comments using the voicenote option on WhatsApp.
- All comments received from I&APs were recorded and an I&AP register compiled and updated as required.
- All comments received were responded to in the Comments and Response (C&R) report which was included in the amended Environmental Impact Assessment Report.
- All comments received during the 30-day comment period were considered in the amended Environmental Impact Assessment Report, the WULA technical summary report and specialist reports.

Table 70: Outcome of the public participation – To be finalised and submitted upon completion of all PPP undertaken for the proposed development.

Person who commented	Comments (support/ object/ concerns)	Reasons for objections / concerns	Applicant's response to the objection/concerns

15. Inputs/Authorisations from other Departments /Stakeholders

- An application was made to CoCT to determine if spare capacity exists in the municipal sewage system to accept the sewage flows generated from the proposed CWA development.

  The key aspects of the response are summarized as follows:

  Treatment Capacity

  - Capacity exists at the Fisantekraal WWTW to accept the sewage flows from the development.

  Network Capacity

  - The municipal sewage network and pumpstations that can convey the sewage to the WWTS are located to the southwest of CWA near the Fisantekraal Settlement and Greenville development.
  - However, network coverage is limited and conveying the flows to the existing municipal pump station in Fisantekraal and then onward conveyance to the Fisantekraal WWTW cannot be achieved without network expansion towards the East.

  Treated Effluent Capacity (Zutari, Engineering Services Report, February 2025)

  - A letter of intent has been submitted to the CoCT Treated Effluent Department to confirm whether the Fisantekraal WWTW would have spare capacity to receive the excess treated effluent generated by the development, should Sewer Option 1 be pursued.
  - The letter of intent also includes the maximum projected treated effluent required for non-potable demand, should Sewer Option 2 be pursued, to confirm whether the Fisantekraal WWTW would have the capacity to meet the development's treated effluent demands. The design will ensure that all treated effluent generated on-site will be effectively managed and disposed of in an environmentally compliant manner; and that no treated effluent will be discharged into the stormwater system.

  Based on subsequent discussions with CoCT officials, they indicated support for a direct route to the Fisantekraal WWTW.

- An enquiry was made to CoCT to determine the availability of municipal infrastructure to provide potable water to the proposed development.

  The key aspects of the response are summarized as follows:

Water Service Provision:

- The site is currently not serviced with a municipal water connection
- The existing buildings on site are serviced through boreholes

Existing Municipal Water Services:

- The site falls within the Spes Bona Reservoir supply zone
- There are no existing municipal potable pipelines in close proximity to the site.
- Although there are some supply mains to the chicken farms to the west of the CWA development the nearest accessible existing municipal water services are found in Fisantekraal settlement.
- The tie in point is along a trunk main from the Spes Bona Reservoir is a 400mm dia. located in the R312 Lichtenburg which road and the extent of which terminates just after the railway crossing.
- There are proposed developments in close proximity where municipal water mains are proposed and include the Greenville development to the south and the Bella Riva development to the east. Both developments were considered as possible tie-in locations however, these developments are still in the planning stage and there are no firm indications that either development will have water infrastructure constructed in the short term in time to supply CWA.

- There are existing land use rights on Portion 4 of Farm 474 Joostenbergs Kloof and Portion 10 of Farm 724 Joostenbergs Vlakte for the current airport operation to conduct business.
- There is a valid mining right and EMP on P23 of Farm 724 and RE 474 of currently subject to a closure application.
- There is no existing EA for the site, activities commenced before any of the applicable NEMA Regulations came into effect.
- There is an approved Alien Vegetation Management plan in place for the existing CWA site (copy can be provided), which will be incorporated into the amended Alien Vegetation Management plan appended to the draft EMPr.
- In a meeting with City of Cape Town Bulk Water and Water Reticulation on the 4th of October 2024, a proposal for bulk water supply to CWA and neighbouring developments was put forth to meet the medium and long term water requirements for the CWA development. The recommendation was based on the bulk water master planning for the northern edge of the city, an initial proposal included constructing a 300ML reservoir at the old Spes Bona reservoir site (hereafter referred to as Spes Bona Reservoir 3) to enhance climate resilience

and meet future water demand. While the proposal underwent an Environmental Impact Assessment (EIA), which approved a pipeline from the proposed Spes Bona 3 Reservoir to Muldersvlei. It was suggested that CoCT Water Reticulation evaluate the feasibility of constructing a reservoir at the proposed site for Spes Bona 3 using the EIA-approved pipeline route to supply water to the site and neighboring developments, noting that no progress has been made on land acquisition for the proposed pipe route. The reservoir size would be determined by CoCT Water Reticulation department, and financing could be partially offset by Development Contributions (DCs) from these developments. Zutari have submitted a letter to CoCT water reticulation to request support for the developments medium and long term water supply (Zutari, Engineering Services Report, February 2025).

16. Section 27 (1)

The requirements contained in Section 27(1) of the National Water Act, 1998 (Act 36 of 1998) have been considered and are discussed further below.

Please Note: All information available at the time of compilation has been used to provide the different aspects of the motivation; additional information may become available as the project proceeds and these sections will be updated accordingly.

a) Existing lawful water uses

An existing lawful water use (ELU) is a water use that lawfully took place in the period two years before the commencement of the NWA. This allows any water use that lawfully took place to continue until such time as it can be converted into a Licence.

The current CWA site has a historical borehole close to the existing runways on the East which supplies the domestic needs to the current CWA development (Figure 8).

b) Need to redress the results of past racial and gender discrimination

The applicant is Cape Winelands Aero (Pty) Ltd, a South African registered private company with three male white directors. The primary decision-making authority is however delegated to the level of a holding company. The holding company for Cape Winelands Aero (Pty) Ltd is RSA Aero Ltd. The directorship of RSA Aero Ltd includes three Historically Disadvantaged Individuals – one female and two males.

The proposed development and its associated water uses are expected to generate social and economic benefits by driving economic growth and job creation during both the construction and operational phases. The CWA represents a substantial private investment that will contribute to employment and business opportunities within the broader Cape Town Metropolitan Area. Employment creation has the potential to facilitate greater workforce participation among historically disadvantaged individuals (HDIs) thereby addressing economic disparities as a result of past discrimination.

The proposed development activities are expected to create a significant number of employment opportunities for HDIs within local communities. Several low-income communities are situated near the proposed CWA site, including Fisantekraal, which is located less than 2 km southwest of the development and could serve as a primary labour source. According to the Socio-Economic Scoping Report (Multi-Purpose Business Solutions, Socio-Economic Impact Assessment, March 2025), 42.67% of the working-age population residing within 10km of the proposed development site was unemployed in 2011. The employment opportunities generated by this project have the potential to enhance economic development in these communities by increasing local participation in the labour market and supporting sustained socio-economic growth.

The Socio-Economic Impact Assessment compiled for the proposed development indicates that the project could sustain approximately 25 107 direct and indirect employment opportunities during the initial two years of construction and approximately 102 732 direct, indirect and indirect employment opportunities during 20 years of operation (Multi-Purpose Business Solutions, Socio-Economic Impact Assessment, March 2025). As a result of these jobs, household income could increase by approximately R4.7 billion during the initial two years of construction. Operational phase job creation could result in an increase in household income of approximately R17.7 billion during 20 years of operation.

The proposed development activities include a labour-intensive construction phase with ongoing capital expenditure requirements over a 20-year time frame. The development therefore represents a good opportunity for the local building sector and members of the local community who are employed in the building sector. Beyond temporary construction-related employment, the development generate long-term job opportunities for HDIs across various sectors, including maintenance, logistics support, security and safety services, retail and hospitality, customer service, ground handling, transportation, training and skills development, and administrative support. Those employed onsite will be given opportunities to learn new skills and continue to develop professionally as they arise within their relevant positions.

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. 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 (Multi-Purpose Business Solutions, Socio-Economic Impact Assessment, March 2025).

The creation of new job opportunities and employee training initiatives is expected to have a positive socio-economic impact on the community. Providing employment and skills development opportunities for local HDIs is a key social benefit, contributing to economic empowerment, workforce development, and long-term social upliftment.

c) Efficient and beneficial use of water in the public interest

The proposed project entails the expansion and upgrade of the current Cape Winelands Airport (CWA), formerly known as Fisantekraal Airfield (FAFK), from a general flying airfield to a commercial airport capable of facilitating long-haul, wide-body flights by airlines and unscheduled operators from across the world. The proposed development activities and associated water uses will facilitate enhanced economic development within the region and provide benefits to local and broader communities.

The CWA is a large-scale private development involving substantial capital investments that would provide numerous public benefits. The proposed development is expected to stimulate economic growth within the region directly and indirectly. The CWA's objective is to adopt an embedded sustainability approach – prioritizing, people, planet and profit. The aim is that sustainability will be fully integrated into all elements of the business.

The proposed development is expected to generate employment opportunities across skilled, semi-skilled, and unskilled labour categories during both the construction and operational phases. A project of this scale is expected to have a significant impact on the local labour market and contribute meaningfully to the regional economy. In addition to direct employment, numerous indirect job opportunities will emerge as a result of the CWA development, supporting industries such as trade, tourism, and related services. While the full extent of capital investment's economic impact is difficult to quantify, its effects will become evident through increased employment, business growth, and broader economic activity once the project is operational.

Furthermore, the airport is strategically located between the three major regional growth centres of Cape Town, Stellenbosch and Drakenstein and along north-south and east-west road networks (Figure 50) and can thus serve both businesses and the tourism industry in the Western Cape (Multi-Purpose Business Solutions, Socio-Economic Impact Assessment, March 2025). This provides opportunities for transport-related development supported by other transport services (public transport, rental cars, etc.) and complementary commercial services. The airport could also serve as a multimodal transport hub given its strategic location near the Saldanha-linked Mellish Station (Rail) and only a few kilometres from the N1 highway, enabling efficient sea-rail-road-air linkages (Multi-Purpose Business Solutions, Socio-Economic Impact Assessment, March 2025).

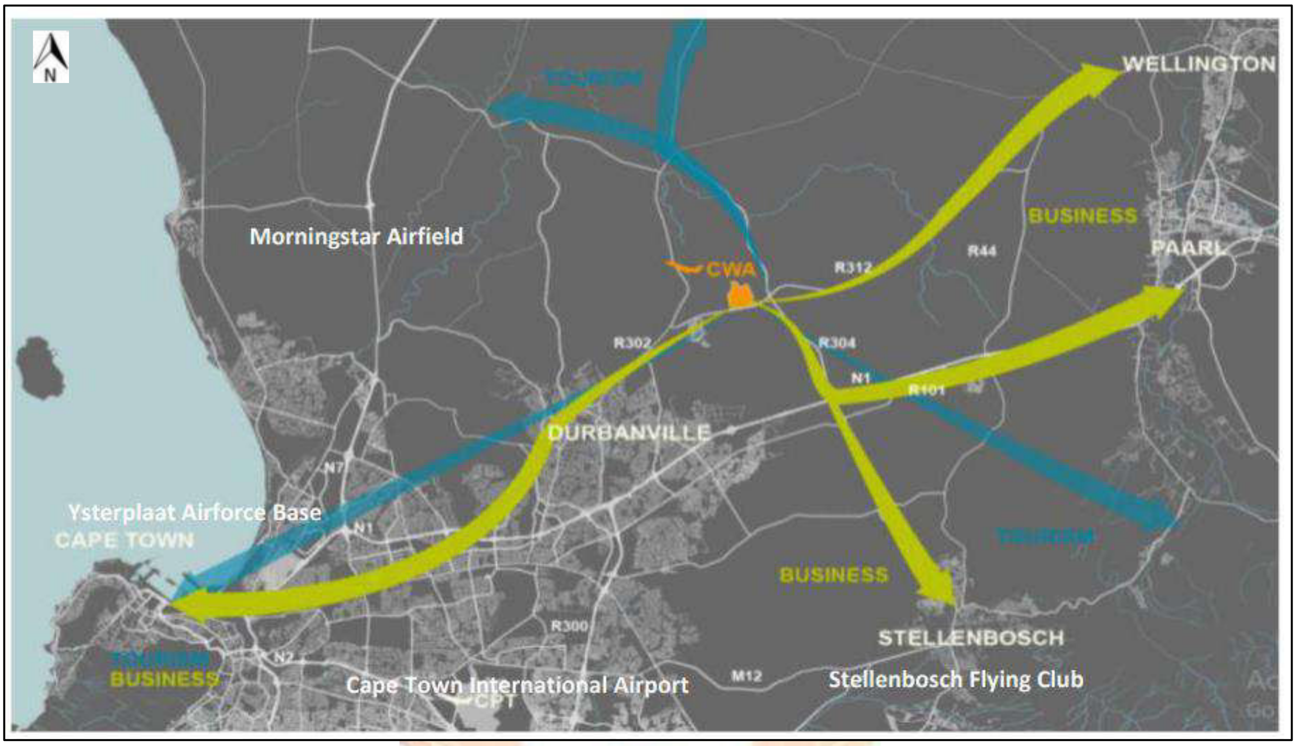


Figure 50: Relative location of the proposed Cape Winelands Airport (Multi-Purpose Business Solutions, Socio-Economic Scoping Report, September 2023).

While the proposed development will have substantial socio-economic benefits, a development of this scale is not without risks. The proposed primary runway coincides with an onsite delineated seep wetland. As such the proposed CWA development will likely result in loss of approximately 6.74ha of wetland habitat of the Seep wetland 1 (Figure 29). The mitigation hierarchy was implemented in full in an effort to avoid this impact, however no reasonable or feasible alternative is available for the runway layout and alignment. As such wetland offsets will be required to compensate for the residual loss of this system.

FEN Consulting was appointed to undertake a freshwater offset investigation to assess suitable offset sites. During the offset investigation it was determined that the proposed development activities will result in a loss of approximately 6.74ha of wetland habitat. When accounting for indirect impacts, the total loss extends to 7.44ha (Figure 14). 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.

Through consultation with various stakeholders including the City of Cape Town, Cape Nature, the DEA&DP and the DWS it was determined that onsite offset would be most beneficial in the current context. The remainer of Seep Wetland 1 (3.68ha) in the eastern part of the study area along with a portion of Channelled Valley Bottom (CVB) Wetland 1 (36.2ha) located further East of the study area into which Seep Wetland 1 drains (via an agricultural drain), have been identified as suitable for rehabilitation and offset purposes (Figure 14). 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 (FEN Draft Wetland Offset Study and Implementation Plan, September 2024).

The selected wetland offset site encompasses approximately 40ha which is available for offset purposes (Figure 17). 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 rehabilitation plan focuses on restoring hydrological and geomorphological processes to support the wetlands' ecological functions. Please refer to Section 8 of this report and the Draft Wetland Offset Study and Implementation Plan developed by FEN, January 2025 for further details on proposed rehabilitation actions.

In addition to the onsite seep wetland that will be directly impacted by the proposed development activities, several wetland systems were identified within the 500m regulated proximity from the proposed development site that may be indirectly impacted by the proposed development (Figure 29) (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025). Given the nature of the proposed development (increased impermeable surfaces or surfaces cleared of vegetation) suitable stormwater management will play an important role in avoiding / minimizing potential impacts on these systems. A concept stormwater management plan has been developed for the site (refer Section 7 of this report). The appointed freshwater specialist has provided input into this plan to ensure that suitable freshwater impact mitigation is incorporated into the detailed designs.

The proposed project does not place the safety, water use or access to water of any downstream community at risk. The stormwater management plan for the proposed development has been designed to take surrounding land areas and communities around the site into consideration and thereby ensure that any potential risks are negated through proper planning.

The proposed development will implement a range of measures, including water-saving technologies, to ensure that water is used effectively, thereby maximizing social and economic benefits while minimizing any potential impacts on the resource or the environment. These measures will include the installation of efficient irrigation systems, rainwater harvesting, and the reuse of treated effluent from the wastewater treatment plant for irrigation and energy generation. For non-potable water requirements, treated wastewater will be used, reducing reliance on groundwater abstraction and enhancing the site's resilience to drought in the short to medium term. By integrating these sustainable practices, the project aims to reduce water consumption, promote responsible water management, and ensure that the benefits of development are realized without compromising the health of local water resources or the surrounding environment.

The proposed CWA development is based on sound commercial principles and will create shareholder value while positively contributing to the South African economy, enabling commercially driven investment, and making a direct economic and social impact. CWA will actively work with the communities closest to the airport, thereby embracing the role that it can play in improving lives and livelihoods within these communities. With the increasing awareness of finite resources that the planet has to offer CWA intends to adopt environmentally responsible methods in all their operations.

d) Socio-economic impact –

i) Of water use or uses if authorised:

The proposed development site is located in the Western Cape of South Africa within the City of Cape Town local municipality. The Western Cape is currently thriving, experiencing excellent year-on-year growth in terms of economic activity and population. The development of new growth nodes and improved connectivity will play an important role in ensuring that this growth can continue. Cape Town as a city is unique in that its geographically isolated from other cities around the world yet enjoys a substantial amount of air traffic. With the expansion of CWA into a commercial airport, Cape Town will become a “Multi-Airport City” which addresses multiple capacity constraints.

Airports play a significant role in commercial activity and can contribute to broader economic growth through the multiplier effect. According to Airports Council International, airports support the economic potential of the communities they serve by fostering business development, employment, and long-term growth.

The Socio-Economic Impact Assessment for the proposed CWA identified both positive and negative socio-economic impacts. Potential negative impacts include changes in traffic flows, effects on the sense of place, nuisance factors, local crime, an influx of job seekers, and the risk of informal settlements due to increased economic activity. Additionally, the presence of construction workers may impact local communities (Multi-Purpose Business Solutions, Socio-Economic Impact Assessment, March 2025). However, with proper site management and the implementation of recommended mitigation measures, these impacts are expected to be low to moderate in significance (Multi-Purpose Business Solutions, Socio-Economic Impact Assessment, March 2025). Overall, the assessment indicates that the benefits of the development outweigh the potential socio-economic costs provided that the recommended mitigation measures are implemented (Multi-Purpose Business Solutions, Socio-Economic Impact Assessment, March 2025).

Results of the Socio-Economic Assessment revealed that unemployment within the region is just over 40%. Analysis of household income levels in the region revealed that approximately 15.43% of the households residing within 10km of the proposed development site had no income, while approximately 42.30% of households with an income earned less than R76 801 per annum. Within 20km of the development, approximately 13.47% of the households indicated that they did not have an income, 33.54% of the households had an annual income of less than R76 801, and 8.52% of households declared an income of more than R614 400 per year (Multi-Purpose Business Solutions, Socio-Economic Impact Assessment, March 2025). Please note that not all respondents disclosed their income to the specialist.

For the period from 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 Cape Town Metropolitan Area. The primary sector contributed 1.66% to the Gross Value Add (GVA) of the CMA 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 contributed 23.44% to the GVA of the Cape Town Metropolitan Area 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 contributed 74,92% to the GVA of the CMA economy in 2005; this increased to 79.14% in 2020. The primary, secondary and tertiary sectors contributed 2.73%, 16.81% and 80.46% to total employment in the CMA economy, respectively in 2020 (Multi-Purpose Business Solutions, Socio-Economic Impact Assessment, March 2025).

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. 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 (Multi-Purpose Business Solutions, Socio-Economic Impact Assessment, March 2025).

The development proposal includes a phased development approach that will take place over a period of several years providing substantial, multi-year employment opportunities within the local building sector. Furthermore, the proposed development is not only labour intensive during the construction phase but will also provide numerous permanent job opportunities during the operational phase of the airport for skilled, semi-skilled and unskilled labour. The proposed development will employ individuals in a wide variety of different roles including maintenance roles, logistic support, security and safety services, retail and hospitality, customer service, ground handling services, transportation services, training and skill development, administrative and clerical support as well as cleaning and landscaping staff.

Given that a substantial proportion of individuals living within 20km from the proposed development have either no income or are living below the poverty line, the numerous direct employment and associated skill development opportunities that will be generated by the CWA development will have far reaching benefits for the local labour force. Furthermore, airports are known drivers of commercial activity. The proposed development is expected stimulate economic growth far beyond is physical development boundaries. The wider effect of a development such as this can often not be quantified but will be seen in work and trade opportunities created in areas such as commerce and tourism during and after completion of the project.

The Socio-Economic Impact Assessment compiled for the proposed development indicates that the project could sustain about 32 433 (direct, indirect, and induced) employment opportunities during construction and ongoing capital expenditure upgrades over 22 years of initial and ongoing construction. This could increase household incomes by R3,8 billion over 22 years. 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.

In terms of economic benefits, an estimated R8,9 billion in capital investment could generate R23,2 billion in new business sales, which could add R8,8 billion (net of the import leakage) to the GGP of the Western Cape economy during construction. During an initial 20-year operational period, which includes a substantial component of maintenance expenditure, an estimated R36,1 billion in nominal terms could generate R76,1 billion in new business sales.

The nature and scale of the proposed development does however raise several negative socio-economic concerns with one of the most significant being the potential influx of people in search of jobs during the construction phase. An influx of job seekers (mainly from the Northern District) during construction would 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 (Multi-Purpose Business Solutions, Socio-Economic Impact Assessment, March 2025). Mitigation measures include a requirement for contractors to employ people from the immediate area whenever possible. Furthermore, 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 (Multi-Purpose Business Solutions, Socio-Economic Impact Assessment, March 2025).

Cape Town's Water Strategy, which was developed in 2019, notes that cost-effective, secure water provision is an essential foundation for economic growth and job creation. The proposed development aims to use available water sources as sustainably as possible to realize its strategic development goals which include economic growth and job creation. Cape Town's Water Strategy further highlights the importance of managing Cape Town as a water wise city. Through implementation of water-saving technologies, landscaping with water-wise vegetation and reuse of treated effluent, the proposed development will minimise the need for additional water supply while simultaneously maximising the socio-economic benefits associated with the proposed development. As such the proposed development aligns well with Cape Town's Water Strategy as it facilitates the sustainable use of water to stimulate economic growth by integrating water-wise principles into the overall development design.

The proposed CWA development is based on sound commercial principles and will create shareholder value while positively contributing to the South African economy, enabling commercially driven investment, and making a direct economic and social impact. Given the nature of the proposed development the social and economic development that will be facilitated by the proposed development will not only benefit local communities but will have far reaching benefits for the provincial and national economy.

ii) Of the failure to authorise water use or uses:

Should the WULA not be granted, the proposed development cannot proceed, and the jobs referred to in d (i) will not be created. The proposed development is a large-scale, long-term project directly generating permanent employment opportunities for skilled, semi-skilled and unskilled labour. The CWA development is also expected to stimulate economic growth within the broader region generating additional indirect employment opportunities in sectors such as commerce and tourism.

The non-authorisation of the water uses will prevent the development of a commercially sustainable airport at this site and will also not enable a reliever airport for CTIA to be developed as per the current proposal. The potential for increased commerce and tourism opportunities in the Western Cape will also not be realised. The Western Cape is currently thriving, experiencing excellent year-on-year growth in terms of economic activity and population. For this growth to continue, new growth nodes, unrestricted air access, and the ease of connectivity, are essential. Non-authorisation of the proposed water uses will prevent this growth from taking place.

Should the proposed water uses not be authorized, the development as currently envisioned will not take place and the large-scale economic opportunities and social upliftment that can result from the proposed development will not be realised.

It should further be noted that the NEMA Scoping Report considered alternatives in terms of location, type of activity, layout, design, and technology. Given the highly specific requirements of the proposed development, no reasonable and feasible alternative currently exists to meet the CWA strategic and business objectives. The Cape Winelands Airport's objective is to adopt an embedded sustainability approach – prioritizing, people, planet and profit. The aim is that sustainability will be fully integrated into all elements of the business. The design of the development and use of technology will thus be strategically implemented to ensure that the needs of the development are met in the most environmentally, socially and economically sustainable manner possible.

e) Any catchment management strategy applicable to the relevant water resource

The Department of Water and Sanitation (DWS) previously divided the country into 19 Water Management Areas (WMAs), each containing a large river system. The proposed development site is located in what used to be the Berg and later the Berg-Olifants Water Management Area (WMA) (WRC, 2017). The Berg-Olifants WMA was administered by the Department of Water and Sanitation (DWS).

In 2017 the GreenCape Sector Development Agency prepared a report for the Water Research Commission and the Western Cape Government on "Managing Water as a Constraint to Development with Decision-Support Tools That Promote Integrated Planning: The Case of the Berg Water Management Area". This report notes that there is increasing recognition that the combined effects of climate change, population growth and continued urbanisation are exerting pressure on limited water resources. At the same time, economic growth remains vital for alleviating poverty (WRC, 2017). Therefore, economic growth is required in spite of significant water resource constraints. At issue then is how to allocate water optimally to enable economic growth, while also ensuring that human needs are met, and ecological systems maintained. Economic development is always linked to access to water (WRC, 2017). According to the GreenCape Sector Development Agency report the historic Berg Water Management Area is a "constrained catchment" where all readily available water has already been allocated (WRC, 2017). In cases such as this additional water resources or reallocation from other users would be required to facilitate future development. However, the development of new water resources requires new infrastructure which has cost implications. These costs will likely need to be borne by the new users. As such, should future users be unable to carry this cost, then the cost of provision of water will become a constraint to economic development.

The WRC report thus highlights the interdependency between economic development and water resources which needs to be taken into account. The CWA development is a large-scale private investment with the capacity to develop the infrastructure needed to supply the site with the necessary water requirements. The proposed CWA development is expected to facilitate substantial economic development within the region and aims to do this as sustainably as possible. The site aims to reduce its potable water demand by implementing efficient technologies to minimize consumption and maximizing water reuse where possible for example, an on-site package treatment plant will treat sewage for reuse in non-potable applications such as irrigation and flushing, reducing reliance on potable water sources and supporting sustainable water use.

f) Likely effect of the water use to be authorized on the water resource and on other water users.

i) Freshwater Impacts (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025):

According to the Freshwater Ecological Assessment prepared by FEN (February 2025), the activities associated with the proposed development could result in the following impacts to onsite and adjacent freshwater features:

- Modification of the seep wetland 1 and CVB wetland 2 and 3's hydrological functioning and water quality
- Changes to the geomorphological processes (sediment balance, erosion and sedimentation).
- Wetland habitat loss (seep wetland 1) altered wetland habitat and impacts to biota.

The proposed development will result in the direct loss of 6.74ha of seep wetland 1 habitat (Figure 17). FEN Consulting was appointed to undertake an offset investigation to identify suitable target wetland areas to be rehabilitated to compensate for the habitat and functionality lost from Seep Wetland 1 as a result of the proposed CWA development. The proposed offset currently involves rehabilitating the remainder of Seep Wetland 1 together with a portion of CVB wetland 1 which is located East of the proposed development area (Figure 17). 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 (FEN, Draft Wetland Offset and Implementation Study, January 2025).

The activities and the associated risks posed by the proposed activities are all highly site-specific, not of a significant extent relative to the area of the freshwater ecosystems assessed and therefore have a limited spatial extent (within the investigation area) (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025). The outcome of the risk assessment matrix undertaken by FEN determined that the activities associated with the proposed CWA development pose a Low-risk significance to the CVB wetlands, and are thus considered acceptable. The construction and operation of the CWA however poses a Moderate risk significance to the seep wetland 1 due to the anticipated 6.74ha wetland habitat loss.

The overall risk significance of the assessed activities is considered moderate. With strict enforcement of the site-specific control measures as provided in Table 21, the significance of impacts arising from the construction and operational phase of the proposed development can be effectively reduced and managed. Based on the results of the RAM and impact assessment, the preferred proposed layout alternative is considered acceptable from a freshwater ecosystem management perspective, with implementation of the outlined control measures. Based on the provision that all control measures that are stipulated in the report be implemented, the project can be authorised under the strict provision that there must be clear evidence of a viable offset and compensation plan that ensures that there is no net loss of biodiversity (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025).

ii) Groundwater Impacts (GEOSS, Groundwater Impact Assessment, February 2025 and GEOSS, WULA Geohydrological Assessment, February 2025):

Based on the Groundwater Impact Assessment prepared by GEOSS, the proposed development could have several impacts on groundwater quality and quantity. Various activities associated with the proposed development pose risks to groundwater quality, these include:

- Potential impact on groundwater quality deterioration because of contamination by construction of the facility
- Potential impact on groundwater quality deterioration because of surface runoff.
- 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-digestor 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 resources as a result of over-abstraction.
- Potential impact on groundwater quality deterioration as a result of over-abstraction
- Potential impact on groundwater quality deterioration as a result wastewater storage before treatment
- Potential impact on groundwater quality deterioration as a result brine storage before treatment
- Potential impact on groundwater quality deterioration as a result of chemical storage associated with WWTW.
- Potential impact on groundwater quality deterioration as a result of result of irrigation with the treated sewage effluent.

Each source/origin of contamination and potential groundwater impacts associated with the proposed development was qualitatively assessed as outlined in Table 28 - Table 41. Should the mitigation measures outlined in Table 28 - Table 41 of this report be implemented, the activities associated with the proposed CWA development will have a Low - Very Low impact significance on groundwater resources (GEOSS, Groundwater Impact Assessment, February 2025).

The groundwater assessments also looked at surrounding water users. Based on this study, it was observed that there are a number of groundwater users in the surrounding area, and it was found that the majority of the users abstract groundwater from the fractured aquifer for agricultural purposes. Further to this, no developments similar to the CWA are present within the region. The developments of interest that were noted include the County Fair chicken farm and the Fisantekraal Wastewater Treatment Works. Each individual impact was assessed with regards to its potential cumulative impact when considered along with the other developments with results presented in Table 42. With implementation of mitigation measures the cumulative impacts range from Very Low to Medium Impact Significance (GEOSS Groundwater Impact Assessment, February 2025).

Overall, 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 (GEOSS Groundwater Impact Assessment, February 2025). The clay found underlying the site does provide some degree of protection to the underlying fractured rock aquifer. However, it must be noted that the vulnerability does increase to the northeast where the Colenso Fault system is located. This area should be considered as a sensitive area in terms of groundwater.

Given the fact that there are groundwater users and the proximity of the Colenso Fault to the CWA, a no-go area for high-risk activities is proposed for the northeastern section of the study area (Figure 39). This no-go area does not include the majority of activities planned for the site, but only certain high-risk activities such as the aviation fuel farm, retail service station or other activities that are considered high risk to groundwater (GEOSS Groundwater Impact Assessment, February 2025).

The Groundwater Impact Assessment indicated that the development can proceed, provided that appropriate mitigation, protection, and monitoring measures are implemented so as not to impact groundwater and associated groundwater users (Table 28 and Table 41). High-risk activities should be avoided in the designated no-go area near the Colenso Fault and a detailed groundwater monitoring program must be finalized once the specifics of the planned activities are confirmed.

iii) **Hydropedological Impacts Risk (Zimpande Research Collaborative, Hydropedological Assessment, February 2025)**

The Hydropedological Assessment undertaken by Zimpande Research Collaborative found:

- At the landscape unit (hillslope) scale streamflow and surface runoff increase modestly by 6.17% and 6.52%, making up 13% of the water balance due to new impervious surfaces and stormwater redirection. Lateral flow and percolation decrease by 2.8% and 3.7%, with minimal overall impact due to the absence of interflow soils. Evapotranspiration is the dominant water loss at 78.53%, and local rainfall remains crucial for wetland dynamics. Slight decrease in profile water has minimal impact on wetland conditions, with a predicted change of no more than one PES class.

- At the hydrological response unit scale, evapotranspiration, the dominant water outflow, decreases due to site clearing and infrastructure, but still accounts for 78.71% of the water balance. Streamflow and surface runoff are projected to increase by 13.62% and 14.26%, respectively, due to impervious surfaces and low soil storage capacity. Lateral flow shows minimal change (-0.4%) and percolation decreases by 4.35%. Slight increase in profile water post-development, indicating higher moisture levels. Hydropedological processes and wetland functionality are expected to remain largely unchanged with effective stormwater management.

The results indicate that the proposed project can be considered for authorisation from a hydropedological perspective as it is not anticipated to cause an unacceptable impact of the wetland recharge mechanisms based on the type of soils identified as well as the quantification of hydropedological losses (Zimpande Research Collaborative, Hydropedological Assessment, February 2025). The PES/EIS and functionality will likely remain unchanged once mitigations have been implemented.

g) Class and the resource quality objectives of the water resource

i) Freshwater Resources:

Key background information relating to the characteristics of the freshwater ecosystems associated with the study area and the associated investigation area are presented in Table 71 below.

Table 71: 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	
Ecoregion	South Western Coastal Belt
Catchment	Berg/Bort/Potberg
Quaternary Catchment	G21E
WMA	Berg
subWMA	Lower Berg
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
MAP (mm)	400 – 500
The coefficient of Variation (% of MAP)	25 – 35
Rainfall concentration index	30 – 55
Rainfall seasonality	Winter
Mean annual temp. (°C)	16 – 18
Winter temperature (July)	6 – 20
Summer temperature (Feb)	14 – 30
Median annual simulated runoff (mm)	60 – 250

Detail of the study area in terms of the National Freshwater Ecosystem Priority Area (NFEPA) (2011) database	
River FEPA	The study area is located within a sub-quaternary catchment currently not considered important in terms of fish or freshwater ecological conservation.
NFEPA Wetlands	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.
Wetland Vegetation Type	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).
NFEPA Rivers	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).

National Biodiversity Assessment (2018): South African Inventory of Inland Aquatic Ecosystems (SAIIAE)
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)	
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)	
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)	
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).

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.

The Scoping Phase Freshwater Ecological Assessment undertaken by FEN (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025) identified a single seep wetland within the proposed development area. In addition, a second seep wetland and four CVB wetland were identified within 500m from the proposed development area (Figure 29).

Classification of the identified freshwater ecosystems were undertaken at Levels 1 - 4 of the Classification System (Ollis et al, 2013). This system was classified as Inland Systems. Table 72 below presents the classification from level 3 to 4 of the Wetland Classification System.

Table 72: Characterisation of the freshwater ecosystems associated with the study and investigation areas (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025).

Freshwater ecosystem	Level 3: Landscape unit	Level 4: Hydrogeomorphic (HGM) Type
Channelled valley bottom wetlands	**Valley Floor:** the base of a valley, situated between two distinct valley side-slopes, where alluvial or fluvial processes typically dominate.	**Channelled valley bottom wetland:** A valley bottom wetland with a river channel running through it.
Seep wetland	**Slope:** an inclined stretch of ground typically located on the side of a mountain, hill or valley, not forming part of a valley floor.	**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.

Seep 1 will be directly impacted while Seep 2 and CVB wetland 2 and 3 will be indirectly impacted by the proposed development activities. These wetlands were therefore quantitatively assessed within the scoping phase freshwater report. Table 73 and Table 74 summarise the findings of the field verification in terms of relevant aspects (hydrology, geomorphology and vegetation components) of the freshwater ecology of these wetland systems.

CVB wetlands 1 and 4 were assessed qualitatively due to the very low quantum of risk of the activities associated with the proposed CWA development to the wetlands considering their approximate location of 330m, 450m and 227m from the study area, respectively (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025).

Table 73: Summary of the results of the channelled valley bottom (CVB) wetlands 2 and 33 associated with the proposed CWA development (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025).

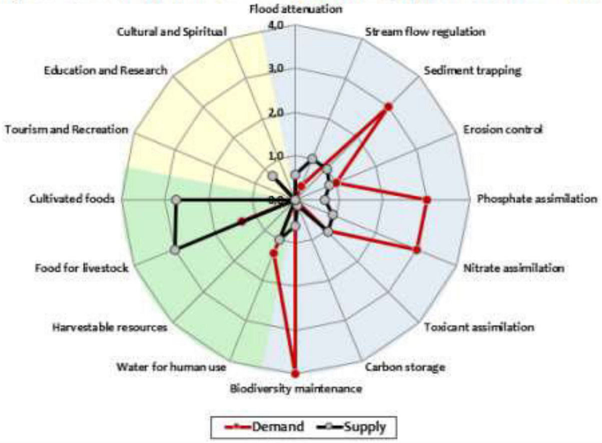
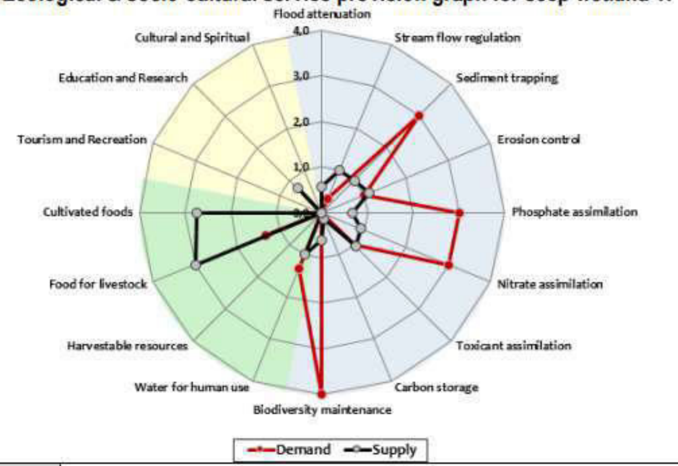
<table>
<tr><td colspan="2">Ecological & socio-cultural service provision graph of the CVB wetland 2:

</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 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 (Figure 30). 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 18, Figure 29). 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]. 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. Vegetation of the wetlands have thus been significantly altered. Nevertheless, the wetlands are still considered important as breeding habitat for bird (including Anthropoides paradiseus (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 30). Both CVB wetlands 2 and CVB wetland 3's extent have been significantly reduced and currently exist as narrow and straightened channels surrounded by cultivated fields (Figure 29 and 30).</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: 0,5 (Very Low)
The overall ecoservice provision of the wetlands are considered very low, with the exception of sediment trapping, nitrate assimilation, biodiversity maintenance 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 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.</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 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.</td></tr>
</table>

Table 74: Summary of the results of the seep wetlands 1 and 25 associated with the proposed CWA development (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025).

<table>
<tr>
<td colspan="2" rowspan="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):</td>
</tr>
<tr>
<td colspan="2">Agricultural activities in the catchment of the seep wetland 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 P. clandestinum, which is heavily grazed, and no longer representing the reference vegetation species of the local biome (Figure 31).</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 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: 0.5 (Very Low)
The overall ecoservice provision of the wetlands are considered very low, with the exception of sediment trapping, nitrate assimilation, biodiversity maintenance 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 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 9.69 ha loss of the seep wetland 1. It is recommended that a wetland offset investigation is undertaken to mitigate the loss of wetland habitat.</td>
</tr>
</table>

Following the assessment of the watercourses that could potentially be directly or indirectly impacted by the proposed development activities the DWS specified Risk Assessment Matrix (GN509 of 2016) was applied by the Freshwater Ecologist to ascertain the significance of risk associated with the proposed development on the key drivers and receptors (hydrology, water quality, geomorphology, habitat and biota) of the assessed wetlands.

According to the RAM the activities associated with the proposed development during both the construction and operational phases pose a Low risk to the CVB wetlands and a Moderate risk to the seep wetland 1 due to the anticipated 6.74ha seep wetland 1 habitat loss as a result of the proposed CWA development encroaching into the wetland.

According to the impact assessment, the proposed development also poses a negative moderate impact to the ecological integrity of the freshwater ecosystems associated with the proposed development mainly to the seep wetland 1 due to the construction activities and operation of the CWA development and related infrastructure. Furthermore, the operation of the CWA and stormwater related impacts associated with the proposed development and anticipated loss of wetland habitat (of seep wetland 1) will cumulatively add to the existing water quality, sediment issues and habitat alteration impacts currently experienced by the freshwater ecosystems.

Control measures listed in the Detailed EIA Phase Freshwater Ecological Assessment (FEN, February 2025) must be implemented in full. A freshwater offset investigation has been undertaken for the 6.74ha loss of freshwater habitat associated with the seep wetland 1, as per consultation between the proponent and the DWS, and guidance and stipulations provided by the DWS in this regard. An onsite wetland offset has been identified and a Wetland Offset Study and Implementation Plan has been developed (FEN, Draft Wetland Offset Study and Implementation Plan, January 2025). With strict enforcement of the site-specific control measures, the significance of impacts arising from the construction and operational phase of the proposed development can be effectively reduced and managed (FEN, Detailed EIA Phase Freshwater Ecological Assessment, February 2025).

ii) Groundwater Resources:

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.

The WULA Geohydrological Assessment undertaken by GEOSS, outlined the Hydrogeological Parameters for Quaternary catchment G21E as presented in the WRC 2012 report (Table 75). In addition, an evaluation was completed using the Aquifer Firm Yield Model. The Aquifer Firm Yield was determined to be 10 874 749m³/a (344.6L/s) with a recharge of 17 435 516m³/a for the catchment G21E. The results of the Aquifer Firm Yield Model for Quaternary Catchment G21E are presented in Table 76.

Table 75: Hydrogeological Parameters for Quaternary catchment G21E

Parameter	Value
Groundwater Level (mbgl)	9.8
Max Drawdown (m)	5
Specific Yield	0.000287
Firm Yield (L/s)	344.6
Firm Yield (L/s/km²)	0.6492
Recharge %	6.2
Recharge Threshold (mm)	22
MAP (mm)	530.6
Hydrological MAR (mm)	68.4
Hydrological MAE (mm)	1485
Baseflow: Default (Mm³/a)	4.46
ET Model	Linear
ET Extinction Depth (m)	4
Riparian Zone (%)	3.4

Table 76: Results of the Aquifer Firm Yield Model for Quaternary Catchment G21E

Name	Q (L/s)	Q (m³/month)	Q (m³/a)
G21E	344.6	893 203.2	10 874 749

The proposed development area has a localized aquifer, referred to as a Groundwater Resource Unit (GRU), formed within the fractured rock aquifer of the Tygerberg Formation. The GRU was delineated using quaternary catchment boundary to the north and west and includes exposed fractured Tygerberg Formation in these areas, the Colenso Fault system to the northeast of the study area and also to the boundary delineation (Figure 51).

On assessment of the geological map, the GRU has an extent of approximately 125km² and the minimum recharge volume was calculated to be 4 112 150m³/a for the GRU. The firm yield of the GRU is calculated to be 2 564 799.3m³/a which is estimated to be approximately 62.4% of recharge. A conservative approach was used to calculate the recharge and firm yield volumes and actual volumes are believed to be higher than the calculated volumes.

The current volume of groundwater abstracted within the GRU, is based on the registered WARMS boreholes (database last accessed 21 February 2025), is 1 445 753m³/a (Figure 51). Note that only registered and active sites were taken into account. Based on these volumes, a volume of 1 119 046,3m³/a (2 564 799.3m³/a – 1 445 753m³/a) is available within the GRU. The additional volume of 163 671,84m³/a (full requested volume) for which a license is being applied, is less than the volume of 1 119 046,3m³/a available within the firm yield of the GRU. Because the firm yield of the GRU is more than the predicted water demand of the property, the license application volume is considered to be within the sustainable supply volume of the aquifer.

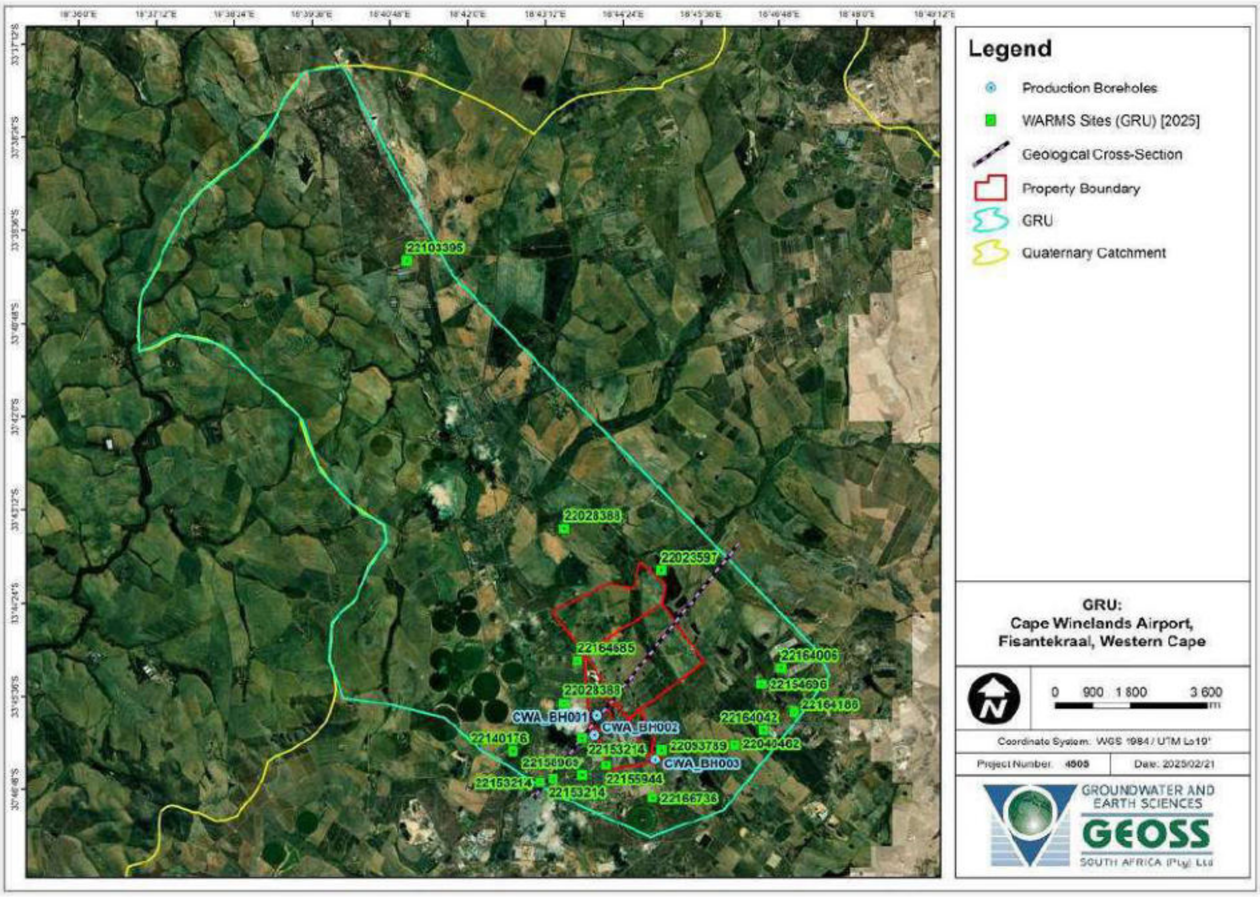


Figure 51: GRU, property boundaries with the existing, recently drilled, hydrocensus. WARMS boreholes production borehole superimposed on the Google Earth image (GEOSS, WULA Geohydrological Assessment, February 2025).

The WULA Geohydrological Assessment undertaken by GEOSS also outlined the following site-specific resource quality management measures:

- Groundwater abstraction volumes must be monitored.
- Water levels must be monitored and should not drop below the critical water level (85mbgl for CWA_BH001, 61mbgl for CWA_BH002 and 101mbgl for CWA_BH003).
- Monitoring information must be assessed regularly (suggest monthly). If the water level in the boreholes drops below the dynamic water level. i.e. 72mbgl for CWA_BH001, 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, 61mbgl for CWA_BH002 and 101mgbl for CWA_BH003. Monitoring will persist after 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 table.

- 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 reduction 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 as stabilized.
- A formal groundwater management plan needs to be designed and implemented.

h) Investments already made and to be made by the water user in respect of the water use in question

The proposed CWA development includes substantial financial investment into the local economy to initiate the project. Approximately R100M has been spent to date and a further approximately R8 billion will be spent over the next 5 years. Furthermore, the ongoing annual investment in operating costs, which will be injected into the local economy through suppliers of products and employment of labour will be ongoing throughout the operation of the development.

i) Strategic importance of the water uses to be authorised

The authorisation of the proposed water uses will be strategic from an economic point of view, enabling the sustainable and efficient use groundwater for the redevelopment and expansion of the current CWA to facilitate economic development. The CWA's objective is to adopt an embedded sustainability approach – prioritizing, people, planet and profit. The aim is that sustainability will be fully integrated into all elements of the business.

According to the National Water Resources Strategy the latest Water Sector Priority Focus Areas 2020 to 2030 are:

- Reducing water demand and increasing supply
- Redistributing water for transformation,
- Managing water and sanitation services under a changing climate,
- Regulating the water and sanitation sector,
- Improving raw water quality,
- Protecting and restoring ecological infrastructure for the green economy,
- Creating effective water sector institutions,
- Promoting international cooperation,
- Building capacity for action,

- Ensuring financial sustainability,
- Managing data and information in line with 4IR and global knowledge,
- Enhancing research, development and innovation,
- Addressing legislative and policy gaps.

The proposed water uses are in line with the following priority areas:

1) **Reducing water demand** – The site aims to reduce its water needs, while at the same time reusing water where possible to decrease the demand on the underlying aquifer. It is proposed to reuse treated effluent from the wastewater plant for irrigation and as feed material into the Biodigester.

   Future irrigation for the site will ensure efficient use of water through water conservation measures, and landscaping will be indigenous to ensure low irrigation need. Initial planting will be undertaken during the winter months to minimize water needed during the establishment phase. Abstraction from the boreholes will be metered and monitored and use on site will be sub metered to enable early leak detection or spikes in on site usage. Installation of toilets, taps, showers and other water use points will be water efficient.

2) **Managing water and sanitation services under a changing climate** – The main risk to the Western Cape by climate change is reduced average rainfall. Surface water supplies will become more strained as temperatures rise, rainfall decreases, and evaporation increases. Ensuring a secure subsurface supply (boreholes) and decreasing the demand from CoCT for potable supply enables the site to be drought resilient and manage their supply more efficiently.

   Waterborne sewer is a high consumer of potable supply. The site aims to reuse treated effluent from the proposed wastewater treatment plant for irrigation and as feed material into the Biodigester, minimising the need for additional water supply and generating alternative source electricity for the site.

When considering how the development may affect or promote justifiable economic and social development, the relevant spatial plans must be considered, including the National Development Plan (NDP), Municipal Integrated Development Plans (IDP), Spatial Development Frameworks (SDF) and Environmental Management Frameworks (EMF). According to the Socio-economic scoping report (Multi-Purpose Business Solutions, Socio-Economic Scoping Report, September 2023), the CWA is compatible with the relevant spatial plans in the following manners:

- The NDP (2012) - The NPD sets out six interlinked priorities that include enabling faster economic growth, higher investment and greater labour absorption. The CWA development subscribes to the NDP principles by offering commercial opportunities close to the Northern District of the CoCT.

- The Western Cape Provincial SDF (2014) - The proposed CWA development will contribute toward private sector investment, reinforce the CoCT economy and create additional employment (in particular in the transport and construction sectors) that will further strengthen growth in the local economy. The project addresses spatial efficiency to some extent, i.e. mixed-use as opposed to mono-functional land uses. The provision of additional airport services will significantly contribute to the tourism sector in the Western Cape as it will increase connectivity and visitors to the region.
- The CoCT Economic Growth Strategy (2013) - The CWA is a large private investment that would contribute toward economic growth and job creation during both the construction and operational phases. The proposed development offers an opportunity for skills development and will contribute to transport infrastructure.
- The CoCT IDP (2022-2027) - The development will ensure a substantial direct investment into the CoCT and represents a significant indirect investment in the area. Direct jobs will be created that will benefit the communities in the surrounding areas during the construction and operational phases. It will also directly support the transport sector by providing additional airport services.
- The CoCT Municipal SDP (2023) - The proposed development subscribes to the spatial strategies of the CoCT as it represents a private investment to establish a new economic and transport hub. It will contribute to creating and attracting investment that will facilitate economic growth and employment opportunities, while also addressing the need for improved aviation services in CoCT.
- The Northern District Plan (2023) - The CWA falls within Sub-district 3, with areas to the west and south earmarked for residential development. Key interventions / actions proposed in the Northern District Plan include amending the urban development edge to provide for inclusion of CWA. However, H & A Planning (2023) noted that the amendment of the urban development edge does not cover the proposed expansion of the airport. Since the landside development of airports should be inside the edge, site-specific circumstances for deviation from the MSDF will thus have to be motivated in terms of the Municipal Planning By-law.

Furthermore, proposed CWA development has aligned itself with the National, Provincial and Local government vision and strategies of climate change and sustainable development. The United Nations Sustainable Development Goals (SDG's) interconnect environmental, social and economic aspects of sustainable development by emphasizing sustainability.

The 17 SDGs are: No poverty (SDG 1), Zero hunger (SDG 2), Good health and well-being (SDG 3), Quality education (SDG 4), Gender equality (SDG 5), Clean water and sanitation (SDG 6), Affordable and clean energy (SDG 7), Decent work and economic growth (SDG 8), Industry, innovation and infrastructure (SDG 9), Reduced inequalities (SDG 10), Sustainable cities and communities (SDG

11), Responsible consumption and production (SDG 12), Climate action (SDG 13), Life below water (SDG 14), Life on land (SDG 15), Peace, justice, and strong institutions (SDG 16), Partnerships for the goals (SDG 17).

According to a preliminary study conducted by industry specialists the proposed project is aligned with several SDGs:

- SDG 1, 2, 3 & 4 (Reduction in poverty, hunger and increase in health, well -being and education) – the project aims to create jobs for breadwinners, resulting in the ability for households to have nutritional food on the table and for the youth to be educated.
- SDG 8 (Decent Work and Economic Growth) - the project aims to be positioned as an 'airport city' and notwithstanding the additional flights that can be accommodated in the Western Cape the focus on non-aeronautical revenue on the landside, such as commercial and property development opportunities, can create job opportunities and economic growth for the region.
- SDG 11 (Sustainable Cities and Communities) - the proposed project aims to be a sustainable and a green airport, and by embracing renewable energy and reducing carbon emissions, the airport can contribute to the development of sustainable and resilient cities and communities.
- SDG 12 (Responsible Consumption and Production) - The proposed project emphasises sustainable practices and reduction in the amount of reserve fuel, and promotes responsible consumption and production, allowing the airport to reduce its environmental impact as well as support the reduction in global aviation fuel consumption.
- SDG 13 (Climate Action) - The proposed project aims to reduce its carbon footprint and include renewable energy which will support this goal both on a local and international level.

j) The quality of water in the water resource which may be required for the Reserve and for meeting international obligations

The proposed development activities include the abstraction of groundwater from three production boreholes located onsite. This water will be treated and used as potable supply for the proposed development. A desktop hydrocensus was carried out using a 2km search radius around the property boundary, to determine if there are any groundwater users in the area (WULA Geohydrological Assessment, February 2025). A search of the National Groundwater Archive (NGA), which provides data on borehole positions, groundwater chemistry and yield, when available, was carried out to identify proximal boreholes.

During the hydrocensus a field verification was undertaken, and 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 7.881mbgl). However, the water levels that were indicated as deeper than 20mbgl all originate from the NGA database. Water levels deeper than 20mbgl do not correspond to the hand-measured resting groundwater levels during the hydrocensus which were all less than 20mbgl. It is therefore considered likely that the NGA water levels deeper than 20mbgl may represent pumping water levels (WULA Geohydrological Assessment, February 2025).

Further, borehole yields range from 0.2 to 8.3L/s, thereby exceeding the regional yields in some areas. The EC is also in keeping with the regional map, ranging from 19.7 to 632mS/m. Total dissolved solids (TDS) values also correlated with measured EC values, while pH was neutral between 6.2 and 7 (WULA Geohydrological Assessment, February 2025).

The three production boreholes present onsite were yield and quality tested by a SANAS accredited laboratory. The water quality results obtained were classified according to the SANS241-1: 2015 standards (Table 15). The groundwater from CWA_BH001 was found to be of "marginal" water quality for human consumption, with elevated turbidity levels related to high concentrations of Fe and Mn in the groundwater (Table 16 & GEOSS, Borehole Yield and Quality Testing of CWA _BH001, September 2022). Groundwater from CWA_BH002 and CWA_BH003 was found to be of poor quality with Fe and Mn levels above the chronic health limit of the SANS 241-1:2015 drinking water guidelines (Table 16 & GEOSS, Borehole Yield and Quality Testing of CWA _BH002, December 2022 & GEOSS, Borehole Yield and Quality Testing of CWA_BH003, December 2024).

According to the WULA Geohydrological Assessment undertaken by GEOSS, over abstraction of groundwater from a borehole can potentially draw poorer water quality from the nearby environment into the borehole. This is likely to affect the groundwater quality in the area in general and might affect the supply in other boreholes within the same aquifer. As such the following mitigation measures were recommended to prevent this impact from taking place:

- 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.

There are no international obligations to be met as far as water distribution is concerned.

k) Probable duration of any undertaking for which a water use is to be authorised

The Water use authorisation will be linked to a long-term investment and operational presence of the landowner in the area and should be reviewed every 5 years to assure demand and use appropriateness. The proposed development will follow a phased approach with upscaling occurring over a period of several years based on market demand. The water use licence should be issued for a period of 40 years. Thereafter it should be renewed on a 20-year basis.

17. Declaration by the applicant with signature confirming that the information submitted is correct.

We the applicant, Capewinelands Aero (Pty) Ltd (Company Registration nr:2021 / 542277 / 07) hereby confirm that the information submitted as part of this WULA application is true.

Signed by: Deen Cloete

....

Signature

Date: 13 March 2025

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

18. Appendices

Appendix A – WULA Status

Application Status

Water User

Capewinelands Aero (Pty) Ltd

Application

WU33620 - WULA for Cape Winelands Airport Expansion project

Duration: Day 0 of 90

Current Status: Applicant : Prepare Technical Report

#	Date	Applicant	Department	Duration in Days
1	Jun 3 2025 1:33PM	Applicant : Prepare Technical Report		12 Day(s) (Current)
2	Jun 2 2025 11:43AM		Pre Application Enquiry	2 Day(s)
3	Apr 22 2025 12:29PM		Site Inspection Determinations	27 Day(s)
4	Apr 17 2025 2:40PM		Site Inspection Determinations	2 Day(s)
5	Apr 7 2025 2:55PM	Applicant : Prepares WUL Application for submission		9 Day(s)
6	Apr 4 2025 9:33AM		Site Inspection Determinations	2 Day(s)
7	Jan 18 2024 9:14AM	Applicant : Prepares WUL Application for submission		293 Day(s)
8	Dec 4 2023 2:37PM		Pre Application Enquiry	18 Day(s)
9	Dec 4 2023 2:37PM		Pre Application Enquiry	1 Day(s)
10	Dec 4 2023 2:34PM	Applicant : Prepares Pre-application for submission		1 Day(s)
11	Nov 16 2023 12:28PM		Pre Application Enquiry	13 Day(s)
12	Nov 15 2023 12:44PM		Pre Application Enquiry	2 Day(s)
13	Oct 19 2023 2:19PM	Applicant : Prepares Pre-application for submission		20 Day(s)

Ms Olivia Brunings (Consultant) e-Mail: olivia@phsconsulting.co.za

e-WULAAS - Water Use Licence Applications

Capewinelands Aero (Pty) Ltd - WULA for Cape Winelands Airport Expansion project (WU33620)

HOME | How To | Consultant | Client | Applications | Withdraw | Cancel Licence | Status | Correspondence | Support | Logout

Phase 1: Application | Water Uses | Properties | Admin Docs | Application Forms | Submit | Phase 2: Site Visit | Confirm Site Visit | Phase 3: Tech Report | Application Forms | Tech Docs | Submit

Pre-Application Water Use Enquiries/Current Water Use Applications

Water User(s)

Capewinelands Aero (Pty) Ltd

WU33620 - WULA for Cape Winelands Airport Expansion project

Add New Pre-Application Enquiry | Remove Application

Application Information (mandatory fields is indicated with a *)

*Authorised Signatory for Application Submission: Mrs Amanda Fritz-Whyte — Add New Authorised Signatory

*Primary Contact Person for Application: Mrs Amanda Fritz-Whyte — Add New Primary Contact

*Type of Application: New Registration

*Application Name: WULA for Cape Winelands Airport Expansion project

(Max 100 characters - Example: Sandworks on Vaalriver in Parys)

Why are you applying for a Water Use Application?

What is the Main Activity that will take place for this Application?

*What is the Main Purpose of the Application? Main Purpose

a. Taking of Water from a Resource
b. Storage of Water
c. Working in or near a Water Course/Drainage Line
e. Discharge of Water containing Waste
Detailed information --> use Main Purpose option...

Appendix B - Water Use Licence Application Geohydrological Assessment: Cape Winelands Airport, Fisantekraal, Western Cape (GEOSS, February 2025)

Water Use Licence Application Geohydrological Assessment: Cape Winelands Airport, Fisantekraal, Western Cape (January Update V4)

Prepared by

GEOSS

28 February 2025

GROUNDWATER AND EARTH SCIENCES

GEOSS

SOUTH AFRICA (Pty) Ltd

Executive Summary

Cape Winelands Airport Ltd requested that GEOSS South Africa (Pty) Ltd compile a geohydrological assessment for their Water Use Licence Application (WULA). The application is to abstract groundwater for use at their facility. The airport is located within Quaternary Catchment G21E, and the General Authorisation (GA) for groundwater abstraction is 150 m^3/ha/a. To date, three boreholes have been drilled on three properties. The total area of the three properties on which the boreholes will be located is 192.82 ha, and a total of 23 445 m^3/a can be abstracted under the GA. The total volume of groundwater that can currently be delivered from the three existing boreholes is 163 671 m^3/a.

The current boreholes mentioned in the study revealed that the area hosts a "fractured" aquifer, which is made up of shale of the Tygerberg Formation (Malmesbury Group). The regional maps indicate yields of 0.5 – 5.0 L/s in the study area. Regarding quality, the area is characterised by 70 – 300 mS/m in the east, and 300 – 1 000 mS/m in the west (as indicated by Electrical Conductivity (EC)).

The three production boreholes that have been drilled are CWA_BH001, CWA_BH002 and CWA_BH003. The production boreholes have also been correctly yield tested (according to SANS 10299_4-2003). The results have been used to determine the sustainable (i.e., long-term and safe) yield of the boreholes. The sustainable yield of the boreholes is within the indicated regional yields of the aquifer. CWA_BH001 yields 1.0 L/s, while CWA_BH002 yields 2.5 L/s and CWA_BH003 yields 1.69 L/s. The proposed sustainable volume to be abstracted from three drilled boreholes is 163 671 m^3/a. Since the proposed abstraction exceeds the GA limit amount, DWS will need to grant a Water Use License. The groundwater quality, specifically EC, is measured at 89 mS/m for CWA_BH001, 156 mS/m for CWA_BH002 and 80.6 mS/m for CWA_BH003. The water quality of the boreholes is within the regional water quality range. An additional 487 640 m^3/a (~15.55 L/s pumping 24 hours per day) is required for the phased development starting in 2038 and continuing till 2060. This additional requirement of water will be provided by surface water.

The current groundwater requirement and supply analysis for the site are provided below:

- GROUNDWATER REQUIREMENT: The current groundwater requirement for the Cape Winelands Airport facility is 155 488 m^3/a.
- GROUNDWATER SUPPLY: The boreholes have been correctly tested and if the boreholes are pumped according to the guidelines set out in this report, a volume of 163 671 m^3/a can be abstracted.

This volume is 5% less than what the boreholes can deliver. If groundwater abstraction stays within these volumes, sustainable abstraction is possible.

The proposed CWA development poses a risk of contamination to the underlying aquifer. The proximity of the Colenso Fault to the CWA also results in a proposed no-go area for certain activities in the northeastern section of the study area. The aquifer is considered to have a "low" to "medium" vulnerability to contamination as it is overlain by a thick layer of clay. The development may proceed; however, only on the basis that the construction and operation of the facility employs relevant mitigation measures so as not to impact on groundwater and associated groundwater users. It is therefore recommended that the development design include a groundwater monitoring plan. It should also be noted that the aquifer, from which abstraction has been proposed, is

vulnerable and various risks have been identified in the report with mitigation measures. It is recommended that the general Groundwater Management guideline outlined in **Section 11** of this report be included in the licence conditions of the WULA.

Tabulated Updates from previous version V 3.1

Name	Report Type	Version	Date	Report Number
Water Use Licence Application Geohydrological Assessment Cape Winelands Airport, Fisantekraal, Western Cape	Water Use Licence Application Geohydrological Assessment	V3.1	14 October 2024	2024/09-24
Changes to Section				**Page Number**
1. Introduction 5. Regional Geology 6. Regional Hydrogeology 7. Volume and Purpose of Water Use 8. Site Specific Information 9. Aquifer Firm Yield Model 11. **Error! Not a valid result for table.** 12. Assumptions and Limitations 13. Conclusion				1 8 11 15 23 50 54 94 102 103
Changes to Maps				**Page Number**
• Map 2: The study site with the property boundary with the production, hydrocensus, NGA, and WARMS boreholes superimposed on a 1:50 000 scale topocadastral map (3318DA, 3318DB, 3318DC & 3318DD). • Map 3: The study site with the property boundary with the production, hydrocensus, NGA, and WARMS boreholes superimposed on an aerial photograph. • Map 4: Geological setting of the study site with the property boundary with the production borehole and the cross-section line (3318, Cape Town) (CGS, 2012). • Map 5: Regional aquifer yield (L/s) (DWAF, 2000). • Map 6: Regional groundwater quality (EC in mS/m) from DWAF (2000). • Map 7: Vulnerability rating (DWAF, 2000) and groundwater depths (mbgl). • Map 8: Interpolated groundwater elevation map for the study area (Bayesian interpolation) (taken from GEOSS, 2024) • Map 9: GRU, property boundaries with the existing, recently drilled, hydrocensus. WARMS boreholes production borehole superimposed on the Google Earth image				4 5 6 9 12 13 28 42
Changes to Appendixes				**Page Number**
Appendix A: Water Balance Appendix B: Borehole log (CWA_BH002) Appendix D: Scientific Yield Testing & Borehole Photo Appendix E: Water Quality Certificate Appendix H: Yield Test Data Analysis				80 93 98 106 132

Please note that changes made to the report since the previous revision have been underlined as requested. As the SDP footprint and activities have not changed, only refined; the changes have not resulted in a change in the assessment outcome as per the previous report for Alternative 3 (Version 3.1).

Client Information:

Prepared for	Amanda Fritz-Whyte PHS Consulting PO Box 1752 Hermanus 7200
Contact Person	Amanda Fritz-Whyte
Contact Email	amanda@phsconsulting.co.za
Contact Number	082 327 2100 / 028 312 1734

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Prepared by	GEOSS South Africa (Pty) Ltd Unit 12, Technostell Building 9 Quantum Street TechnoPark Stellenbosch 7600
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Document Information and History:

Report Name	**Water Use Licence Application Geohydrological Assessment: Cape Winelands Airport, Fisantekraal, Western Cape (January Update V4)**		
Report No	2025/01-08		
Suggested Citation	GEOSS (2025). Water Use Licence Application Geohydrological Assessment: Cape Winelands Airport, Fisantekraal, Western Cape (January Update V4). GEOSS Report Number: 2025/01-08. GEOSS – South Africa (Pty) Ltd. Stellenbosch, South Africa.		
GEOSS Project Number	2021_09-4505_M2.1		
Cover Photo	Image of the study area 2022		
Issue	Version	Date	Reviewed by
1	1.0	21 September 2022	Julian Conrad
2	2.0	28 March 2024	Julian Conrad
3	3.1	14 October 2024	Julian Conrad
4	4.0	28 February 2025	Julian Conrad

Principal Author(s) and Reviewer(s):

Original Author	Principal Author	Principal Reviewer
Preanna Naicker	Danita Hohne	Julian Conrad
BSc Hons Geology	MSc Geochemistry	MSc Hydrogeology
118533	400455/14	400159/05
Geological Science (Pr.Sci.Nat)	Earth Science (Pr.Sci.Nat)	Earth Science (Pr.Sci.Nat)

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Abbreviations

AD	Available Drawdown
ADAF	Anti-icing and de-icing fluids
AFYM	Aquifer Firm Yield Model
BH	Borehole
BOD	Biological Oxygen Demand
BTEX	Benzene, toluene, ethylbenzene and xylenes
CDT	Constant Discharge Test
CF	Country Fair
CGS	Council for Geoscience
CMA	Catchment Management Agency
CWA	Cape Winelands Airport
DD	Decimal degrees
DO	dissolved oxygen
DWA	Department of Water Affairs (pre- 1994)
DWAF	Department of Water Affairs and Forestry (1994 - 2009)
DWS	Department of Water and Sanitation (2009 - …….)
EC	Electrical Conductivity
FC	Flow Characteristic
GA	General Authorisation
GRU	Groundwater Resource Unit
GRO	Gasoline Range Organics
ha	hectare
HBH	Hydrocensus Borehole
IARF	Infinite acting radial flow
km	kilometre
L/s	litres per second
L/day	litres per day
m	metres
m^3/a	metres cubed per annum
mamsl	meters above mean sea level
mbgl	metres below ground level
$m^3/ha/a$	metres cubed per hectare per annum
mg/L	milligrams per litre
mm	millimetre
mm/a	millimetres per annum
mS/m	milliSiemens per meter
NGA	National Groundwater Archive
ORP	Oxidation reduction potential
PFC	Perfluorochemicals
SDP	site development plan
TDS	total dissolved solids
TOC	total organic carbon
TPH	Total Petroleum Hydrocarbons
UST	underground storage tank
SANAS	South African National Accreditation System
SANS	South African National Standard
TDS	total dissolved solids
WARMS	Water Authorisation Registration Management System
WGS84	World Geodetic System 1984
WMA	Water Management Area
WWTW	Waste water treatment works
WULA	Water Use Licence Application

Glossary of Terms

aquifer	a geological formation, which has structures or textures that hold water or permit appreciable water movement through them [from National Water Act (Act No. 36 of 1998)].
borehole	includes a well, excavation, or any other artificially constructed or improved groundwater cavity which can be used for the purpose of intercepting, collecting or storing water from an aquifer; observing or collecting data and information on water in an aquifer; or recharging an aquifer.
electrical conductivity	the ability of groundwater to conduct electrical current, due to the presence of charged ionic species in solution (Freeze and Cherry, 1979).
fractured aquifer	fissured and fractured bedrock resulting from decompression and/or tectonic action. Groundwater occurs predominantly within fissures and fractures.
groundwater	water found in the subsurface in the saturated zone below the water table or piezometric surface i.e., the water table marks the upper surface of groundwater systems.
groundwater resource unit:	a groundwater body that has been delineated or grouped into a single significant water resource based on one or more characteristics that are similar across that unit.
groundwater vulnerability:	the vulnerability of groundwater to contaminants generated by human activities taking into account the inherent geological, hydrological, hydrogeological characteristics of an aquifer.
sustainable yield	the maximum rate of withdrawal that can be sustained by an aquifer without causing an unacceptable decline in the hydraulic head or deterioration in water quality in the aquifer.

SPECIALIST EXPERTISE

CURRICULUM VITAE- DANITA HOHNE

GENERAL

Nationality:	South African
Profession:	Hydrogeologist
Specialization:	Groundwater exploration, development, management and monitoring. Hydrogeological impact studies and assessment of groundwater –Managed Aquifer Recharge.
Position in firm:	Senior Hydrogeologist at GEOSS South Africa (Pty) Ltd
Date commenced:	August 2023
Year of birth & ID #:	1984 – 840805 0144 085
Language skills:	Afrikaans (mother tongue), English (average)

KEY SKILLS

- Hydrogeological technical input on projects
- Working on Managed Aquifer Recharge (MAR) projects in the Karoo towns.
- Guidance and comments on Shale Gas Development
- Groundwater development - borehole drilling and test pumping supervision and analysis.
- Groundwater monitoring –development and analysis of groundwater level and quality data.
- Groundwater management – sustainable aquifer development and management.

EDUCATIONAL AND PROFESSIONAL STATUS

Qualifications

2020	M.Sc. (Geochemistry)	University of the Free State, South Africa
2007	B.Sc (Hons) Geology	University of the Free State, South Africa
2006	B.Sc Geology	University of the Free State, South Africa

Publications and symposiums

Papers and Chapters:

CSIR: Shale Gas Development in the Central Karoo: A Scientific Assessment of the Opportunities and Risks. 2016.

- South African Journal of Geology Special Issue on South African Hydrostratgraphy; Case study: Methane gas in groundwater system located in a dolerite ring structure in the Karoo, South Africa, Sept 2019
- Journal of African Earth Sciences; Enhancing groundwater recharge in the main Karoo, South Africa during periods of drought through managed aquifer recharge. Sept 2020.
- Mitigating Climate Change with Managed Aquifer Recharge: 5 Case Studies. IAH 50th Congress Cape Town 2023
- A Conceptual model for methane gas occurrence in the western karoo as part of a geochemical baseline for shale gas development. IAH 50th Congress Cape Town
- Strategic Environmental Assessment for Shale Gas Development. Part of the CSIR Multi Author team for the Water Chapter
- Springer April 2024: Managed aquifer recharge in the Western Karoo; South Africa: Success and challenges in Monograph on "Artificial Recharge to Groundwater and Rain Water Harvesting: Issues & Learning from Developing Countries"

Memberships/Organisations

- Groundwater Division of the Geological Society of South Africa Mem. No. 004
- South African Council for National Scientific Professions (SACNASP) Mem. No. 400445/14
- International Association for Hydrogeologist (IAH) Men No. 136321

EMPLOYMENT RECORD

31 July 2023 to present:	GEOSS South Africa (Pty) Ltd, Senior Hydrogeologist
14 Aril 2009 – 21 July 2023	Department of Water and Sanitation: Northern Cape: Scientific Technician Grade B

SPECIALIST DECLARATION

I, Danita Hohne, as the appointed independent specialist hereby declare that I:

- act/ed as the independent specialist in this application;
- regard the information contained in this report as it relates to our specialist input/study to be true and correct;
- do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the National Water Act, 1998 (Act No.36 of 1998) and the amended regulations in section 26 (1)(k) and 41 (6) of this Act: Regulations Regarding the Procedural Requirements for Water Use Licence Applications and Appeals, published in Government Gazette on No.;267 (Government Gazette, 2017);
- have and will not have no vested interest in the proposed activity proceeding;
- have disclosed, to the applicant and competent authority, any material information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the National Water Act, 1998 (Act No.36 of 1998) and the amended regulations in section 26 (1)(k) and 41 (6) of this Act: Regulations Regarding the Procedural Requirements for Water Use Licence Applications and Appeals, published in Government Gazette on No.;267 (Government Gazette, 2017);
- are fully aware of and meet the responsibilities in terms of the National Water Act, 1998 (Act No.36 of 1998) and the amended regulations in section 26 (1)(k) and 41 (6) of this Act: Regulations Regarding the Procedural Requirements for Water Use Licence Applications and Appeals, published in Government Gazette on No.;267 (Government Gazette, 2017), and that failure to comply with these requirements may constitute and result in disqualification; and
- have provided the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not.

Danita Hohne
GEOSS South Africa (Pty) Ltd
SACNASP – Pr.Sci.Nat
28 February 2025

1 Introduction

Cape Winelands Airport Ltd requested that GEOSS South Africa Pty (Ltd) compile a geohydrological assessment for their Water Use Licence Application (WULA). The application is to abstract groundwater for use at their facility (**Map 1**), which is associated with the following properties outside Durbanville, Western Cape:

- Portion 10 of the Farm Joostenburg Vlakte No. 724
- Remainder of the Joostenburg Vlakte No. 724
- Portion 23 of the Farm Joostenburg Vlakte No. 724
- Remainder of the Farm No. 474
- Portion 4 of the Farm No. 474
- Portion 7 of the Farm Kliprug No. 942

A summary of the details relevant to the boreholes for use on the property is presented in **Table 1** and includes the newly drilled CWA_BH003. Please refer to the relevant WULA documentation for the water use on site.

Table 1: Details of production boreholes for CWA.

Borehole	Latitude (DD, WGS84)	Longitude (DD, WGS84)	Borehole Depth (m)
CWA_BH001	-33.76452	18.73271	100.0
CWA_BH002	-33.76876	18.732067	100.4
CWA_BH003	-33.774037	18.747742	149.9

It is proposed that the abstracted groundwater be used for industrial and domestic purposes to operate the airport on the property. Regarding the legal aspect of the proposed groundwater use, the following details have relevance in **Table 2:**

Table 2: General Authorisation limit for the CWA Fistantekraal.

Property	Remainder of the Joostenburg Vlakte No. 724	Portion 10 of the Farm Joostenburg Vlakte No. 724	Portion 4 of the Farm No. 474	Combined property
Borehole	CWA_BH001	CWA_BH002	CWA_BH003	-
Quaternary Catchment	G21E	G21E	G21E	G21E
Property Size (ha)	42.34	113.96	36.52	192.82
General Authorization (m^3/ha/a)	150	150	150	150
General authorization zone	D	D	D	D
General authorization volume (m^3/a)	6 351	17 094	5 478	28 923
Required abstraction for the property (m^3/a)	**31 536**	**78 840**	**53 295.84**	**163 671.84**
Is General Authorization exceeded?	**Yes**	**Yes**	**Yes**	**Yes**

The calculation in **Table 2** indicates that the groundwater use must be licensed with the Department of Water and Sanitation (DWS). It is a requirement from DWS that a geohydrological report must accompany the groundwater portion of the licence application. The application will be submitted to the regional DWS office. When a Water Use Licence (WUL) is granted, the management of the WUL will fall under the authority of the Berg Olifants Water Management Area (WMA).

2 Scope of Work

The scope of work is to provide groundwater specialist services, including the tasks outlined below:

- Complete a geohydrological characterization of the groundwater in the vicinity of the property;
- Determine the sustainable (i.e., long-term and safe) yield of the borehole as well as the quality of the groundwater.
- Complete an assessment of groundwater's importance in the area through a hydrocensus.
- Document the above findings in a format fully compatible with the requirements for a water use license application (to be submitted to DWS).

The assessment has been conducted per accepted best practice principles.

3 Methodology

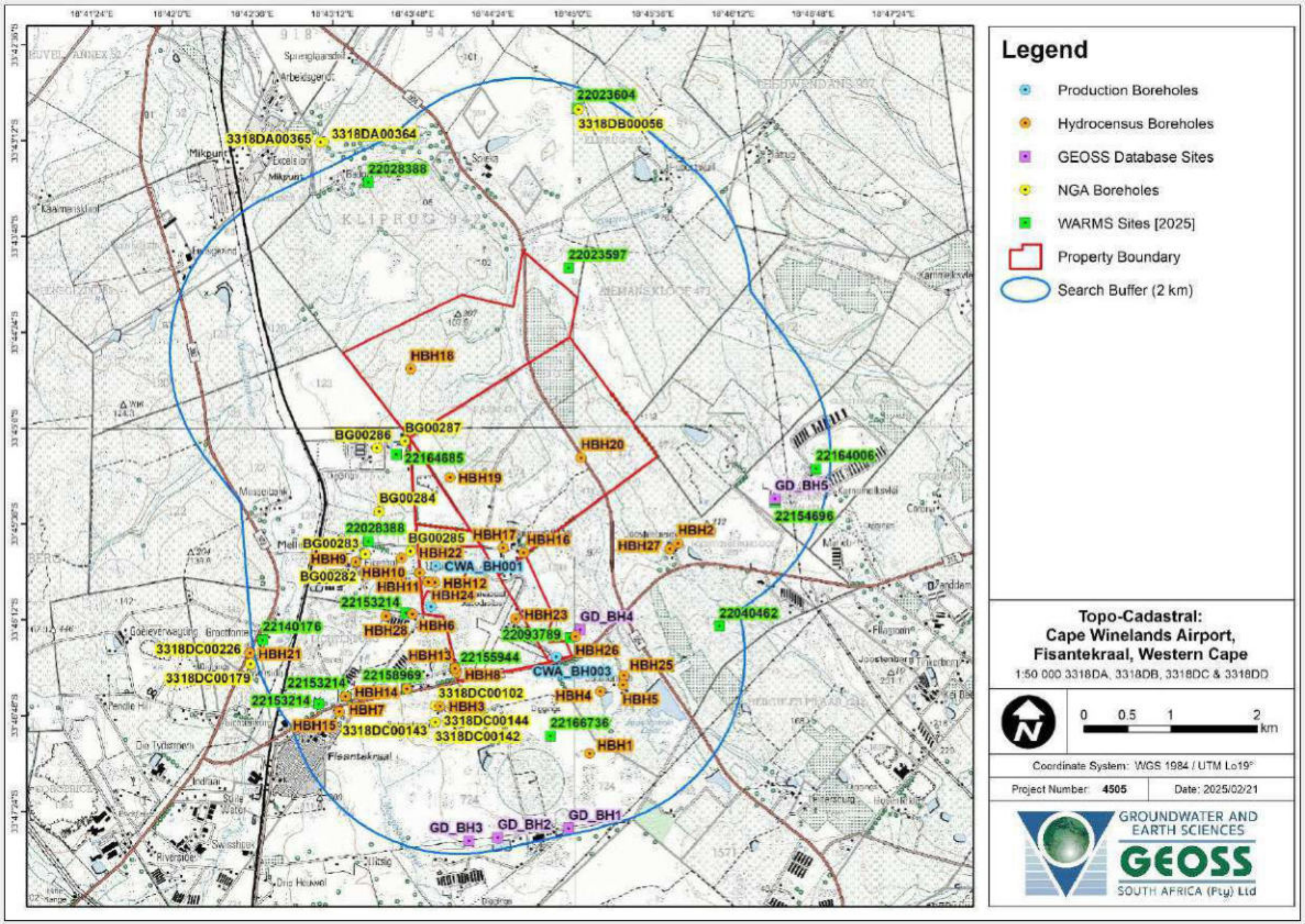
The procedure adopted for this study involved a desktop study followed by field work. The initial desktop study involved obtaining and reviewing all relevant data for the project site. This included examining relevant site plans, reports, and geological maps of the area and analysing data from multiple groundwater databases that contained information on groundwater yield and quality.

A site visit was then conducted to collect additional data and verify as much of the existing data as possible. This included a hydrocensus of groundwater users in the area and noting any subsurface conditions where possible. The local minimum potential of the aquifer in question and the boreholes' sustainable yields were calculated.

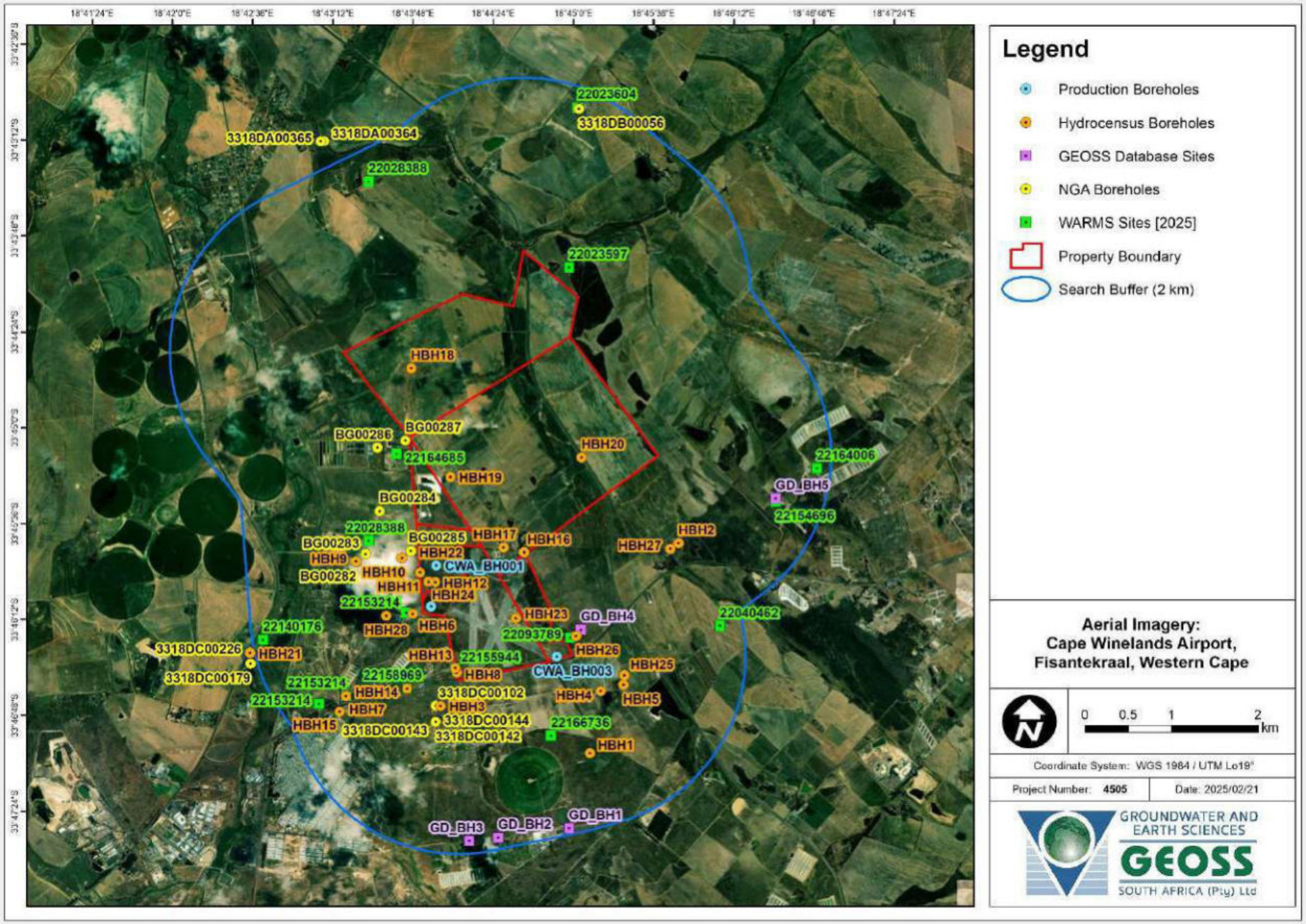
All collected data was analysed and interpreted to assess the potential risks associated with the proposed water use as they pertain to groundwater and the sustainability of the proposed abstraction. Management recommendations were included to ensure sustainability of the proposed water use.

Within a regional context, the study area is shown in **Map 1. Map 2** and **Map 3** show more detailed views of the study site with relevant information (borehole positions at and near the property) superimposed on a 1:50 000 topo-cadastral map and satellite image, respectively.

Map 1: Locality of the proposed Cape Winelands Airport, Fisantekraal.



<u>*Map 2:*</u> *The study site with the property boundary with the production, hydrocensus, NGA, and WARMS boreholes superimposed on a 1:50 000 scale topocadastral map (3318DA, 3318DB, 3318DC & 3318DD).*



<u>Map 3:</u> The study site with the property boundary with the production, hydrocensus, NGA, and WARMS boreholes superimposed on an aerial photograph.

4 Regional Setting

4.1 Site Context

The proposed Cape Winelands Airport site is located approximately 10 km northeast of Durbanville, in the Western Cape. The property is within quaternary catchment G21E, part of the Berg River Water Management Area. The quaternary catchment is 530 km^2 in extent and has a groundwater General Authorisation (GA) of 150 m^3/a/ha. This quaternary catchment mainly comprises agricultural land and residential, commercial, and industrial holdings to a smaller extent.

The site is located north of the R312 (Lichtenburg Road), between the R302 and the R304. The surrounding area is predominantly zoned for agriculture. Agricultural farms, livestock farms and poultry farms mainly surround the site. Some areas are also used for recreational activities and a waste water treatment facility (WWTF) is also located to the northwest of the boundary.

Two rivers flow toward the northwest in the area. The Klapmuts River passes the CWA to the north, and the Mosselbank River passes the CWA on the western side.

4.2 Topography

Rolling hills characterise the topography of the site and its surroundings. The typical on-site elevation is 90 - 120 m above mean sea level (mamsl). The proposed airport itself is located on a more even and level landscape.

4.3 Climate

The Fisantekraal area experiences a Mediterranean Climate with mild wet winters and warm dry summers. **Figure 1** shows the monthly average minimum and maximum air temperature distribution and **Figure 2** the monthly median rainfall and evaporation distribution for Durbanville (Schulze, 2009). The long-term (1950 – 2000) mean annual precipitation for the study area is 532 mm/a. The rainfall exceeds evaporation in the winter months (May to August) and the peak groundwater recharge period will thus be in the winter. During the summer months, groundwater assists in meeting the water requirements for the area.

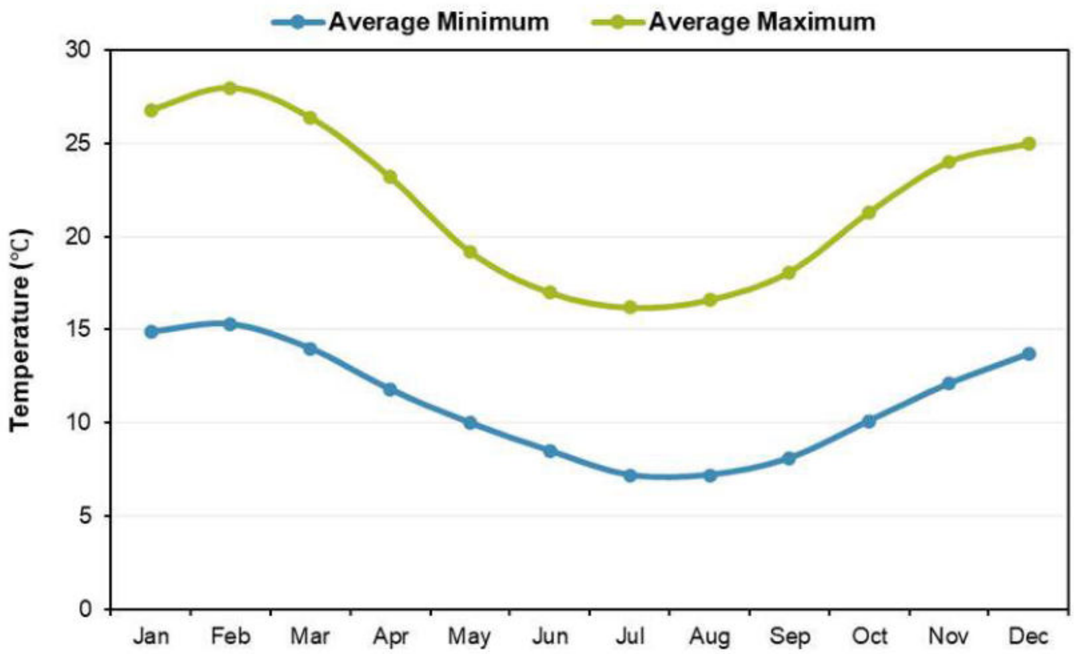


Figure 1: Monthly average minimum and maximum air temperatures for the study area (Schulze, 2009).

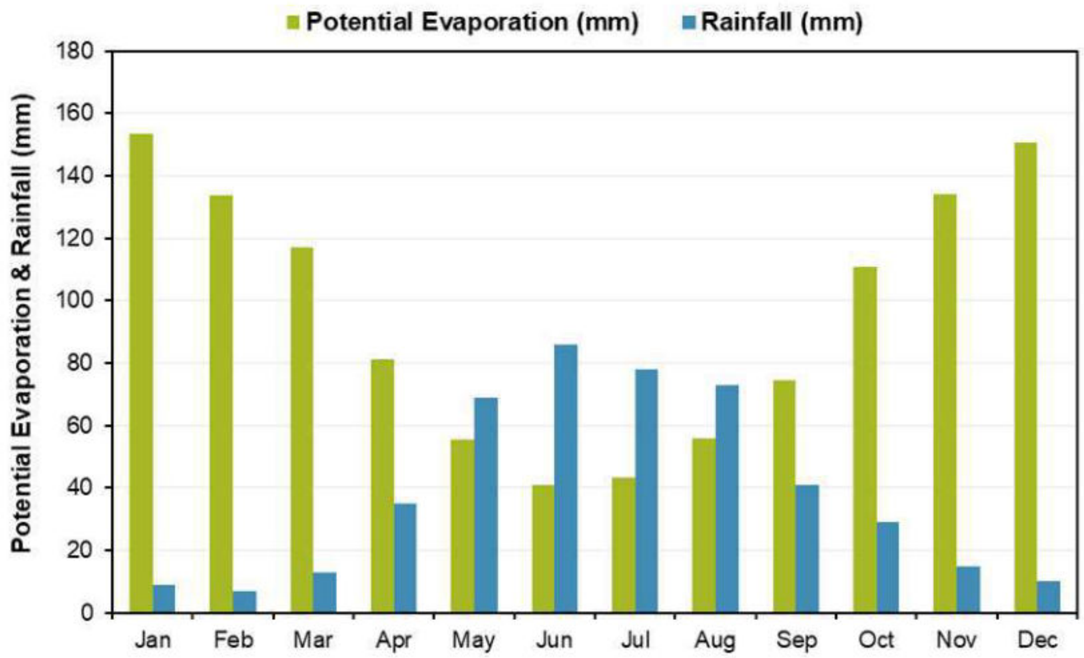


Figure 2: Monthly average rainfall and evaporation distribution for the study area (Schulze, 2009).

5 Regional Geology

The Geological Survey of South Africa (now the Council for Geoscience) has mapped the area at 1:250 000 scale (3318, Cape Town). The main geology of the area is listed in **Table 3** and the geological setting is shown **in Map 4.**

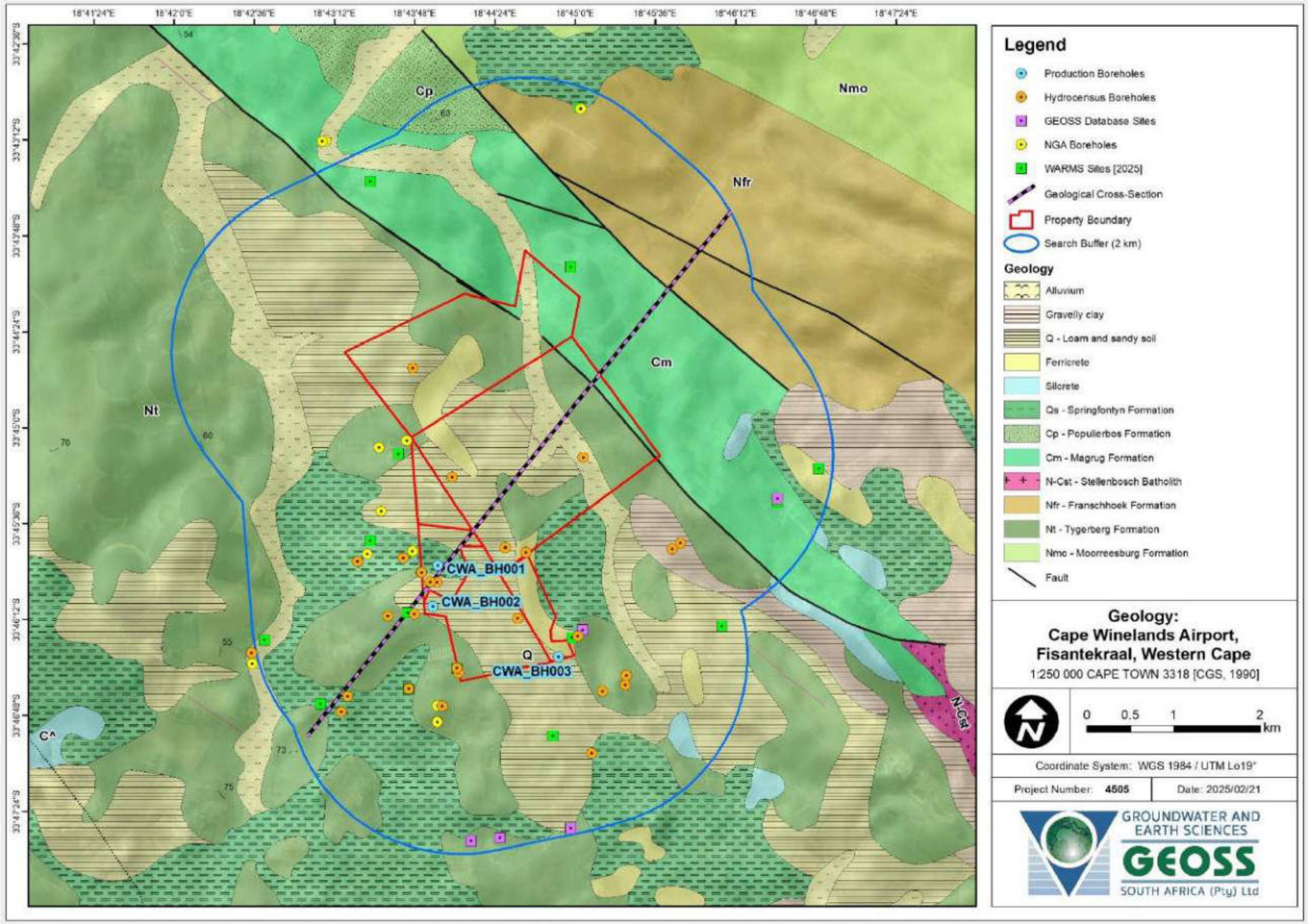
Table 3: Geological formations within the study area.

Code	Formation/Pluton	Group/Suite	Description
	Alluvium	Quaternary	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	Shale, mudstone and sandy shale, mainly reddish
Cm	Magrug Formation		Conglomerate, grit and sandstone, often reddish brown
Nf	Franschhoek Formation	Malmesbury	Grey, feldspathic conglomerate, grit and sandstone, with minor shale
Nt	Tygerberg Formation		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

The geology underneath the proposed Cape Winelands Airport is shale of the Tygerberg Formation (Nt), which is part of the Malmesbury Group and is the basement rock of the area. Regionally, the Malmesbury Group is overlain by different Quaternary formations (Qgg, Qg, Qf and Qs).

Based on drilling information in the surrounding area, it has been observed that boreholes in the surrounding area had a general geological log that started with overburden and clay between 0 – 40 m, followed by weathered bedrock between 40 – 60 m), followed by bedrock (shale, sandstone, greywacke, phyllite).

A regional fault structure (the Colenso Fault) is mapped along the northeastern boundary of the Cape Winelands Airport. This fault structure stretches from Langebaan through to just north of Stellenbosch and is believed to be as wide as ~7 km in places (Kisters et al., 2002). A conceptual geological cross-section based on literature is presented **in Figure 3.** Materials that appear to have been derived from the Cape Granite Suite also appear to be present in the area (GEOSS, 2022a).



Map 4: *Geological setting of the study site with the property boundary with the production borehole and the cross-section line (3318, Cape Town) (CGS, 2012).*

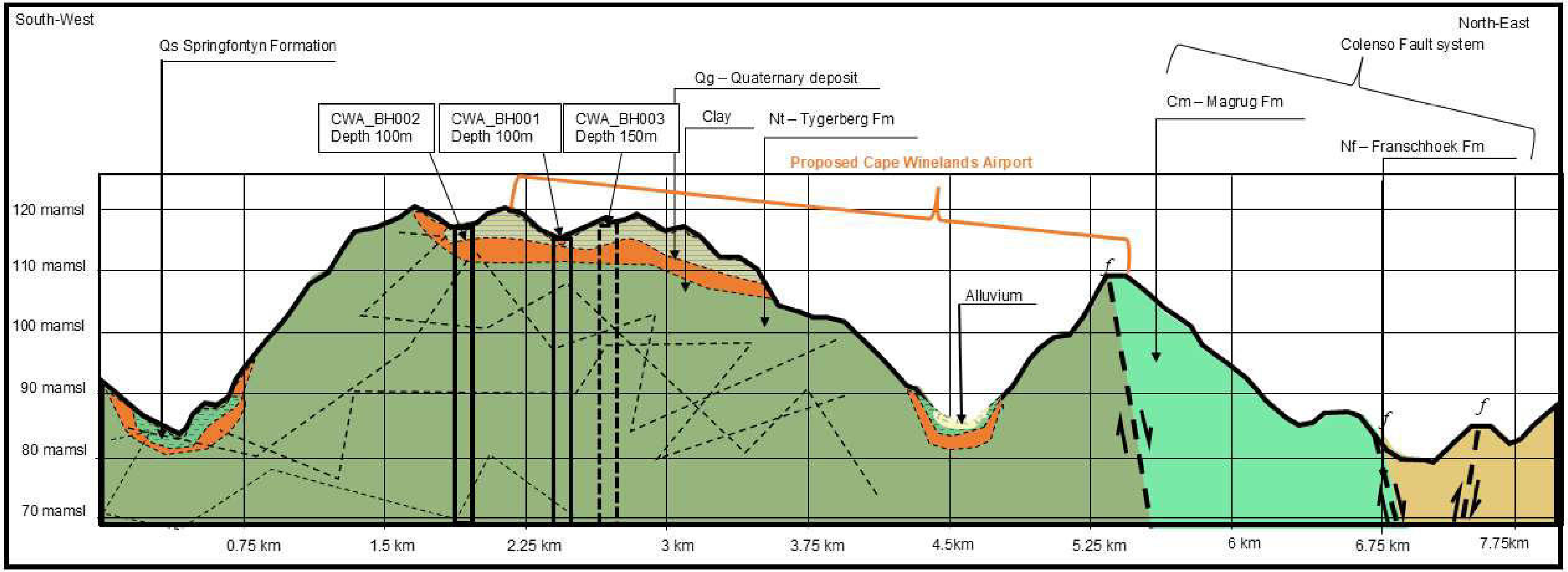


***Figure 3:** Schematic and conceptual southwest to north-east cross-section.*

6 Regional Hydrogeology

The aquifer yield and aquifer quality classifications are based on regional datasets, and therefore, only provide an indication of conditions to be expected.

6.1 Aquifer Yield

According to the 1 : 500 000 scale groundwater map of Cape Town (3318), the study area hosts a **fractured aquifer** with an average **borehole yield in the range of 0.5 – 5.0 L/s** (DWAF, 2000) (**Map 5**). A fractured aquifer describes an aquifer where groundwater only occurs in narrow fractures within the bedrock and is most likely associated with the Tygerberg Formation in the area. A fractured aquifer is defined as a formation that contains sufficient fissures, fractures, cracks, joints and faults that yields economic quantities of water to boreholes and springs. Groundwater will then move along these fractures and joints. The fractured aquifer on the map likely refers to the exposed Tygerberg Formation.

6.2 Aquifer Quality

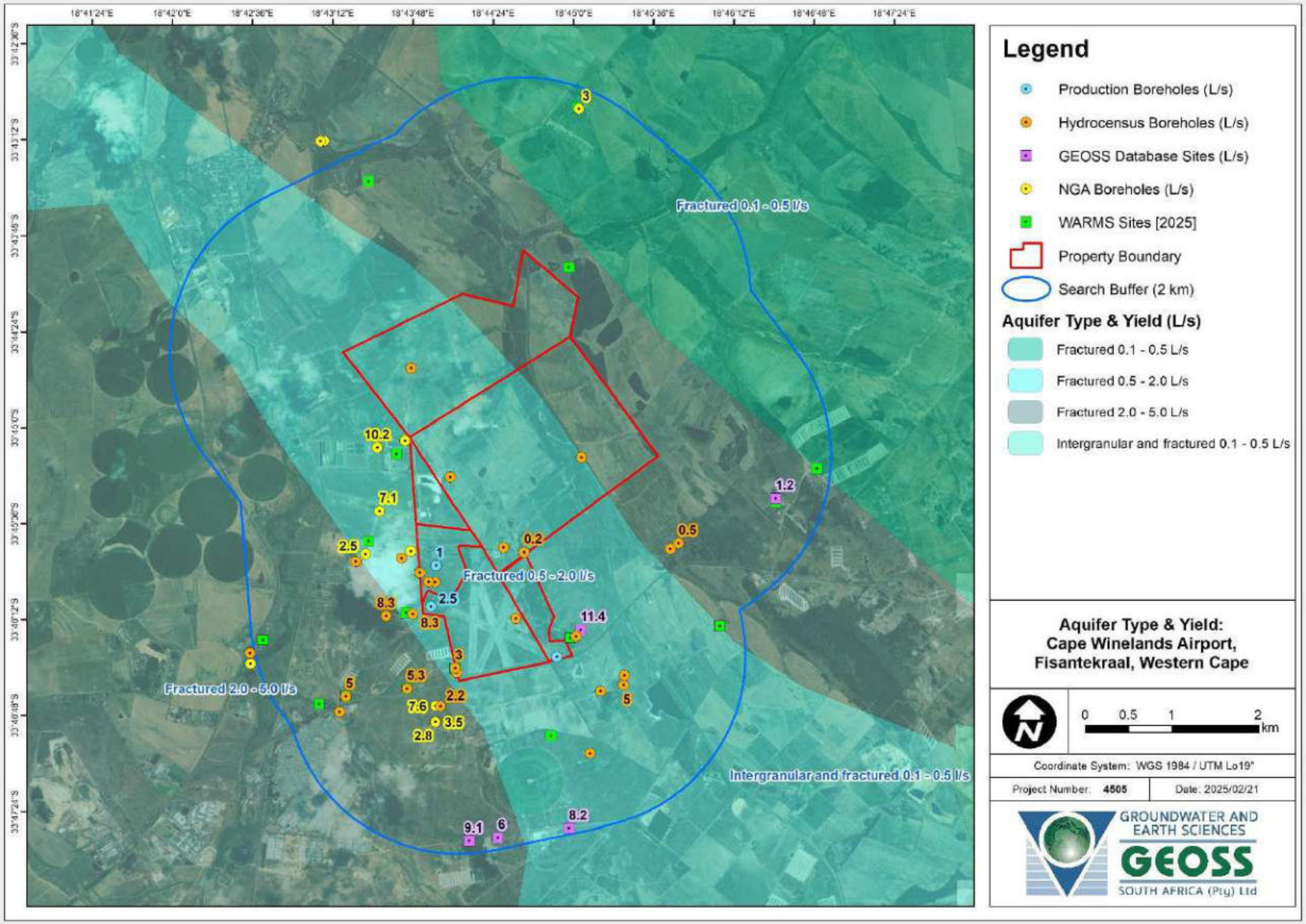
Electrical conductivity (EC) is a measure of the ability of the groundwater to conduct electricity. EC is directly related to the concentration of dissolved ions in the water, and this parameter is used to indicate groundwater quality. The groundwater map indicates that the aquifer has electrical conductivity values of 70 – 1 000 mS/m (**Map 6**) (DWAF, 2000). Better quality water is observed in the north-western area with values ranging between 70 – 300 mS/m. Poorer water quality is observed in the southeastern area with values ranging between 300 – 1 000 mS/m (**Map 6**) (DWAF, 2005). In terms of domestic water standards (DWAF, 1998b), water quality in the area ranges from **good** (Class I) (70 – 150 mS/m) to **dangerous** (Class IV) (>520 mS/m).

6.3 Aquifer Vulnerability Classification

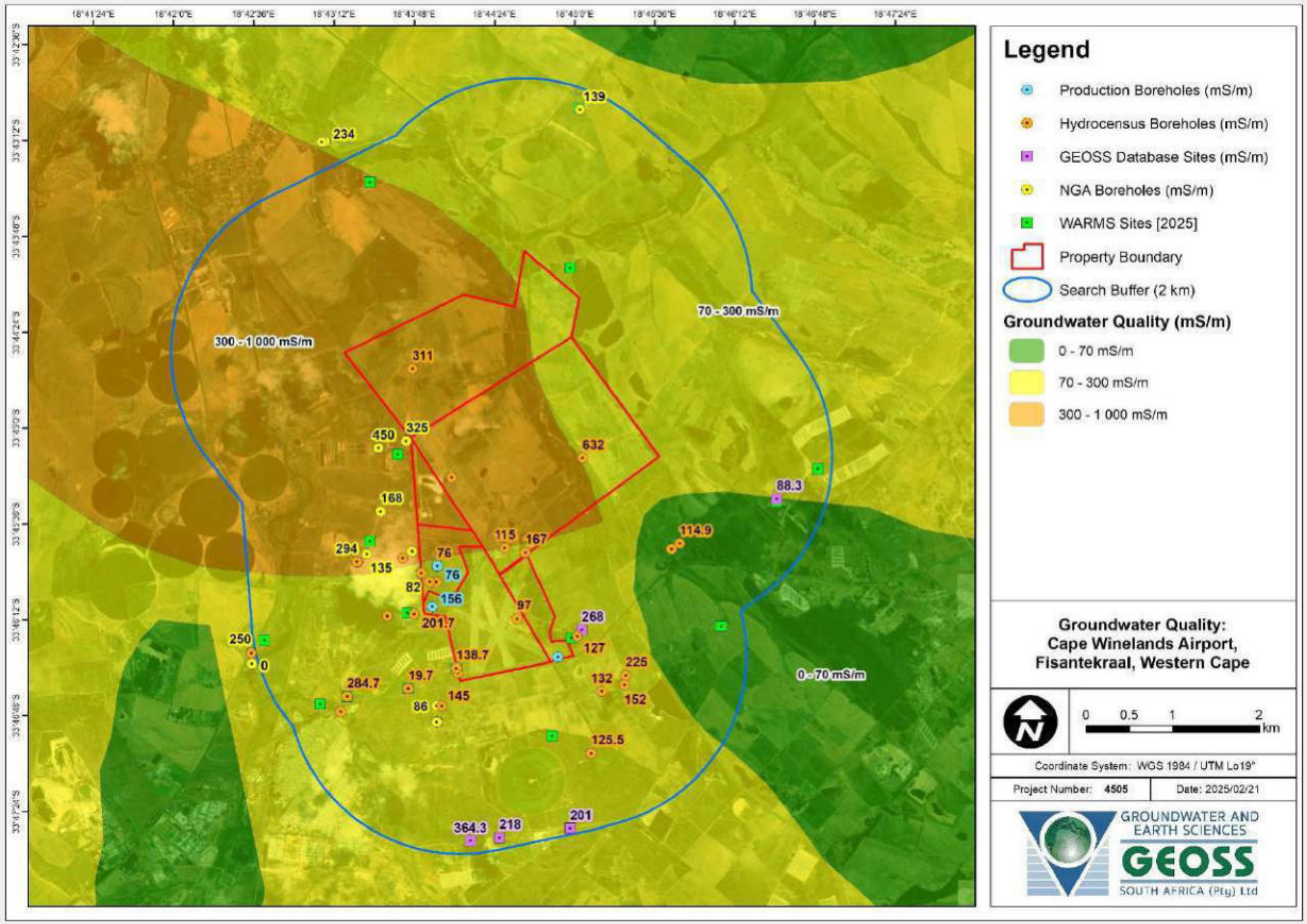
The national scale groundwater vulnerability map, which was developed according to the DRASTIC methodology (Conrad and Munch, 2007), indicates that the study area has a "**low**" to "**medium**" vulnerability to surface-based contaminants (**Map 7**). The DRASTIC method considers the following factors:

D	= depth to groundwater	(5)	R	= recharge	(4)
A	= aquifer media	(3)	S	= soil type	(2)
T	= topography	(1)	I	= impact of the vadose zone	(5)
C	= conductivity (hydraulic)	(3)			

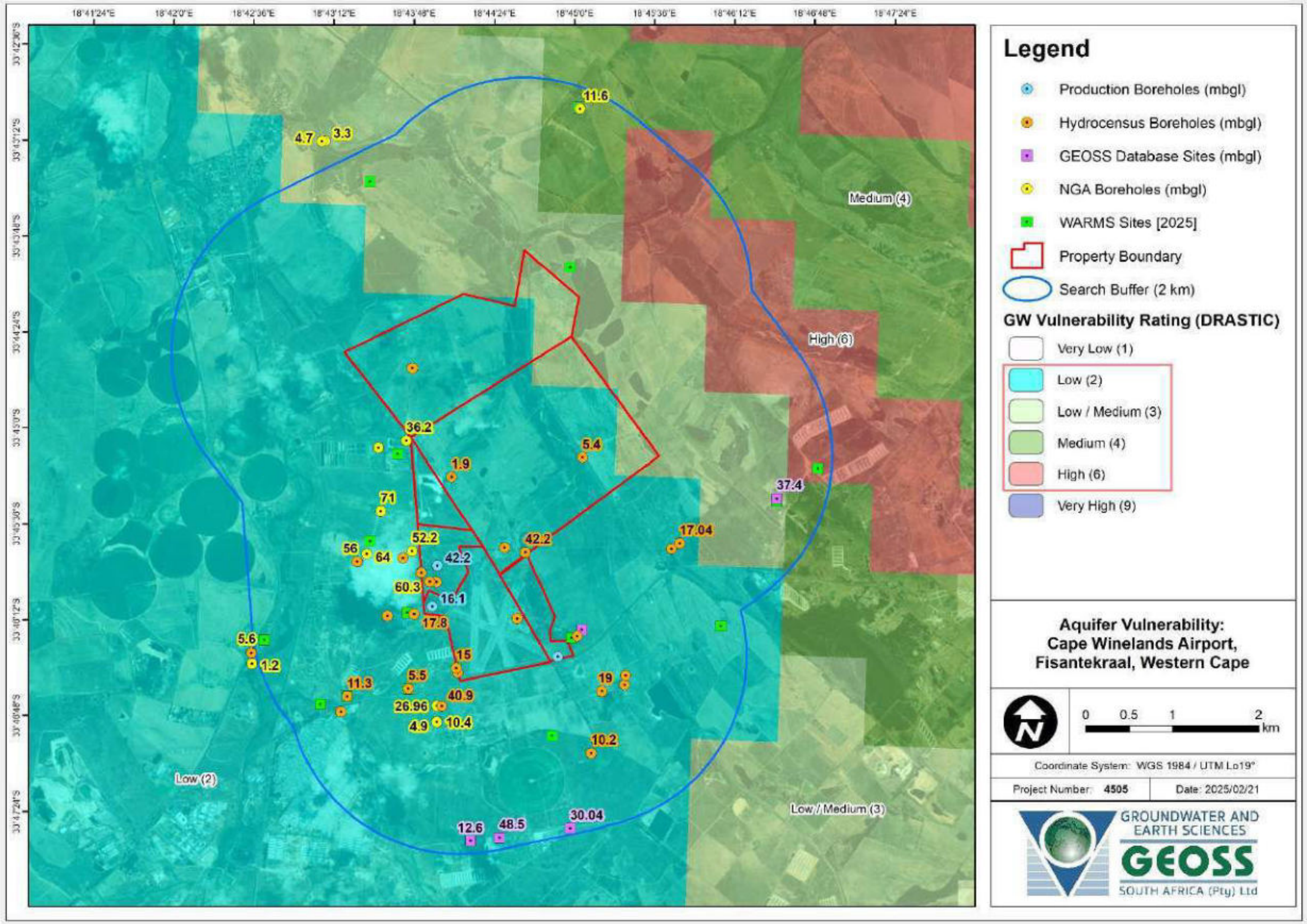
The number indicated in parenthesis after each factor description is that factor's weighting or relative importance. The **low** to **medium** vulnerability classification indicates that the susceptibility of the aquifer to contamination from anthropogenic activities, is relatively low. This classification is because the Malmesbury Group rock weathers to clay. Clays are typically associated with lower permeability, retarding the migration of potential contaminants and offering protection to potentially underlying aquifers. However, it must be noted that the vulnerability does increase to the northeast, where the Colenso Fault system is located. This area should be considered as a sensitive area in terms of groundwater.



Map 5: Regional aquifer yield (L/s) (DWAF, 2000).



Map 6: Regional groundwater quality (EC in mS/m) from DWAF (2000).



<u>Map 7:</u> *Vulnerability rating (DWAF, 2000) and groundwater depths (mbgl).*

7 Volume and Purpose of Water Use

Although this report focuses on groundwater abstraction triggering Section 21 (a) water use, other water uses are also triggered under Section 21 which can have an impact on the groundwater resources and are briefly discussed below (PHS Consulting, 2024):

- **(a) taking water from a water resource** - Abstraction of water from proposed three boreholes for potable use onsite and taking from surface water storage for use on site.
- **(b) storing water – Storage of water in stormwater ponds, reservoirs, weirs and the old quarry.**
- **(c) impeding or diverting the flow of water in a watercourse** - Construction within the regulated area of wetlands on site; Any infrastructure/ buildings within the regulated area of or crossing underneath drainage lines / streams / wetlands.
- **(e) engaging in a controlled activity identified as such in section 37(1) or declared under section 38 (1)** - Irrigation with water containing waste, i.e., irrigation with treated effluent from the on-site sewage treatment plant.
- **(f) discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit** - (surplus) treated effluent discharged from the site into the receiving environment when required.
- **(g) disposing of waste in a manner which may detrimentally impact on a water resource** - Storage of domestic and biodegradable industrial wastewater for the purpose of re-use or eventual disposal.
- **(i) altering the bed, banks, course or characteristics of a watercourse** - Construction within the regulated area of wetlands on site; Any infrastructure / buildings within the regulated area of or crossing underneath drainage lines / streams / wetlands.
- **(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** - Dewatering of areas from time to time for continued operation / safety on site and for the initial construction period.

The risk assessment for the other water uses is discussed **in Section 10** of this report.

Consequently, prior to the authorisation of the above water uses, the risk of the development on groundwater resources in the area has been evaluated. The properties that form part of the Cape Winelands Airport precinct are located within Quaternary Catchment G21E, and thus the General Authorisation (GA) regarding groundwater abstraction is 150 m^3/ha/a.

The total area of the Remainder of the Joostenburg Vlakte No. 724, Portion 10 of the Farm Joostenburg Vlakte No. 724 and Portion 4 of Farm No 474 is 192.82 ha and a total of 28 923 m^3/a can be abstracted under the GA.

The proposed volume to be abstracted from the three properties from drilled and yield tested boreholes is 163 671 m^3/a (5.19 L/s, 24 hours per day). Since the proposed new abstraction exceeds the GA limit amount, a groundwater use license will need to be granted by DWS. This will provide water to the Cape Winelands Airport till 2038 at the start of Phase PAL 2.

For phase PAL 2 starting in 2038 until phase PAL 4 ending in 2060, additional water would be required and this would be supplied by municipal supply and treated effluent that amounts to 487

640 m³/a or 15.55 L/s in 2060. The Aquifer Firm Yield Model was used to calculate the Groundwater Resource Unit (GRU) which also indicated that it can still currently support the additional required volume (**Section 9**).

The water demand will be used for business/commercial, yard connection, warehouses, hotels, parks, wash facilities, club buildings, industrial, parking grounds, garage and filling stations, terminal buildings and biodigester.

The groundwater for phases PAL 1 to the end of PAL 4 lifespan will be abstracted from three (CWA_BH001, CWA_BH002, CWA_BH003) production boreholes (**Map 2 and Map 3**). The production boreholes were correctly yield tested (according to SANS 10299_4-2003) and the results were used to determine the sustainable (i.e., long term and safe) yield of the boreholes. The total conservative volume, which can be abstracted from the boreholes is 163 671 m³/a.

The additional water required for phases PAL 1 to PAL 4 will be supplied from the treated effluent plant and municipal supply (potable water). The accumulative volume of the effluent treatment plant, municipal supply, and boreholes are indicated in the simplified Demand and Supply table. The water balance also shows volumes that will be available for non-portable supply. This water will be used for the bio-digester and irrigation purposes at Cape Winelands. This table also includes the Demand and Supply for each of the other phases in **Table 4**. The water balance for each phase can be viewed in **Appendix A**.

Table 4: Demand and Supply table simplified.

Phase	Demand for portable water(m³/a)	Supply for potable water (m³/a)	Surplus for potable water (m³/a)
PAL 1	161 382	321 583	160 200
PAL 2	261 732	324 159	62 426
PAL 3	299 481	324 159	24 678
PAL 4	314 493	324 159	9 665
Phase	**Demand for non-portable water (m³/a)**	**Supply for non-portable water (m³/a)**	**Surplus for non-portable water (m³/a)**
PAL 1	170 378	170 378	0
PAL 2	278 920	278 920	0
PAL 3	304 395	304 395	0
PAL 4	332 358	332 358	0

7.1 Proposed Development

The reader is referred to the Groundwater Impact Assessment for the Proposed Cape Winelands Airport, Fisantekraal, Western Cape: GEOSS 2024. The proposed development discussed here are taken directly from the report mentioned above.

The existing footprint of the airfield covers approximately 150 ha. Several of the neighbouring properties have been acquired, therefore taking the proposed development area up to 660 ha. The development will comprise a combination of mixed office, retail, aircraft hangers of varying sizes, parking spaces, heliports, commercial buildings, hotels, terminal buildings and administrative buildings with a total estimated building area of 395 000 m² (Zutari, 2024). There are currently three development options that are being investigated for the current study site (CWA Ltd, 2024):

1. Alternative 1: No-go Option (No further development)
2. Alternative 2: Initial Preferred Alternative (Expansion of the site)
3. Alternative 3: New Preferred Alternative (Expansion of the site)

7.1.1 Alternative 1: No-go Option

There are currently four concrete strips that are 90 m in width, each in varying lengths between 700 m and 1 500 m (**Figure 4**). The information presented in this section is based on the Cape Winelands Airport Development Project Description (CWA Ltd, 2024). Details for the existing runways are detailed in **Table 5** and illustrated in **Figure 8.**

Table 5: Details for the current runways at Cape Winelands Airport (CWA Ltd, 2023)

Runway	Length (m)
Runway 01-19	1 080
Runway 03-21	1 454
Runway 05-23	1 050
Runway 14-32	1 230

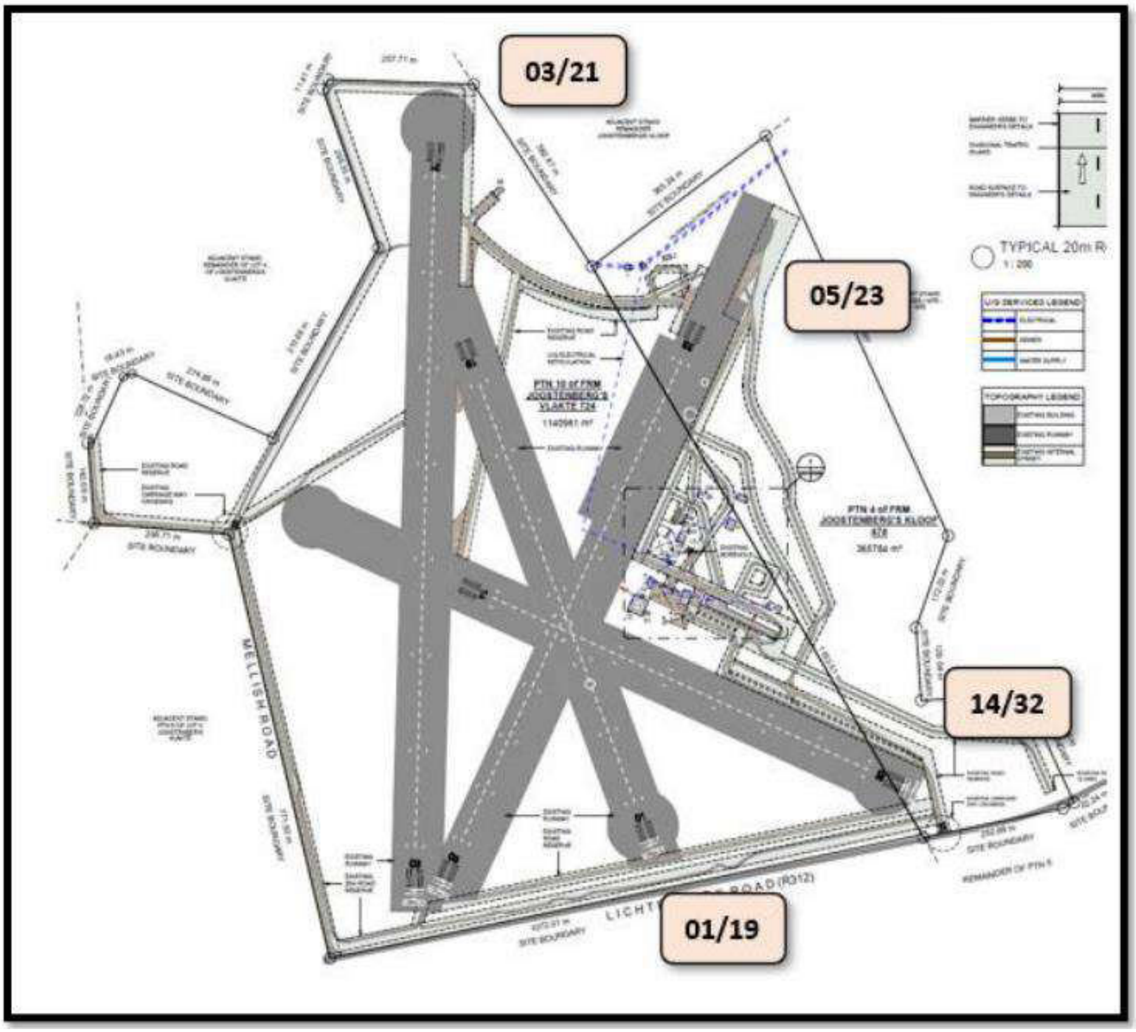


Figure 4: Current site layout indicating the four existing concrete strips (No-go development option)

The first alternative is not considered to be viable as it does not create any value to the region, various stakeholders, customers and the communities (CWA, 2023b). The assessment of the second and third alternatives are currently preferred as it will provide improved infrastructure, service delivery and value to the region, stakeholders, customers and the communities. The detailed feasibility study discussing the three development alternatives are documented in the Runway Alternatives Report (Version 4) (CWA Ltd, 2024).

- **Alternative 2: Initial Preferred Alternative**

The 'initial preferred alternative' development option is planned to occur over two phases. The Phase 1 and Phase 2 plans for the initial preferred development alternative have been provided in **Figure 5 and Figure 6**, respectively.

During Phase 1 of this development alternative, the following runways will be included:

1. Primary Runway at orientation 01-19 and length of 3 500 m, Code 4F Runway (45 m wide) .
2. Secondary Runway at orientation 14-32 and length of 700 m, Code 1A Cross Runway (18 m wide). This runway is an existing runway and will enable light aircraft operations.

During Phase 2 of this development alternative:

1. The secondary runway (14-32) will be decommissioned.

The main characteristics of the planned runways are as follows:

Table 6: Dimensions of two runways in Phase 1 (CWA Ltd, 2023)

Runway designation	RWY length (m)	RWY width (m)	RWY shoulders width	Overall width (m)
01-19	3 500	45	2 x 15 m	75
14-32	700	18	-	18

Source: NACO

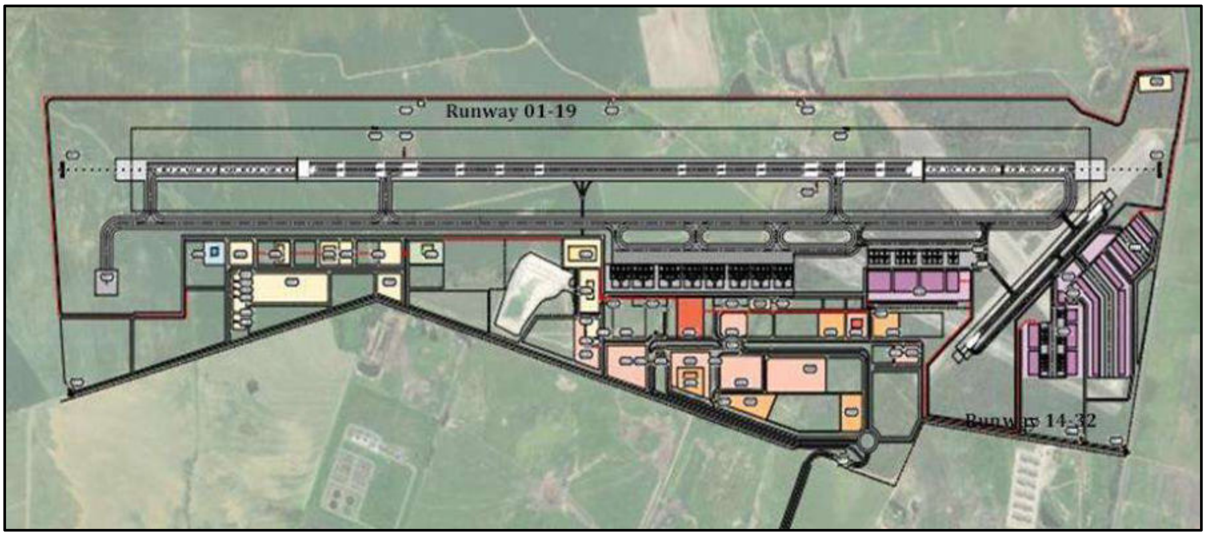


Figure 5: Initial Preferred Development Option (Phase 1) for the CWA (CWA Ltd, 2023b).

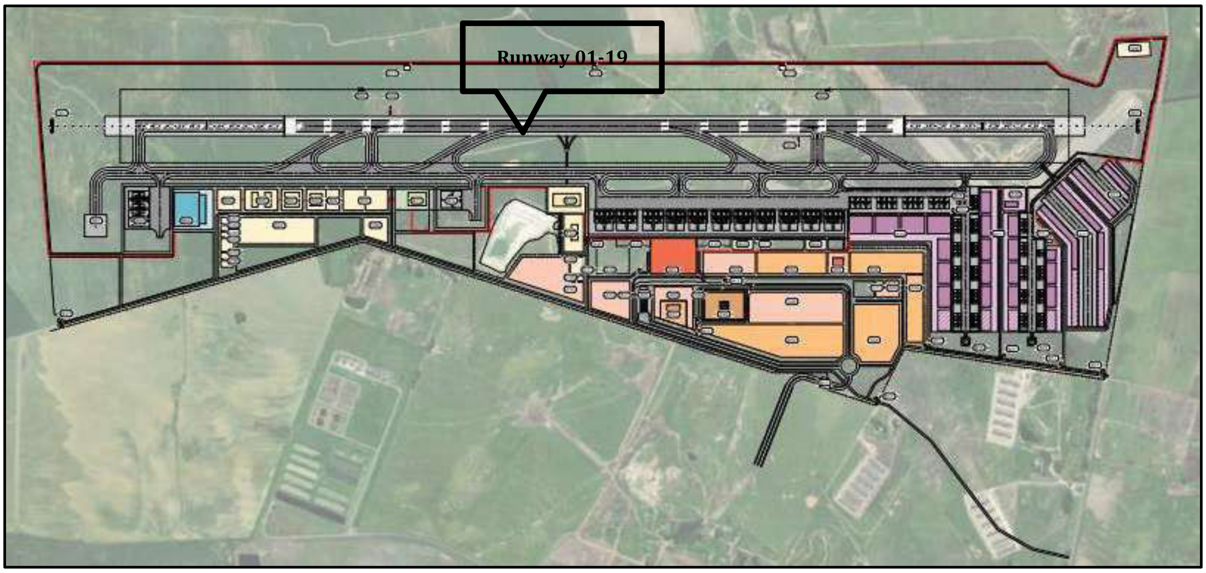


Figure 6: Initial Preferred Development Option (Phase 2) for the CWA (CWA Ltd, 2023b).

- **Alternative 3: Previous Preferred Alternative**

The 'previous preferred alternative' development option will host the same precincts mentioned in Alternative 2 with the main difference being that the secondary runway (14-32) will no longer be included in the development. The Phase 1 and Phase 2 plans for the previous preferred development alternative have been provided in **Figure 7 and Figure 8** respectively.

During Phase 1 of this development:

2. The airport will comprise of only one runway which will be at an orientation of 01-19 and a length of 3.5 km (details **in Table 6**) 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 (CWA Ltd, 2024).

During Phase 2 of this development:

3. The airport development will focus on the continued development of the various precincts with the main runway shared by all operators, including scheduled commercial as well as general aviation (CWA Ltd, 2024).

Figure 7: Previous Preferred Development Option (Phase 1) for the CWA (CWA Ltd, August 2024).

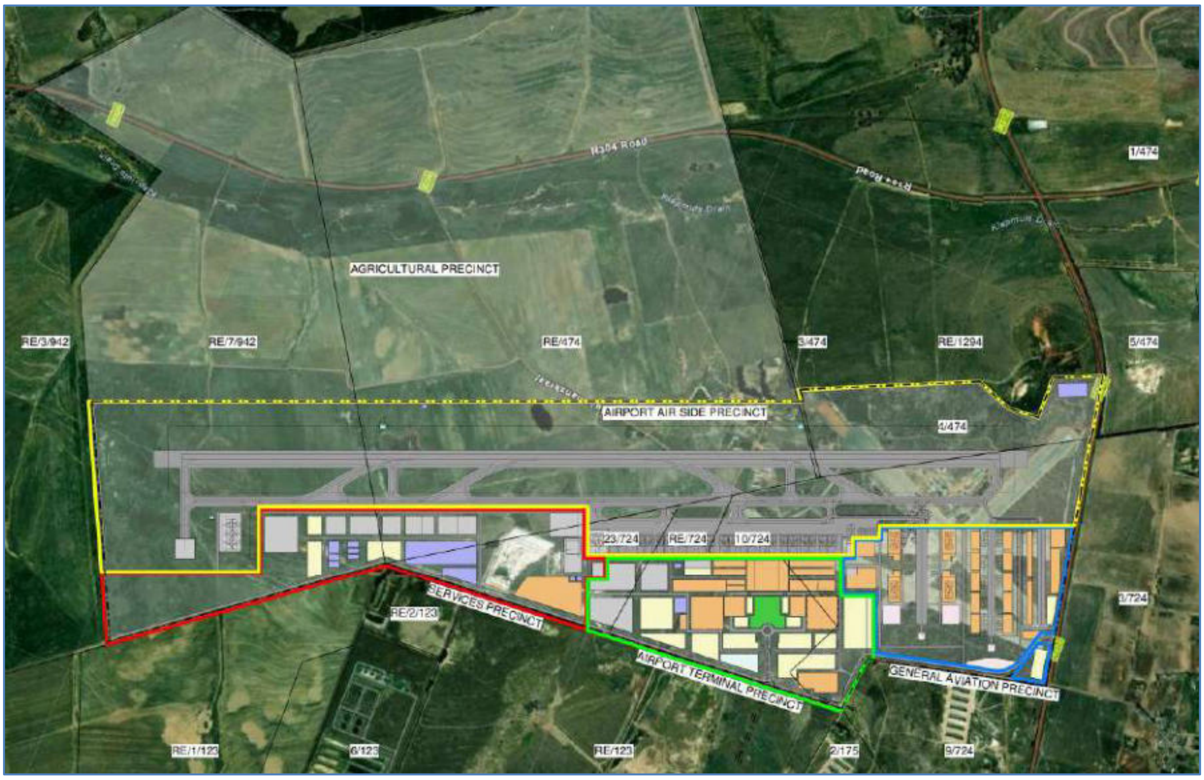


Figure 8: Previous Preferred Development Option (Phase 2) for the CWA (CWA Ltd, August 2024).

Alternative 4: New Preferred Alternative

Based on the comments received from Interested and Affected Parties (IAPs) as well as organs of state during the **Public Participation Process** (PPP), the new preferred **Alternative 4** was developed. **Alternative 4** has been developed from the previous preferred **Alternative 3**. It consists of the same footprint and scope as **Alternative 3**, but minor additions were included (the fuel line has been extended into the GA precinct; the internal precinct boundaries have been corrected; the three production boreholes are indicated; the incoming potable line has been added). This alternative also omits the short cross runway initially included in the project scope, this can be seen in **Figure 9 and Figure 10** (CWA Ltd, January 2025).

Figure 9: New Preferred Development Option (Phase 1) for the CWA (CWA Ltd, August 2024).

Figure 10: New Preferred Development Option (Phase 2) for the CWA (CWA Ltd, January 2025).

Proposed development of Alternative 2, Alternative 3 or Alternative 4 will have five main precincts (H & A Planning, 2024):

1. Agricultural precinct
    1. This is the largest precinct and makes up 53% of the site. The precinct will be used for active farming. The available land is large enough to be farmed on its own, but will most likely be rented out to farmers
2. Airport airside precinct
    1. This is a highly regulated and secured area. Vehicular and pedestrian access will be strictly controlled and all the activity in this precinct relates to aircraft movement and loading/unloading of freight and passengers.
3. General aviation precinct
    1. The precinct services all non-scheduled aviation including recreational, training, chartered, crop spraying, firefighting and private business. The heliport is also included in this precinct.
4. Airport terminal precinct
    1. This is the public face of the airport.
5. Services precinct
    1. This precinct will accommodate the utility services and avionic infrastructure required for the airport. The infrastructure uses include Aircraft Rescue and Fire Fighting (ARFF), Control Tower, Ground Support Equipment (GSE) maintenance, the WWTW, the biogas plant, electrical substations and the fuel farm.

8 Site Specific Information

8.1 Desktop Assessment (Existing Groundwater Information)

To determine whether there are any groundwater users in the area that may be affected by activities on site, a database search was conducted using a 2-km radius around the site. This portion of the study was completed by obtaining groundwater information from existing databases. A search was conducted on a number of databases, namely the National Groundwater Archive (NGA), the Water Use Authorisation and Registration Management System (WARMS) database as well as the internal GEOSS database. These resources provide data on borehole positions, groundwater chemistry and yield, when available. The first desktop assessment (GEOSS 2022a) was conducted in January 2022 and updated in subsequent revisions of the hydrogeological scoping report and the draft impact assessment report (GEOSS 2022b and GEOSS 2024).

Subsequently, this search has been updated again and data available to GEOSS up until 6 September 2024 was used. Based on the desktop assessment of the various databases, there are a number of groundwater users in the area surrounding the site, particularly to the southwest and southeast.

8.1.1 National Groundwater Archive (NGA) Database

Assessment of the National Groundwater Archive (NGA) database, which provides data on borehole and wellpoint positions, groundwater level, chemistry and yield, indicated that 16 boreholes and wellpoints are located within a 2 km search area of the site. The NGA sites are shown on **Map 3** and summarised in **Table 7.**

Table 7: Summary of NGA borehole/wellpoint details.

Site ID	Latitude (DD, WGS84)	Longitude (DD, WGS84)	Water Level (mbgl)	Yield (L/s)	EC (mS/m)	Depth (m)	Lithology
BG00282	-33.76409	18.72275	56.00	-	294	100.00	-
BG00283	-33.76328	18.7239	71.88	2.53	135	93.38	-
BG00284	-33.7588	18.72564	71.00	7.12	168	77.40	-
BG00285	-33.76298	18.72955	52.2	-	-	61.00	-
BG00286	-33.7522	18.72539	41.34	10.17	450	60.46	-
BG00287	-33.75148	18.72887	36.23	-	-	90.00	-
BG00288	-33.76524	18.7306	60.34	-	82	100.00	-
3318DC00102	-33.77912	18.73259	26.96	7.6	86	36.96	-
3318DC00142	-33.78079	18.73259	-	-	-	68.58	Clay
3318DC00143	-33.78079	18.7326	10.36	3.46	-	0-34.14 34.14-96.01	Clay Sandstone
3318DC00144	-33.7808	18.73259	4.88	2.77	-	0-39.32 39.32-78.03	Clay Sandstone
3318DA00364	-33.72022	18.71882	3.33	-	234	60.96	-
3318DA00365	-33.72023	18.71843	4.68	-	-	60.96	-
3318DC00226	-33.77349	18.70946	5.56	-	250	-	-
3318DC00179	-33.77467	18.70954	1.24	-	517	6.50	-
3318DB00056	-33.71690	18.750650	11.6	3.00	139	91.00	-

**Database accessed on 5 September 2024*

The NGA database indicates that the groundwater quality ranges from 82 mS/m to 517 mS/m, which is in line with the regional mapping (DWAF, 2000). The boreholes are generally deep, typically exceeding 60 m. The water levels range from shallow to deep (from 1.24 mbgl to 71 mbgl). The yields that are reported range from 2 L/s to 10 L/s and the lithology is indicated to be clay between 0 - 70 m followed by sandstone. It must be noted that the NGA data is not always accurate, and it is therefore used in conjunction with site data to help conceptualise the hydrogeological setting.

8.1.2 Water Use Authorisation and Registration Management System (WARMS) Database

Assessment of the Water Use Authorisation and Registration Management System (WARMS) database (July 2023) revealed 21 registered boreholes within 2 km of the study site. Only active and registered sites were included. Water use in the area includes irrigation, livestock watering and urban use. The borehole details are listed in **Table 8** and are presented in **Map 3.**

Table 8: Summary of WARMS borehole details.

WARMS_ID	Latitude (DD, WGS84)	Longitude (DD, WGS84)	Registered volume (m³/a)	Use
22023597	-33.733434	18.749368	5 00	Industry (Urban)
22023604	-33.716772	18.750478	30 000	Industry (Urban)
22028388	-33.724440	18.724440	102 200	Agriculture: Livestock
22028388	-33.761926	18.724300	79 620	Agriculture: Irrigation
22040462	-33.770878	18.768118	21 366	Agriculture: Livestock
22093789	-33.772070	18.749418	365	Schedule 1
22140176	-33.772194	18.711083	8 620	Agriculture: Irrigation
22153214	-33.769426	18.728956	10 000	Agriculture: Livestock
22153214	-33.778090	18.721430	12 000	Agriculture: Livestock
22153214	-33.778889	18.718056	12 000	Agriculture: Livestock
22154696	-33.757920	18.775100	24 540	Agriculture: Livestock
22154696	-33.764700	18.786100	49 211	Agriculture: Livestock
22155944	-33.775183	18.735044	24 540	Agriculture: Livestock
22158969	-33.777314	18.729019	12 000	Agriculture: Livestock
22164006	-33.754463	18.780229	73 625	Agriculture: Livestock
22164685	-33.752858	18.727801	25 550	Agriculture: Livestock
22166736	-33.782295	18.746968	25 000	Agriculture: Irrigation
22103395	-33.666900	18.683500	848 000	Agriculture: Livestock
22164042	-33.767800	18.775500	23 750	Agriculture: Livestock
22164186	-33.763900	18.783410	12 000	Agriculture: Livestock
22023604	-33.716700	18.750400	30 000	Industry Urban
22040462	-33,770877	18,768118	21 366	Agriculture: Livestock
Total Volume Allocated		1 445 753 m³/a		

8.1.3 GEOSS Internal Database

Five groundwater sites (boreholes) were identified through the GEOSS Internal Database search, and the locations of these sites are spatially represented on **Map 3** and summarised **in Table 9.**

Table 9: Summarised details for the GEOSS borehole details.

Site ID	Latitude (DD, WGS84)	Longitude (DD, WGS84)	EC (mS/m)	Yield (L/s)	Water Level (mbgl
GD_BH1	-33.791927	18.749209	201.0	8.2	30.04
GD_BH2	-33.792879	18.740346	218.0	6.0	48.50
GD_BH3	-33.793220	18.736756	364.3	9.1	12.60
GD_BH4	-33.771231	18.750721	268.0	11.4	-
GD_BH5	-33.757592	18.775103	88.3	1.2	37.40

8.2 Hydrocensus

A site visit was conducted on 26th January 2022 to assess groundwater use and to obtain more data on borehole positions, groundwater chemistry, borehole yield, groundwater level and geology within the study area. The information obtained was used in conjunction with previous work completed by GEOSS in the surrounding area (GEOSS, 2022a). The results of the field investigation are presented **in Table 10.** The boreholes are indicated on the maps **in Map 2** and **Map 3.**

After a complete hydrocensus was carried out, it was established that groundwater abstraction is taking place in the area. It should be noted that the hydrocensus occurred during the COVID-19 pandemic which made obtaining data difficult. Updates were also given on borehole conditions and use from neighbouring farms in August 2024, which is also updated in **Table 10.** Additional background information on groundwater was sourced from local drilling companies operating in the Durbanville area (GEOSS 2024). It was reported that yields are generally low in the area, specifically in the north-eastern side of the study area – south of the Colenso Fault system.

The data obtained from the hydrocensus indicates that borehole depths are highly variable, ranging from 6.5 m to 200 m. The water level ranges from 1.24 mbgl to 71.88 mbgl. However, the water levels that were indicated as deeper than 20 mbgl all originate from the NGA database. Water levels deeper than 20 mbgl do not correspond to the hand-measured resting groundwater levels during the hydrocensus which were all less than 20 mbgl. It is, therefore, considered likely that the NGA water levels deeper than 20 mbgl may represent pumping water levels.

Further, borehole yields range from 0.2 to 8.3 L/s, thereby exceeding the regional yields in some areas. The EC is also in keeping with the regional map, ranging from 19.7 to 632 mS/m. The borehole HBH14 displaying the low EC of 19.7 mS/m is the only exception in the dataset. i.e. EC < 70 mS/m. Total dissolved solids (TDS) values also correlated with measured EC values, while pH was neutral between 6.2 and 7.9.

Table 10: Hydrocensus Data (Updated August 2024)

ID	Latitude (DD, WGS84)	Longitude (DD, WGS84)	Depth (m)	Water Level (mbgl)	Yield (L/s)	Field Chemistry	General comments	Picture
HBH1	-33.784100	18.751830	19	10.15	-	EC: 125.5 mS/m	BH collapsed.	
HBH2	-33.762230	18.762950	103	17.04	0.54	EC: 114.9 mS/m	Used in the nursery.	
HBH3	-33.779160	18.733200	83.2	40.87	2.2	EC: 145 mS/m TDS: 710 mg/L pH: 6.2	Used for livestock.	
HBH4	-33.777640	18.753190	-	19	-	EC: 132 mS/m TDS: 650 mg/L pH: 6.7	Livestock watering, BH in use.	

ID	Latitude (DD, WGS84)	Longitude (DD, WGS84)	Depth (m)	Water Level (mbgl)	Yield (L/s)	Field Chemistry	General comments	Picture
HBH5	-33.776990	18.756030	-	-	5	EC: 152 mS/m TDS: 750 mg/L pH: 6.7	Domestic use and garden irrigation. Borehole overgrown.	
HBH6	-33.769530	18.729780	102	17.8	8.3	EC: 201.7 mS/m TDS: 1210 mg/L pH: 7.1	County Fair (CF) production borehole. 2024 comment on behalf of CF indicates that the borehole is now dry and no longer in use.	
HBH7	-33.778100	18.721400	90	11.27	5	EC: 284.7 mS/m TDS: 1708 mg/L pH: 7.9	County Fair production borehole	
HBH8	-33.775660	18.735240	-	-	-	-	County Fair borehole. BH welded shut. Not in use. 2024 comment on behalf of CF indicates that the borehole is now dry.	

ID	Latitude (DD, WGS84)	Longitude (DD, WGS84)	Depth (m)	Water Level (mbgl)	Yield (L/s)	Field Chemistry	General comments	Picture
HBH9	-33.764040	18.722660	-	-	-	-	Borehole used for household supply.	
HBH10	-33.763711	18.728400	-	-	-	-	Tanks concentrated with red staining, likely groundwater use.	
HBH11	-33.765210	18.730670	-	-	-	-	Could not gain permission to access borehole.	
HBH12	-33.766220	18.732568	-	-	-	-	Could not gain access to borehole.	

ID	Latitude (DD, WGS84)	Longitude (DD, WGS84)	Depth (m)	Water Level (mbgl)	Yield (L/s)	Field Chemistry	General comments	Picture
HBH13	- 33.775183	18.735044	200	15	3	EC: 138.7 mS/m TDS: 832 mg/L pH: 7.5	County Fair production borehole.	
HBH14	- 33.777314	18.729019	156	5.5	5.3	EC: 19.7 mS/m TDS: 118 mg/L pH: 8.7	County Fair production borehole.	
HBH15	- 33.779700	18.720600	-	-	-	-	Used for garden irrigation, iron staining on walls.	No photo taken
HBH16	- 33.763135	18.743671	30	42.2	0.2	EC: 167 mS/m TDS: 830 mg/L pH: 6.4	Livestock and domestic use.	

ID	Latitude (DD, WGS84)	Longitude (DD, WGS84)	Depth (m)	Water Level (mbgl)	Yield (L/s)	Field Chemistry	General comments	Picture
HBH17	-33.762654	18.741142	60	-	-	EC: 115 mS/m TDS: 570 mg/L pH: 6.3	Lots of iron. Livestock and domestic use.	
HBH18	-33.743924	18.729662	25	-	-	EC: 311 mS/m TDS: 1580 mg/L pH: 6.2	Used for livestock.	
HBH19	-33.755274	18.734510	15	1.9	-	-	Not in use.	
HBH20	-33.753275	18.750856	-	5.4	-	EC: 632 mS/m TDS: 1820 mg/L pH: 7.0	Used for livestock.	

ID	Latitude (DD, WGS84)	Longitude (DD, WGS84)	Depth (m)	Water Level (mbgl)	Yield (L/s)	Field Chemistry	General comments	Picture
HBH21	-33.773543	18.709450	-	-	-	-	Domestic use and livestock.	
HBH22	-33.764537	18.732657	-	-	-	EC: 76 mS/m TDS: 370 mg/L pH: 7.2	Low iron, good quality water. Previous owner has used this water as drinking water in their house. Later renamed to CWA_BH001 (/CWA_EastBH).	
HBH23	-33.76618	18.731747	-	-	-	EC: 97 mS/m TDS: 480 mg/L pH: 6.7	Airport borehole. Yellow colour in water.	
HBH24	-33.775995	18.756157	-	-	-	-	Could not gain access to borehole.	

ID	Latitude (DD, WGS84)	Longitude (DD, WGS84)	Depth (m)	Water Level (mbgl)	Yield (L/s)	Field Chemistry	General comments	Picture
HBH25	-33.771891	18.750147	-	-	-	EC: 225 mS/m TDS: 1120 mg/L pH: 6.5	Not in use.	
HBH26	-33.762813	18.761930	-	-	-	EC: 127 mS/m TDS: 630 mg/L pH: 6.8	Used for livestock.	
HBH27	-33.762813	18.761930	-	-	-	-	Not in use.	
HBH28	-33.77403	18.747742	102	17.8	8.3	-	County Fair borehole. Borehole is in use. Used for chicken house cooling, irrigation and firefighting. Quality reported to be brackish with high iron and sulphur odour, not suitable for drinking (livestock or human).	

8.3 Groundwater Flow Direction

Groundwater flow generally follows surface topography, flowing from high elevation to lower elevation areas. To evaluate the relationship between groundwater levels and topography, the surface elevations and water table elevations are plotted relative to each other to assess the applicability of an interpolation technique. Where close correlation between surface and water table elevations exists, interpolation techniques are an appropriate method to estimate values for areas with limited data (GEOSS, 2024).

Groundwater level data from the field hydrocensus and NGA were used and used to generate a groundwater level contour map to determine groundwater flow direction. Bayesian interpolation was used, making use of surface topography to infer the groundwater level based on the topography where no groundwater level data was available. The correlation between the elevation and the groundwater level is presented in **Figure 11**, and indicates a 94.78% correlation between surface topography and water level elevation. Bayesian interpolation is, therefore, considered an acceptable interpolation technique. **Map 8** shows the general flow direction across the study area. The groundwater locally flows northwest (perpendicular to the contour lines, from higher elevation to lower elevation) (GEOSS, 2024).

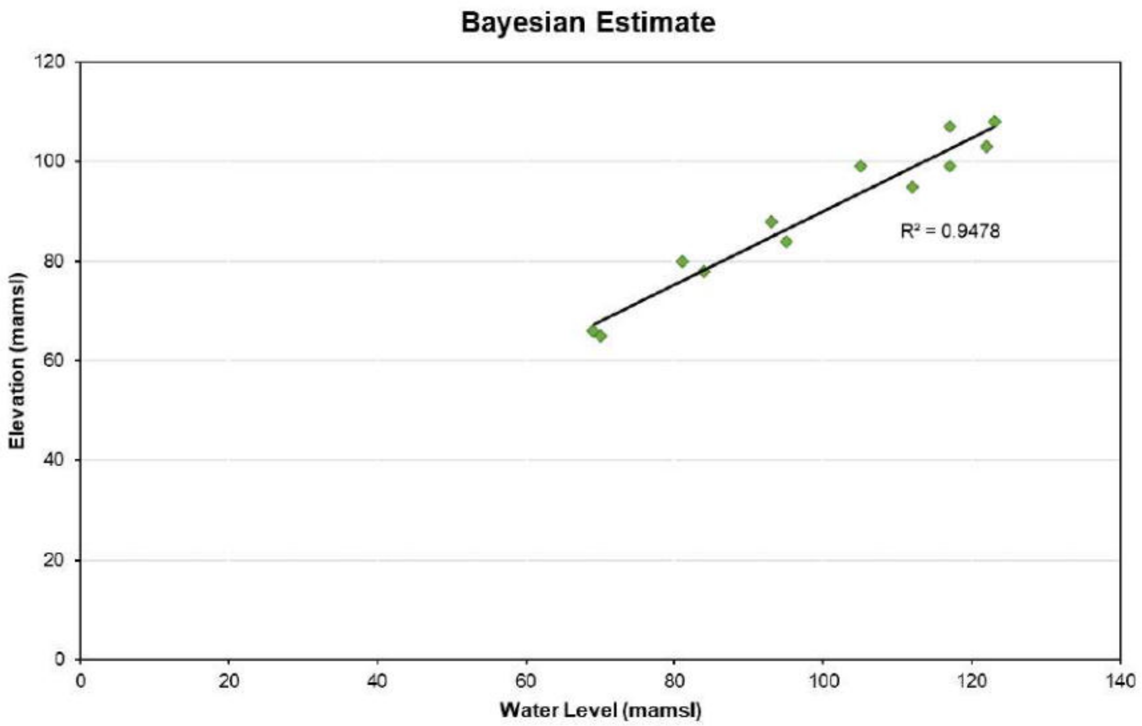
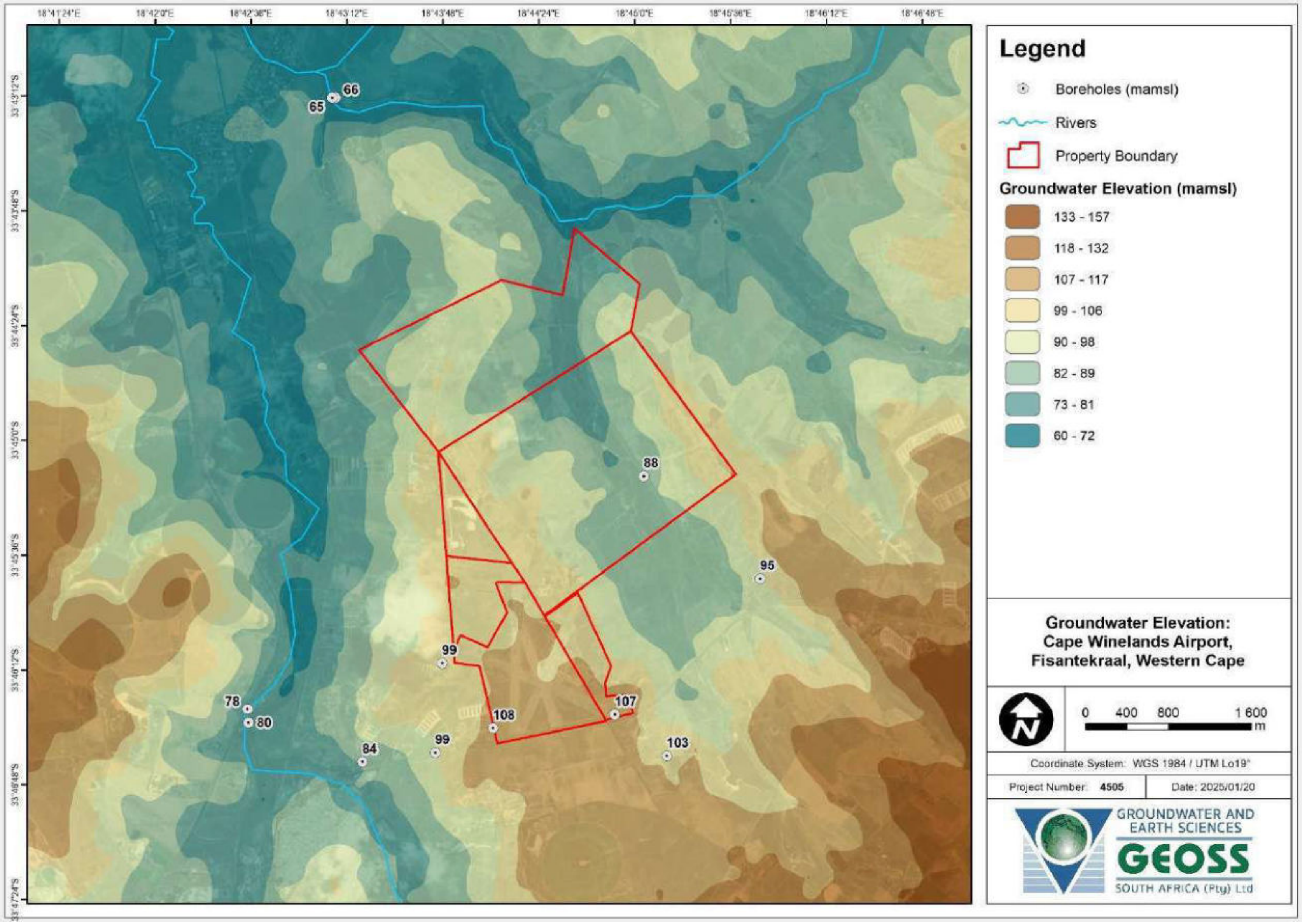


Figure 11: Correlation between surface topography and groundwater elevation for the boreholes proximal to the study site (GEOSS 2024)



Map 8: Interpolated groundwater elevation map for the study area (Bayesian interpolation) (taken from GEOSS, 2024)

8.4 Yield Testing

8.4.1 Methodology

The yield testing for CWA_BH001 was undertaken by ATS under the supervision of GEOSS from 5 to 8 April 2022. The yield testing for CWA_BH002 was undertaken by ATS under the supervision of GEOSS from 22 to 27 November 2022. Lastly, yield testing for CWA_BH003 was undertaken by ATS under the management and supervision of GEOSS SA from 25 November to 4 December 2024 and all three tests were carried out according to the National Standard (SANS 10299-4:2003. Part 4 – Test pumping of water boreholes).

This included a Step Test, Constant Discharge Test and recovery monitoring for the Step Test. The boreholes are pumped at a constant rate for one-hour intervals and the flow rates are incrementally increased for each step. This test is followed by a Constant Discharge Test (CDT) where the borehole is pumped at a constant rate for an extended period of time, followed by recovery monitoring. The water level drawdown is monitored at pre-determined intervals during these tests (drawdown refers to the difference in water level from the rest water level (RWL) measured before commencement of the yield test). All raw data and measurements taken during the actual yield test are presented in **Appendix D.**

The yield test data was analysed using the excel-based FC program, developed by the IGS (Institute for Groundwater Studies) in Bloemfontein. The sustainable yield of the borehole was calculated based upon long-term extrapolations of the CDT data according to (1) the Cooper-Jacob approximation of the Theis solution for confined aquifers, (2) the Barker Generalised Radial Flow Model (GRF) for hydraulic tests in fractured rock and (3) the Flow Characteristic (FC) method(s) using first and second derivative calculations. Boundary conditions are accounted for in multiplication factors to the rate of drawdown (derivatives), according to each of the above three methods. These three methods are briefly described below.

1. The Cooper-Jacob approximation of the Theis solution for confined aquifers was designed for porous media aquifers, where infinite acting radial flow (IARF) was observed during the pumping of a borehole. The application of this method to fractured aquifers was discussed by Meier et al (1998), concluding that T estimates using the Cooper-Jacob analysis gave an effective T for the fracture zone. The Cooper-Jacob analysis (and more accurately the Theis method) is therefore viable for analysing pumping test data for fractured aquifers where IARF is observed. The parameters are then used to predict theoretical long-term drawdowns.
2. The Barker GRF Model (Barker. 1988) uses fracture hydraulic conductivity, fracture storativity and flow domain to predict drawdown due to abstraction in a borehole in a fractured medium. By changing these values, a curve of drawdown predictions can be made to fit real world data and therefore predict theoretical long-term drawdowns.
3. The FC methods are the Basic FC, the FC Inflection Point, and the FC Non-Linear. The Basic FC and the FC Inflection Point methods make use of the derivatives of the drawdown data to predict theoretical long-term drawdowns and the scale back factors are applied to selected available drawdowns. The FC Non-Linear method uses curve fitting of the Step Test data to predict theoretical long-term drawdowns. Due to the short nature of the Step Test. this method is usually not included if the other methods of analysis differ from it.

In all three methods, the available drawdown was carefully selected to ensure that the flow regime described by the analytical solution is not extrapolated beyond its applicable depth, which may easily result in an overuse of the resource. For CWA_BH001, this was 43 m. For CWA_BH002 this was CWA_BH003 m, based on the fracture depth at 69 mbgl intersected during drilling, calculated as the geomean of the maximum drawdown reached during the CDT and the drawdown to the pump depth. For CWA_BH003 this was 74 m (101 mbgl), based on the first fracture intersected in the borehole and the rest water level prior to the start of the second A two-year extrapolation time without recharge to the aquifer was selected as per the recommendations within the FC method program.

Water samples were collected at the end of the yield test and submitted for inorganic chemical analysis.

8.4.2 Yield testing at CWA_BH001

The yield testing was conducted between the 5th and the 8th of April 2022. The borehole was measured at a depth of 100 meters before the start of the test. The test pump was installed at a depth of 89.8 meters below ground level (mbgl). The RWL at the start of the test was 40.32 mbgl.

During the Step Test, the water level was drawn down 36.41 meters below the rest water level (76.73 mbgl) at the end of the 4th step rate of 4 L/s. **Figure 12** shows the time-series drawdown for the Step Test.

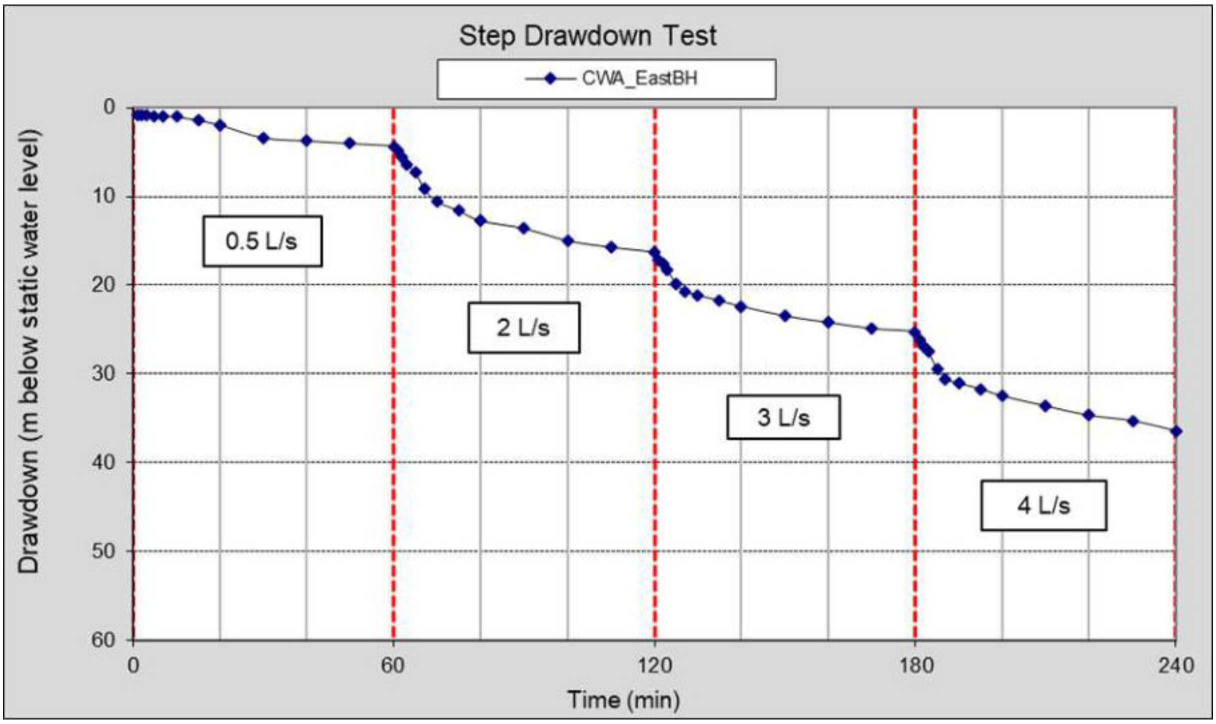


Figure 12: Step Test drawdown data for CWA_BH001.

The water level recovered to 42.22 mbgl after the step test, before the CDT was started. Based on the results of the Step Test, the CDT was conducted at a rate of 3.3 L/s. At the end of the 24-hour period, the water level had drawn down 42.97 meters below the rest water level (85.19 mbgl). The semi-log plot of the drawdown is presented in **Figure 13**

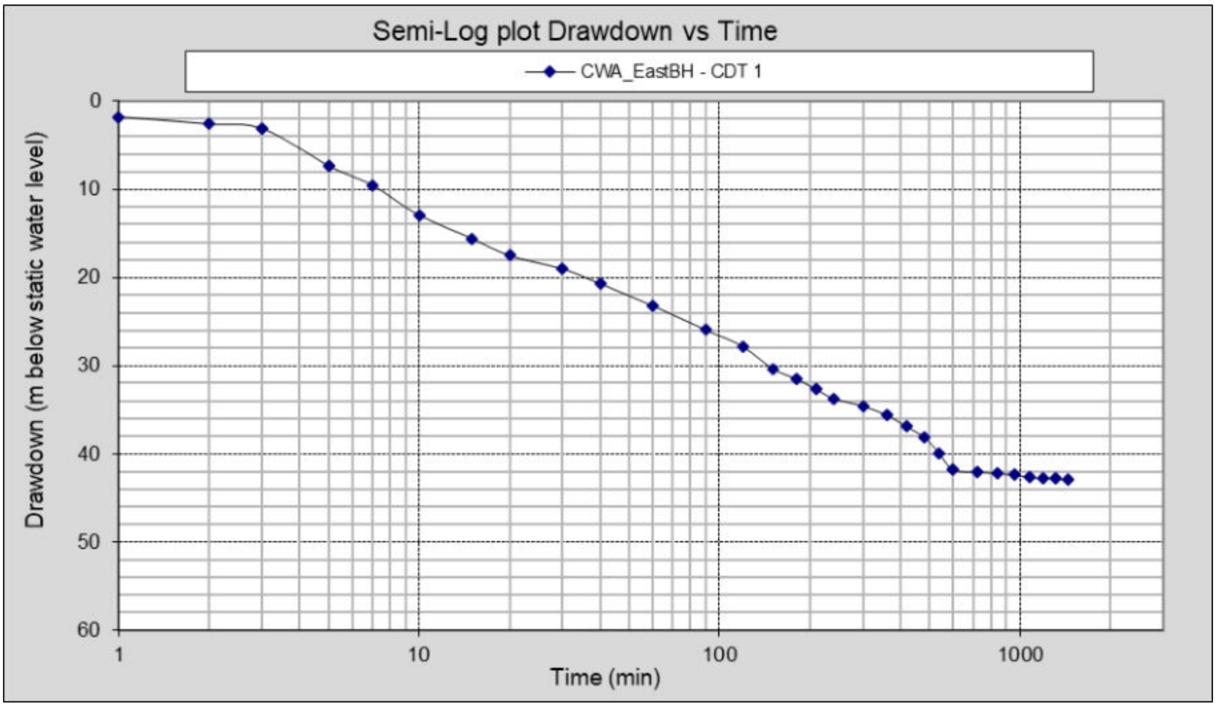


Figure 13: Semi-Log Plot of drawdown during the CDT of CWA_BH001 (3.3 L/s).

The recovery of the water level was monitored after the CDT and is presented in **Figure 14.** The recovery of the water level is moderate, attaining 97.8 % recovery after 24 hours.

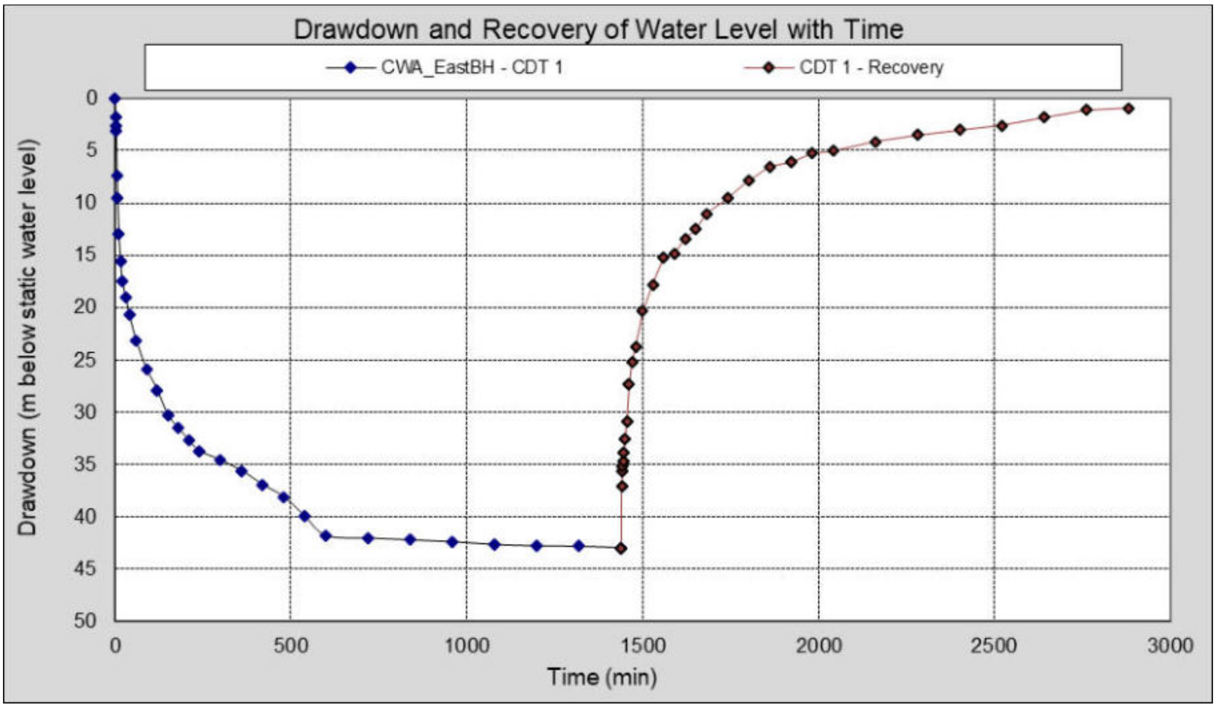


Figure 14: Time-series drawdown and recovery for CWA_BH001 (3.3 L/s).

Several methods were used to assess the yield test data as presented in **Table 11** It is recommended that the borehole can be abstracted from at a rate of up to 1.0 L/s for up to 24 hours per day. The assessments were based on an available drawdown of 43 meters.

Table 11: Yield Determination – CWA_BH001

CWA_BH001			
Method	**Sustainable Yield (L/s)**	**Late *T (m^2/d)**	***AD used (m)**
Basic FC	1.0	2.9	43
Cooper-Jacob	1.0	3.7	43
FC Non-Linear	0.9	4	43
Barker	0.9		43
Average Q_sust (L/s)	**1.0**		
Recommended Abstraction			
Abstraction Rate (L/s)	**Abstraction Duration (hours)**		**Recovery Duration (hours)**
1	24		0

**AD- Available Drawdown*
** T – Transmissivity*

8.4.3 Yield testing at CWA_BH002

CWA_BH002 was drilled and logged on the 22nd of November 2022. The drilling log can be viewed in **Appendix B**. Camera logging was also done and this can be viewed in **Appendix C.** The yield testing was conducted between the 22nd and 27th November 2022. The borehole was measured to a depth of 100.4 meters below ground level (mbgl). The test pump was installed at a depth of 82.3 mbgl. The rest water level (RWL) at the start of the test was 16.13 mbgl.

During the step test, the water level was drawn down 65.53 meters below the rest water level (pump inlet) during the 4th step at a rate of 23.3 L/s (83 880 L/hour).**Figure 15** shows the time-series drawdown for the Step Test.

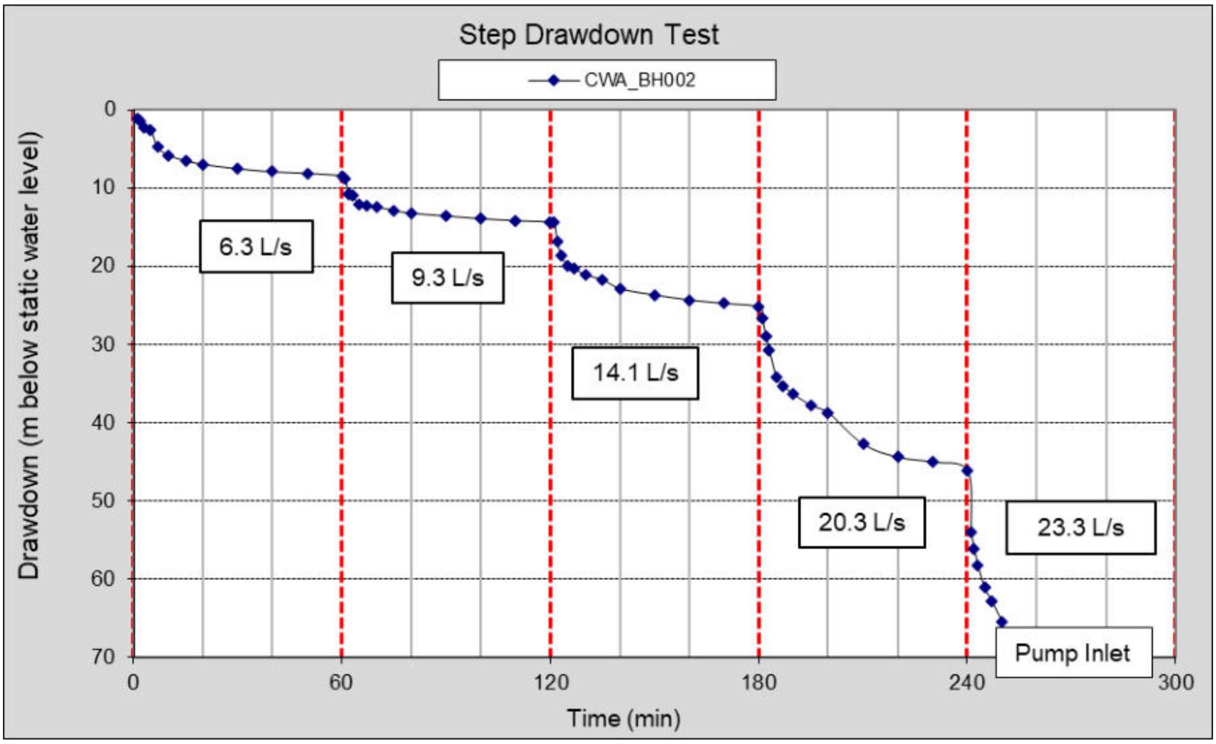


Figure 15: Step Test drawdown data for CWA_BH002.

The water level was left to recover overnight to a depth of 19.98 mbgl before starting the CDT. Based on the results of the Step Test. the 48-hour CDT was conducted at a rate of 17 L/s (61 200 L/hour). At the end of the 48-hour period. the water level had drawn down 58.55 meters below the rest water level (78.53 mbgl). The increased rate of drawdown observed after 1200 minutes of testing is indicative of boundary conditions (**Figure 16**)This was incorporated in the sustainable yield analysis of the borehole and is the cause for the low sustainable yield from the borehole.

The semi-log plot of the drawdown from the CDT is presented **in Figure 16** The available drawdown (AD) is indicated with the horizontal red line at 43 m, which was selected based on the fracture depth of 69 mbgl.

During the testing of CWA_BH002, CWA_BH001, and HBH6 (a borehole located on a neighbouring property) were monitored. No influence was observed at CWA_BH001 and HBH6 and confirms the low transmissivity of the borehole **Table 12*: Yield Determination - CWA_BH002*.** Although no influence was observed during the testing period. The influence will be observed during longer periods of production. Thus, all three of the boreholes must be monitored during production.

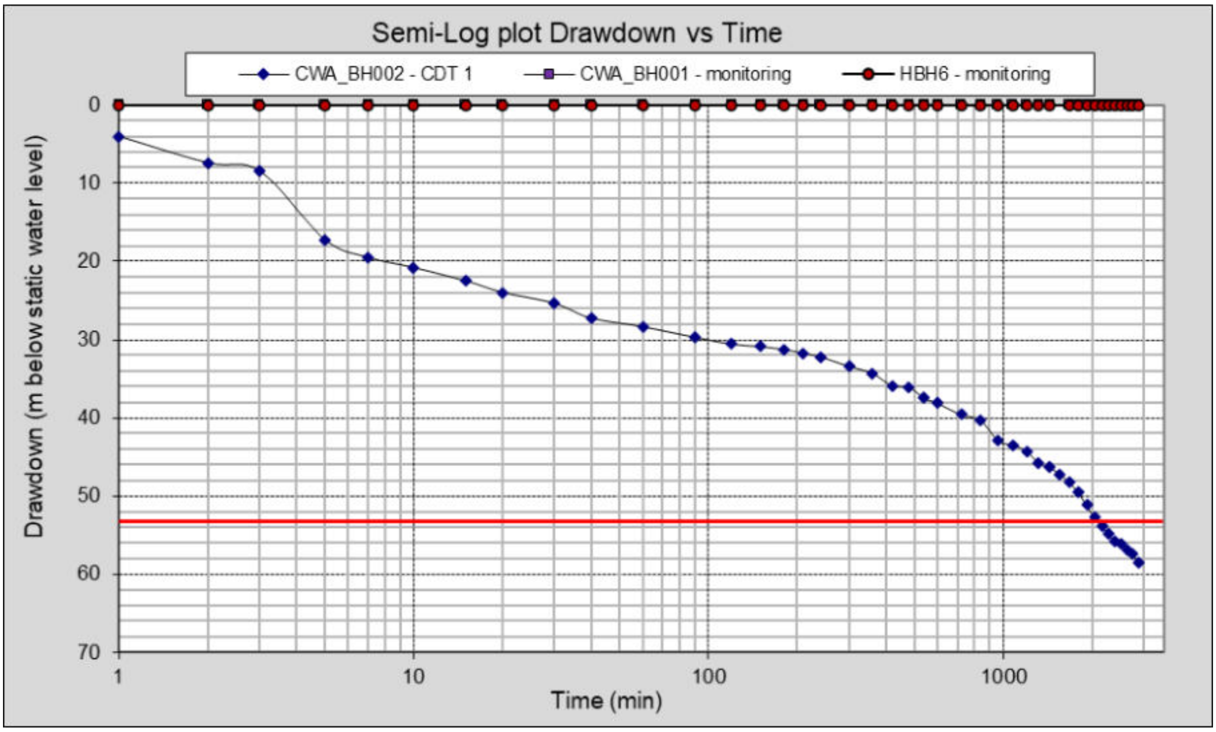


Figure 16: Semi-Log Plot of drawdown during the CDT of CWA_BH002 (17 L/s).

The recovery of the water level was monitored after the 48-hour CDT and is presented in **Figure 17.** The recovery was slow, only reaching 85 % in 48 hours. This is of concern and can lead to dewatering if the borehole is not managed correctly.

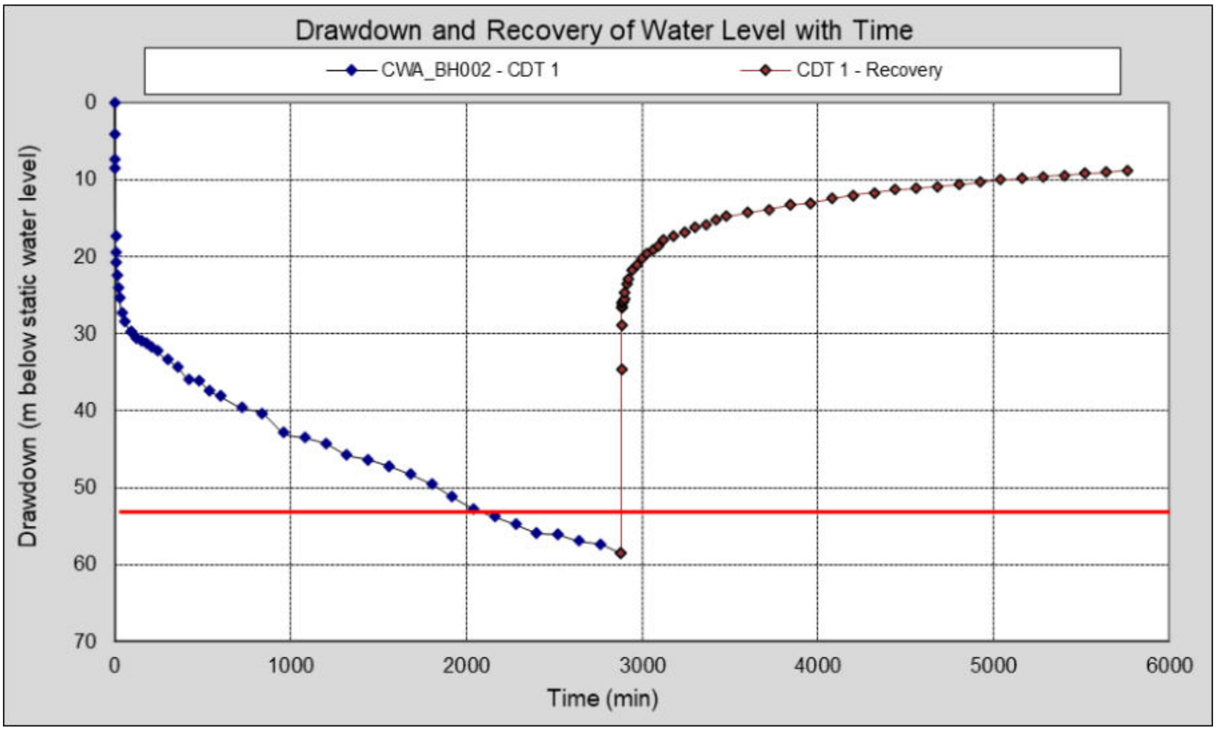


Figure 17: Time-series drawdown and recovery for CWA_BH002 (17 L/s).

Several methods were used to assess the yield test data as presented in **Table 12.** It is recommended that the borehole can be abstracted from at a rate of up to 2.5 L/s (9 000 L/hour) for up to 24 hours per day. The assessments were based on an available drawdown (AD) of CWA_BH003 meters (69 mbgl).

Table 12: Yield Determination - CWA_BH002

CWA_BH002			
Method	**Sustainable Yield (L/s)**	**Late *T (m²/d)**	***AD used (m)**
Basic FC	2.3	5.3	53
Cooper-Jacob	2.7	6.1	53
FC Non-Linear	3.4	16	53
Barker	1.4		53
Average Q_sust (L/s)	**2.5**		
Recommended Abstraction			
Abstraction Rate (L/s)	**Abstraction Duration (hours)**		**Recovery Duration (hours)**
2.5	24		0

**AD- Available Drawdown*

** T – Transmissivity*

8.4.4 Yield Testing at CWA_BH003

The yield testing was conducted between the 25th of November and the 4th December 2024. The borehole was measured to a depth of 149.9 meters below ground level (mbgl). The test pump was installed at a depth of 106.44 mbgl. The rest water level (RWL) at the start of the test was 18.89 mbgl.

During the step test, the water level was drawn down 72.7 meters below the rest water level

(91.59 mbgl) during the 4th step at a rate of 9.24 L/s (33 264 L/hour, pump max). **Figure 18** shows the time-series drawdown for the Step Test.

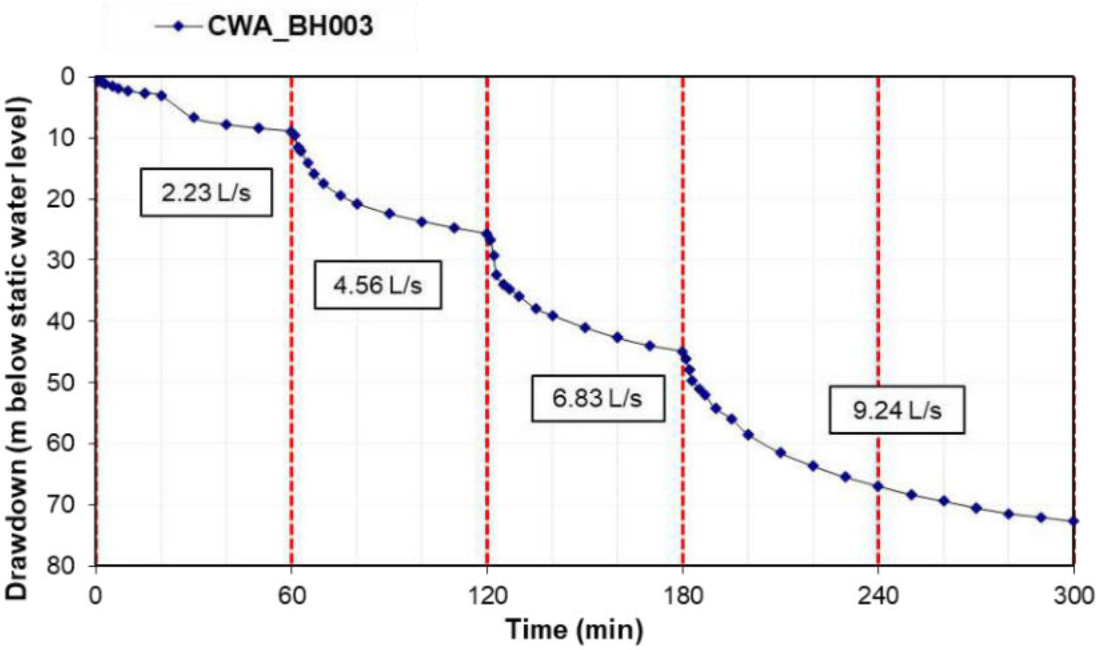


Figure 18: Step Test drawdown data for CWA_BH003.

The water level was left to recover overnight. Before starting the CDT, the water level recovered to 22.99 mbgl. Based on the results of the Step Test, the planned 48-hour CDT was conducted at a rate of 6.45 L/s (23 220 L/hour). After 38 hours the test rig experienced a breakdown. The borehole was left to recover for 38 hours (pump time) before restarting the CDT. Before restarting the CDT, the water level recovered to 26.8 mbgl. The CDT was restarted at a rate of 6.13 L/s (22 068 L/hour). At the end of the 48-hour period, the water level had drawn down 70.19 meters below the rest water level (96.99 mbgl). The semi-log plot of the drawdown from the CDT is presented in **Figure 19.** The available drawdown (AD) is indicated with the horizontal red line at 78 m below the rest water level of the first CDT (101 mbgl).

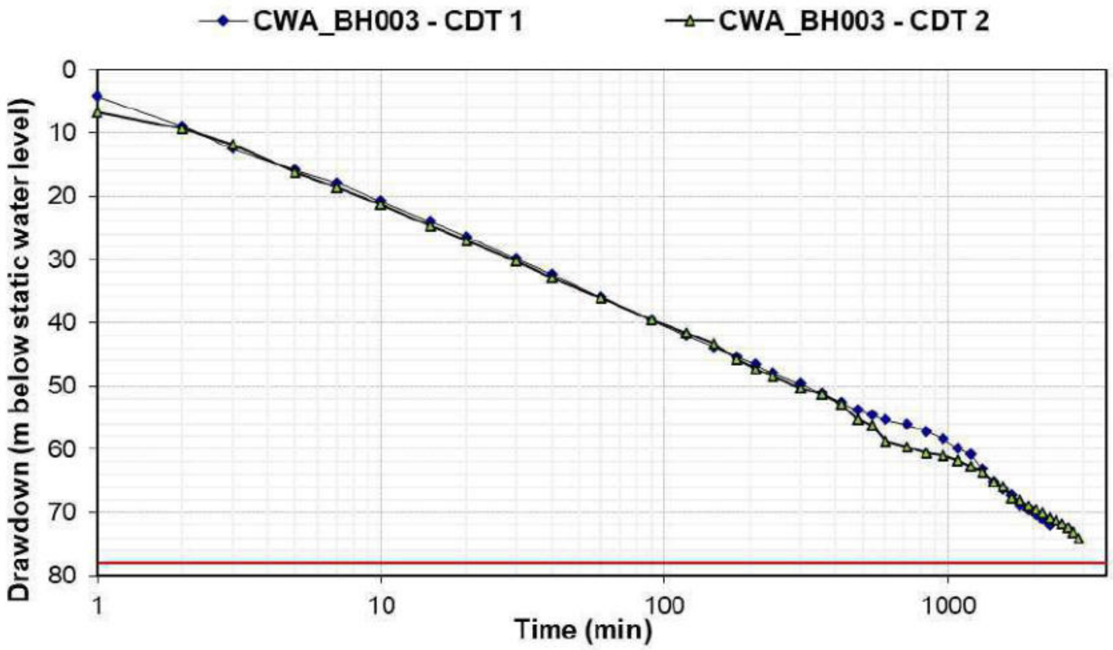


Figure 19: Semi-Log Plot of drawdown during the CDT of CWA_BH003 (CDT1: 6.45 L/s, CDT2: 6.13 L/s).

The recovery of the water level was monitored after the CDT and is presented in **Figure 20.** The recovery was good, reaching 95.6% of the drawdown during the second CDT, in 29 hours. Monitoring will be essential to determine the long-term recovery of the borehole.

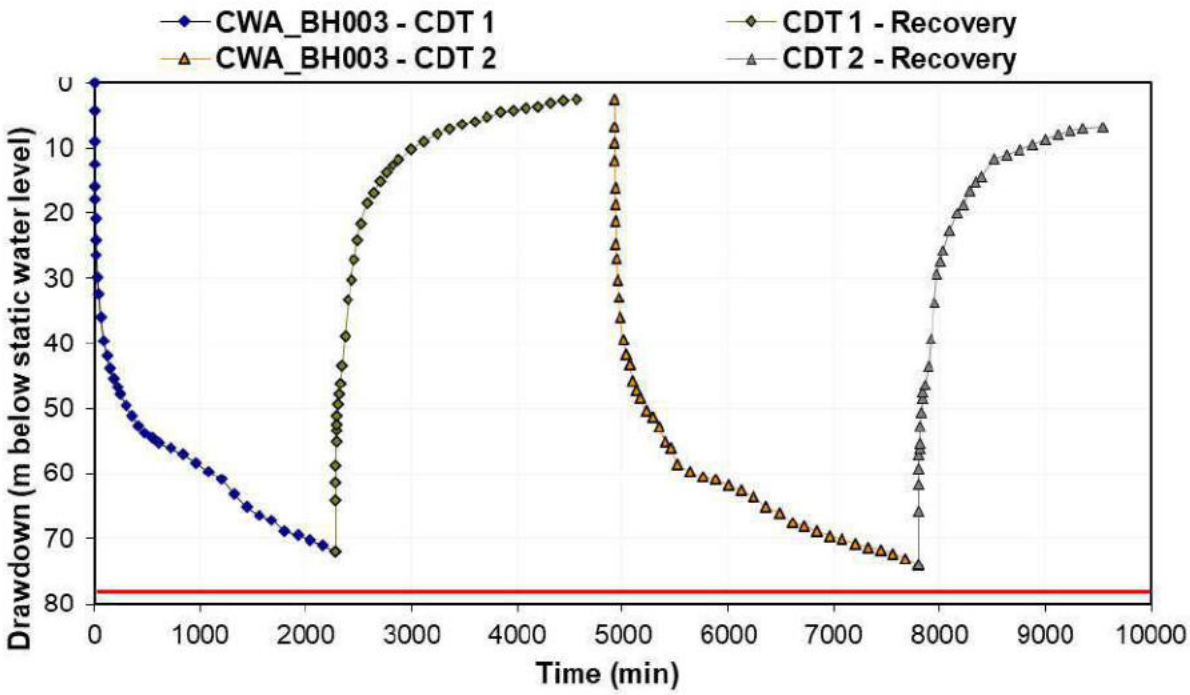


Figure 20: Time-series drawdown and recovery for CWA_BH003 (CDT1: 6.45 L/s, CDT2: 6.13 L/s).

Several methods were used to assess the yield test data as presented in **Table 13** It is recommended that the borehole can be abstracted from at a rate of up to 1.69 L/s (6 084 L/hour) for up to 24 hours per day. The assessments were based on an available drawdown (AD) of 74 meters below the RWL of the second CDT, which equates to 101 mbgl.

Table 13: Yield Determination – CWA_BH003.

CWA_BH003			
Method	**Sustainable Yield (L/s)**	**Late *T (m^2/d)**	***AD used (m)**
Basic FC	1.82	3.8	74.0
Cooper-Jacob	1.85	4.3	74.0
FC Non-Linear	1.39	5	74.0
Barker	1.69		74.0
Average Q_sust (L/s)	**1.69**		

Recommended Abstraction		
Abstraction Rate (L/s)	**Abstraction Duration (hours)**	**Recovery Duration (hours)**
1.69	24	0

**AD- Available Drawdown

* **T** – Transmissivity

8.4.4.1 Radius of influence

Due to lack of access and monitoring infrastructure, no boreholes within a reasonable distance from CWA_BH003 were monitored during the testing of CWA_BH003. Transmissivity was calculated through the Theis method using the drawdown response in CWA_BH003. The transmissivity of the system was calculated at 4.3 m^2/d. A storativity value of $5x10^{-4}$ was used for the radius of influence calculation based on an average expected value of confined aquifers as report by (Todd, 1980). Based on the aquifer parameters the radius of influence was calculated for the recommended sustainable yield of the borehole. Observed drawdowns of up to 13.5 m, 9.5 m, and 6 m are expected at approximately 310 m (HBH6), 640 m (HBH4), and 1200 m (HBH8) from CWA_BH003, respectively, at the recommended sustainable abstraction rate (1.69 L/s, 24 hours/day) after two years without recharge (**Figure 21**).

It must be stressed that the Cooper-Jacob modelling of radius of influence is based on a homogenous, confined aquifer and therefore does not account for the heterogeneity associated with secondary aquifers (fractured rock). Thus, the radius of influence model will only provide an indication of how abstraction at CWA_BH003 will impact the water level in the fracture network. This suggests that the cone of depression will not expand equivalently in all directions surrounding the borehole, but will rather propagate along the fracture network within the secondary aquifer. It will be essential for all neighbouring boreholes to be monitored by the respective owners to ensure sustainable use and to determine the cumulative impact of regional abstraction on the groundwater resource.

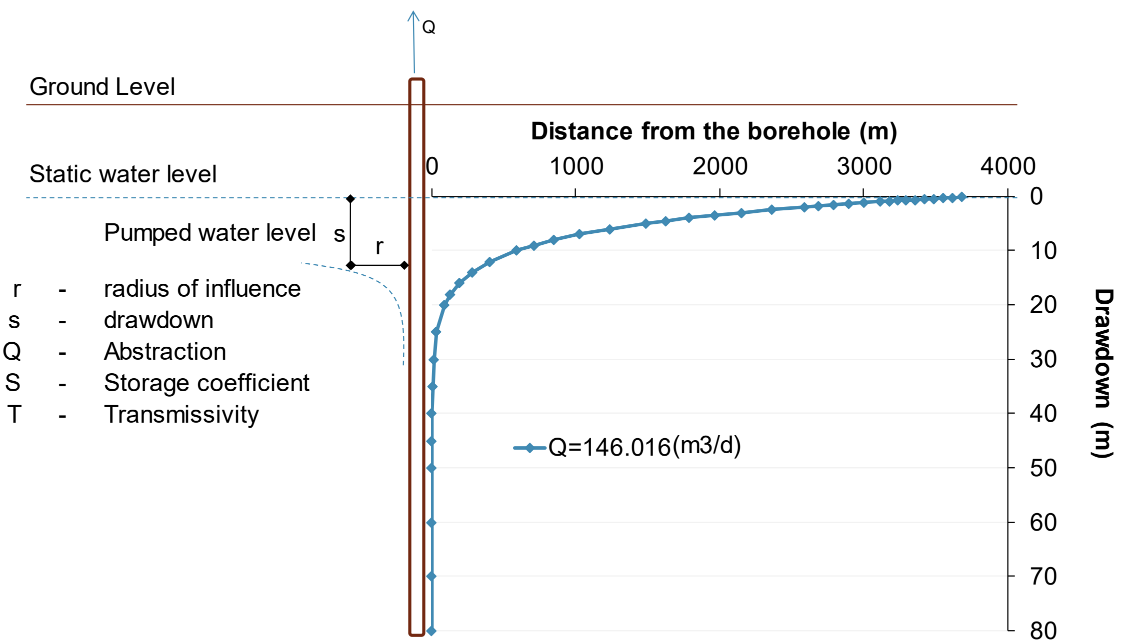


Figure 21: Radius of influence for CWA_BH003 at the recommended sustainable yield (1.69 L/s).

8.4.5 Summary of the yield of the borehole

The yield test data indicates that the boreholes may sustainably abstract 163 671 m^3/a from the aquifer system. The volume of water requested in the WULA is equal to the sustainable yield and, therefore, is considered sustainable. The borehole abstraction rate and basic management guidelines are listed in **Table 14**. This is below the safe yield of the borehole, and aquifer over-abstraction is unlikely to occur if these rates are adhered to. It should be noted that this is a conservative yield (for use throughout the year). However, to ensure that the yield is sustainable, the water level and abstraction should be monitored over time. This data should be reviewed on a regular basis (suggested monthly) to ensure that the yield is sustainable.

Table 14: Borehole Abstraction Recommendations

Borehole Details				
Borehole Name	**Latitude (DD)**	**Longitude (DD)**	**Borehole Depth (m)**	**Inner Diameter (mm)**
CWA_BH001	-33.84071	18.53738	100	158
CWA_BH002	-33.76876	18.732067	100.4	203
CWA_BH003	-33.774037	18.747742	149.9	170
Abstraction Recommendations				
Borehole Name	**Abstraction rate (L/s)**	**Abstraction Duration (hrs)**	**Recovery Duration (hrs)**	**Possible Volume Abstracted (L/d)**
CWA_BH001	1.0	24	0	86 400
CWA_BH002	2.5	24	0	216 000
CWA_BH003	1.69	24	0	146.016
Pump Installation Details				
Borehole Name	**Pump Installation Depth (mbgl)**	**Critical Water Level (mbgl)**	**Dynamic Water Level (mbgl)***	**Rest Water Level (mbgl)**
CWA_BH001	93	85	72	42.22
CWA_BH002	65	61	40	16.13
CWA_BH003	107	101	61	18.89

* Typical water level expected during long-term production

8.5 Water Quality Analysis

The boreholes were sampled after the yield test and submitted for inorganic and microbiological chemical analysis to a SANAS-accredited laboratory (Vinlab) in the Western Cape. The certificate of analysis for the sample is presented in **Appendix E**. The chemistry results were compared to three different standards set out below.

The chemistry results obtained have been classified according to the SANS241-1: 2015 standards for domestic water (*Table 15*). **Table 17** presents the water chemistry analysis results. colour coded according to the SANS241-1: 2015 drinking water assessment standards.

Table 15: Classification table for the specific limits.

Acute Health	Aesthetic	Chronic Health	Operational	Acceptable

The chemistry results have also been classified according to the DWAF (1998b) standards for domestic water. Table 16 enables an evaluation of the water quality with regards to the various parameters measured (DWAF, 1998b). **Table 18** presents the water chemistry analysis results colour-coded according to the DWAF domestic water assessment standards.

Table 16: Classification table for the groundwater results (DWAF, 1998b).

Class	Water quality	Description
Class 0	Ideal	Suitable for lifetime use.
Class I	Good	Suitable for use, rare instances of negative effects.
Class II	Marginal	Conditionally acceptable. Negative effects may occur.
Class III	Poor	Unsuitable for use without treatment. Chronic effects may occur.
Class IV	Dangerous	Totally unsuitable for use. Acute effects may occur.

Table 17: Groundwater quality analysis classified results according to SANS 241-1:2015.

Analyses	CWA_ BH001	CWA_ BH002	CWA_ BH003	SANS 241-1:2015
Date sampled	Apr 2022	Nov 2022	December 2024	
pH (at 25 °C)	7.3	6.8	7.2	≥5 - ≤9.7 Operational
Conductivity (mS/m) (at 25 °C)	89.0	155.9	80.6	≤170 Aesthetic
Total Dissolved Solids (mg/L)	603.42	1057.00	546.47	≤1200 Aesthetic
Turbidity (NTU)	18.70	121.00	64.10	≤5 Aesthetic ≤1 Operational
Colour (mg/L as Pt)	<15	<15	<15	≤15 Aesthetic
Sodium (mg/L as Na)	130	184	149	≤200 Aesthetic
Potassium (mg/L as K)	4	4	3	N/A
Magnesium (mg/L as Mg)	16	48	19	N/A
Calcium (mg/L as Ca)	17	39	20	N/A
Chloride (mg/L as Cl)	207.57	430.19	294.37	≤300 Aesthetic
Sulphate (mg/L as SO_4)	13.89	38.04	17.39	≤250 Aesthetic ≤500 Acute Health
Combined Nitrate & Nitrite (ratio)	<1.05	<1.05	0.068	≤1 Acute Health
Nitrate Nitrogen (mg/L as N)	<1.00	<1.00	<1.00	≤11 Acute Health
Nitrite Nitrogen (mg/L as N)	<0.05	<0.05	<0.05	≤0.9 Acute Health
Ammonia Nitrogen (mg/L as N)	<0.15	<0.15	<0.15	≤1.5 Aesthetic
Total Alkalinity (mg/L as $CaCO_3$)	102.1	83.6	72.0	N/A
Total Hardness (mg/L as $CaCO_3$)	108.1	294.3	127.9	N/A
Fluoride (mg/L as F)	0.17	<0.15	<0.15	≤1.5 Chronic Health
Aluminium (mg/L as Al)	<0.008	0.016	<0.008	≤0.3 Operational
Total Chromium (mg/L as Cr)	<0.004	<0.004	<0.004	≤0.05 Chronic Health
Manganese (mg/L as Mn)	0.329	1.272	0.466	≤0.1 Aesthetic ≤0.4 Chronic Health
Iron (mg/L as Fe)	1.881	7.344	3.944	≤0.3 Aesthetic ≤2 Chronic Health
Nickel (mg/L as Ni)	<0.008	<0.008	<0.008	≤0.07 Chronic Health
Copper (mg/L as Cu)	0.010	0.010	<0.002	≤2 Chronic Health
Zinc (mg/L as Zn)	<0.008	<0.008	<0.008	≤5 Aesthetic
Arsenic (mg/L as As)	<0.010	<0.010	<0.010	≤0.01 Chronic Health
Selenium (mg/L as Se)	<0.008	<0.008	<0.008	≤0.04 Chronic Health
Cadmium (mg/L as Cd)	0.002	<0.001	0.001	≤0.003 Chronic Health
Antimony (mg/L as Sb)	<0.013	<0.013	<0.013	≤0.02 Chronic Health
Mercury (mg/L as Hg)	<0.001	<0.001	<0.001	≤0.006 Chronic Health
Lead (mg/L as Pb)	<0.008	<0.008	<0.008	≤0.01 Chronic Health
Uranium (mg/L as U)	<0.028	<0.028	<0.028	≤0.03 Chronic Health
Cyanide (mg/L as CN^-)	<0.01	<0.01	0.010	≤0.2 Acute Health
Total Organic Carbon (mg/L as C)	2.46	2.15	2.19	N/A
E.coli (cfu/100 mL)	nd	nd	-	Not Det. Acute Health-1
Total Coliform Bacteria (cfu/100 mL)	nd	nd	-	Not Det.≤10 Operational
Heterotrophic Plate Count (cfu/mL)	69	nd	-	≤1000 Operational
Charge balance %	-1.1	-1.0	4.0	≥-5 - ≤5 Acceptable

Table 18: Classified groundwater sample results according to DWAF (1998b).

Analyses:	**CWA_ BH001**	**CWA_ BH002**	**CWA_ BH003**	**DWA (1998) Drinking Water Assessment Guide**				
				Class 0	**Class I**	**Class II**	**Class III**	**Class IV**
pH	7.3	6.8	7.2	5-9.5	4.5-5 & 9.5-10	4-4.5 & 10-10.5	3-4 & 10.5-11	< 3 & >11
Conductivity (mS/m)	89.0	155.9	80.6	<70	70-150	150-370	370-520	>520
Turbidity (NTU)	18.70	121.00	64.10	<0.1	0.1-1	1.0-20	20-50	>50
Total Dissolved Solids	603.42	1057.00	546.47	<450	450-1 000	1 000-2 400	2 400-3 400	>3 400
Sodium (as Na)	130	184	149	<100	100-200	200-400	400-1 000	>1 000
Potassium (as K)	4	4	3	<25	25-50	50-100	100-500	>500
Magnesium (as Mg)	16	48	19	<70	70-100	100-200	200-400	>400
Calcium (as Ca)	17	39	20	<80	80-150	150-300	>300	
Chloride (as Cl)	207.57	430.19	294.37	<100	100-200	200-600	600-1 200	>1 200
Sulphate (as SO_4)	13.89	38.04	17.39	<200	200-400	400-600	600-1 000	>1 000
Nitrate (as N)	<1.05	<1.05	<1.0	<6	6.0-10	10-20	20-40	>40
Fluoride (as F)	0.17	<0.15	<0.15	<0.7	0.7-1.0	1.0-1.5	1.5-3.5	>3.5
Manganese (as Mn)	0.329	1.272	0.466	<0.1	0.1-0.4	0.4-4	4-10	>10
Iron (as Fe)	1.881	7.344	3.944	<0.5	0.5-1.0	1.0-5.0	5-10	>10
Copper (as Cu)	0.010	0.010	<0.002	<1	1-1.3	1.3-2	2.0-15	>15
Zinc (as Zn)	<0.008	<0.008	<0.008	<20	>20			
Arsenic (as As)	<0.010	<0.010	<0.010	<0.010	0.01-0.05	0.05-0.2	0.2-2.0	>2.0
Cadmium (as Cd)	0.002	<0.001	0.001	<0.003	0.003-0.005	0.005-0.020	0.020-0.050	>0.050
Hardness (as $CaCO_3$)	108.10	294.300	127.9	<200	200-300	300-600	>600	
Faecal coliforms	nd	nd	-	0	0-1	1.0-10	10-100	>100
Total coliforms	nd	nd	-	0	0-10	10-100	100-1 000	>1 000
Charge Balance %	-1.1	-1.0	4	≥-5 - ≤5 Acceptable				

8.5.1 Chemical Diagrams

From the chemical results presented in **Table 17 and Table 18,** groundwater from CWA_BH002 and CWABH003 is of poor quality. The primary parameters of concern are elevated iron and manganese. Both iron and manganese exceed the chronic health limit of the SANS 241-1:2015 drinking water guidelines. Iron biofouling and precipitation will occur in the borehole. The precipitation of iron will result in the clogging of the borehole as well as the abstraction infrastructure. To minimize the effect of the iron precipitation, the borehole will have to be managed correctly and a proper cleaning and maintenance plan needs to be implemented. The observed elevated turbidity is related to iron precipitate in the water and will need to be filtered from the water before use. The electrical conductivity is slightly elevated and the pH of the water is near neutral. The groundwater of CWA_BH002 and CWA_BH003 is of poorer quality compared to the quality of previously tested CWA_BH001.

Several chemical diagrams have been plotted for the groundwater sample and these are useful for the chemical characterisation of the water and illustrate the similarities and differences in the water types. The Stiff Diagram is a graphical representation of the equivalent concentrations of the cations (positive ions) and anions (negative ions). This diagram shows concentrations of cations and anions relative to each other and direct reference can be made to specific salts in the water. From **Figure 22,** CWA_BH002 and CWA_BH003 are classified as a Sodium & Potassium/Chloride hydrofacies. This is typical of groundwater associated with the Tygerberg Formation. The chemical signatures of CWA_BH002 and CWA_BH003 are similar to that of CWA_BH001. However, the ion concentrations at CWA_BH002 and CWA_BH003 is more elevated compared to CWA_BH001.

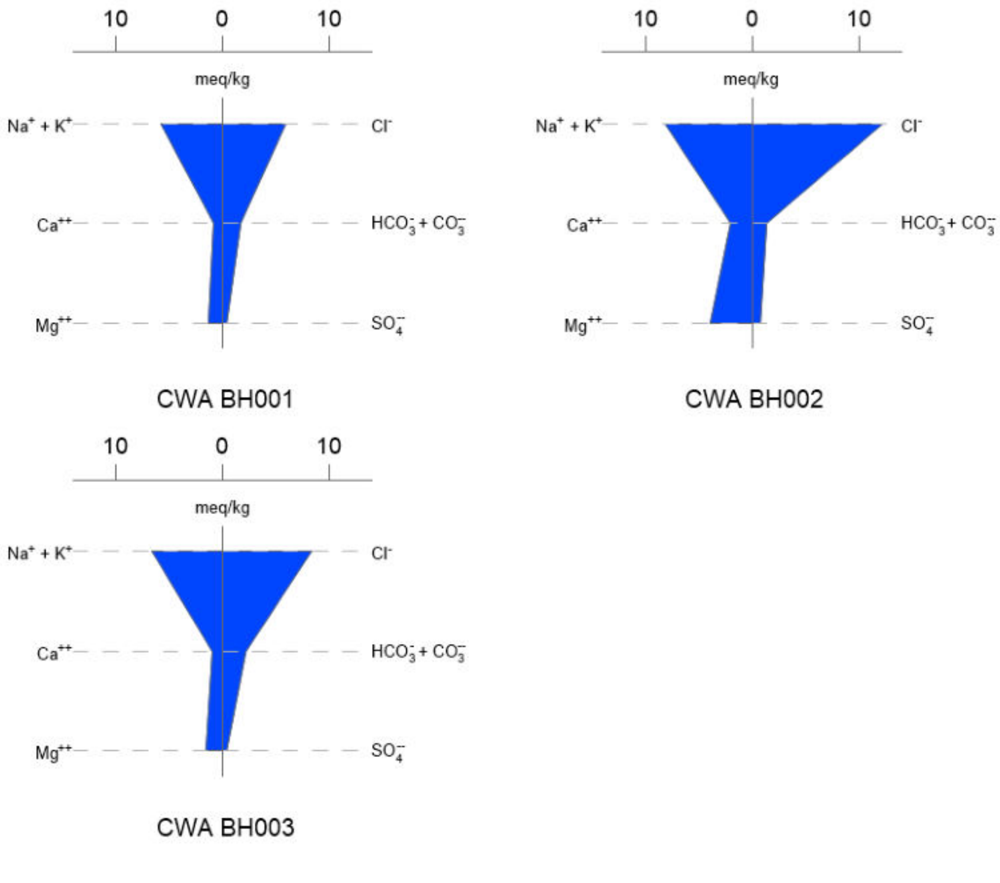


Figure 22: Stiff diagram of the groundwater sample.

The Sodium Adsorption Ratio (SAR) of the groundwater plots as S1/C3, thus classified as low risk in terms of sodium adsorption and high risk in terms of salinity hazard. This graph is typically applicable to irrigation, however, is dependent on soil texture and crop type as seen in **Figure 23**

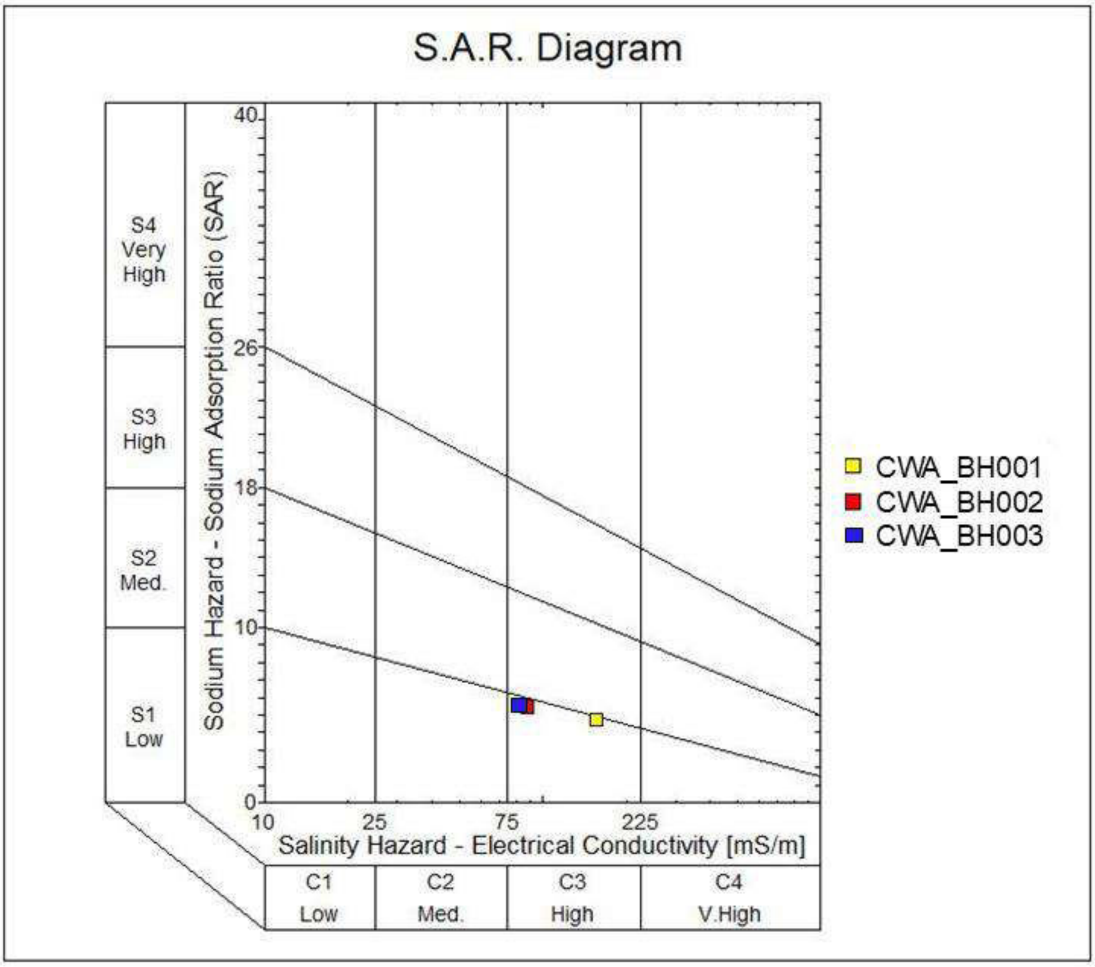


Figure 23: SAR diagram of the groundwater sample.

9 Aquifer Firm Yield Model

To evaluate the sustainable volume of groundwater that can be abstracted from the aquifer for the property, the Aquifer Firm Yield Model (AFYM) was utilised (WRC, 2012). The model uses a single-cell "Box Model" approach and makes use of a critical management water level, below which aquifer storage levels cannot be drawn down, to provide estimates of aquifer firm and assured yields.

The "Box Model" approach is schematically presented in **Figure 24**

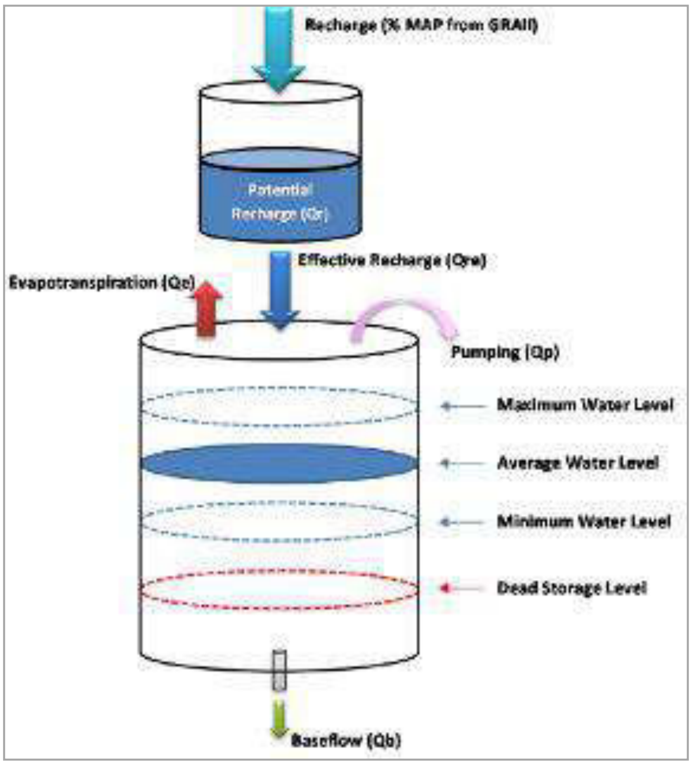


Figure 24: Aquifer Firm Yield lumped box model (Murray et al 2012).

An evaluation was completed using the Aquifer Firm Yield model (Murray et al 2012). The Input parameters used for the catchment are the default values presented in WRC (Murray et al 2012). These are taken from datasets like WR2005 (e.g. rainfall data) (Middleton and Bailey, 2008) and GRAII (e.g. specific yield and recharge (%MAP)) (DWAF, 2005). and others generated during the WRC (Murray et al 2012) (e.g. recharge threshold and riparian zone (% catchment area)). The parameters for quaternary catchment G21E. with an area of 530 km^2 are presented in Table 19.

Table 19: Hydrogeological Parameters for Quaternary catchment G21E (Murray et al 2011).

Parameter	G21E
Groundwater Level (mbgl)	9.8
Max Drawdown (m)	5
Specific Yield	0.000287
Firm Yield (L/s)	344.6
Firm Yield (L/s/km^2)	0.6492
Recharge %	6.2
Recharge Threshold (mm)	22
MAP (mm)	530.6
Hydrological MAR (mm)	68.4
Hydrological MAE (mm)	1485
Baseflow: Default (Mm^3/a)	4.46
ET Model	Linear
ET Extinction Depth (m)	4
Riparian Zone (%)	3.4

The Aquifer Firm Yield Model was run, and the Aquifer Firm Yield was determined to be 10 874 749 m^3/a (344.6 L/s) with a recharge of 17 435 516 m^3/a for the catchment G21E. The results of the Aquifer Firm Yield Model for Quaternary Catchment G21E are presented in Table 20.

Table 20: Results of the Aquifer Firm Yield Model for Quaternary Catchments G10M and G10L.

Name	Q (L/s)	Q (m³/month)	Q (m³/a)
G21E	344.6	893 203.2	10 874 749

For this study area, geological features enable the definition of a more localised aquifer (i.e., a groundwater resource unit (GRU)). The three boreholes are drilled into the fractured rock aquifer which the Tygerberg Formation constitutes. Two boreholes are drilled to a depth of 100 m while the last borehole is drilled to a depth of 149.9 m. The GRU was delineated using the quaternary catchment boundary to the north and west and includes exposed fractured Tygerberg Formation in these areas, the Colenso Fault system to the northeast of the study area, and the boundary delineation. The GRU has been delineated and is displayed in **Map 9** and **Figure 3** depicts a schematic cross-section of the geology and the groundwater flow.

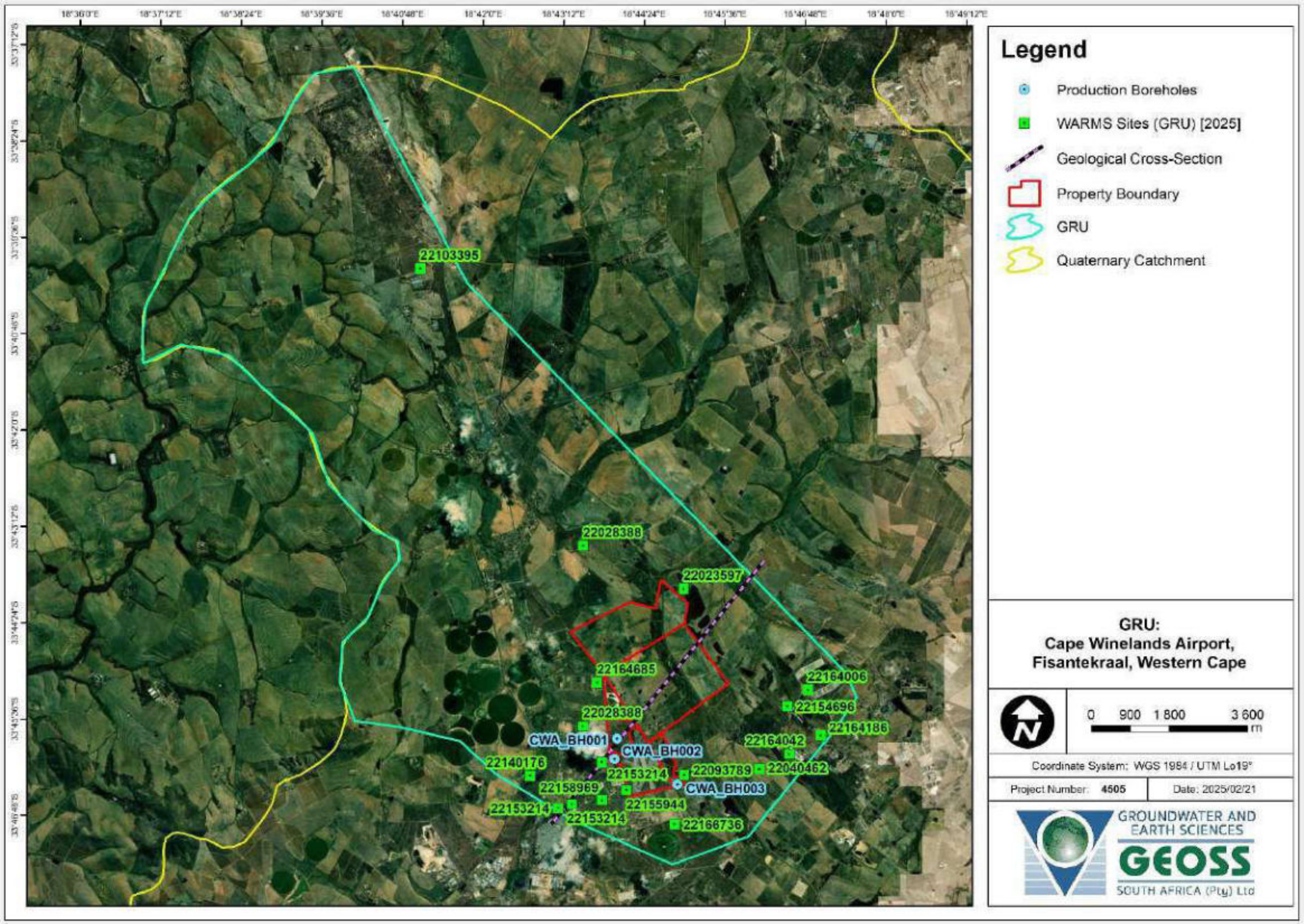
On assessment of the geological map, the GRU has an extent of approximately 125 km^2. Using the GRAII recharge values the combined direct vertical recharge (minimum recharge volume) is calculated to be 4 112 150 m^3/a for the GRU. The firm yield of the GRU is calculated to be 2 564 799.3 m^3/a which is estimated to be approximately 62.4 % of recharge.

It is important to note that a conservative approach was used to calculate the recharge and firm yield volumes and that the actual volumes are believed to be higher than the calculated volumes.

The current volume of groundwater abstracted within the GRU, is based on the registered WARMS boreholes (database last updated January 2025), which is 1 445 753 m^3/a (**Map 9**). Note that only registered and active sites were taken into account. Based on these volumes a volume of 1 119 046.3 m^3/a (2 564 799.3 m3/a – 1 445 753 m^3/a) is available within the GRU. The additional volume of 163 671.84 m^3/a (full requested volume) for which a license is being applied, is less than the volume of 1 140 412.3 m^3/a available within the firm yield of the GRU. Because the firm yield of the GRU is more than the predicted water demand of the property, the license application volume is considered to be within the sustainable supply volume of the aquifer.

GRU (125 km^2)

Total recharge = 4 112 150 m^3/a
Total firm yield = 2 564 799.3 m^3/a
Authorised existing abstraction (from WARMS 2025) = **1 445 753** m^3/a
Available ground water = 1 119 046.3 m^3/a
Requested additional groundwater use = 163 671.3 m^3/a
Is there sufficient groundwater for this application? YES



Map 9: GRU, property boundaries with the existing, recently drilled, hydrocensus. WARMS boreholes production borehole superimposed on the Google Earth image

10 Groundwater Risk Assessment

The reader is referred to the Groundwater Impact Assessment for the Proposed Cape Winelands Airport, Fisantekraal, Western Cape: GEOSS 2024. The impacts discussed here are taken directly from the report mentioned above.

Due to the minor differences for development alternatives 3 and 4, the difference in impact to groundwater resources will be negligible. Therefore, the impact assessment detailed in the section below applies to both development option 2 and 3. The proposed development will include several facilities all of which are centred around the aerodrome, a summary of the envisaged development includes the following main components relevant to the groundwater impact assessment:

- 3 500 m runway
- 700 m runway
- Taxiways
- Aprons
- Isolated (hard)stands
- Landside Infrastructure
- Bulk Fuel storage (e.g. Petroleum, Jet A1, LPG, AVGAS)
- Stormwater infrastructure
- Solar Photovoltaic facilities
- Biogas digesters for energy generation

For a more detailed overview of the development, the reader is referred to Section 4 of this report or to the project description given in CWA (2021, 2023, 2024, 2025) and subsequent revisions.

10.1 Sources

Sources of contamination can be divided into two phases, i.e. those occurring during construction of the development (Construction Phase), and those occurring during the operation of the facility (Operational Phase).

Origins, operations and locations for contamination at civil airport sites around the globe as per Nunes et al. (2011), along with other potential contaminant sources have been summarised in Table 21 Where the origin refers to the process of transporting the contaminant to the groundwater, the location indicates the physical place where the contaminants are generated/released; and the operation indicates the activity during which the contaminant is released into the environment. Nunes et al. (2011) compiled information from reports on airports where contamination had taken place. 19 contaminants were assessed and divided into several origins (**Figure 25**). The origins included accidental release (Ac), surface release (S), atmospheric deposition (A), leaks (L), and surface runoff (R). It is clear that surface runoff appears to be the most widespread origin (reported for 17 of the contaminants), followed by surface releases (reported for 15 of the contaminants), and leaks (reported for 14 of the contaminants) (**Figure 25**).

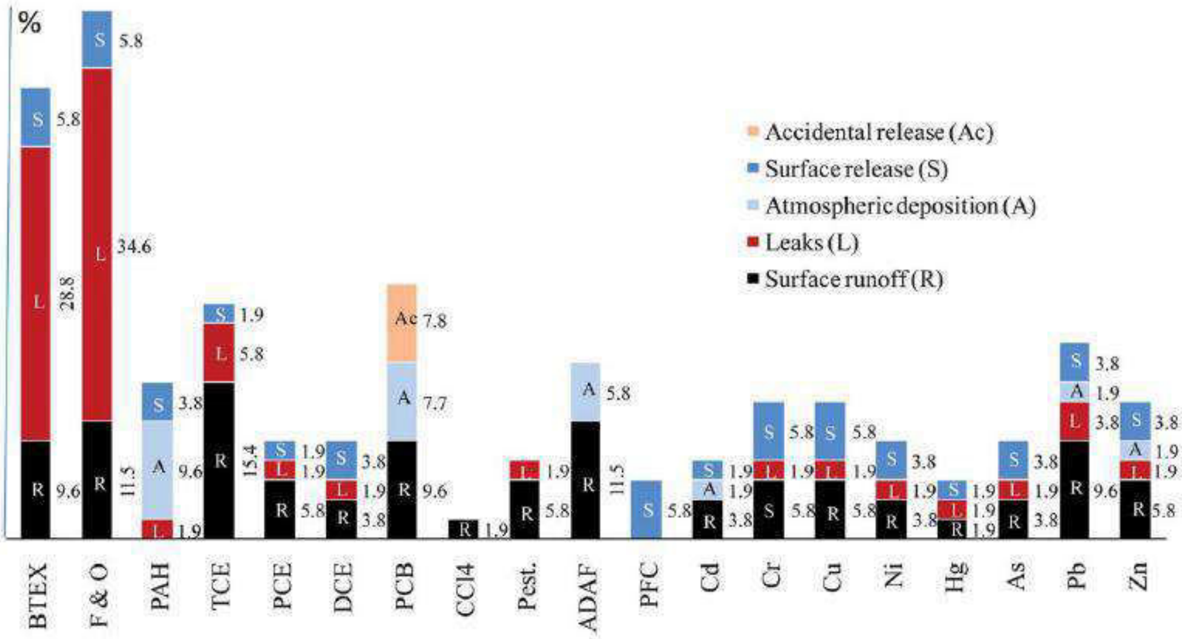


Figure 25: Reported frequency of contaminants for several origins (Nunes et al., 2011). F & O: fuels and Oils; ADAF: anti-icing and de-icing fluids; PFC: perfluorochemicals.

Table 21: Origins, locations, and operations of potential groundwater impact sources at Civil airports (adapted from Nunes, 2011).

Origin	Location	Operations
Surface runoff	Runways, taxiways, aprons, roadways, maintenance areas, vehicle parking areas, hangars, workshops, and other paved areas	Refuelling, handling, parking of vehicles, maintenance of aircraft, vehicles and other equipment, drained by rainwater, pavement cleaning
Leaks from fuel storage and distribution	Fuel Farm	Refuelling on fuel farms and storage of other chemical substances (pesticides, lubricants, solvents, etc.)
Leaks from fuel storage and distribution	AVGAS storage area	Refuelling (hydrant systems) and storage of other chemical substances (solvents, antioxidants, etc.)
Leaks from fuel storage and distribution	Retail services station (petrol station)	Refuelling and storage of other chemical substances (lubricants and solvents)
Leaks from bulk fuel storage	Construction laydown areas, fuel farms, refuelling stations, fuel storage areas	Storage and refuelling on and around construction laydown areas, storage of large amounts of fuel.
Atmospheric deposition	Unpaved areas	Aircraft operations (engine starting, run-ups, testing, ground manoeuvring, take-off, and landing), handling vehicles and equipment, heating systems, and winter operations
Direct release	Unpaved areas, fire-fighting training areas, and storage facilities	Weed control, fire-fighting training, storage/ deposition of substances in unpaved/pervious areas
Accidental contamination (other origins)	Electrical substations, green areas, hangars, workshops, cargo terminal, and storage facilities	Leaks during operation or servicing of electrical substations, spills of pesticides, spills of chemical substances used in cleaning and maintenance of aircraft, handling vehicles and other equipment, spills from cargo

In addition to the potential pollution sources noted above, pollution sources with waste water treatment need to be considered. These potential contamination sources include:

- storage of wastewater before treatment,
- storage of brine from treated potable water,
- storage of chemicals associated with WWTW, and
- irrigation of the landscape with treated wastewater.

The final potential pollution source that needs to be considered is the nearby biodigester. It was initially proposed that the biodigester would use chicken manure as a feedstock, however, concerns arose regarding "digestate' from biodigesters potentially leading to nutrient pollution of surface and groundwater bodies if not properly managed. Subsequently, the design of the biodigester has been altered whereby the feed stream will be comprised of treated effluent from the WWTW (200 m^3/day) and cultivated biomass/energy crop (15 t/day). Further, organic waste from the site may be used to supplement the feed. Treated biosolids from the WWTW may also be used to supplement the feed stream on the condition that they are not tested to be hazardous (CWA, 2025).

10.2 Pathways

Contamination from the sources could potentially infiltrate into the subsurface (soils and groundwater), due to preferential flow paths like the boreholes on site or the edges of buildings and/or conduits constructed for stormwater management and or reticulation of services that extend deeper into the ground. The migration of contaminated water northward/downgradient in the subsurface to groundwater users is unlikely; however, at this stage it is unknown the extent of excavation that will take place. Should substantial deep excavations be required, which for example intersect mostly unweathered, but fractured bedrock potential exists for infiltration of contaminants into the groundwater table.

10.3 Receptors

Receptors within the area include the underlying aquifer and groundwater users, as well as on site workers via through dermal contact with contaminated soils or water. For a risk to groundwater to exist, there must be a source(s), pathway(s) and receptor(s); these are presented in **Figure 26 All three are present in this case.**

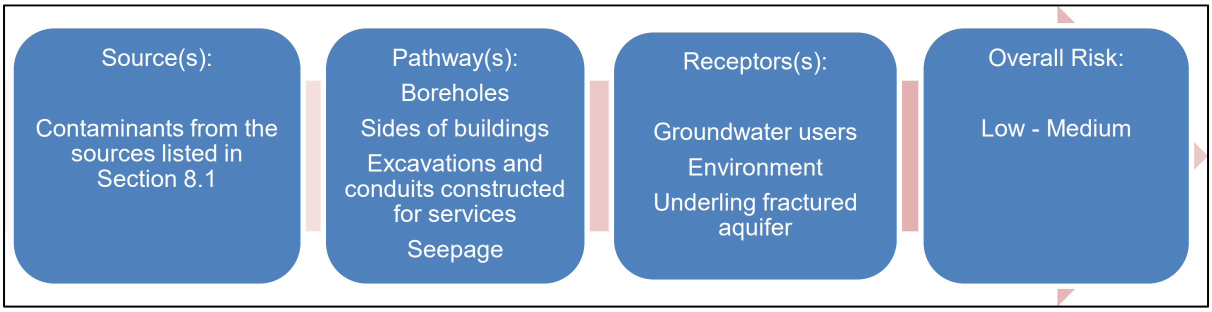


Figure 26: Source, Pathway and Receptor assessment.

10.4 Risk Impact Assessment

There are risks associated with the proposed development at the site. During the construction and operational phase of the proposed development, soil and groundwater contamination could result due to several potential contaminant sources detailed in Section 8.1 . Each source/origin of contamination and impacts associated with groundwater abstraction has been qualitatively assessed during the EIA process and impact tables inclusive of mitigation measures are presented. At present, the projected time for decommissioning of the facility is unknown and therefore, this has not been included in this study.

At present, the final designs of the structures on the site are not available. It is anticipated that some subsurface structures will be required, e.g., for basement parking lots. Since the groundwater in the region is typically well below 30 mbgl, it is anticipated that dewatering will not be required during construction. However, based on the information collected during the preliminary geotechnical assessment there are areas of local perched water tables across the site (GEOSS, 2022b). Such areas may require some dewatering activities during construction. It has been communicated that the proposed SDP for the current preferred development alternative may evolve as part of the EIA process, and may be updated along with other preferred alternatives (CWA, 2025). Any revisions to the site development plan (SDP) that are not dealt with appropriately in this document will need to be assessed once the most up-to-date SDP is available.

Each risk is qualitatively assessed based on the existing information. The risk rating has been carried out according to the criteria in **Appendix D.**

10.4.1 Development Alternative 1 (No-go Option)

Development alternative 1 (also referred to as the no-go option) would entail the preservation of the site as is and no further development. Current aviation activity at the airport consists of flight school operations and other unscheduled general aviation (GA) flights. These includes private owner-pilots and limited charter operations in light fixed-wing aircraft, as well as helicopters, gyrocopters and micro flights. Flight activity at the airport currently averages ±100 air traffic movements (ATM; take-offs and landings) per day, varying with weather conditions, seasons and days of the week (NACO, 2023). Consequently, the following risks exist for the existing development:

10.4.1.1 Surface Runoff

Table 22 presents a summary of possible impacts and proposed mitigation measures for surface run-off caused by the development.

10.4.1.2 Leaks from Storage and Distribution

Table 23 presents a summary of possible impacts and proposed mitigation measures for surface leaks for fuel storage and distribution.

10.4.1.3 Atmospheric Deposition

Table 24 presents a summary of possible impacts and proposed mitigation measures for atmospheric deposition which occur as a result of aircraft operations, which includes engine starting, testing, ground manoeuvring, take-off, landing, and run-ups.

10.4.1.4 Direct/Surface Release

Table 25 presents a summary of possible impacts and proposed mitigation measures for surface leaks for direct/surface release. Additional information is presented in Section 8.4.2 below where the risk also exists.

10.4.1.5 Accidental Release

Table 26 presents a summary of possible impacts and proposed mitigation measures for surface leaks for direct/surface release. Additional information is presented in Section 8.4.2 below where the risk also exists.

Table 22: Impact table for contamination of groundwater as a result of surface runoff.

Potential impact on groundwater quality deterioration because of surface runoff.		
Impact	**Description**	
Nature of Impact	Contamination of groundwater and surrounding environment due to contaminated stormwater emanating from the facility infiltrating into the groundwater, leading to a decrease in groundwater quality.	
Status of Impact	Negative	
Recommended mitigation measures	**Description**	
Impact avoidance/ Prevention/ Mitigation	Ensure that the current stormwater management systems are equipped with catch pits to isolate fuel and other contaminants. Properly designed stormwater management systems are required. 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 discharging 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 (for a more detailed description the reader is referred to CEDR, 2016). Petrol interceptors might be considered to mitigate the risks of contaminants draining into the environment.	
Assessment of impact	**Rating before mitigation**	**Rating after mitigation**
Extent of impact	Local (L)	Site Specific (SS)
Duration of impact	Long term (L)	Short term (S)
Magnitude of negative impact	Medium (M)	Low (L)
Magnitude of positive impact	Zero (Z)	Zero (Z)
Intensity of impact	Destructive – Medium (M)	Destructive – Low (L)
Probability of occurrence	Possible (Po)	Improbable (Im)
Significance	**Low (L)**	**Very Low (VL)**
Confidence	Sure (S)	Sure (S)

Table 23: Impact table for contamination of groundwater as a result of leaks from fuel storage and distribution.

Potential impact on groundwater quality deterioration because of leaks from fuel storage and distribution.	
Impact	**Description**
Nature of Impact	Containment, distribution and storage of fuel and other chemical substances (e.g. cleaning agents for apparatus associated with airport equipment used for operation/pesticides for vegetated areas).
Status of Impact	Negative
Recommended mitigation measures	**Description**
Impact avoidance/ Prevention/ Mitigation	Necessary levels of protection and monitoring will need to be installed on site to reduce the risk of contamination. Here we list some general recommendations for the storage and containment of petrol and diesel. Similar approaches may be required for different types of fuel required at the airport refuelling depot; however, this should be guided by relevant industry practises and international airport development guidelines. The mitigation measures listed below must be employed to ensure no contamination of the aquifer takes place. 1. 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; 2. Fuel lines and sumps must be secondary contained where lines are joined. 3. The filling station must include the following design measures: • **<u>Fuel Containment Area</u>** 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. • **<u>Forecourt Area</u>** 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 4. All containment manholes must be regularly inspected as part of the normal management procedures at the service station. 5. 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 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) (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 500 L.** 6. The installation of the UST's and associated pipework must comply with the National Building Regulations and Standards Act No. 103 of 1977; 7. 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); 8. 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 BAR and to all required SABS / SANS standards and applicable legislation. A report thereafter, based on the engineer's findings, it to be submitted to the DEA & DP Land Management and Pollution Directorates for inspection and the City of Cape Town Municipality. 9. 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** 10. 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; 11. Construction of a reinforced concrete slab over the USTs, its thickness and strength are to be determined by

	a qualified Engineer; 12. 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; and 13. The USTs are to be fitted with a tank containment sump, fitted on top of the tank and a dispenser containment sump must be provided, fitted underneath the dispenser as containment. A Filler spill containment must also be provided for remote filler containment purposes; 14. 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; **15. 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);** 16. The UST is to be inspected before installation for damage, including factures or damage to coating work. 17. 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. 18. The UST must be buried 750 mm below finished ground level in accordance with SANS 10089-3; 19. 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 1000 kPa, tank 35 kPa); and c) Inspection of slab over tank before concreting; **Pipework** 20. 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. 21. 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; 22. 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; 23. Vent pipes above ground are to be galvanised mild steel and are to be at least 1000 mm 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** 24. 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: 25. 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; 26. When ownership of the UST and associated underground pipework changes; 27. 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; 28. 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. 29. USTs are to be fitted with a monitoring tube to allow for the monitoring of leaks through the tank surface; 30. Leak detectors are to be installed to the submersible pumps within UST manholes to ensure that there are no line leaks; 31. 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. 32. 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 0.5 m to 1 m in order to locate the vents in the 16 mm diameter monitoring pipe over portion of this depth 33. The Groundwater Monitoring Action Plan must be included as an Annexure to the approved EMP. **34. Observation wells must be installed in the sand fill surrounding the underground storage tanks for regular monitoring purposes** 35. All containment manholes must be regularly inspected as part of the normal management procedures at the

<table>
<tr><td></td><td colspan="2">service station
36. 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.
37. 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
38. Installation of pump islands in the forecourt area. The pumps are to be fitted with a Spill Containment Chamber;
39. 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.</td></tr>
<tr><th>Assessment of impact</th><th>Rating before mitigation</th><th>Rating after mitigation</th></tr>
<tr><td>Extent of impact</td><td>Local (L)</td><td>Site Specific (SS)</td></tr>
<tr><td>Duration of impact</td><td>Long term (L)</td><td>Short term (S)</td></tr>
<tr><td>Magnitude of negative impact</td><td>Medium (M)</td><td>Low (L)</td></tr>
<tr><td>Magnitude of positive impact</td><td>Zero (Z)</td><td>Zero (Z)</td></tr>
<tr><td>Intensity of impact</td><td>Destructive – Medium (M)</td><td>Destructive – Low (L)</td></tr>
<tr><td>Probability of occurrence</td><td>Possible (Po)</td><td>Improbable (Im)</td></tr>
<tr><td>Significance</td><td>Medium (M)</td><td>Very Low (VL)</td></tr>
<tr><td>Confidence</td><td>Sure (S)</td><td>Sure (S)</td></tr>
</table>

Table 24: Impact table for contamination of groundwater as a result of atmospheric deposition

Potential impact on groundwater quality deterioration because of atmospheric deposition.		
Impact	**Description**	
Nature of Impact	Aircraft operations (engine starting, run-ups, testing, ground manoeuvring, take-off, and landing), handling vehicles and equipment, and heating and/or cooling systems.	
Status of Impact	Negative	
Recommended mitigation measures	**Description**	
Impact avoidance/ Prevention/ Mitigation	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. Ensure vehicles are well-maintained and always parked on paved surfaces.	
Assessment of impact	**Rating before mitigation**	**Rating after mitigation**
Extent of impact	Local (L)	Site Specific (SS)
Duration of impact	Long term (L)	Short term (S)
Magnitude of negative impact	Low (L)	Low (L)
Magnitude of positive impact	Zero (Z)	Zero (Z)
Intensity of impact	Destructive – Low (L)	Destructive – Low (L)
Probability of occurrence	Possible (Po)	Improbable (Im)
Significance	**Low (L)**	**Very Low (VL)**
Confidence	Sure (S)	Sure (S)

Table 25: Impact table for contamination of groundwater as a result of Direct Release

Potential impact on groundwater quality deterioration because of direct release.		
Impact	**Description**	
Nature of Impact	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 (Cheng et. al., 2009). 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.	
Status of Impact	Negative	
Recommended mitigation measures	**Description**	
Impact avoidance/ Prevention/ Mitigation	For routine burns and training purposes, make use of biodegradable fuels, which once burned minimises 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 should be monitored and analysed for several chemical parameters (to be established once the composition of the extinguishing agents used on site are known) and must be disposed of or stored appropriately in accordance with the National Water Act (DWS, 1998) (and relevant amendments).	
Assessment of impact	**Rating before mitigation**	**Rating after mitigation**
Extent of impact	Local (L)	Site Specific (SS)
Duration of impact	Long term (L)	Long term (L)
Magnitude of negative impact	Low (L)	Low (L)
Magnitude of positive impact	Zero (Z)	Zero (Z)
Intensity of impact	Destructive – Medium (M)	Destructive – Low (L)
Probability of occurrence	Probable (Pr)	Improbable (Im)
Significance	**Low (L)**	**Low (L)**
Confidence	Sure (S)	Sure (S)

Table 26: Impact table for contamination of groundwater as a result of Accidental Release

Potential impact on groundwater quality deterioration because of Accidental Release.		
Impact	**Description**	
Nature of Impact	The origins of accidental releases of contaminants to the environment are electrical infrastructure (substations) and spillages by chemical storage facilities (Nunes, 2011).	
Status of Impact	Negative	
Recommended mitigation measures	**Description**	
Impact avoidance/ Prevention/ Mitigation	Ensure that the construction and design of the bunding for storage of chemical substances that are stored on site is appropriate. Ensure that existing electrical infrastructure (where risk of contamination exists, i.e. substations) is located 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.	
Assessment of impact	**Rating before mitigation**	**Rating after mitigation**
Extent of impact	Local (L)	Site Specific (SS)
Duration of impact	Long term (L)	Long term (L)
Magnitude of negative impact	Medium (M)	Low (L)
Magnitude of positive impact	Zero (Z)	Zero (Z)
Intensity of impact	Destructive – Medium (M)	Destructive – Low (L)
Probability of occurrence	Possible (Po)	Improbable (Im)
Significance	**Low (L)**	**Very Low (VL)**
Confidence	Sure (S)	Sure (S)

10.4.2 Development Alternatives 2, 3 and 4 (Further Development)

As the differences between these two development options are minor, the same risks exist for both alternatives and are assessed below.

10.4.2.1 Construction and Development

Table 27 presents a summary of possible impacts and proposed mitigation measures associated with on site development and construction of the proposed airport. Many of the risks related to construction are also applicable during the operational phase of the facility, therefore, the mitigation measures presented here should be kept in mind during operation of the facility. As a simple example, vehicles pose risk of fuel leakage which could potentially contaminate the subsoil and groundwater beneath the site and therefore, vehicles should be well maintained and parked in areas where risk for contamination is minimal, e.g. hard stand areas.

10.4.2.2 Surface Run-off

Table 28 presents a summary of possible impacts and proposed mitigation measures for surface run-off caused by the development.

10.4.2.3 Leaks from Storage and Distribution

Table 29 presents a summary of possible impacts and proposed mitigation measures for surface leaks for fuel storage and distribution.

10.4.2.4 Atmospheric Deposition

Table 30 presents a summary of possible impacts and proposed mitigation measures for atmospheric deposition which occur as a result of aircraft operations, which includes engine starting, testing, ground manoeuvring, take-off, landing, and run-ups.

10.4.2.5 Direct/Surface Release

Table 31 presents a summary of possible impacts and proposed mitigation measures for surface leaks for direct/surface release. Compounds incorporated in extinguishing agents used for extinguishing fires during emergencies have been associated with soil and groundwater contamination at firefighting training facilities, namely at Tyndall AFB and Wurtsmith AFB, both in the USA (Nunes, 2011). Based on discussions with the Airports Company of South Africa, fire and rescue training takes place on a monthly basis, during which live fires are extinguished. Depending on the quality and quantity of the waste generated from these training exercises, a Water Use License (WUL) may be required for storage and/or disposal of such wastes.

10.4.2.6 Accidental Release

Table 32 presents a summary of possible impacts and proposed mitigation measures for surface leaks for accidental release. Based on information compiled by Nunes (2011), the two main causes of accidental release of contaminants into the environment include electrical infrastructure (for example substations), and spills form containers of chemical substances. Capacitors are integral to electrical infrastructure; capacitors and dielectric fluid have been found to constitute the principal sources of polychlorinated biphenyls (PCBs) from electrical infrastructure (Nunes, 2011). Several studies have identified these compounds as being carcinogenic (Nunes, 2011; and references therein).

10.4.2.7 Energy Supply

The Consulting Electrical Engineers Bulk Services Design Report indicates: that CWA ideally intends to act independently of the electrical grid with Eskom (coal-fired) mains source intended and required as a backup source in the event of plant-failure/maintenance operations or unfavourable weather conditions. The Consulting Electrical Engineers Bulk Services Design Report indicates two types of sustainable energy sources considered:

1. CWA treated sewerage effluent in the biodigester plant to run spar-ignition gas-engine generator sets.
2. Photo-voltaic power supplies, including optional storage batteries.

The above means of energy generation poses unique risks for groundwater contamination and water availability. Table 33 highlights the risks identified for the establishment of a biodigester plant on the site to generate electricity as well as presents some mitigation measures to reduce the impacts anticipated with such an electricity generation plant. It is planned that the biodigester primarily makes use of treated sewage effluent from the WWTW (200 m^3/day) and cultivated biomass/energy crop (15 t/day). It can also make use of a combination of other sources of waste, including general organic waste. The on-site source of general waste will feed directly into the biodigester and contribute to the generation of energy from waste. The biodigester plant creates biogas, and the "waste" from the biodigester plant comprises "liquid fertilizer" which could possibly be distributed to local farms. Treated biosolids from the WWTW could potentially also be used in the biodigester if tested and found to be non-hazardous (CWA, 2025). Further, potential for contamination of groundwater exists during the operation of the facility where the digestate may leak and be transported to the groundwater.

Some elements contained in the digestate have potential to contaminate groundwater, nevertheless some studies have concluded that a relatively low potential for groundwater contamination exists for digestate used as fertiliser as compared to inorganic fertilisers (Tshikalange, et al., 2019). Other studies (e.g. Teglia et al., 2011) have indicated that "using organic residues on agricultural land can bring environmental impacts such as groundwater pollution or harmful gaseous emissions". Although not dealt with exhaustively, some of the "parameters presented… are predominantly influenced by the dose used on land and the period of application."

Table 34 indicates the risks associated with a solar photovoltaic facility for the generation of electricity for the proposed development. The main risk associated with the proposed solar voltaic facility is the cleaning of solar panels to ensure optimal energy generation.

Impacts on groundwater associated with construction of the above-mentioned facilities would be similar in nature to those for the entire facility, the reader is referred to Section 10.4.2.1. Any revisions to the site development plan (SDP) that are not dealt with appropriately in this document will need to be assessed once the most up-to-date SDP is available.

10.4.2.8 Groundwater resource depletion as a result of over-abstraction

Over-abstraction of groundwater from a borehole is likely to lead to depletion of the water levels in the area over time. This can cause damage to the aquifer and also damage the groundwater dependant ecosystems in addition to possibly impacting neighbouring groundwater users. Since there is considerable groundwater use in the area it is essential that the borehole is well managed and does not over-abstract to ensure impact on the neighbouring properties does not occur. The borehole has been tested according to SANS 10299_4-2003 and the maximum sustainable yield has been determined to be 104 857 m^3/a. The yield calculated is conservative and if abstraction is kept to the recommended rate, over-abstraction is unlikely to occur. The risk assessment is presented **Table 35.**

Groundwater water level monitoring is recommended monthly to ensure that groundwater abstraction is sustainable. The monitoring will also indicate if the groundwater resource is impacted and if mitigation measures can be instituted before long term impacts occur. Mitigation for over-abstraction would mean a reduction in abstraction.

10.4.2.9 Groundwater quality deterioration as a result of over-abstraction

Over-abstraction of groundwater from a borehole can potentially draw poorer water quality from the nearby environment into the borehole. This is likely to affect the groundwater quality in the area in general and might affect the supply in other boreholes within the same aquifer. As indicated by the regional datasets the groundwater quality is in the range of 70 – 300 m S/m and 300 – 1 000 mS/m further northwest. Thus, this risk is valid and care should be taken to ensure that the proposed production boreholes do not draw poor quality water into the area. If abstraction is kept to the recommended rate, the risk would be low, but quality monitoring should be done to ensure that deterioration in quality does not occur. The risk assessment is presented in **Table 36.**

Groundwater quality monitoring is recommended to ensure that groundwater abstraction is sustainable. The monitoring will also indicate if the groundwater resource is impacted and if mitigation measures can be instituted before long term impacts occur. Mitigation for over-abstraction would be a reduction in abstraction.

10.4.2.10 Storage of wastewater before treatment

Storing wastewater on-site carries significant environmental considerations, particularly concerning groundwater contamination and the resultant decrease of groundwater quality. In areas where groundwater is connected to surface water, this may pose substantial environmental risks to the existing freshwater ecosystems. To mitigate these concerns, it is essential to employ secure storage containers, implement effective bunding measures, and establish spill containment protocols to prevent any leakage from compromising groundwater quality. The risk assessment for the storage of wastewater is presented in **Table 37.**

10.4.2.11 Storage of brine from treated potable water

The storage of brine poses significant environmental risk especially to groundwater contamination and can lead to hypersaline conditions within the aquifer. This is especially significant in instances contaminated aquifers are connected with surface water, as saline water can have extremely adverse impacts on freshwater biota. Effectively sealed containers, appropriate bunding measures, and spill containment measures are required to prevent any leakages from entering the groundwater system. The risk assessment for the storage of brine is presented in **Table 38.**

10.4.2.12 Storage of chemicals associated with WWTW

Storing chemicals for wastewater treatment plants (WWTW) carries substantial environmental implications, particularly in terms of groundwater quality. This concern is heightened when contaminated aquifers interconnect with surface water bodies, as the chemicals associated with WWTW can severely freshwater ecosystems. To address these risks, it is imperative to utilize securely sealed containers, implement suitable bunding measures, and establish spill containment protocols to prevent any leakage from compromising the groundwater system. The risk assessment for the storage of WWTW chemicals is presented in **Table 39**

10.4.2.13 Irrigation of the landscape with treated wastewater

Over-abstraction of groundwater from a borehole is likely to lead to depletion of the water levels in the area over time. This can cause damage to the aquifer and also damage the groundwater dependant ecosystems in addition to possibly impacting neighbouring groundwater users. Since there is considerable groundwater use in the area it is essential that the borehole is well managed and does not over-abstract to ensure impact on the neighbouring properties does not occur. The borehole has been tested according to SANS 10299_4-2003 and the maximum sustainable yield has been determined to be 104 857 m^3/a. The yield calculated is conservative and if abstraction is kept to the recommended rate. over-abstraction is unlikely to occur. The risk assessment is presented in **Table 40.**

Table 27: Impact table for groundwater contamination as a result of construction of the facility.

Potential impact on groundwater quality deterioration because of contamination by construction of the facility.		
Impact	**Description**	
Nature of Impact	Contamination of groundwater and surrounding environment due to the construction processes of the facility such as concrete batching, leading to a decrease in groundwater quality.	
Status of Impact	Negative	
Recommended mitigation measures	**Description**	
Impact avoidance/ Prevention/ Mitigation	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. Fuel spillages are deal with in more detail in subsequent tables, the mitigation measures should also be adopted here. 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.	
Assessment of impact	**Rating before mitigation**	**Rating after mitigation**
Extent of impact	Site Specific (SS)	Site Specific (SS)
Duration of impact	Short term (S)	Short term (S)
Magnitude of negative impact	Low (L)	Low (L)
Magnitude of positive impact	Zero (Z)	Zero (Z)
Intensity of impact	Destructive – Low (L)	Destructive – Low (L)
Probability of occurrence	Possible (Po)	Improbable (Im)
Significance	**Very Low (VL)**	**Very Low (VL)**
Confidence	Sure (S)	Sure (S)

Table 28: Impact table for contamination of groundwater as a result of surface runoff.

Potential impact on groundwater quality deterioration because of surface runoff.		
Impact	**Description**	
Nature of Impact	Contamination of groundwater and surrounding environment due to contaminated stormwater emanating from the facility infiltrating into the groundwater, leading to a decrease in groundwater quality.	
Status of Impact	Negative	
Recommended mitigation measures	**Description**	
Impact avoidance/ Prevention/ Mitigation	Installation of appropriate stormwater systems with catch pits to isolate fuel and other contaminants. Properly designed stormwater management systems and is required. 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 (for a more detailed description the reader is referred to CEDR, 2016). Petrol interceptors might be considered to mitigate the risks of contaminants draining into the environment.	
Assessment of impact	**Rating before mitigation**	**Rating after mitigation**
Extent of impact	Local (L)	Site Specific (SS)
Duration of impact	Long term (L)	Short term (S)
Magnitude of negative impact	Medium (M)	Low (L)
Magnitude of positive impact	Zero (Z)	Zero (Z)
Intensity of impact	Destructive – Medium (M)	Destructive – Low (L)
Probability of occurrence	Possible (Po)	Improbable (Im)
Significance	**Medium (M)**	**Very Low (VL)**
Confidence	Sure (S)	Sure (S)

Table 29: Impact table for contamination of groundwater as a result of leaks from fuel storage and distribution.

Potential impact on groundwater quality deterioration because of leaks from fuel storage and distribution.	
Impact	**Description**
Nature of Impact	Containment, distribution and storage of fuel and other chemical substances (e.g. cleaning agents for apparatus associated with airport equipment used for operation/pesticides for vegetated areas).
Status of Impact	Negative
Recommended mitigation measures	**Description**
Impact avoidance/ Prevention/ Mitigation	Necessary levels of protection and monitoring will need to be installed on site to reduce the risk of contamination. Here we list some general recommendations for the storage and containment of petrol and diesel. Similar approaches may be required for different types of fuel required at the airport refuelling depot; however, this should be guided by relevant industry practises and international airport development guidelines. The mitigation measures listed below must be employed to ensure no contamination of the aquifer takes place. 40. 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; 41. Fuel lines and sumps must be secondary contained where lines are joined. 42. The filling station must include the following design measures: • <u>**Fuel Containment Area**</u> 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. • <u>**Forecourt Area**</u> 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 43. All containment manholes must be regularly inspected as part of the normal management procedures at the service station. 44. 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: **d) 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 stations and consumer installations.** **e) SANS 10 400TT (Fire Protection) 53 Sections 1-6 (The application of the National Building Regulations-Installation of Liquid Fuel Dispensing Pumps and Tanks);** **f) 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 500 L.** 45. The installation of the UST's and associated pipework must comply with the National Building Regulations and Standards Act No. 103 of 1977; 46. 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); 47. 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 BAR and to all required SABS / SANS standards and applicable legislation. A report thereafter, based on the engineer's findings, it to be submitted to the DEA & DP Land Management and Pollution Directorates for inspection and the City of Cape Town Municipality. 48. 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** 49. 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; 50. Construction of a reinforced concrete slab over the USTs, its thickness and strength are to be determined

	by a qualified Engineer; 51. 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; and 52. The USTs are to be fitted with a tank containment sump, fitted on top of the tank and a dispenser containment sump must be provided, fitted underneath the dispenser as containment. A Filler spill containment must also be provided for remote filler containment purposes; 53. 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; **54. 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);** 55. The UST is to be inspected before installation for damage, including factures or damage to coating work. 56. 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. 57. The UST must be buried 750 mm below finished ground level in accordance with SANS 10089-3; 58. The local Fire Department must be informed two (2) working days before installation commences and to be called for inspection at the following stages: d) Installation of tank on clean sand bed before backfilling e) Witness pressure test (delivery lines 1000 kPa, tank 35 kPa); and f) Inspection of slab over tank before concreting; **Pipework** 59. 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. 60. 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; 61. 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; 62. Vent pipes above ground are to be galvanised mild steel and are to be at least 1000 mm 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** 63. 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: 64. 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; 65. When ownership of the UST and associated underground pipework changes; 66. 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; 67. 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. 68. USTs are to be fitted with a monitoring tube to allow for the monitoring of leaks through the tank surface; 69. Leak detectors are to be installed to the submersible pumps within UST manholes to ensure that there are no line leaks; 70. 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. 71. 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 0.5 m to 1 m in order to locate the vents in the 16 mm diameter monitoring pipe over portion of this depth 72. The Groundwater Monitoring Action Plan must be included as an Annexure to the approved EMP. **73. Observation wells must be installed in the sand fill surrounding the underground storage tanks for regular monitoring purposes** 74. All containment manholes must be regularly inspected as part of the normal management procedures at the service station

	75. 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. **76. 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** 77. Installation of pump islands in the forecourt area. The pumps are to be fitted with a Spill Containment Chamber; 78. 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.	
Assessment of impact	**Rating before mitigation**	**Rating after mitigation**
Extent of impact	Local (L)	Site Specific (SS)
Duration of impact	Long term (L)	Short term (S)
Magnitude of negative impact	Medium (M)	Low (L)
Magnitude of positive impact	Zero (Z)	Zero (Z)
Intensity of impact	Destructive – Medium (M)	Destructive – Low (L)
Probability of occurrence	Possible (Po)	Improbable (Im)
Significance	**Medium (M)**	**Very Low (VL)**
Confidence	Sure (S)	Sure (S)

Table 30: Impact table for contamination of groundwater as a result of atmospheric deposition.

Potential impact on groundwater quality deterioration because of atmospheric deposition.		
Impact	**Description**	
Nature of Impact	Aircraft operations (engine starting, run-ups, testing, ground manoeuvring, take-off, and landing), handling vehicles and equipment, and heating and/or cooling systems.	
Status of Impact	Negative	
Recommended mitigation measures	**Description**	
Impact avoidance/ Prevention/ Mitigation	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. Ensure vehicles are well-maintained and always parked on paved surfaces.	
Assessment of impact	**Rating before mitigation**	**Rating after mitigation**
Extent of impact	Local (L)	Site Specific (SS)
Duration of impact	Long term (L)	Short term (S)
Magnitude of negative impact	Low (L)	Low (L)
Magnitude of positive impact	Zero (Z)	Zero (Z)
Intensity of impact	Destructive – Low (L)	Destructive – Low (L)
Probability of occurrence	Possible (Po)	Improbable (Im)
Significance	**Low (L)**	**Very Low (VL)**
Confidence	Sure (S)	Sure (S)

Table 31: Impact table for contamination of groundwater as a result of Direct Release.

Potential impact on groundwater quality deterioration because of direct release.		
Impact	**Description**	
Nature of Impact	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 (Cheng et. al., 2009). 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.	
Status of Impact	Negative	
Recommended mitigation measures	**Description**	
Impact avoidance/ Prevention/ Mitigation	For routine burns and training purposes, make use of biodegradable fuels, which once burned minimises 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. 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.	
Assessment of impact	**Rating before mitigation**	**Rating after mitigation**
Extent of impact	Local (L)	Site Specific (SS)
Duration of impact	Long term (L)	Long term (L)
Magnitude of negative impact	Low (L)	Low (L)
Magnitude of positive impact	Zero (Z)	Zero (Z)
Intensity of impact	Destructive – Medium (M)	Destructive – Low (L)
Probability of occurrence	Probable (Pr)	Improbable (Im)
Significance	**Low (L)**	**Low (L)**
Confidence	Sure (S)	Sure (S)

Table 32: Impact table for contamination of groundwater as a result of Accidental Release.

Potential impact on groundwater quality deterioration because of Accidental Release.		
Impact	**Description**	
Nature of Impact	The origins of accidental releases of contaminants to the environment are electrical infrastructure (substations) and spillages by chemical storage facilities (Nunes, 2011).	
Status of Impact	Negative	
Recommended mitigation measures	**Description**	
Impact avoidance/ Prevention/ Mitigation	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.	
Assessment of impact	**Rating before mitigation**	**Rating after mitigation**
Extent of impact	Local (L)	Site Specific (SS)
Duration of impact	Long term (L)	Long term (L)
Magnitude of negative impact	Medium (M)	Low (L)
Magnitude of positive impact	Zero (Z)	Zero (Z)
Intensity of impact	Destructive – Medium (M)	Destructive – Low (L)
Probability of occurrence	Possible (Po)	Improbable (Im)
Significance	**Medium (M)**	**Low (L)**
Confidence	Sure (S)	Sure (S)

Table 33: Impact table for contamination of groundwater as a result of bio-digestor facilities for energy generation.

Potential impact on groundwater quality deterioration because of bio-digestor facilities for energy generation.		
Impact	**Description**	
Nature of Impact	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.	
Status of Impact	Negative	
Recommended mitigation measures	**Description**	
Impact avoidance/ Prevention/ Mitigation	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.	
Assessment of impact	**Rating before mitigation**	**Rating after mitigation**
Extent of impact	Local (L)	Site Specific (SS)
Duration of impact	Long term (L)	Short term (S)
Magnitude of negative impact	Medium (M)	Very low (VL)
Magnitude of positive impact	Zero (Z)	Zero (Z)
Intensity of impact	Destructive – Medium (M)	Destructive – Low (L)
Probability of occurrence	Possible (Po)	Improbable (Im)
Significance	**Medium (M)**	**Very low (VL)**
Confidence	Sure (S)	Sure (S)

Table 34: Impact table for contamination of groundwater as a result of operation of photovoltaic solar facilities.

Potential impact on groundwater quality deterioration because of the operation of photovoltaic solar facilities.		
Impact	**Description**	
Nature of Impact	Use of cleaning agents to ensure maximal power generation from solar panels.	
Status of Impact	Negative	
Recommended mitigation measures	**Description**	
Impact avoidance/ Prevention/ Mitigation	Make use of biodegradable cleaning agents to ensure little to no impact on the quality of the groundwater is experienced.	
Assessment of impact	**Rating before mitigation**	**Rating after mitigation**
Extent of impact	Local (L)	Site Specific (SS)
Duration of impact	Long term (L)	Short term (S)
Magnitude of negative impact	Low (L)	Very Low (VL)
Magnitude of positive impact	Zero (Z)	Zero (Z)
Intensity of impact	Destructive – Low (L)	Destructive – Very Low (VL)
Probability of occurrence	Possible (Po)	Improbable (Im)
Significance	**Low (L)**	**Very low (VL)**
Confidence	Sure (S)	Sure (S)

Table 35: Impact table for depletion of the groundwater resource as a result of over-abstraction.

Potential impact due to the depletion of groundwater resources as a result of over-abstraction.		
Impact	**Description**	
Nature of Impact	Over-abstraction from the borehole would drop the regional groundwater level.	
Status of Impact	Negative	
Recommended mitigation measures	**Description**	
Impact avoidance/ Prevention/ Mitigation	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. 72 mbgl for CWA_BH001, 40 mbgl for CWA_BH002, and 61 mbgl 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. 85 mgbl for CWA_BH001, 61 mbgl 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. A formal groundwater management plan needs to be designed and implemented.	
Assessment of impact	**Rating before mitigation**	**Rating after mitigation**
Extent of impact	Local (L)	Site Specific (SS)
Duration of impact	Long term (L)	Short term (S)
Magnitude of negative impact	Medium (M)	Low (L)
Magnitude of positive impact	Zero (Z)	Zero (Z)
Intensity of impact	Destructive – Medium (M)	Destructive –Low (L)
Probability of occurrence	Definite (D)	Possible (Po)
Significance	**Medium (M)**	**Very Low (VL)**
Confidence	Sure (S)	Sure (S)

Table 36: Impact table for groundwater quality deterioration as a result of over-abstraction.

Potential impact on groundwater quality deterioration as a result of over-abstraction		
Impact	**Description**	
Nature of Impact	Exposure and oxidation of minerals through the lowering of the water table, with potential water quality impacts when water levels recover.	
Status of Impact	Negative	
Recommended mitigation measures	**Description**	
Impact avoidance/ Prevention/ Mitigation	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.	
Assessment of impact	**Rating before mitigation**	**Rating after mitigation**
Extent of impact	Local (L)	Site Specific (SS)
Duration of impact	Long term (L)	Short term (S)
Magnitude of negative impact	Medium (M)	Low (L)
Magnitude of positive impact	Zero (Z)	Zero (Z)
Intensity of impact	Destructive – Medium (M)	Destructive –Low (L)
Probability of occurrence	Improbable (Im)	Improbable (Im)
Significance	**Medium (M)**	**Very Low (VL)**
Confidence	Sure (S)	Sure (S)

Table 37: Impact table for groundwater quality deterioration as a result of waste water storage.

Potential impact on groundwater quality deterioration as a result waste water storage before treatment		
Impact	**Description**	
Nature of Impact	Contamination of groundwater due to the cracking, leaking or overflow of the concrete ponds and/or pipelines within the WWTW and to and from inflow and outflow points, allowing the seepage of contaminants into the groundwater.	
Status of Impact	Negative	
Recommended mitigation measures	**Description**	
Impact avoidance/ Prevention/ Mitigation	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.	
Assessment of impact	**Rating before mitigation**	**Rating after mitigation**
Extent of impact	Site Specific (L)	Site Specific (SS)
Duration of impact	Long term (L)	Short term (S)
Magnitude of negative impact	Medium (M)	Low (L)
Magnitude of positive impact	Zero (Z)	Zero (Z)
Intensity of impact	Destructive – Medium (M)	Destructive –Low (L)
Probability of occurrence	Possible (Po)	Improbable (Im)
Significance	**Medium (M)**	**Very Low (VL)**
Confidence	Sure (S)	Sure (S)

Table 38: Impact table for groundwater quality deterioration as a result of brine storage.

Potential impact on groundwater quality deterioration as a result waste water storage before treatment		
Impact	**Description**	
Nature of Impact	Contamination of groundwater due to the cracking, leaking or overflow of the concrete ponds and/or pipelines containing brine from treated potable water, allowing the seepage of contaminants into the groundwater.	
Status of Impact	Negative	
Recommended mitigation measures	**Description**	
Impact avoidance/ Prevention/ Mitigation	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 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.	
Assessment of impact	**Rating before mitigation**	**Rating after mitigation**
Extent of impact	Site Specific (L)	Site Specific (SS)
Duration of impact	Long term (L)	Short term (S)
Magnitude of negative impact	Medium (M)	Low (L)
Magnitude of positive impact	Zero (Z)	Zero (Z)
Intensity of impact	Destructive – Medium (M)	Destructive –Low (L)
Probability of occurrence	Possible (Po)	Improbable (Im)
Significance	**Medium (M)**	**Very Low (VL)**
Confidence	Sure (S)	Sure (S)

Table 39: Impact table for groundwater quality deterioration as a result of chemical storage associated with WWTW.

Potential impact on groundwater quality deterioration as a result waste water storage before treatment		
Impact	**Description**	
Nature of Impact	Contamination of groundwater due to the leaking or spilling of containers storing chemicals associated with the WWTW, allowing the seepage of contaminants into the groundwater.	
Status of Impact	Negative	
Recommended mitigation measures	**Description**	
Impact avoidance/ Prevention/ Mitigation	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. 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.	
Assessment of impact	**Rating before mitigation**	**Rating after mitigation**
Extent of impact	Site Specific (L)	Site Specific (SS)
Duration of impact	Long term (L)	Short term (S)
Magnitude of negative impact	Medium (M)	Low (L)
Magnitude of positive impact	Zero (Z)	Zero (Z)
Intensity of impact	Destructive – Medium (M)	Destructive –Low (L)
Probability of occurrence	Possible (Po)	Improbable (Im)
Significance	**Medium (M)**	**Very Low (VL)**
Confidence	Sure (S)	Sure (S)

Table 40: Impact table for groundwater quality deterioration as a result of result of irrigation with the treated sewage effluent.

Potential impact on groundwater quality deterioration as a result waste water storage before treatment		
Impact	**Description**	
Nature of Impact	Contamination of groundwater due to irrigation with poorly treated waste water effluent (TSE)	
Status of Impact	Negative	
Recommended mitigation measures	**Description**	
Impact avoidance/ Prevention/ Mitigation	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. It is recommended that Groundwater Management Plan be implemented to ensure the groundwater quality is not negatively affected by the irrigation with treated effluent.	
Assessment of impact	**Rating before mitigation**	**Rating after mitigation**
Extent of impact	Local (L)	Site Specific (SS)
Duration of impact	Long term (L)	Short term (S)
Magnitude of negative impact	Medium (M)	Low (L)
Magnitude of positive impact	Zero (Z)	Zero (Z)
Intensity of impact	Destructive – Medium (M)	Destructive –Low (L)
Probability of occurrence	Possible (Po)	Improbable (Im)
Significance	**Medium (M)**	**Very Low (VL)**
Confidence	Sure (S)	Sure (S)

10.5 Cumulative Assessment

During the course of this assessment, it appears that the majority of water users in the area utilise the underlying groundwater resource for agricultural purposes. Further to this, no developments similar to the CWA are present within the region. The developments of interest that were noted include the County Fair chicken farm and the Fisantekraal Wastewater Treatment Works. Each individual impact was assessed with regards to its potential cumulative impact when considered along with the other developments. These are presented in **Table 41.**

Table 41: Cumulative impacts in relation to other regional developments.

Type of cumulative impact	Significance rating before mitigation	Significance rating after mitigation
Construction and Development	Very Low (VL)	Very Low (VL)
Surface Run-off	Medium (M)	Medium (M)
Leaks Storage and Distribution	Medium (M)	Medium (M)
Atmospheric Deposition	Low (L)	Very Low (VL)
Direct/Surface Release	Low (L)	Low (L)
Accidental Release	Medium (M)	Low (L)
Energy Supply	Medium (M)	Very Low (VL)
Groundwater resource depletion as a result of over-abstraction	High (H)	Low (L)
Groundwater quality deterioration as a result of over-abstraction	High (H)	Low (L)
Storage of wastewater before treatment	Medium (M)	Very Low (VL)
Storage of brine from treated potable water	Medium (M)	Very Low (VL)
Storage of chemicals associated with WWTW	Medium (M)	Very Low (VL)
Irrigation of the landscape with treated wastewater	Medium (M)	Very Low (VL)

11 Groundwater Management Plan

11.1 Proposed Groundwater Monitoring Plan For Production Boreholes

11.1.1 Monitoring Infrastructure

1. An "observation pipe" needs to be installed (32 mm inner diameter, class 10 as shown in **(Appendix G)** from the pump depth to the surface, closed at the bottom and slotted for the bottom 5 – 10 m, for the production borehole. This allows for a 'window' of access down the borehole which enables manual water level monitoring and can house an electronic water level logger.
2. Care has been taken to equip the borehole in such a way that contaminants cannot easily enter the borehole, but due to the high vulnerability of the primarily aquifer, it is also advices that due diligence is followed when storing fuel and other contaminants, such as pesticides on the site. Over-fertilization should also be avoided as these nutrients could leach into the groundwater.
3. Continuous monitoring of groundwater levels using pressure transducers in the borehole is ideal. The water level in the boreholes may not drop below the critical water level (**Table 14**). If the water level in the borehole drops below the critical water level, abstraction must be immediately reduced by 10 %. Monitoring must continue and after 30 days, if the water level in the borehole does not recover to above the critical water level, abstraction must be reduced by a further 10%. This process must continue until the water level in the borehole is stable. If the low levels persist for more than 60 days, abstraction be stopped until the levels have been restored.
4. Water quality monitoring which includes sampling and analysis of the groundwater at an accredited laboratory is important. A sampling interval of quarterly is recommended for the first year of monitoring, thereafter, the water quality monitoring should be reviewed and can potentially be reduced to bi-annual or annually as seen in Table 42.
5. The monitoring data should be reviewed on quarterly basis for the first 2 years and can then be scaled down to bi-annually.
6. Installation of a sampling tap at the production borehole (to monitor water quality) is essential.
7. Installation of a flow volume meter at the production borehole (to monitor abstraction rates and volumes) is also important. External flow (e.g., mag-flow) meters are recommended.
8. Abstraction volumes must be monitored and recorded by a designated person on site. Depending on the frequency of use, daily, weekly or monthly abstraction should be recorded.
9. The appropriate borehole pump must be installed, i.e., not an over-sized pump that is choked with a gate valve. If the monitoring shows that more water can be abstracted, then the duration of pumping time can be increased (not the flow rate).
10. If required, the pump and borehole casing (and associated infrastructure) can be serviced annually and cleaned.
11. A geohydrologist should review the above information at least annually to ensure optimal groundwater abstraction and management occurs.
12. The relevant DWS monitoring officer (as specified in the Water Use Licence) should be informed if water levels are dropping to critical level in Table 14 or if any parameters, as specified in **Table 42,** changes by 20%.

The groundwater abstraction should be reviewed to ensure that it is sustainable based on the monitoring data obtained.

Table 42: Proposed groundwater monitoring parameters.

Parameter	Frequency
Groundwater Level	Ideally every 15 minutes with a data logger
Chemical parameters	
pH (at 25 °C)	Quarterly (Field Chemistry)
Conductivity (mS/m) (at 25 °C)	Quarterly (Field Chemistry)
Total Dissolved Solids (mg/L)	Quarterly (Field Chemistry)
Turbidity (NTU)	Quarterly*
Colour (mg/L as Pt)	Quarterly*
Sodium (mg/L as Na)	Quarterly*
Potassium (mg/L as K)	Quarterly*
Magnesium (mg/L as Mg)	Quarterly*
Calcium (mg/L as Ca)	Quarterly*
Chloride (mg/L as Cl)	Quarterly*
Sulphate (mg/L as SO_4)	Quarterly*
Nitrate & Nitrite Nitrogen (mg/L as N)	Quarterly*
Nitrate Nitrogen (mg/L as N)	Quarterly*
Nitrite Nitrogen (mg/L as N)	Quarterly*
Ammonia Nitrogen (mg/L as N)	Quarterly*
Total Alkalinity (mg/L as $CaCO_3$)	Quarterly*
Total Hardness (mg/L as $CaCO_3$)	Quarterly*
Fluoride (mg/L as F)	Quarterly*
Aluminium (mg/L as Al)	Quarterly*
Total Chromium (mg/L as Cr)	Quarterly*
Manganese (mg/L as Mn)	Quarterly*
Iron (mg/L as Fe)	Quarterly*
Nickel (mg/L as Ni)	Quarterly*
Copper (mg/L as Cu)	Quarterly*
Zinc (mg/L as Zn)	Quarterly*
Arsenic (mg/L as As)	Quarterly*
Selenium (mg/L as Se)	Quarterly*
Cadmium (mg/L as Cd)	Quarterly*
Antimony (mg/L as Sb)	Quarterly*
Mercury (mg/L as Hg)	Quarterly*
Lead (mg/L as Pb)	Quarterly*
Uranium (mg/L as U)	Quarterly*
Cyanide (mg/L as CN-)	Quarterly*
Total Organic Carbon (mg/L as C)	Quarterly*
E.coli (count per 100 ml)	Quarterly*
Total Coliform Bacteria (count per 100 ml)	Quarterly*
Heterotrophic Plate Count (count per ml)	Quarterly*
Total Petroleum Hydrocarbons (TPH)	Quarterly*
*Can be reduced to bi-annually or annually if reviewed and deemed appropriate	

11.2 Proposed Groundwater Monitoring Plan for Monitoring Boreholes

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 as described in **Section 8.3.** 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 43** and illustrated in **Map 10.**

Table 43: 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

11.2.1 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 27;** 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 12 mm. 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 500 mm needs to be installed at the top of the hole to prevent ingress of surface water.

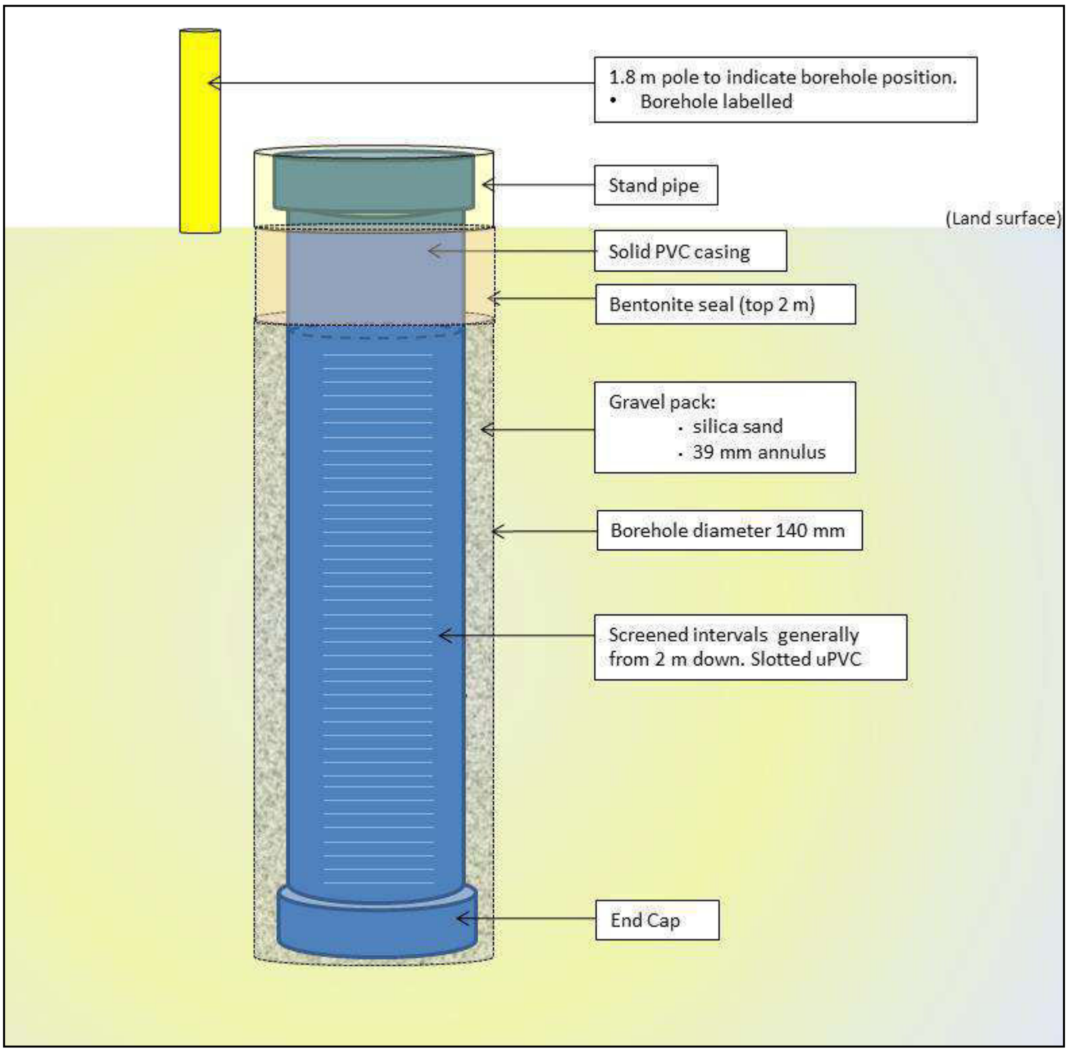


Figure 27: Schematic representation of the proposed general borehole construction.

11.2.2 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.

11.2.3 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.

11.2.4 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.

11.2.5 Monitoring Frequency and Parameter Analysis

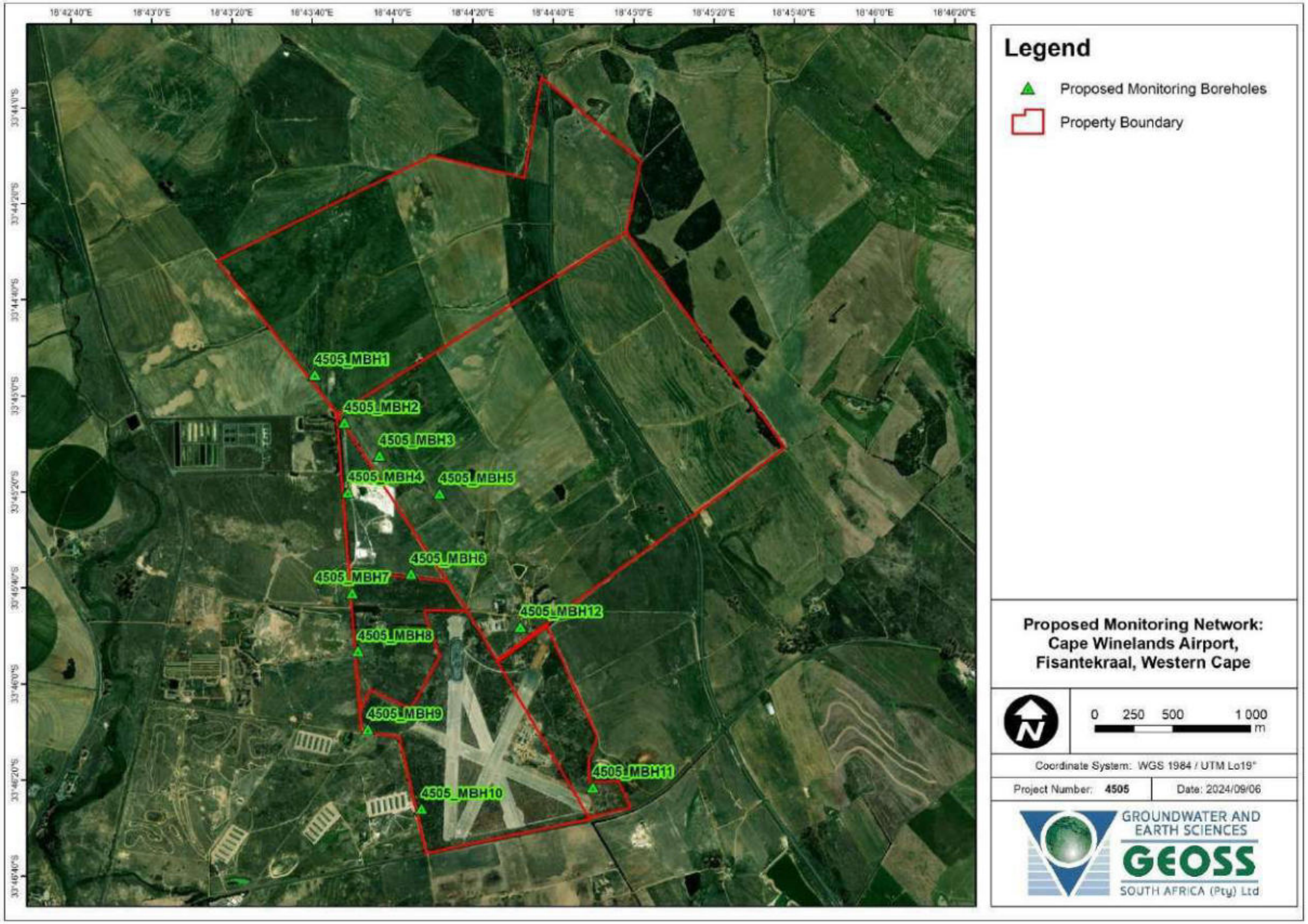
In order to best understand and monitor the site, it is recommended that monthly water level measurements be taken to determine seasonal fluctuation. It is further recommended that the water quality on site is monitored on a quarterly basis for the first year, after which the frequency can be reduced 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 developed and the intricate details of the services are made available, a more detailed, standalone monitoring programme report will need to be developed.**Table 44** indicates the potential parameters for ongoing monitoring, this will be revised upon approval and development of the CWA.

Table 44: 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.*



Map 10: Proposed groundwater monitoring locations across the Cape Winelands Airport development

12 Assumptions and Limitations

During this study, certain assumptions limited the accuracy of the data acquired and the outcome of this report.

- The groundwater quality was conducted from one set of test results. Seasonal changes may occur in the chemistry of the water from the borehole and this has not been accounted for.
- The coordinates of the NGA boreholes are sometimes found to be inaccurate. Hence, it was difficult to incorporate the NGA data accurately into the field hydrocensus.
- All registered abstraction volumes (that could be obtained from the WARMS January 2025 data) were taken into account when calculating the available volumes within the firm yield of the GRU. This database is updated continuously, however, access to the latest data is limited and not easily accessible.
- Available data was sourced from the relevant groundwater databases and sources. The aquifer vulnerability, yield and quality data is predominantly accurate, albeit mapped at a regional scale.
- At the time of the report issue, the available site development plans were not yet approved for development, resulting in a generalised recommendation for groundwater monitoring. Once the site is developed and the intricate details of the services are made available, a more detailed, standalone monitoring programme report will need to be developed.
- A further limitation was the temporal nature of the site visit. The field work was undertaken on a single day in January 2022, and does not account for the temporal variability of the water table, i.e. the shallow water table. This is not expected to alter the risk assessment for the site.
- It is possible that there are a greater number of groundwater users in the area than what has been reported in this study as not all groundwater use tends to be registered, particularly when small volumes are used for domestic purposes.
- We have assumed that the available published geological and hydrogeological data on which our study has been based, is accurate. The interpretation of the analysis results that have been presented here are based on standard rating tables.
- The hydrocensus data and chemistry data in this report is representative of the day and time on which it was collected. Seasonal variation can be expected for the water level and the water quality of the area; however, these variations are typically quite minor and will not change the conclusions in this report.
- During the baseline assessment, a single groundwater sample was collected from the study area which was initially deemed sufficient and for the purpose of this study. Subsequent studies have analysed additional samples in the area and found that groundwater quality generally shows a limited spatial variability.
- The impact assessment has been based on information available at the time of report compilation, and the mitigation measures presented may need to be updated/reassessed once the final development plans are available.
- The GRU takes into account recharge in the form of rainfall. and not recharge via lateral

through-flow. Thus, the available groundwater in the local aquifer is likely higher than that indicated in the GRU calculations presented.

GEOSS has endeavoured to highlight all the risk associated with the planned facilities and activities as far as reasonably possible given the information available and collected to date. Since geological materials are inherently non-homogeneous, there will be deviation from the conditions presented in this report and similar reports compiled for the area by GEOSS.

13 Conclusion

Cape Winelands Airport Ltd requested that GEOSS South Africa Pty (Ltd) compile a geohydrological assessment for their Water Use Licence Application (WULA). The application is to abstract groundwater for use at their facility. The airport is located within Quaternary Catchment G21E, and thus the GA regarding groundwater abstraction is 150 m^3/ha/a. The total area for all the properties on which the boreholes are located is 192.82 ha and a total of 28 923 m^3/a can be abstracted under the GA. The sustainable volume to be abstracted from the three drilled production boreholes is 163 671 m^3/a.

The investigation entailed a desktop study of the local geology, climate, aquifer type, and groundwater quality. Groundwater use in the area was also investigated through a field study. The local minimum potential of the aquifer in question was calculated as well as the sustainable yield of the boreholes. The current production boreholes have been correctly yield tested (according to SANS 10299_4-2003) and the results were used to determine the sustainable (i.e. long term and safe) yield of the boreholes. By making use of the Aquifer Firm Yield Model and calculation for that GRU, the abstraction of the total volume of 163 671 m^3/a can be considered sustainable **(Section 9)**.

The proposed CWA development poses a risk of contamination to the underlying aquifer. The proximity of the Colenso Fault to the CWA also results in a proposed no-go area for certain activities in the northeastern section of the study area. The aquifer is considered to have a "low" to "medium" vulnerability to contamination as it is overlain by a thick layer of clay. The development may proceed; however, only on the basis that the construction and operation of the facility employs relevant mitigation measures so as not to impact on groundwater and associated groundwater users. It is therefore recommended that the development design include a groundwater monitoring plan.

It is recommended that the general Groundwater Management guideline outlined in **Section 11** of this report be included in the licence conditions of the WULA to take into account the various risk associated with the phased development of the airport.

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Appendix A: Water Balance

Water management plan for Cape Winelands Airport. Fisantekraal for PAL 1-2032

PAL 1 Requirement (m^3)															
PAL 1 Water Use (e.g., Industrial Use, Domestic Use, etc.)															
Months	Business/Commercial			Yard connection			Warehouse			Hotel			Park grounds only		
	Potable Use	Non Potable Use (Toilets)	Non Potable Use (Irrigation)	Potable Use	Non Potable Use (Toilets)	Non Potable Use (Irrigation)	Potable Use	Non Potable Use (Toilets)	Non Potable Use (Irrigation)	Potable Use	Non Potable Use (Toilets)	Non Potable Use (Irrigation)	Potable Use	Non Potable Use (Toilets)	Non Potable Use (Irrigation)
January	6006	2002	890	197	66	29	1101	367	163	819	273	121	0	0	6254
February	6056	2019	897	199	66	29	1110	370	165	826	275	122	0	0	6306
March	6764	2255	1002	222	74	33	1240	413	184	923	308	137	0	0	7043
April	6708	2236	994	221	74	33	1230	410	182	915	305	136	0	0	6985
May	6019	2006	892	198	66	29	1104	368	163	821	274	122	0	0	6267
June	5385	1795	798	177	59	26	987	329	146	735	245	109	0	0	5607
July	6447	2149	955	212	71	31	1182	394	175	880	293	130	0	0	6713
August	6298	2099	933	207	69	31	1155	385	171	859	286	127	0	0	6558
September	6485	2162	961	213	71	32	1189	396	176	885	295	131	0	0	6752
October	7062	2354	1046	232	77	34	1295	432	192	964	321	143	0	0	7354
November	6429	2143	952	211	70	31	1179	393	175	877	292	130	0	0	6694
December	7075	2358	1048	233	78	34	1297	432	192	965	322	143	0	0	7367
Total (m^3/a)	76736	25579	11368	2523	841	374	14070	4690	2084	10469	3490	1551	0	0	79901

Water management plan for Cape Winelands Airport Continues for Phase PAL 1A-2032

PAL 1 Requirement (m^3)																
PAL 1 Water Use (e.g., Industrial Use, Domestic Use, etc.)																
Months	Wash Facility			Club - Buildings only			Industrial			Parking Grounds (car park)			Garage and filling station			
	Potable Use	Non Potable Use (Toilets)	Non Potable Use (Irrigation)	Potable Use	Non Potable Use (Toilets)	Non Potable Use (Irrigation)	Potable Use	Non Potable Use (Toilets)	Non Potable Use (Irrigation)	Potable Use	Non Potable Use (Toilets)	Non Potable Use (Irrigation)	Potable Use	Non Potable Use (Toilets)	Non Potable Use (Irrigation)	
January	0	0	0	0	0	0	556	185	82	0	0	0	210	70	31	
February	0	0	0	0	0	0	561	187	83	0	0	0	212	71	31	
March	0	0	0	0	0	0	626	209	93	0	0	0	237	79	35	
April	0	0	0	0	0	0	621	207	92	0	0	0	235	78	35	
May	0	0	0	0	0	0	557	186	83	0	0	0	210	70	31	
June	0	0	0	0	0	0	499	166	74	0	0	0	188	63	28	
July	0	0	0	0	0	0	597	199	88	0	0	0	225	75	33	
August	0	0	0	0	0	0	583	194	86	0	0	0	220	73	33	
September	0	0	0	0	0	0	600	200	89	0	0	0	227	76	34	
October	0	0	0	0	0	0	654	218	97	0	0	0	247	82	37	
November	0	0	0	0	0	0	595	198	88	0	0	0	225	75	33	
December	0	0	0	0	0	0	655	218	97	0	0	0	247	82	37	
Total (m^3/a)	0	0	0	0	0	0	7106	2369	1053	0	0	0	2683	894	397	

Water management plan for Cape Winelands Airport Continues for Phase PAL 1A-2032

PAL 1 Requirement (m^3)															
PAL 1 Water Use (e.g., Industrial Use, Domestic Use, etc.)															
					Demand (m^3)				Supply (m^3)						
Months	Terminal Building			Biodigester							Groundwater supply (m3) Treated to potable levels				
	Potable Use	Non Potable Use (Toilets)	Non Potable Use (Irrigation)	Non Potable Use (Irrigation)	Total Potable Requirement (m^3/a)	Total Non-Potable Requirement (m3/a)	Municipal supply available	Municipal supply required	Municipal Supply (Back up to be installed only Potable)	On-Site Treated Sewer Effluent (m^3) (treated to non-potable levels)	CWA_ BH001	CWA_ BH002	CWA_ BH003	Total Potable Supply (m^3/a)	Total Non-Potable Supply (m^3/a)
January	3741	1247	554	1000	12632	13336	14325	0	0	13336	2544	6361	3726	26957	13336
February	3772	1257	559	1008	12737	13447	12939	809	809	13447	2298	5746	3884	24867	13447
March	4213	1404	624	1126	14226	15019	14325	1020	1020	15019	2544	6361	4300	27531	15019
April	4178	1393	619	1117	14108	14895	13863	1328	1328	14895	2462	6156	4161	26643	14895
May	3749	1250	555	1002	12658	13364	14325	0	0	13364	2544	6361	3753	26984	13364
June	3354	1118	497	897	11326	11957	13863	0	0	11957	2462	6156	2707	25189	11957
July	4016	1339	595	1073	13560	14315	14325	354	354	14315	2544	6361	4300	27531	14315
August	3923	1308	581	1049	13246	13984	14325	40	40	13984	2544	6361	4300	27531	13984
September	4039	1346	598	1080	13638	14398	13863	858	858	14398	2462	6156	4161	26643	14398
October	4399	1466	652	1176	14853	15681	14325	1647	1647	15681	2544	6361	4300	27531	15681
November	4004	1335	593	1070	13520	14274	13863	741	741	14274	2462	6156	4161	26643	14274
December	4407	1469	653	1178	14879	15709	14325	1674	1674	15709	2544	6361	4300	27531	15709
Total (m^3/a)	**47797**	**15932**	**7081**	**12775**	**161382**	**170378**			**8470**	**170378**	**29959**	**74898**	**48055**	**321583**	**170378**

Water management plan for Cape Winelands Airport Continues for Phase PAL 2-2038

PAL 2 Requirement (m^3)															
PAL 2 Water Use (e.g., Industrial Use, Domestic Use, etc.)															
Months	Business/Commercial			Yard connection			Warehouse			Hotel			Park grounds only		
	Potable Use	Non Potable Use (Toilets)	Non Potable Use (Irrigation)	Potable Use	Non Potable Use (Toilets)	Non Potable Use (Irrigation)	Potable Use	Non Potable Use (Toilets)	Non Potable Use (Irrigation)	Potable Use	Non Potable Use (Toilets)	Non Potable Use (Irrigation)	Potable Use	Non Potable Use (Toilets)	Non Potable Use (Irrigation)
January	9308	3103	1379	210	70	31	3499	1166	518	1639	546	243	0	0	6254
February	9385	3128	1390	211	70	31	3528	1176	523	1652	551	245	0	0	6306
March	10483	3494	1553	236	79	35	3941	1314	584	1846	615	273	0	0	7043
April	10396	3465	1540	234	78	35	3908	1303	579	1830	610	271	0	0	6985
May	9328	3109	1382	210	70	31	3506	1169	519	1642	547	243	0	0	6267
June	8346	2782	1236	188	63	28	3137	1046	465	1469	490	218	0	0	5607
July	9992	3331	1480	225	75	33	3756	1252	556	1759	586	261	0	0	6713
August	9761	3254	1446	220	73	33	3669	1223	544	1719	573	255	0	0	6558
September	10049	3350	1489	226	75	34	3778	1259	560	1769	590	262	0	0	6752
October	10945	3648	1621	246	82	37	4114	1371	610	1927	642	285	0	0	7354
November	9963	3321	1476	224	75	33	3745	1248	555	1754	585	260	0	0	6694
December	10964	3655	1624	247	82	37	4122	1374	611	1931	644	286	0	0	7367
Total (m^3/a)	118919	39640	17618	2678	893	397	44704	14901	6623	20938	6979	3102	0	0	79901

Water management plan for Cape Winelands Airport Continues for Phase PAL 2-2038

PAL 2 Requirement (m^3)															
PAL 1A Water Use (e.g., Industrial Use, Domestic Use, etc.)															
Months	Wash Facility			Club - Buildings only			Industrial			Parking Grounds (car park)			Garage and filling station		
	Potable Use	Non Potable Use (Toilets)	Non Potable Use (Irrigation)	Potable Use	Non Potable Use (Toilets)	Non Potable Use (Irrigation)	Potable Use	Non Potable Use (Toilets)	Non Potable Use (Irrigation)	Potable Use	Non Potable Use (Toilets)	Non Potable Use (Irrigation)	Potable Use	Non Potable Use (Toilets)	Non Potable Use (Irrigation)
January	0	0	0	0	0	0	556	185	82	0	0	0	210	70	31
February	0	0	0	0	0	0	561	187	83	0	0	0	212	71	31
March	0	0	0	0	0	0	626	209	93	0	0	0	237	79	35
April	0	0	0	0	0	0	621	207	92	0	0	0	235	78	35
May	0	0	0	0	0	0	557	186	83	0	0	0	210	70	31
June	0	0	0	0	0	0	499	166	74	0	0	0	188	63	28
July	0	0	0	0	0	0	597	199	88	0	0	0	225	75	33
August	0	0	0	0	0	0	583	194	86	0	0	0	220	73	33
September	0	0	0	0	0	0	600	200	89	0	0	0	227	76	34
October	0	0	0	0	0	0	583	194	86	0	0	0	220	73	33
November	0	0	0	0	0	0	600	200	89	0	0	0	227	76	34
December	0	0	0	0	0	0	654	218	97	0	0	0	247	82	37
Total (m^3/a)	0	0	0	0	0	0	7039	2346	1043	0	0	0	2658	886	394

Water management plan for Cape Winelands Airport Continues for Phase PAL 2-2038

PAL 2 Requirement (m³) — PAL 2 Water Use (e.g., Industrial Use, Domestic Use, etc.)															
	Demand (m³)								Supply (m³)						
Months	Terminal Building			Biodigester							Groundwater supply (m3) Treated to potable levels				
	Potable Use	Non Potable Use (Toilets)	Non Potable Use (Irrigation)	Non Potable Use (Irrigation)	Total Potable Requirement (m³/a)	Total Non-Potable Requirement (m3/a)	Municipal supply available	Municipal supply required	Municipal Supply (Back up to be installed only Potable)	On-Site Treated Sewer Effluent (m³) (treated to non-potable levels)	CWA_BH001	CWA_BH002	CWA_BH003	Total Potable Supply (m³/a)	Total Non-Potable Supply (m³/a)
January	5072	1691	751	5714	20493	21835	14325	7287	7287	21835	2544	6361	4300	27531	21835
February	5114	1705	758	5761	20664	22016	12939	8736	8736	22016	2298	5746	3884	24867	22016
March	5712	1904	846	6435	23080	24591	14325	9874	9874	24591	2544	6361	4300	27531	24591
April	5665	1888	839	6382	22889	24387	13863	10109	10109	24387	2462	6156	4161	26643	24387
May	5082	1694	753	5726	20536	21881	14325	7331	7331	21881	2544	6361	4300	27531	21881
June	4547	1516	674	5123	18375	19578	13863	5595	5595	19578	2462	6156	4161	26643	19578
July	5444	1815	807	6134	21999	23439	14325	8793	8793	23439	2544	6361	4300	27531	23439
August	5318	1773	788	5992	21490	22897	14325	8284	8284	22897	2544	6361	4300	27531	22897
September	5476	1825	811	6169	22126	23574	13863	9346	9346	23574	2462	6156	4161	26643	23574
October	5964	1988	883	6719	24000	25628	14325	10794	10794	25628	2544	6361	4300	27531	25628
November	5429	1810	804	6116	21942	23375	13863	9163	9163	23375	2462	6156	4161	26643	23375
December	5974	1991	885	6731	24139	25720	14325	10933	10933	25720	2544	6361	4300	27531	25720
Total (m³/a)	**64797**	**21599**	**9600**	**73000**	**261732**	**278920**			**106244**	**278920**	**29959**	**74898**	**50631**	**324159**	**278920**

Water management plan for Cape Winelands Airport Continues for Phase PAL 3-2044

PAL 3 Requirement (m³)																
PAL 3 Water Use (e.g., Industrial Use, Domestic Use, etc.)																
Months	Business/Commercial			Yard connection			Warehouse			Hotel			Park grounds only			
	Potable Use	Non Potable Use (Toilets)	Non Potable Use (Irrigation)	Potable Use	Non Potable Use (Toilets)	Non Potable Use (Irrigation)	Potable Use	Non Potable Use (Toilets)	Non Potable Use (Irrigation)	Potable Use	Non Potable Use (Toilets)	Non Potable Use (Irrigation)	Potable Use	Non Potable Use (Toilets)	Non Potable Use (Irrigation)	
January	10618	3539	1573	230	77	34	3831	1277	568	1639	546	243	0	0	6254	
February	10706	3569	1586	232	77	34	3863	1288	572	1652	551	245	0	0	6306	
March	11958	3986	1772	259	86	38	4315	1438	639	1846	615	273	0	0	7043	
April	11859	3953	1757	257	86	38	4279	1426	634	1830	610	271	0	0	6985	
May	10640	3547	1576	230	77	34	3839	1280	569	1642	547	243	0	0	6267	
June	9520	3173	1410	206	69	31	3435	1145	509	1469	490	218	0	0	5607	
July	11398	3799	1689	247	82	37	4113	1371	609	1759	586	261	0	0	6713	
August	11134	3711	1650	241	80	36	4018	1339	595	1719	573	255	0	0	6558	
September	11464	3821	1698	248	83	37	4137	1379	613	1769	590	262	0	0	6752	
October	12485	4162	1850	270	90	40	4505	1502	667	1927	642	285	0	0	7354	
November	11365	3788	1684	246	82	36	4101	1367	608	1754	585	260	0	0	6694	
December	12507	4169	1853	271	90	40	4513	1504	669	1931	644	286	0	0	7367	
Total (m³/a)	135655	45218	20097	2936	979	435	48950	16317	7252	20938	6979	3102	0	0	79901	

Water management plan for Cape Winelands Airport Continues for Phase PAL 3-2044

PAL 3 Requirement (m^3)															
PAL 3 Water Use (e.g., Industrial Use, Domestic Use, etc.)															
Months	Wash Facility			Club - Buildings only			Industrial			Parking Grounds (car park)			Garage and filling station		
	Potable Use	Non Potable Use (Toilets)	Non Potable Use (Irrigation)	Potable Use	Non Potable Use (Toilets)	Non Potable Use (Irrigation)	Potable Use	Non Potable Use (Toilets)	Non Potable Use (Irrigation)	Potable Use	Non Potable Use (Toilets)	Non Potable Use (Irrigation)	Potable Use	Non Potable Use (Toilets)	Non Potable Use (Irrigation)
January	0	0	0	0	0	0	556	185	82	0	0	0	210	70	31
February	0	0	0	0	0	0	561	187	83	0	0	0	212	71	31
March	0	0	0	0	0	0	626	209	93	0	0	0	237	79	35
April	0	0	0	0	0	0	621	207	92	0	0	0	235	78	35
May	0	0	0	0	0	0	557	186	83	0	0	0	210	70	31
June	0	0	0	0	0	0	499	166	74	0	0	0	188	63	28
July	0	0	0	0	0	0	597	199	88	0	0	0	225	75	33
August	0	0	0	0	0	0	583	194	86	0	0	0	220	73	33
September	0	0	0	0	0	0	600	200	89	0	0	0	227	76	34
October	0	0	0	0	0	0	583	194	86	0	0	0	220	73	33
November	0	0	0	0	0	0	600	200	89	0	0	0	227	76	34
December	0	0	0	0	0	0	654	218	97	0	0	0	247	82	37
Total (m^3/a)	0	0	0	0	0	0	7039	2346	1043	0	0	0	2658	886	394

Water management plan for Cape Winelands Airport Continues for Phase PAL 3-2044

PAL 3 Requirement (m^3)															
PAL 3 Water Use (e.g., Industrial Use, Domestic Use, etc.)															
					Demand (m^3)				Supply (m^3)						
Months	Terminal Building			Biodigester							Groundwater supply (m3) Treated to potable levels				
	Potable Use	Non Potable Use (Toilets)	Non Potable Use (Irrigation)	Non Potable Use (Irrigation)	Total Potable Requirement (m^3/a)	Total Non-Potable Requirement (m3/a)	Municipal supply available	Municipal supply required	Municipal Supply (Back up to be installed only Potable)	On-Site Treated Sewer Effluent (m^3) (treated to non-potable levels)	CWA_ BH001	CWA_ BH002	CWA_ BH003	Total Potable Supply (m^3/a)	Total Non-Potable Supply (m^3/a)
January	6364	2121	943	6285	23448	23829	14325	10242	10242	23829	2544	6361	4300	27531	23829
February	6417	2139	951	6337	23643	24027	12939	11715	11715	24027	2298	5746	3884	24867	24027
March	7167	2389	1062	7078	26407	26836	14325	13201	13201	26836	2544	6361	4300	27531	26836
April	7108	2369	1053	7020	26189	26614	13863	13409	13409	26614	2462	6156	4161	26643	26614
May	6377	2126	945	6298	23497	23879	14325	10291	10291	23879	2544	6361	4300	27531	23879
June	5706	1902	845	5635	21024	21365	13863	8244	8244	21365	2462	6156	4161	26643	21365
July	6831	2277	1012	6747	25171	25579	14325	11965	11965	25579	2544	6361	4300	27531	25579
August	6673	2224	989	6591	24589	24988	14325	11383	11383	24988	2544	6361	4300	27531	24988
September	6871	2290	1018	6786	25316	25727	13863	12536	12536	25727	2462	6156	4161	26643	25727
October	7483	2494	1109	7390	27474	27972	14325	14268	14268	27972	2544	6361	4300	27531	27972
November	6812	2271	1009	6727	25105	25509	13863	12325	12325	25509	2462	6156	4161	26643	25509
December	7496	2499	1111	7404	27619	28069	14325	14413	14325	28069	2544	6361	4300	27531	28069
Total (m^3/a)	**81304**	**27101**	**12045**	**80300**	**299481**	**304395**			**143905**	**304395**	**29959**	**74898**	**50631**	**324159**	**304395**

Water management plan for Cape Winelands Airport Continues for Phase PAL 4-2060

PAL 4 Requirement (m³)															
PAL 4 Water Use (e.g., Industrial Use, Domestic Use, etc.)															
Months	Business/Commercial			Yard connection			Warehouse			Hotel			Park grounds only		
	Potable Use	Non Potable Use (Toilets)	Non Potable Use (Irrigation)	Potable Use	Non Potable Use (Toilets)	Non Potable Use (Irrigation)	Potable Use	Non Potable Use (Toilets)	Non Potable Use (Irrigation)	Potable Use	Non Potable Use (Toilets)	Non Potable Use (Irrigation)	Potable Use	Non Potable Use (Toilets)	Non Potable Use (Irrigation)
January	10 618	3 539	1 573	241	80	36	3 831	1 277	568	1 639	546	243	0	0	7 877
February	10 706	3 569	1 586	243	81	36	3 863	1 288	572	1 652	551	245	0	0	7 942
March	11 958	3 986	1 772	271	90	40	4 315	1 438	639	1 846	615	273	0	0	8 871
April	11 859	3 953	1 757	269	90	40	4 279	1 426	634	1 830	610	271	0	0	8 798
May	10 640	3 547	1 576	241	80	36	3 839	1 280	569	1 642	547	243	0	0	7 893
June	9 520	3 173	1 410	216	72	32	3 435	1 145	509	1 469	490	218	0	0	7 063
July	11 398	3 799	1 689	258	86	38	4 113	1 371	609	1 759	586	261	0	0	8 456
August	11 134	3 711	1 650	252	84	37	4 018	1 339	595	1 719	573	255	0	0	8 260
September	11 464	3 821	1 698	260	87	38	4 137	1 379	613	1 769	590	262	0	0	8 504
October	12 485	4 162	1 850	283	94	42	4 505	1 502	667	1 927	642	285	0	0	9 262
November	11 365	3 788	1 684	258	86	38	4 101	1 367	608	1 754	585	260	0	0	8 431
December	12 507	4 169	1 853	283	94	42	4 513	1 504	669	1 931	644	286	0	0	9 279
Total (m³/a)	135 655	45 218	20 097	3 074	1 025	455	48 950	16 317	7 252	20 938	6 979	3 102	0	0	100 635

Water management plan for Cape Winelands Airport Continues for Phase 4-2060

PAL 4 Requirement (m^3)															
PAL 4 Water Use (e.g., Industrial Use, Domestic Use, etc.)															
Months	Wash Facility			Club - Buildings only			Industrial			Parking Grounds (car park)			Garage and filling station		
	Potable Use	Non Potable Use (Toilets)	Non Potable Use (Irrigation)	Potable Use	Non Potable Use (Toilets)	Non Potable Use (Irrigation)	Potable Use	Non Potable Use (Toilets)	Non Potable Use (Irrigation)	Potable Use	Non Potable Use (Toilets)	Non Potable Use (Irrigation)	Potable Use	Non Potable Use (Toilets)	Non Potable Use (Irrigation)
January	0	0	0	0	0	0	556	185	82	0	0	0	210	70	31
February	0	0	0	0	0	0	561	187	83	0	0	0	212	71	31
March	0	0	0	0	0	0	626	209	93	0	0	0	237	79	35
April	0	0	0	0	0	0	621	207	92	0	0	0	235	78	35
May	0	0	0	0	0	0	557	186	83	0	0	0	210	70	31
June	0	0	0	0	0	0	499	166	74	0	0	0	188	63	28
July	0	0	0	0	0	0	597	199	88	0	0	0	225	75	33
August	0	0	0	0	0	0	583	194	86	0	0	0	220	73	33
September	0	0	0	0	0	0	600	200	89	0	0	0	227	76	34
October	0	0	0	0	0	0	654	218	97	0	0	0	247	82	37
November	0	0	0	0	0	0	595	198	88	0	0	0	225	75	33
December	0	0	0	0	0	0	655	218	97	0	0	0	247	82	37
Total (m^3/a)	0	0	0	0	0	0	7 106	2 369	1 053	0	0	0	2 683	894	397

Water management plan for Cape Winelands Airport Continues for Phase 4-2060

PAL 4 Requirement (m³)															
PAL 4 Water Use (e.g., Industrial Use, Domestic Use, etc.)															
					Demand (m³)				Supply (m³)						
Months	Terminal Building			Biodigester	Total Potable Requirement (m³/a)	Total Non-Potable Requirement (m3/a)	Municipal supply available	Municipal supply required	Municipal Supply (Back up to be installed only Potable)	On-Site Treated Sewer Effluent (m³) (treated to non-potable levels)	Groundwater supply (m3) Treated to potable levels			Total Potable Supply (m³/a)	Total Non-Potable Supply (m³/a)
	Potable Use	Non Potable Use (Toilets)	Non Potable Use (Irrigation)	Non Potable Use (Irrigation)							CWA_ BH001	CWA_ BH002	CWA_ BH003		
January	7 521	2 507	1 114	6 285	24 616	26 014	14 325	11 410	11 410	26 014	2 544	6 361	4 300	27 531	26 014
February	7 583	2 528	1 123	6 337	24 820	26 230	12 939	12 893	12 893	26 230	2 298	5 746	3 884	24 867	26 230
March	8 470	2 823	1 255	7 078	27 722	29 297	14 325	14 517	14 325	29 297	2 544	6 361	4 300	27 531	29 297
April	8 400	2 800	1 244	7 020	27 493	29 055	13 863	14 713	13 863	29 055	2 462	6 156	4 161	26 643	29 055
May	7 537	2 512	1 117	6 298	24 668	26 069	14 325	11 462	11 462	26 069	2 544	6 361	4 300	27 531	26 069
June	6 743	2 248	999	5 635	22 071	23 325	13 863	9 291	9 291	23 325	2 462	6 156	4 161	26 643	23 325
July	8 073	2 691	1 196	6 747	26 424	27 925	14 325	13 218	13 218	27 925	2 544	6 361	4 300	27 531	27 925
August	7 887	2 629	1 168	6 591	25 813	27 280	14 325	12 607	12 607	27 280	2 544	6 361	4 300	27 531	27 280
September	8 120	2 707	1 203	6 786	26 577	28 087	13 863	13 797	13 797	28 087	2 462	6 156	4 161	26 643	28 087
October	8 843	2 948	1 310	7 390	28 944	30 589	14 325	15 739	14 325	30 589	2 544	6 361	4 300	27 531	30 589
November	8 050	2 683	1 193	6 727	26 348	27 844	13 863	13 568	13 568	27 844	2 462	6 156	4 161	26 643	27 844
December	8 859	2 953	1 312	7 404	28 996	30 643	14 325	15 790	14 325	30 643	2 544	6 361	4 300	27 531	30 643
Total (m³/a)	**96 086**	**32 029**	**14 235**	**80 300**	**314 493**	**332 358**			**155 086**	**332 358**	**29 959**	**74 898**	**50 631**	**324 159**	**332 358**

Appendix B: Borehole log (CWA_BH002)

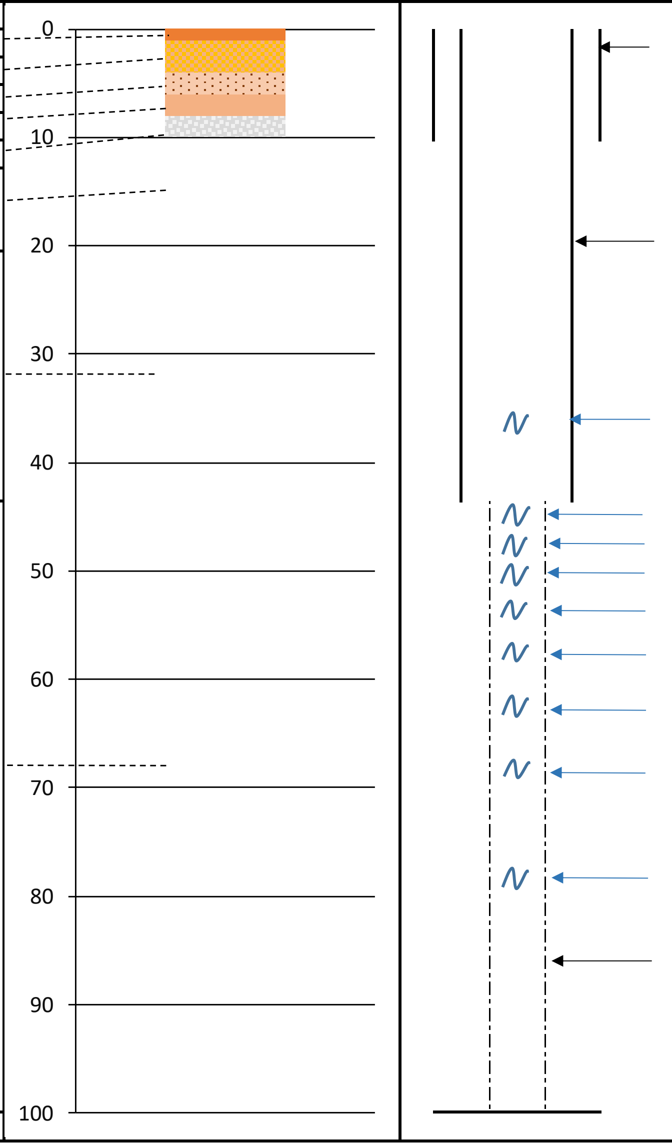
Log of Borehole No.: CWA_BH002

Location:	Cape Winelands Airport	**Latitude:**	-33.76876
Date:	02-Nov-22	**Longitude:**	18.732067
Client:	Capital Expendature Projects	**Ground Elevation:**	123 mamsl

Lithological Description | **Lithology Symbol & Depth (m)** | **Borehole Construction** | **Description & water strike**

Lithological Description

- Overburden (0 - 1 m)
- Red-brown clay (1 - 4 m)
- Quartz-rich sand (4 - 6 m)
- Yellow-orange clay (6 - 8 m)
- Quartzitic gravel (8 - 10 m)
- Light-grey - white clay (10 - 20 m)
- Grey-green highly weathered shale (20 - 43 m)
- Dark-green shale with quartz veining in places (43 - 100 m).



Description & water strike

304 mm Normal air percussion drilling & 273 mm solid steel casing (0 - 8 m)

254 mm Normal air percussion drilling & 219 mm solid steel casing (0 - 40 m)

Water strike at 37 m

Water strike at 43 m
Water strike at 47 m
Water strike at 50 m
Water strike at 54 m
Water strike at 58 m
Water strike at 61 m
Water strike at 69 m
Water strike at 79 m

203 mm Normal air percussion drilling with open borehole construction (43 - 100 m)

End of borehole at 100 m

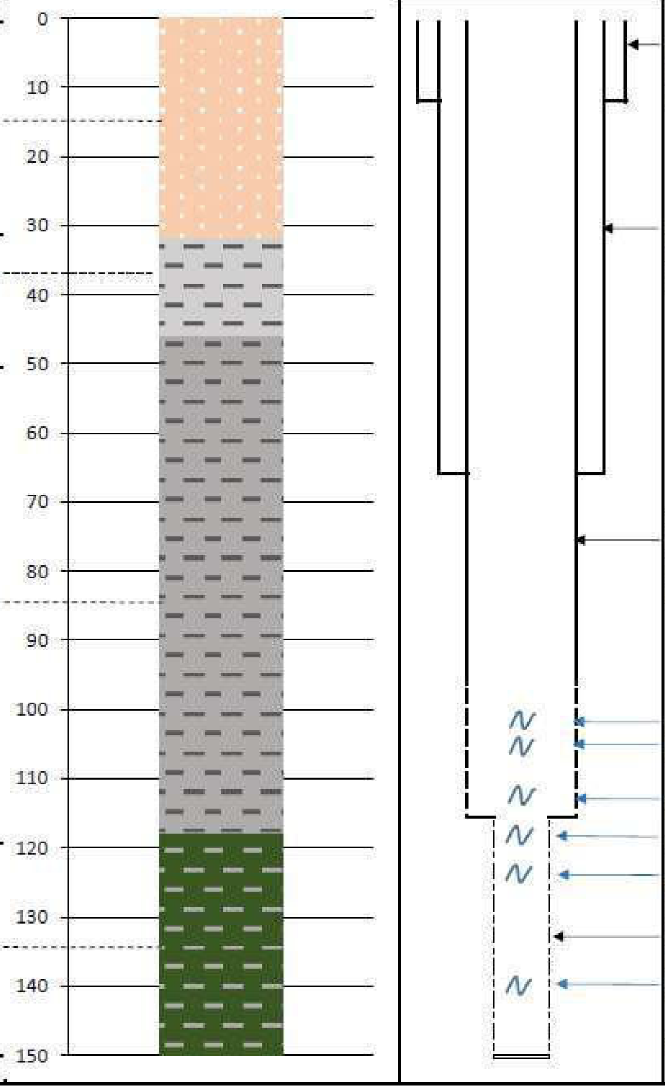
Drilled By:	Gerritsen Drilling SA	**Remarks:**	Airlift yield = 44 000 L/h
Drill Method:	Air percussion		
Logged By:	GEOSS South Africa		

GEOSS SOUTH AFRICA (Pty) Ltd

Log of Borehole No.: CWA_BH003

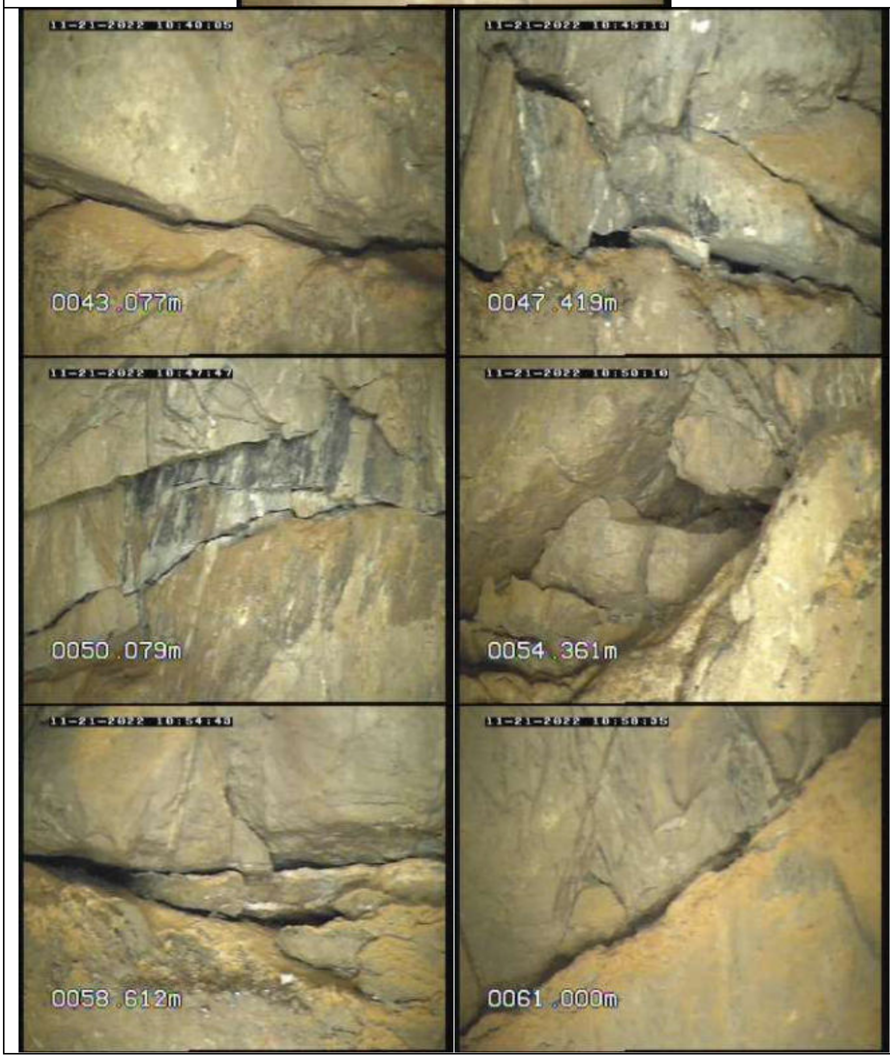
Location:	Cape Winelands Airport	**Latitude:**	-33.774037
Date:	05-Nov-24	**Longitude:**	18.747742
Client:	Capital Expendature Projects	**Ground Elevation:**	126 mamsl

Lithological Description	Lithology Symbol & Depth (m)	Borehole Construction	Description & water strike
Overburden and clay (0 - 32 m)			304 mm Normal air percussion drilling & 273 mm solid steel casing (0 - 12 m)
Highly weathered light grey shale (32 - 46 m)			254 mm Normal air percussion drilling & 219 mm solid steel casing (0 - 65 m)
Highly weathered light grey shale (46 - 118 m)			223 mm Normal air percussion drilling & 177 mm solid steel casing, perforated from 95 - 114 m (0 - 114 m)
			Water strike at 101 m
			Water strike at 105 m
			Water strike at 112 m
			Water strike at 117 m
Competent dark green-grey shale with occasional quart veining (118 - 150 m)			Water strike at 123 m
			165 mm Normal air percussion drilling with open borehole construction (114 - 150 m)
			Water strike at 140 m
			End of borehole at 150 m



Drilled By:	Gerritsen Drilling SA	**Remarks:**	Airlift yield = 23 000 L/h
Drill Method:	Air percussion		
Logged By:	GEOSS South Africa		

Appendix C: Camera Logging

CWA_BH002 Camera Logging – 21 November 2022	
	The camera log was conducted to confirm the borehole construction and fracture depths. The water level during the camera logging was at 15.19 mbgl. The water was turbid during the camera logging.
	A 273 mm steel casing has been installed to a depth of 8 mbgl. A secondary 219 mm steel casing has been installed to a depth of 40.76 mbgl. The 219 mm steel casing is properly seated in the bedrock and all joints are correctly welded.
	Several large fractures were observed during the camera logging. all corresponding to the information obtained during the drilling. The main fractures were observed at 43. 47. 50. 54. 58 and 61 mbgl. These fractures are likely to be the main water bearing fractures.

 	Two deeper fractures were observed at 69 and 79 mbgl. Although the drilling indicated that these fractures were water bearing. they are not considered as part of the primary water bearing fractures.
	Quartz veining was observed at several depths within the borehole.
	The borehole was logged to a depth of 100.4 mbgl.

Appendix D: Scientific Yield Testing & Borehole Photo

Abbreviations	
EC	Electrical conductivity
mbgl	Meters below ground level
mbch	Meters below casing height
mbdl	Meters below datum level
magl	Meters above ground level
L/S	Litres per second
RPM	Rates per minute
S/W/L	Static water level
µS/cm	Microsiemens per centimetre

ATS

BOREHOLE TEST RECORD

PR0JECT #	P2647
BBR	ERNST
PRODUCTION BONUS:	THABANG
	TINASHE
	MARTIN
EC meter number	#151

CONSULTANT: GEOSS

DISTRICT: COCT

PROVINCE: WESTERN CAOE

FARM / VILLAGE NAME : FISANTEKRAAL

DATE TESTED: 05/04/2022

MAP REFERENCE:

CO-ORDINATES:

FORMAT ON GPS: hddd ° mm ' ss.s " OR hddd ° mm.mmm ' OR hddd.ddddd

LATITUDE: ° ' " OR ° ' OR S 33.76452

LONGITUDE: ° ' " OR ° ' OR E 018.73271

BOREHOLE NO: CWA-EAST BOREHOLE

TRANSMISSIVITY VALUE:

TYPE INSTALLATION: SUBMERSIBLE

BOREHOLE DEPTH: (mbgl) 100.44

COMMENTS: INSTALLED 94.00 O PIEZOMETER TUBE (32MM)

SAMPLE INSTRUCTIONS :

Water sample taken	Yes	No	Test for:	macro	bacterio-logical	
Date sample taken	07/04/2022		If consultant took sample, give name:			
Time sample taken	07H30					

DATA CAPTURED BY:	ZOE
DATA CHECKED BY:	AVN

CONSULTANT GUIDELINES

BOREHOLE DEPTH:		m	STEP 1:		l/s	WATER STRIKE 1:			m
BLOW YIELD:		m	STEP 2:		l/s	WATER STRIKE 2:			m
STATIC WATER LEVEL:		m	STEP 3:		l/s	WATER STRIKE 3:			m
PUMP INSTALLATION DEPTH:		m	STEP 4:		l/s	**COMMENTS:**			
RECOVERY:			STEP 5:		l/s				
AFTER STEPS:		h	STEP 6:		l/s	TELEPHONE NUMBERS PHONE : (NAME & TEL)			
AFTER CONSTANT:		h	STEP DURATION:		min				

DESCRIPTION:	**UNIT**	**QTY**		**UNIT**	**QTY**
STRAIGHTNESS TEST:	**NO**	0	BOREHOLE DEPTH AFTER TEST:	**M**	100.81
VERTICALLY TEST:	**NO**	0	BOREHOLE WATER LEVEL AFTER TEST: (mbch)	**M**	41.23
CASING DETECTION:	**NO**	1	SAND/GRAVEL/SILT PUMPED?	**YES/NO**	**0**
SUPPLIED NEW STEEL BOREHOLE COVER:	**NO**	0	DATA REPORTING AND RECORDING	**NO**	1
BOREHOLE MARKING	**NO**	1	SLUG TEST:	**NO**	0
SITE CLEANING & FINISHING	**NO**	1	LAYFLAT (M):	**M**	100
LOGGERS FOR WATERLEVEL MONITORING	**NO**	0	LOGGERS FOR pH AND EC:	**NO**	0

It is hereby acknowledged that upon leaving the site, all existing equipment is in an acceptable condition.

NAME: ________________ **SIGNATURE:** ______________

DESIGNATION: ________________ **DATE:** ______________

BOREHOLE TEST CONTROL SHEET

Groundwater Solutions t/a AB PUMPS

Borehole number:		CWA-EAST BOREHOLE	Old / Alternative number:		
Contractor:		ATS	Supervisor:		ERNST
Operator:		THABNAG	Rig number & Type rig:		#27

EXISTING EQUIPMENT

Type pump	Depth	Condition	Drive unit	Condition	Pump house	Condition	Remarks
SUBMERSIBL	93.8	GOOD	ELECTRIC	GOOD			

TESTING EQUIPMENT

Pump type	Depth installed (m)	Date & time (started)	Date & time (completed)
WA22-2	89.80	05/04/2022 12H30	05/04/2022 18H30

MULTI-RATE OR STEPTEST DETAILS

STEP	DURATION (MIN)	RECOVERY (MIN)	YIELD (L/S)		DRAWDOWN (m)
1	60		0.53	l/s	4.36
2	60		2.01	l/s	16.33
3	60		3.02	l/s	25.26
4	60	120	4.02	l/s	36..41
5				l/s	
6				l/s	
7				l/s	
8				l/s	
Calibration:				l/s	
TOTAL:	240	120		l/s	

COMMENT:

CONSTANT RATE DISCHARGE TEST

Pump type	Depth installed (m)	Date & time (started)		Date & time (completed)	
WA22-2	89.80	06/04/2022	08H00	08/04/2022	08H00
Yield l/s	**Drawdown (m)**	**Duration (min)**		**Recovery (min)**	
3.31	42.97	1440		1440	
Total: (Multi-rate and Constant Discharge rate)		1680		1560	

COMMENT:

MAINTENANCE

Work time:	hour	Transport existing equipm.	Km	Travelling (To fix);	Km

List of parts replaced or repaired:

	Borehole number	Duration (min) CONSTANT	Drawdown (m)	Hand/logger	Distance (m)
Observation Hole 1					0
Observation Hole 2					0
Observation Hole 3					0
Observation Hole 4					
Observation Hole 5					

GENERAL

ESTABLISHMENT	From:		To:			
Site Move	From project#		To #:	P2647	Travelling km:	17
	Village	Borehole no	Village	Borehole no		
	YARD	YARD	FISANTEKRAAL	CWA-EAST BOREHOLE		
Maintenance:	Work time hr		Parts repaired/ replaced		Travelling km	
After test measurements	Water level	41.23	Borehole depth	100.81	Casing depth m	RUST
Water level before installing test pump: (mbch)			40.62			
Depth before installing test pump:			100.44			
Testpump Installed	**Once** /Twice /More		Reason:			
Installed Testpump	**<10 l/s** / >10ls/s		Reason:	LOW YIELD		
Was existing equipment re-installed:		**Yes:**	No:	If not where was it left:		
GPS Unit number:			GARMIN			
EC Unit number:			#151			
Remarks:						
Signed Contractor:				Signed Consultant:		

FORM 5 E

STEPPED DISCHARGE TEST & RECOVERY

BOREHOLE TEST RECORD SHEET

PROJ NO :	P2647	MAP REFERENCE:		PROVINCE:	WESTERN CAOE
BOREHOLE NO:	CWA-EAST BOR	LATITUDE:	S 33.76452	DISTRICT:	COCT
ALT BH NO:	0	LONGITUDE:	E 018.73271	SITE NAME:	FISANTEKRAAL
ALT BH NO:	0				
BOREHOLE DEPTH (m)	100.44	DATUM LEVEL ABOVE CASING (m):	0.30	EXISTING PUMP:	
WATER LEVEL (mbdl):	40.90	CASING HEIGHT: (magl):	0.28	CONTRACTOR:	ATS
DEPTH OF PUMP (m):	89.80	DIAM PUMP INLET (mm):	158.00	PUMP TYPE:	WA22-2

STEPPED DISCHARGE TEST & RECOVERY

DISCHARGE RATE 1 — RPM 298 — DATE: 05/04/2022 TIME: 12H30

TIME (MIN)	DRAW DOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)
1	0.77		1	
2	0.81		2	
3	0.87		3	
5	0.94		5	
7	1.02		7	
10	1.05	0.38	10	
15	1.46	0.48	15	
20	1.98	0.51	20	
30	3.40	0.55	30	
40	3.75		40	
50	4.04	0.53	50	
60	4.36		60	
70			70	
80			80	
90			90	
100			100	
110			110	
120			120	
pH			150	
TEMP		°C	180	
EC	1	µS/cm	210	

DISCHARGE RATE 2 — RPM 670 — DATE: 05/04/2022 TIME: 13H30

TIME (MIN)	DRAW DOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)
1	4.89		1	
2	5.52		2	
3	6.40	1.47	3	
5	7.23	1.68	5	
7	9.14		7	
10	10.59	2.03	10	
15	11.63		15	
20	12.76	2.01	20	
30	13.60		30	
40	15.00	2.03	40	
50	15.74		50	
60	16.33	2.01	60	
70			70	
80			80	
90			90	
100			100	
110			110	
120			120	
pH			150	
TEMP		°C	180	
EC	1	µS/cm	210	

DISCHARGE RATE 3 — RPM 904 — DATE: 05/04/2022 TIME: 14H30

TIME (MIN)	DRAW DOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)
1	17.09		1	
2	17.54	2.88	2	
3	18.31	3.03	3	
5	19.80		5	
7	20.67	3.01	7	
10	21.11		10	
15	21.75	3.02	15	
20	22.59		20	
30	23.47	3.04	30	
40	24.19		40	
50	24.89	3.02	50	
60	25.26		60	
70			70	
80			80	
90			90	
100			100	
110			110	
120			120	
pH			150	
TEMP		°C	180	
EC	1	µS/cm	210	

DISCHARGE RATE 4 — RPM 1154 — DATE: 05/04/2022 TIME: 15H30

TIME (MIN)	DRAW DOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)
1	23.12		1	32.48
2	26.94		2	29.29
3	27.38	3.77	3	25.27
5	29.41	4.03	5	22.37
7	30.54		7	19.24
10	31.04	4.02	10	17.81
15	31.67		15	16.21
20	32.48	4.05	20	15.13
30	33.61		30	13.82
40	34.66	4.03	40	12.53
50	35.27		50	11.16
60	36.41	4.02	60	10.29
70			70	10.01
80			80	9.82
90			90	8.37
100			100	8.03
110			110	7.74
120			120	7.21
pH			150	
TEMP		°C	180	
EC	1	µS/cm	210	
			240	
			300	
			360	

DISCHARGE RATE 5 — RPM — DATE: TIME:

TIME (MIN)	DRAW DOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)
1			1	
2			2	
3			3	
5			5	
7			7	
10			10	
15			15	
20			20	
30			30	
40			40	
50			50	
60			60	
70			70	
80			80	
90			90	
100			100	
110			110	
120			120	
pH			150	
TEMP		°C	180	
EC		µS/cm	210	
			240	
			300	
			360	

DISCHARGE RATE 6 — RPM — DATE: TIME:

TIME (MIN)	DRAW DOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)
1			1	
2			2	
3			3	
5			5	
7			7	
10			10	
15			15	
20			20	
30			30	
40			40	
50			50	
60			60	
70			70	
80			80	
90			90	
100			100	
110			110	
120			120	
pH			150	
TEMP		°C	180	
EC		µS/cm	210	
			240	
			300	
			360	

S/W/L:(mbch) 40.62

FORM 5 F

CONSTANT DISCHARGE TEST & RECOVERY

BOREHOLE TEST RECORD SHEET

PROJ NO :	P2647	MAP REFERENCE:	S 33.76452	PROVINCE:	WESTERN CAOE
BOREHOLE NO:	CWA-EAST BOREHOLE		E 018.73271	DISTRICT:	COCT
ALT BH NO:	0			SITE NAME:	FISANTEKRAAL
ALT BH NO:	0				
BOREHOLE DEPTH:	100.44	DATUM LEVEL ABOVE CASING (m):	0.30	EXISTING PUMP:	0
WATER LEVEL (mbdl):	42.80	CASING HEIGHT: (magl):	0.28	CONTRACTOR:	ATS
DEPTH OF PUMP (m):	89.80	DIAM PUMP INLET(mm):	158	PUMP TYPE:	WA22-2

CONSTANT DISCHARGE TEST & RECOVERY

TEST STARTED				**TEST COMPLETED**					
DATE:	06/04/2022	TIME:	08H00	DATE:		TIME:		TYPE OF PUMP:	WA22-2

DISCHARGE BOREHOLE					OBSERVATION HOLE 1 NR: Distance(m);			OBSERVATION HOLE 2 NR: Distance(m);			OBSERVATION HOLE 3 NR: Distance(m);	
TIME (MIN)	DRAW DOWN (M)	YIELD (L/S)	TIME MIN	RECOVERY (M)	TIME: (min)	Drawdown m	Recovery (m)	TIME: (min)	Drawdown (m)	Recovery (m)	TIME: (min)	Drawdown (m)
1	1.77		**1**	37.09	**1**			**1**			**1**	
2	2.58		**2**	35.60	**2**			**2**			**2**	
3	3.10	2.82	**3**	35.21	**3**			**3**			**3**	
5	7.32	3.31	**5**	34.75	**5**			**5**			**5**	
7	9.57		**7**	33.81	**7**			**7**			**7**	
10	12.94	3.33	**10**	32.34	**10**			**10**			**10**	
15	15.58		**15**	30.91	**15**			**15**			**15**	
20	17.51	3.30	**20**	27.38	**20**			**20**			**20**	
30	19.03		**30**	25.21	**30**			**30**			**30**	
40	20.69	3.32	**40**	23.72	**40**			**40**			**40**	
60	23.23		**60**	20.34	**60**			**60**			**60**	
90	25.93	3.30	**90**	17.82	**90**			**90**			**90**	
120	27.88		**120**	15.16	**120**			**120**			**120**	
150	30.32	3.32	**150**	14.91	**150**			**150**			**150**	
180	31.52		**180**	13.38	**180**			**180**			**180**	
210	32.69	3.33	**210**	12.53	**210**			**210**			**210**	
240	33.72		**240**	11.06	**240**			**240**			**240**	
300	34.39	3.31	**300**	9.55	**300**			**300**			**300**	
360	35.61		**360**	7.86	**360**			**360**			**360**	
420	36.92	3.33	**420**	6.50	**420**			**420**			**420**	
480	38.12		**480**	6.12	**480**			**480**			**480**	
540	39.97	3.32	**540**	5.29	**540**			**540**			**540**	
600	41.33		**600**	5.01	**600**			**600**			**600**	
720	42.07	3.30	**720**	4.12	**720**			**720**			**720**	
840	42.23		**840**	3.46	**840**			**840**			**840**	
960	42.41	3.32	**960**	3.04	**960**			**960**			**960**	
1080	42.67		**1080**	2.59	**1080**			**1080**			**1080**	
1200	42.79	3.30	**1200**	1.84	**1200**			**1200**			**1200**	
1320	42.88		**1320**	1.09	**1320**			**1320**			**1320**	
1440	42.97	3.31	**1440**	0.96	**1440**			**1440**			**1440**	
1560			**1560**		**1560**			**1560**			**1560**	
1680			**1680**		**1680**			**1680**			**1680**	
1800			**1800**		**1800**			**1800**			**1800**	
1920			**1920**		**1920**			**1920**			**1920**	
2040			**2040**		**2040**			**2040**			**2040**	
2160			**2160**		**2160**			**2160**			**2160**	
2280			**2280**		**2280**			**2280**			**2280**	
2400			**2400**		**2400**			**2400**			**2400**	
2520			**2520**		**2520**			**2520**			**2520**	
2640			**2640**		**2640**			**2640**			**2640**	
2760			**2760**		**2760**			**2760**			**2760**	
2880			**2880**		**2880**			**2880**			**2880**	
3000			**3000**		**3000**			**3000**			**3000**	
3120			**3120**		**3120**			**3120**			**3120**	
3240			**3240**		**3240**			**3240**			**3240**	
3360			**3360**		**3360**			**3360**			**3360**	
3480			**3480**		**3480**			**3480**			**3480**	
3600			**3600**		**3600**			**3600**			**3600**	
3720			**3720**		**3720**			**3720**			**3720**	
3840			**3840**		**3840**			**3840**			**3840**	
3960			**3960**		**3960**			**3960**			**3960**	
4080			**4080**		**4080**			**4080**			**4080**	
4200			**4200**		**4200**			**4200**			**4200**	
4320			**4320**		**4320**			**4320**			**4320**	
Total time pumped(min):				1440		**W/L**			**W/L**			**W/L**
Average yield (l/s):				3.31								

Abbreviations	
EC	Electrical conductivity
mbgl	Meters below ground level
mbch	Meters below casing height
mbdl	Meters below datum level
magl	Meters above ground level
L/S	Litres per second
RPM	Rates per minute
S/W/L	Static water level
µS/cm	Microsiemens per centimeter

BOREHOLE TEST RECORD

PR0JECT #	P2746
TEAM MEMBERS	

CONSULTANT: GEOSS
DISTRICT: REUBEN
PROVINCE: WESTERN CAPE
FARM / VILLAGE NAME : WINELANDS AIRFIELD
DATE TESTED: 22-11-2022

BOREHOLE LOCATION & ACCESS INFORMATION:

BOREHOLE COORDINATES		**COMMENTS ON ACCESS IF ANY:**
LATITUDE (SOUTH):	S33.768800	
LONGITUDE (EAST):	E18.731861	
BOREHOLE NO:	**CWA-BH002**	
TRANSMISSIVITY VALUE:		
TYPE INSTALLATION:	**NEW BOREHOLE**	
BOREHOLE DEPTH: (mbg	**100.1**	

MAINTENANCE RECORD:		**REHABILITATION RECORD:**		**DIGITAL CAMERA LOGGING:**		**EQUIPMENT FISHING RECORD**	
Labour hours:		**Jetting hours:**		**Camera logged once:**		**Hours spent:**	
Cost of material:		**Brushing hours:**		**Camera logged twice:**			
Travelling (km):		**Airlifting hours:**		**Camera logged three times:**		**OTHER COSTS ON PROJECT:**	
		Sulphamic Acid KG's		**Camera work sent to client:**		**Courier of samples:**	
		Boresaver KG's				**Km's for delivery:**	
		Soda Ash KG's				**Cost of packaging:**	

COMMENTS:	**RECOMMENDATIONS / CORRECTIVE ACTIONS:**

SAMPLE INSTRUCTIONS :

Water sample taken	**Yes**	No	If consultant took sample, give name:		**DATA CAPTURED BY**	AVN
Date sample taken	24-11-2022		If sample courier, to where:		**DATA CHECKED BY:**	AVN
Time sample taken	16H00					

DESCRIPTION:	**UNIT**	**QTY**		**UNIT**	**QTY**
STRAIGHTNESS TEST:	**NO**	0	BOREHOLE DEPTH AFTER TEST:	**M**	100.10
VERTICALLY TEST:	**NO**	0	BOREHOLE WATER LEVEL AFTER TEST: (mbch)	**M**	26.23
CASING DETECTION:	**NO**	0	SAND/GRAVEL/SILT PUMPED?	**YES/NO**	**0**
SUPPLIED NEW STEEL BOREHOLE COVER:	**NO**	0	DATA REPORTING AND RECORDING	**NO**	1
BOREHOLE MARKING	**NO**	0	SLUG TEST:	**NO**	0
SITE CLEANING & FINISHING	**NO**	1	LAYFLAT (M):	**M**	150
LOGGERS FOR WATERLEVEL MONITORING	**NO**	0	LOGGERS FOR pH AND EC:	**NO**	0

It is hereby acknowledged that upon leaving the site, all existing equipment is in an acceptable condition.

NAME: ______________________ **SIGNATURE:** ______________________

DESIGNATION: ______________________ **DATE:** ______________________

FORM 5 E

STEPPED DISCHARGE TEST & RECOVERY

BOREHOLE TEST RECORD SHEET

PROJ NO :	P2746	Coordinates: SOUTH:	S33.768800	PROVINCE:	WESTERN CAPE
BOREHOLE NO:	CWA-BH002	EAST:	E18.731861	DISTRICT:	REUBEN
ALT BH NO:	0			SITE NAME:	WINELANDS AIRFIELD
ALT BH NO:	0				
BOREHOLE DEPTH (m)	100.10	DATUM LEVEL ABOVE CASING (m):	0.64	EXISTING PUMP:	0
WATER LEVEL (mbdl):	16.77	CASING HEIGHT: (magl):	0.00	CONTRACTOR:	ATS
DEPTH OF PUMP (m):	82.30	DIAM PUMP INLET (mm):	170.00	PUMP TYPE:	WA110-2

STEPPED DISCHARGE TEST & RECOVERY

DISCHARGE RATE 1			RPM	
DATE:	22-11-2022	TIME:	07H30	
TIME (MIN)	DRAW DOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)
1	1.21		**1**	
2	1.40		**2**	
3	2.34	3.51	**3**	
5	2.56	5.73	**5**	
7	4.76		**7**	
10	5.82	6.31	**10**	
15	6.52		**15**	
20	6.98	6.29	**20**	
30	7.53		**30**	
40	7.93	6.30	**40**	
50	8.11		**50**	
60	8.43	6.31	**60**	
70			**70**	
80			**80**	
90			**90**	
100			**100**	
110			**110**	
120			**120**	
pH			**150**	
TEMP		°C	**180**	
EC		µS/cm	**210**	

DISCHARGE RATE 2			RPM	
DATE:	22-11-202	TIME:	08H30	
TIME (MIN)	DRAW DOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)
1	8.76		**1**	
2	10.83	8.39	**2**	
3	10.98	9.41	**3**	
5	12.13		**5**	
7	12.23	9.38	**7**	
10	12.41		**10**	
15	12.88	9.43	**15**	
20	13.22		**20**	
30	13.59	9.25	**30**	
40	13.94		**40**	
50	14.19	9.21	**50**	
60	14.33		**60**	
70			**70**	
80			**80**	
90			**90**	
100			**100**	
110			**110**	
120			**120**	
pH			**150**	
TEMP		°C	**180**	
EC		µS/cm	**210**	

DISCHARGE RATE 3			RPM	
DATE:	22-11-202	TIME:	09H30	
TIME (MIN)	DRAW DOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)
1	14.40		**1**	
2	16.86	13.01	**2**	
3	18.64	14.12	**3**	
5	19.91		**5**	
7	20.33	14.09	**7**	
10	21.10		**10**	
15	21.73	14.18	**15**	
20	22.87		**20**	
30	23.68	14.18	**30**	
40	24.31		**40**	
50	24.74	14.13	**50**	
60	25.20		**60**	
70			**70**	
80			**80**	
90			**90**	
100			**100**	
110			**110**	
120			**120**	
pH			**150**	
TEMP		°C	**180**	
EC		µS/cm	**210**	

DISCHARGE RATE 4			RPM	
DATE:	22-11-2022	TIME:	10H30	
TIME (MIN)	DRAW DOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)
1	26.66		**1**	
2	28.95		**2**	
3	30.84	19.77	**3**	
5	34.18	20.31	**5**	
7	35.29		**7**	
10	36.37	20.34	**10**	
15	37.80		**15**	
20	38.78	20.32	**20**	
30	42.77		**30**	
40	44.40	20.27	**40**	
50	45.02		**50**	
60	46.16	20.30	**60**	
70			**70**	
80			**80**	
90			**90**	
100			**100**	
110			**110**	
120			**120**	
pH			**150**	
TEMP		°C	**180**	
EC		µS/cm	**210**	
			240	
			300	
			360	

DISCHARGE RATE 5			RPM	
DATE:	22-11-202	TIME:	11H30	
TIME (MIN)	DRAW DOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)
1	53.94		**1**	31.50
2	56.06	23.31	**2**	26.18
3	58.27	23.35	**3**	21.63
5	61.12		**5**	17.04
7	62.83	23.29	**7**	14.67
10	65.53		**10**	13.06
	65.53	19.09	**15**	11.27
	65.53	18.26	**20**	10.16
	65.53	18.04	**30**	8.53
			40	7.72
			50	7.09
			60	6.68
			70	6.25
			80	5.96
			90	5.65
			100	5.45
			110	5.30
			120	5.06
pH			**150**	4.65
TEMP		°C	**180**	4.37
EC		µS/cm	**210**	4.13
			240	3.92
			250	3.85
			360	

DISCHARGE RATE 6			RPM	
DATE:		TIME:		
TIME (MIN)	DRAW DOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)
1			**1**	
2			**2**	
3			**3**	
5			**5**	
7			**7**	
10			**10**	
15			**15**	
20			**20**	
30			**30**	
40			**40**	
50			**50**	
60			**60**	
70			**70**	
80			**80**	
90			**90**	
100			**100**	
110			**110**	
120			**120**	
pH			**150**	
TEMP		°C	**180**	
EC		µS/cm	**210**	
			240	
			300	
			360	

S/W/L:(mbch) 15.29

FORM 5 F

CONSTANT DISCHARGE TEST & RECOVERY

BOREHOLE TEST RECORD SHEET

PROJ NO :	P2746	Coordinates: SOUTH:	S33.768800	PROVINCE:	WESTERN CAPE
BOREHOLE NO:	CWA-BH002	EAST:	E18.731861	DISTRICT:	REUBEN
ALT BH NO:	0			SITE NAME:	WINELANDS AIRFIELD
ALT BH NO:	0				
BOREHOLE DEPTH:	100.10	DATUM LEVEL ABOVE CASING (m):	0.64	EXISTING PUMP:	0
WATER LEVEL (mbdl):	20.62	CASING HEIGHT: (magl):	0.00	CONTRACTOR:	ATS
DEPTH OF PUMP (m):	82.30	DIAM PUMP INLET(mm):	170	PUMP TYPE:	WA110-2

CONSTANT DISCHARGE TEST & RECOVERY

TEST STARTED				**TEST COMPLETED**					
DATE:	22-11-2022	TIME:	16H10	DATE:		TIME:		TYPE OF PUMP:	WA110-2

DISCHARGE BOREHOLE					OBSERVATION HOLE 1 NR: Distance(m);			OBSERVATION HOLE 2 NR: Distance(m);			OBSERVATION HOLE 3 NR: Distance(m);	
TIME (MIN)	DRAW DOWN (M)	YIELD (L/S)	TIME MIN	RECOVERY (M)	TIME: (min)	Drawdown m	Recovery (m)	TIME: (min)	Drawdown (m)	Recovery	TIME: (min)	Drawdown (m)
1	4.02		**1**	34.65	**1**			**1**			**1**	
2	7.40		**2**	28.92	**2**			**2**			**2**	
3	8.47	15.89	**3**	26.69	**3**			**3**			**3**	
5	17.24	17.01	**5**	26.46	**5**			**5**			**5**	
7	19.51		**7**	25.93	**7**			**7**			**7**	
10	20.78	16.98	**10**	25.79	**10**			**10**			**10**	
15	22.46		**15**	25.43	**15**			**15**			**15**	
20	23.96	17.04	**20**	24.61	**20**			**20**			**20**	
30	25.35		**30**	23.53	**30**			**30**			**30**	
40	27.26	17.12	**40**	22.95	**40**			**40**			**40**	
60	28.37		**60**	21.75	**60**			**60**			**60**	
90	29.68	17.07	**90**	21.06	**90**			**90**			**90**	
120	30.54		**120**	20.31	**120**			**120**			**120**	
150	30.87	17.04	**150**	19.68	**150**			**150**			**150**	
180	31.23		**180**	19.09	**180**			**180**			**180**	
210	31.74	17.07	**210**	18.60	**210**			**210**			**210**	
240	32.23		**240**	17.85	**240**			**240**			**240**	
300	33.41	17.00	**300**	17.37	**300**			**300**			**300**	
360	34.29		**360**	16.84	**360**			**360**			**360**	
420	35.93	16.96	**420**	16.13	**420**			**420**			**420**	
480	36.11		**480**	15.90	**480**			**480**			**480**	
540	37.48	17.03	**540**	15.11	**540**			**540**			**540**	
600	38.12		**600**	14.71	**600**			**600**			**600**	
720	39.57	17.01	**720**	14.22	**720**			**720**			**720**	
840	40.31		**840**	13.84	**840**			**840**			**840**	
960	42.87	17.07	**960**	13.28	**960**			**960**			**960**	
1080	43.51		**1080**	13.02	**1080**			**1080**			**1080**	
1200	44.26	17.03	**1200**	12.44	**1200**			**1200**			**1200**	
1320	45.77		**1320**	12.01	**1320**			**1320**			**1320**	
1440	46.33	17.00	**1440**	11.71	**1440**			**1440**			**1440**	
1560	47.16		**1560**	11.31	**1560**			**1560**			**1560**	
1680	48.23	17.04	**1680**	11.12	**1680**			**1680**			**1680**	
1800	49.51		**1800**	10.93	**1800**			**1800**			**1800**	
1920	51.18	17.01	**1920**	10.65	**1920**			**1920**			**1920**	
2040	52.74		**2040**	10.35	**2040**			**2040**			**2040**	
2160	53.82	17.05	**2160**	10.04	**2160**			**2160**			**2160**	
2280	54.80		**2280**	9.85	**2280**			**2280**			**2280**	
2400	55.84	17.03	**2400**	9.62	**2400**			**2400**			**2400**	
2520	56.10		**2520**	9.40	**2520**			**2520**			**2520**	
2640	56.92	17.07	**2640**	9.19	**2640**			**2640**			**2640**	
2760	57.33		**2760**	8.98	**2760**			**2760**			**2760**	
2880	58.55	17.04	**2880**	8.80	**2880**			**2880**			**2880**	
3000			**3000**		**3000**			**3000**			**3000**	
3120			**3120**		**3120**			**3120**			**3120**	
3240			**3240**		**3240**			**3240**			**3240**	
3360			**3360**		**3360**			**3360**			**3360**	
3480			**3480**		**3480**			**3480**			**3480**	
3600			**3600**		**3600**			**3600**			**3600**	
3720			**3720**		**3720**			**3720**			**3720**	
3840			**3840**		**3840**			**3840**			**3840**	
3960			**3960**		**3960**			**3960**			**3960**	
4080			**4080**		**4080**			**4080**			**4080**	
4200			**4200**		**4200**			**4200**			**4200**	
4320			**4320**		**4320**			**4320**			**4320**	
Total time pumped(min):				2880		**W/L**			**W/L**			**W/L**
Average yield (l/s):				17.04								

Abbreviations	
EC	Electrical conductivity
mbgl	Meters below ground level
mbch	Meters below casing height
mbdl	Meters below datum level
magl	Meters above ground level
L/S	Litres per second
RPM	Rates per minute
S/W/L	Static water level
µS/cm	Microsiemens per centimeter

BOREHOLE TEST RECORD

PR0JECT #	P3032
TEAM MEMBERS	MICHAEL
	PHILLIP
	CHINODA
	JOHANNES
	TAFARA

CONSULTANT: GEOSS
DISTRICT: FISANTEKRAAL
PROVINCE: WESTERN CAPE
FARM / VILLAGE NAME : CAPE WINELANDS AIRPORT
DATE TESTED: 25/11/2024

BOREHOLE LOCATION & ACCESS INFORMATION:

BOREHOLE COORDINATES

LATITUDE (SOUTH):	33.77404
LONGITUDE (EAST):	18.74773

COMMENTS ON ACCESS IF ANY:

BOREHOLE NO:	CWA -003
TRANSMISSIVITY VALUE:	
TYPE INSTALLATION:	NEW BOREHOLE (MANHOLE)
BOREHOLE DEPTH: (mbg	149.9

MAINTENANCE RECORD:

Labour hours:	
Cost of material:	
Travelling (km):	

REHABILITATION RECORD:

Jetting hours:	
Brushing hours:	
Airlifting hours:	
Sulphamic Acid KG's	
Boresaver KG's	
Soda Ash KG's	

DIGITAL CAMERA LOGGING:

Camera logged once:	
Camera logged twice:	
Camera logged three times:	
Camera work sent to client:	

EQUIPMENT FISHING RECORD

Hours spent:	

OTHER COSTS ON PROJECT:

Courier of samples:	
Km's for delivery:	
Cost of packaging:	

COMMENTS:

We started the first constant discharge test at 6.4l/s, the test stopped after 2280 minutes due to engine failure. We restarted the test at 6.1 l/s and then a top rod stripped. We had to restart the test again at 6.1l/s for 48 hours

RECOMMENDATIONS / CORRECTIVE ACTIONS:

SAMPLE INSTRUCTIONS :

Water sample taken	Yes	No	If consultant took sample, give name:		DATA CAPTURED BY	EC
Date sample taken	03/12/2024		If sample courier, to where:		DATA CHECKED BY:	AH
Time sample taken	07H50					

DESCRIPTION:	UNIT	QTY		UNIT	QTY
STRAIGHTNESS TEST:	NO	0	BOREHOLE DEPTH AFTER TEST:	M	149.90
VERTICALLY TEST:	NO	0	BOREHOLE WATER LEVEL AFTER TEST: (mbch)	M	25.8
CASING DETECTION:	NO	1	SAND/GRAVEL/SILT PUMPED?	YES/NO	0
SUPPLIED NEW STEEL BOREHOLE COVER:	NO	0	DATA REPORTING AND RECORDING	NO	1
BOREHOLE MARKING	NO	0	SLUG TEST:	NO	0
SITE CLEANING & FINISHING	NO	1	LAYFLAT (M):	M	200
LOGGERS FOR WATERLEVEL MONITORING	NO	0	LOGGERS FOR pH AND EC:	NO	0

It is hereby acknowledged that upon leaving the site, all existing equipment is in an acceptable condition.

NAME: ______________________ **SIGNATURE:** ______________________

DESIGNATION: ______________________ **DATE:** ______________________

FORM 5 E

STEPPED DISCHARGE TEST & RECOVERY

BOREHOLE TEST RECORD SHEET

PROJ NO :	P3032	Coordinates:	SOUTH:	33.77404		PROVINCE:	WESTERN CAPE
BOREHOLE NO:	CWA -003		EAST:	18.74773		DISTRICT:	FISANTEKRAAL
ALT BH NO:	0					SITE NAME:	CAPE WINELANDS AIRPORT
ALT BH NO:	0						
BOREHOLE DEPTH (m)	149.90		DATUM LEVEL ABOVE CASING (m):		0.95	EXISTING PUMP:	0
WATER LEVEL (mbdl):	19.84		CASING HEIGHT: (magl):		GROUNDLEV	CONTRACTOR:	ATS
DEPTH OF PUMP (m):	106.40		DIAM PUMP INLET (mm):		170.00	PUMP TYPE:	WA 50-2

STEPPED DISCHARGE TEST & RECOVERY

DISCHARGE RATE 1			RPM	295
DATE:	25/11/2024	TIME:	12H40	
TIME (MIN)	DRAW DOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)
1	0.67		1	
2	0.98	2.23	2	
3	1.07		3	
5	1.54	2.22	5	
7	1.95		7	
10	2.31	2.20	10	
15	2.74		15	
20	3.09	2.23	20	
30	6.71		30	
40	7.82	2.23	40	
50	8.44		50	
60	8.97	2.24	60	
70			70	
80			80	
90			90	
100			100	
110			110	
120			120	
pH			150	
TEMP	20.00	°C	180	
EC	28	µS/cm	210	

DISCHARGE RATE 2			RPM	532
DATE:	25/11/2024	TIME:	13H40	
TIME (MIN)	DRAW DOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)
1	9.63		1	
2	11.45		2	
3	12.15		3	
5	14.18	4.32	5	
7	15.82		7	
10	17.50	4.59	10	
15	19.38		15	
20	20.69	4.56	20	
30	22.38		30	
40	23.65	4.55	40	
50	24.69		50	
60	25.72	4.56	60	
70			70	
80			80	
90			90	
100			100	
110			110	
120			120	
pH			150	
TEMP	21.60	°C	180	
EC	272	µS/cm	210	

DISCHARGE RATE 3			RPM	732
DATE:	25/11/2024	TIME:	14H40	
TIME (MIN)	DRAW DOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)
1	27.62		1	
2	29.15		2	
3	32.40	6.82	3	
5	33.90		5	
7	34.82	6.81	7	
10	35.89		10	
15	37.93	6.80	15	
20	38.98		20	
30	41.00	6.82	30	
40	42.68		40	
50	43.93	6.83	50	
60	44.97		60	
70			70	
80			80	
90			90	
100			100	
110			110	
120			120	
pH			150	
TEMP	19.60	°C	180	
EC	297	µS/cm	210	

DISCHARGE RATE 4			RPM	970
DATE:	25/11/2024	TIME:	13H40	
TIME (MIN)	DRAW DOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)
1	46.10		1	62.42
2	47.85	8.65	2	57.63
3	49.70		3	53.90
5	50.98	8.88	5	50.27
7	51.93	9.20	7	48.03
10	54.17		10	45.67
15	55.90	9.24	15	42.48
20	58.41		20	39.92
30	61.50	9.23	30	34.19
40	63.64		40	30.93
50	65.43	9.24	50	27.61
60	66.93		60	23.52
70	68.30	9.25	70	21.20
80	69.33		80	19.76
90	70.48	9.25	90	17.22
100	71.38		100	17.00
110	72.00	9.24	110	16.23
120	72.70		120	15.27
pH			150	13.19
TEMP	18.20	°C	180	
EC	297	µS/cm	210	
			240	
			300	
			360	

DISCHARGE RATE 5			RPM	
DATE:		TIME:		
TIME (MIN)	DRAW DOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)
1			1	
2			2	
3			3	
5			5	
7			7	
10			10	
15			15	
20			20	
30			30	
40			40	
50			50	
60			60	
70			70	
80			80	
90			90	
100			100	
110			110	
120			120	
pH			150	
TEMP		°C	180	
EC		µS/cm	210	
			240	
			300	
			360	

DISCHARGE RATE 6			RPM	
DATE:		TIME:		
TIME (MIN)	DRAW DOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)
1			1	
2			2	
3			3	
5			5	
7			7	
10			10	
15			15	
20			20	
30			30	
40			40	
50			50	
60			60	
70			70	
80			80	
90			90	
100			100	
110			110	
120			120	
pH			150	
TEMP		°C	180	
EC		µS/cm	210	
			240	
			300	
			360	

S/W/L:(mbch) 18.28

FORM 5 F

CONSTANT DISCHARGE TEST & RECOVERY

BOREHOLE TEST RECORD SHEET

PROJ NO :	P3032	Coordinates:	SOUTH: 33.77404	PROVINCE:	WESTERN CAPE
BOREHOLE NO:	CWA -003		EAST: 18.74773	DISTRICT:	FISANTEKRAAL
ALT BH NO:	0			SITE NAME:	CAPE WINELANDS AIRPORT
ALT BH NO:	0				
BOREHOLE DEPTH:	149.90	DATUM LEVEL ABOVE CASING (m):	0.95	EXISTING PUMP:	0
WATER LEVEL (mbdl):	23.34	CASING HEIGHT: (magl):	GROUND	CONTRACTOR:	ATS
DEPTH OF PUMP (m):	106.40	DIAM PUMP INLET(mm):	170	PUMP TYPE:	WA 50-2

CONSTANT DISCHARGE TEST & RECOVERY

TEST STARTED				**TEST COMPLETED**			
DATE:	26/11/2024	TIME:	09H40	DATE:	29/11/2024	TIME:	13H40
TYPE OF PUMP:	WA 50-2						

DISCHARGE BOREHOLE					OBSERVATION HOLE 1 NR: Distance(m);			OBSERVATION HOLE 2 NR: Distance(m);			OBSERVATION HOLE 3 NR: Distance(m);	
TIME (MIN)	DRAW DOWN (M)	YIELD (L/S)	TIME MIN	RECOVERY (M)	TIME: (min)	Drawdown m	Recovery (m)	TIME: (min)	Drawdown (m)	Recovery (m)	TIME: (min)	Drawdown (m)
1	4.26		1	64.19	1			1			1	
2	8.97		2	61.47	2			2			2	
3	12.43	6.48	3	58.73	3			3			3	
5	15.85		5	55.08	5			5			5	
7	17.86	6.46	7	53.30	7			7			7	
10	20.80		10	52.37	10			10			10	
15	24.05	6.47	15	51.11	15			15			15	
20	26.34		20	49.43	20			20			20	
30	29.81	6.48	30	47.84	30			30			30	
40	32.26		40	46.11	40			40			40	
60	36.00	6.45	60	43.49	60			60			60	
90	39.57		90	38.78	90			90			90	
120	41.98	6.47	120	33.30	120			120			120	
150	43.80		150	30.16	150			150			150	
180	45.32	6.46	180	27.08	180			180			180	
210	46.60		210	24.11	210			210			210	
240	47.89	6.45	240	21.61	240			240			240	
300	49.60		300	18.37	300			300			300	
360	51.10	6.48	360	16.82	360			360			360	
420	52.56		420	15.13	420			420			420	
480	53.71	6.45	480	13.70	480			480			480	
540	54.50		540	12.69	540			540			540	
600	55.30	6.47	600	11.73	600			600			600	
720	56.12		720	10.05	720			720			720	
840	57.09	6.46	840	8.90	840			840			840	
960	58.31		960	7.86	960			960			960	
1080	59.74	6.45	1080	7.02	1080			1080			1080	
1200	60.83		1200	6.33	1200			1200			1200	
1320	63.07	6.47	1320	6.01	1320			1320			1320	
1440	65.11		1440	5.23	1440			1440			1440	
1560	65.34	6.48	1560	4.41	1560			1560			1560	
1680	67.14		1680	4.23	1680			1680			1680	
1800	68.85	6.43	1800	3.88	1800			1800			1800	
1920	69.44		1920	3.59	1920			1920			1920	
2040	70.25	6.42	2040	2.97	2040			2040			2040	
2160	71.00		2160	2.76	2160			2160			2160	
2280	71.98	6.44	2280	2.46	2280			2280			2280	
2400			2400		2400			2400			2400	
2520			2520		2520			2520			2520	
2640			2640		2640			2640			2640	
2760			2760		2760			2760			2760	
2880			2880		2880			2880			2880	
3000			3000		3000			3000			3000	
3120			3120		3120			3120			3120	
3240			3240		3240			3240			3240	
3360			3360		3360			3360			3360	
3480			3480		3480			3480			3480	
3600			3600		3600			3600			3600	
3720			3720		3720			3720			3720	
3840			3840		3840			3840			3840	
3960			3960		3960			3960			3960	
4080			4080		4080			4080			4080	
4200			4200		4200			4200			4200	
4320			4320		4320			4320			4320	
Total time pumped(min):				2880		W/L			W/L			W/L
Average yield (l/s):				6.44								

FORM 5 F

CONSTANT DISCHARGE TEST & RECOVERY

BOREHOLE TEST RECORD SHEET

PROJ NO :	P3032	Coordinates: SOUTH: 33.77404		PROVINCE:	WESTERN CAPE
BOREHOLE NO:	CWA -003	EAST: 18.74773		DISTRICT:	FISANTEKRAAL
ALT BH NO:	0			SITE NAME:	CAPE WINELANDS AIRPORT
ALT BH NO:	0				
BOREHOLE DEPTH:	149.90	DATUM LEVEL ABOVE CASING (m):	0.95	EXISTING PUMP:	0
WATER LEVEL (mbdl):	27.80	CASING HEIGHT: (magl):	GROUND	CONTRACTOR:	ATS
DEPTH OF PUMP (m):	106.40	DIAM PUMP INLET(mm):	170	PUMP TYPE:	WA 50-2

CONSTANT DISCHARGE TEST & RECOVERY

TEST STARTED				TEST COMPLETED					
DATE:	01/12/2024	TIME:	08H00	DATE:		TIME:	19H00	TYPE OF PUMP:	WA 50-2

DISCHARGE BOREHOLE					OBSERVATION HOLE 1 NR: Distance(m);			OBSERVATION HOLE 2 NR: Distance(m);			OBSERVATION HOLE 3 NR: Distance(m);	
TIME (MIN)	DRAW DOWN (M)	YIELD (L/S)	TIME MIN	RECOVERY (M)	TIME: (min)	Drawdown m	Recovery (m)	TIME: (min)	Drawdown (m)	Recovery	TIME: (min)	Drawdown (m)
1	2.84		1	61.96	1			1			1	
2	5.45		2	57.80	2			2			2	
3	8.09		3	55.51	3			3			3	
5	12.30		5	53.26	5			5			5	
7	14.82	5.93	7	52.32	7			7			7	
10	17.43	5.99	10	51.50	10			10			10	
15	20.88	6.12	15	48.91	15			15			15	
20	23.23		20	46.84	20			20			20	
30	26.49	6.14	30	44.65	30			30			30	
40	29.10		40	43.79	40			40			40	
60	32.20	6.11	60	42.53	60			60			60	
90	35.63		90	39.65	90			90			90	
120	37.84	6.13	120	35.49	120			120			120	
150	39.49		150	29.92	150			150			150	
180	41.95	6.10	180	25.63	180			180			180	
210	43.53		210	23.58	210			210			210	
240	44.64	6.13	240	21.87	240			240			240	
300	46.60		300	18.81	300			300			300	
360	47.41	6.14	360	16.15	360			360			360	
420	49.08		420	14.88	420			420			420	
480	51.40	6.11	480	12.75	480			480			480	
540	52.32		540	11.47	540			540			540	
600	54.80	6.13	600	10.63	600			600			600	
720	55.91		720	7.85	720			720			720	
840	56.69	6.14	840	7.15	840			840			840	
960	57.11		960	6.44	960			960			960	
1080	57.96	6.10	1080	5.68	1080			1080			1080	
1200	58.80		1200	4.96	1200			1200			1200	
1320	59.75	6.15	1320	4.21	1320			1320			1320	
1440	61.80		1440	3.58	1440			1440			1440	
1560	62.13	6.13	1560	3.20	1560			1560			1560	
1680	63.81		1740	2.95	1680			1680			1680	
1800	64.24	6.11	1800	2.46	1800			1800			1800	
1920	65.12		1920		1920			1920			1920	
2040	65.77	6.10	2040		2040			2040			2040	
2160	66.25		2160		2160			2160			2160	
2280	66.96	6.15	2280		2280			2280			2280	
2400	67.48		2400		2400			2400			2400	
2520	67.92	6.12	2520		2520			2520			2520	
2640	68.53		2640		2640			2640			2640	
2760	69.24	6.14	2760		2760			2760			2760	
2880	70.19		2880		2880			2880			2880	
3000			3000		3000			3000			3000	
3120			3120		3120			3120			3120	
3240			3240		3240			3240			3240	
3360			3360		3360			3360			3360	
3480			3480		3480			3480			3480	
3600			3600		3600			3600			3600	
3720			3720		3720			3720			3720	
3840			3840		3840			3840			3840	
3960			3960		3960			3960			3960	
4080			4080		4080			4080			4080	
4200			4200		4200			4200			4200	
4320			4320		4320			4320			4320	
Total time pumped(min):				2880		W/L			W/L			W/L
Average yield (l/s):				6.10								

Borehole: CWA_BH002

Appendix E: Water Quality Certificate

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2022-04-12

TEST REPORT

Water

Geoss South Africa (Pty) Ltd
Attn: - Alison
P.O.Box 12412
Die Boord, Stellenbosch
Die Boord, Stellenbosch
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Sample Details					
SampleID	W26855				
Water Type	Drinking Water				
Water Source	Borehole				
Sample Temperature					
Description	4505_D2_CWA_EastBH				
PO Number	4505_D2_CWA_EastBH				
Date Received	2022-04-08				
Condition	Good				

Water - Routine

	Unit	Method	Uncertainty	Limit	Results	Results	Results	Results	Results
pH@25C* (Water)		VIN-05-MW01	0.1%	>= 5 to <= 9.7	7.33				
Conductivity@25C* (Water)	mS/m	VIN-05-MW02	^	<= 170	89				
Turbidity (Water)	ntu			<= 5	18.7				
Total dissolved solids (Water)	mg/L			<= 1200	603.42				
Free Chlorine (Water)	mg/L			<= 5	<0.02				
Ammonia (NH4) as N* (Water)	mg/L	VIN-05-MW08	10%	<= 1.5	<0.15				
Nitrate as N* (Water)	mg/L	VIN-05-MW08	10%	<= 11	<1.00				
Nitrite as N* (Water)	mg/L	VIN-05-MW08	10%	<= 0.9	<0.05				
Chloride (Cl-)* - Water	mg/L	VIN-05-MW08	10%	<= 300	207.57				
Sulphates (SO4)* - Water	mg/L	VIN-05-MW08	10%	<= 500	13.89				
Fluoride (F)* - Water	mg/L	VIN-05-MW08	10%	<= 1.5	0.17				
Alkalinity as CaCO3 (Water)	mg/L				102.10				
Colour (Water)	mg/L Pt-Co			<= 15	<15				
Total Organic Carbon (Water)	mg/L			<=10	2.46				
Date Tested					2022-04-08				

Water - Metals

	Unit	Method	Uncertainty	Limit	Results	Results	Results	Results	Results
Calcium* (Ca) - Water	mg/L	VIN-05-MW43	14.60%		17				
Magnesium* (Mg) - Water	mg/L	VIN-05-MW43	8.49%		16				

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*Accredited methods. Vinlab is not liable to any client for any loss or damages suffered which could, directly or remotely, be linked to our services Alcohol results are obtained using the most appropriate or a combination of one of the following methods: Py= pycnometer; W=winescan; Al=alcolyzer. W = Winescan. Micro results: Enumeration of yeast: WL nutrient, 3 days unless otherwise specified, 30°C. Samples that have had prior microbiological spoilage or treatment for spoilage should always be sterile filtered at botting. SO2 additions less than 10 days may depress the growth of microbes in culture although they are viable/active in the wine. Some microbes, especially lactobacilli, may not grow in culture even where viable/potentially active in the wine.

^ - Conductivity: <1000mS/m = 1mS/m , >1000mS/m = 9mS/m
^^ - COD, LR = 16mg/L, MR = 48mg/L, HR = 477mg/L

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Sodium* (Na) - Water	mg/L	VIN-05-MW43	11.45%	<= 200	130				
Potassium* (K) - Water	mg/L	VIN-05-MW43	9.42%		4				
Zinc* (Zn) - Water	mg/L	VIN-05-MW43	19.40%	<= 5	<0.008				
Antimony (Sb) - Water	µg/L			<=20	<13.0				
Arsenic (As) - Water	µg/L			<= 10	<10.0				
Boron (B)* Water	µg/L	VIN-05-MW43	11.79%	<= 2400	29				
Cadmium (Cd)* Water	µg/L	VIN-05-MW43	12.26%	<= 3	2				
Chromium* (Cr) - Water	µg/L	VIN-05-MW43	13.03%	<= 50	<4				
Copper* (Cu) - Water	µg/L	VIN-05-MW43	11.57%	<= 2000	10				
Iron* (Fe) - Water	µg/L	VIN-05-MW43	12.49%	<= 2000	1881				
Lead* (Pb) - Water	µg/L	VIN-05-MW43	16.32%	<= 10	<8				
Manganese* (Mn) - Water	µg/L	VIN-05-MW43	12.44%	<= 400	329				
Nickel* (Ni) - Water	µg/L	VIN-05-MW43	17.38%	<= 70	<8				
Selenium (Se) - Water	µg/L			<= 40	<10.0				
Aluminium* (Al) - Water	µg/L	VIN-05-MW43	13.49%	<= 300	<8				
Cyanide (CN) - Water	µg/L			<= 200	<10.0				
Mercury (Hg) - Water	µg/L			<= 6	<1.0				
Barium (Ba)* Water	µg/L	VIN-05-MW43	14.09%	<= 700	129				
Uranium (U) - Water	µg/L			<= 30	<28				
Date Tested					2022-04-11				

Water - Micro

	Unit	Method	Uncertainty	Limits	Results	Results	Results	Results	Results
Total Coliforms* (Water)	cfu/100mL	VIN-05-MW09		<= 10	nd				
E-Coli* (Water)	cfu/100mL	VIN-05-MW09		not detected	nd				
Heterotrophic plate count	cfu/mL			<= 1000	69				
Date Tested					2022-04-08				

Comments

W26855
Two Samples received,

Ion Balance = 0.7%

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^ - Conductivity <1000mS/m = 1mS/m , >1000mS/m = 9mS/m
^^ - COD, LR = 16mg/L, MR = 48mg/L, HR = 477mg/L

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AEFourie

Adelize Fourie
Laboratory Manager (Waterlab)
VIN-05-
M01,M02,M03,M04,M05,MO8,M10,M28,
M43, MW01, MW02, MW03, MW04,
MW05, MW06, MW07, MW08/9/10

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^ - Conductivity <1000mS/m = 1mS/m , >1000mS/m = 9mS/m
^^ - COD, LR = 16mg/L, MR = 48mg/L, HR = 477mg/L

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TEST REPORT

Water

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Sample Details					
SampleID	W33544				
Water Type	Drinking Water				
Water Source	Borehole				
Sample Temperature					
Description	4505_J1_CWA_BH002				
Batch Number					
PO Number	4505_J1_CWA_BH002				
Date Received	2022-11-29				
Condition	Good				

Water - Routine	Unit	Method	Uncertainty	Limit	Results	Results	Results	Results	Results
pH@25C (Water)		VIN-05-MW01	^^^	>= 5 to <= 9.7	6.80				
Conductivity@25C (Water)	mS/m	VIN-05-MW02	^	<= 170	155.9				
Turbidity (Water)#	ntu			<= 5	121.0				
Total dissolved solids (Water)#	mg/L			<= 1200	1057.00				
Free Chlorine (Water)#	mg/L			<= 5	<0.02				
Ammonia (NH4) as N (Water)	mg/L	VIN-05-MW08	2.5%	<= 1.5	<0.15				
Nitrate as N (Water)	mg/L	VIN-05-MW08	10%	<= 11	<1.00				
Nitrite as N (Water)	mg/L	VIN-05-MW08	10%	<= 0.9	<0.05				
Chloride (Cl-) - Water	mg/L	VIN-05-MW08	2.73%	<= 300	430.19				
Sulphates (SO4) - Water	mg/L	VIN-05-MW08	7.56%	<= 500	38.04				
Fluoride (F) - Water	mg/L	VIN-05-MW08	9.74%	<= 1.5	<0.15				
Alkalinity as CaCO3 (Water)#	mg/L				83.60				
Colour (Water)#	mg/L Pt-Co			<= 15	<15				
Total Organic Carbon (Water)#	mg/L			<=10	2.15				
Date Tested					2022-11-29				

Water - Metals	Unit	Method	Uncertainty	Limit	Results	Results	Results	Results	Results
Calcium (Ca) - Water	mg/L	VIN-05-MW43	14.60%		39				

Please click here for SANS241-1:2015 drinking water limits

^ - Conductivity <1000mS/m = ±1mS/m , >1000mS/m = ±9mS/m
^^ - COD, LR = ±16mg/L, MR = ±46mg/L, HR = ±477mg/L
^^^ - pH ± 0.1

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TEST REPORT

Water

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Magnesium (Mg) - Water	mg/L	VIN-05-MW43	8.49%		48				
Sodium (Na) - Water	mg/L	VIN-05-MW43	11.45%	<= 200	184				
Potassium (K) - Water	mg/L	VIN-05-MW43	9.42%		4				
Zinc (Zn) - Water	mg/L	VIN-05-MW43	19.40%	<= 5	<0.008				
Antimony (Sb) - Water‡	µg/L			<=20	<13.0				
Arsenic (As) - Water‡	µg/L			<= 10	<10.0				
Boron (B) Water	µg/L	VIN-05-MW43	11.79%	<= 2400	30				
Cadmium (Cd) Water	µg/L	VIN-05-MW43	12.26%	<= 3	<1				
Chromium (Cr) - Water	µg/L	VIN-05-MW43	13.03%	<= 50	<4				
Copper (Cu) - Water	µg/L	VIN-05-MW43	11.57%	<= 2000	10				
Iron (Fe) - Water	µg/L	VIN-05-MW43	12.49%	<= 2000	7344				
Lead (Pb) - Water	µg/L	VIN-05-MW43	16.32%	<= 10	<8				
Manganese (Mn) - Water	µg/L	VIN-05-MW43	12.44%	<= 400	1272				
Nickel (Ni) - Water	µg/L	VIN-05-MW43	17.38%	<= 70	<8				
Selenium (Se) - Water‡	µg/L			<= 40	<10.0				
Aluminium (Al) - Water	µg/L	VIN-05-MW43	13.49%	<= 300	16				
Cyanide (CN) - Water‡	µg/L			<= 200	<10.0				
Mercury (Hg) - Water‡	µg/L			<= 6	<1.0				
Barium (Ba) Water	µg/L	VIN-05-MW43	14.09%	<= 700	238				
Uranium (U) - Water‡	µg/L			<= 30	<28				
Date Tested					2022-11-30				

Water - Micro

	Unit	Method	Uncertainty	Limits	Results	Results	Results	Results	Results
Total Coliforms (Water)	cfu/100mL	VIN-05-MW09		<= 10	nd				
E-Coli (Water)	cfu/100mL	VIN-05-MW09		not detected	nd				
Heterotrophic plate count‡	cfu/mL			<= 1000	nd				
Date Tested					2022-11-29				

Comments

W33544
Two Samples received.

Ion balance = 1.2%

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* - Conductivity <1000mS/m = ±1mS/m ; >1000mS/m = ±9mS/m
** - COD, LR = ±16mg/L, MR = ±46mg/L, HR = ±477mg/L
*** - pH ± 0.1

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2022-12-02

TEST REPORT

Water

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Adelize Fourie
Laboratory Manager (Waterlab)
VIN-05-
[illegible]

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* - Conductivity <1000mS/m = ±1mS/m , >1000mS/m = ±8mS/m
** - COD, LR = ±10mg/L, MR = ±40mg/L, HR = ±477mg/L
*** - pH ± 0.1

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2024-12-10

TEST REPORT

Water

Geoss South Africa (Pty) Ltd

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Sample Details					
SampleID	W58385				
Water Type	Drinking Water				
Water Source	Borehole				
Sample Temperature					
Description	CWA_BH03				
Batch Number	CWA_BH03				
PO Number	4505_P1				
Date Received	2024-12-05				
Condition	Good				

Water - Routine

	Unit	Method	Uncertainty	Limit	Results	Results	Results	Results	Results
pH@25C (Water)		VIN-05-MW01	^^^	>= 5 to <= 9.7	7.16				
Conductivity@25C (Water)	mS/m	VIN-05-MW02	^	<= 170	80.6				
Turbidity (Water)*	ntu			<= 5	64.1				
Total dissolved solids (Water)*	mg/L			<= 1200	546.47				
Free Chlorine (Water)*	mg/L			<= 5	<0.02				
Ammonia (NH4) as N (Water)	mg/L	VIN-05-MW08	8.90%	<= 1.5	<0.15				
Nitrate as N (Water)	mg/L	VIN-05-MW08	11.00%	<= 11	<1.00				
Nitrite as N (Water)	mg/L	VIN-05-MW08	4.50%	<= 0.9	<0.05				
Chloride (Cl-) - Water	mg/L	VIN-05-MW08	10.12%	<= 300	294.37				
Sulphates (SO4) - Water	mg/L	VIN-05-MW08	7.56%	<= 500	17.39				
Fluoride (F) - Water	mg/L	VIN-05-MW08	12.30%	<= 1.5	<0.15				
Alkalinity as CaCO3 (Water)*	mg/L				72.00				
Colour (Water)*	mg/L Pt-Co			<= 15	<15				
Total Organic Carbon (Water)*	mg/L			<=10	2.19				
Date Tested					2024-12-05				

Water - Metals

	Unit	Method	Uncertainty	Limit	Results	Results	Results	Results	Results
Calcium (Ca) - Water	mg/L	VIN-05-MW43	14.60%		20				
Magnesium (Mg) - Water	mg/L	VIN-05-MW43	8.49%		19				
Sodium (Na) - Water	mg/L	VIN-05-MW43	11.45%	<= 200	149				
Potassium (K) - Water	mg/L	VIN-05-MW43	9.42%		3				

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Vinlab is not liable to any client for any loss or damages suffered which could, directly or remotely, be linked to our services Alcohol results are obtained using the most appropriate or a combination of one of the following methods: Py= pycnometer, W=winescan; Al=alcolyzer. W = Winescan. Micro results: Enumeration of yeast: WL nutrient, 3 days unless otherwise specified, 30°C. Samples that have had prior microbiological spoilage or treatment for spoilage should always be sterile filtered at bottling. SO2 additions less than 10 days may depress the growth of microbes in culture although they are viable/active in the wine. Some microbes, especially lactobacilli, may not grow in culture even where viable/potentially active in the wine.

^ - Conductivity <1000mS/m = ±1mS/m , >1000mS/m = ±3mS/m
^^ - COD, LR = ±16mg/L, MR = ±48mg/L, HR = ±477mg/L
^^^ - pH ± 0,1

sanas Testing Laboratory T1131

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2024-12-10

vinlab H₂O
Your partner in quality water analysis

TEST REPORT

Water

Geoss South Africa (Pty) Ltd

Attn: Alison McDuling

P.O.Box 12412
Die Boord, Stellenbosch
7613
+27218801079

@VinlabSA

Zinc (Zn) - Water	mg/L	VIN-05-MW43	19.40%	<= 5	<0.008				
Antimony (Sb) - Water*	µg/L			<= 20	<13.0				
Arsenic (As) - Water*	µg/L			<= 10	<10.0				
Boron (B) Water	µg/L	VIN-05-MW43	11.79%	<= 2400	42				
Cadmium (Cd) Water	µg/L	VIN-05-MW43	12.26%	<= 3	1				
Chromium (Cr) - Water	µg/L	VIN-05-MW43	13.03%	<= 50	<4				
Copper (Cu) - Water	µg/L	VIN-05-MW43	11.57%	<= 2000	<2				
Iron (Fe) - Water	µg/L	VIN-05-MW43	12.49%	<= 2000	3944				
Lead (Pb) - Water	µg/L	VIN-05-MW43	16.32%	<= 10	<8				
Manganese (Mn) - Water	µg/L	VIN-05-MW43	12.44%	<= 400	466				
Nickel (Ni) - Water	µg/L	VIN-05-MW43	17.38%	<= 70	<8				
Selenium (Se) - Water*	µg/L			<= 40	<10.0				
Aluminium (Al) - Water	µg/L	VIN-05-MW43	13.49%	<= 300	<8				
Cyanide (CN) - Water*	µg/L			<= 200	10.0				
Mercury (Hg) - Water*	µg/L			<= 6	<1.0				
Barium (Ba) Water	µg/L	VIN-05-MW43	14.09%	<= 700	275				
Uranium (U) - Water*	µg/L			<= 30	<28				
Date Tested					2024-12-05				

Comments

W58385
Ion balance = 4.0%

Adelize Fourie
Laboratory Manager (Waterlab)
VIN-05-
M01,M02,M03,M04,M05,M08,M10,M28,
M43, MW01, MW02, MW03, MW04,
MW05, MW06, MW07, MW08/9/10,
MW12, MW13, MW14

Please click here for SANS241-1:2015 drinking water limits

*** Not SANAS Accredited. Results marked "Not SANAS Accredited" in this report are not included in the SANAS Scope of Accreditation for Vinlab.**

* - Conductivity <1000mS/m = ±1mS/m , >1000mS/m = ±9mS/m
** - COD, LR = ±16mg/L, MR = ±48mg/L, HR = ±477mg/L
*** - pH ± 0.1

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sanas Testing Laboratory T1031

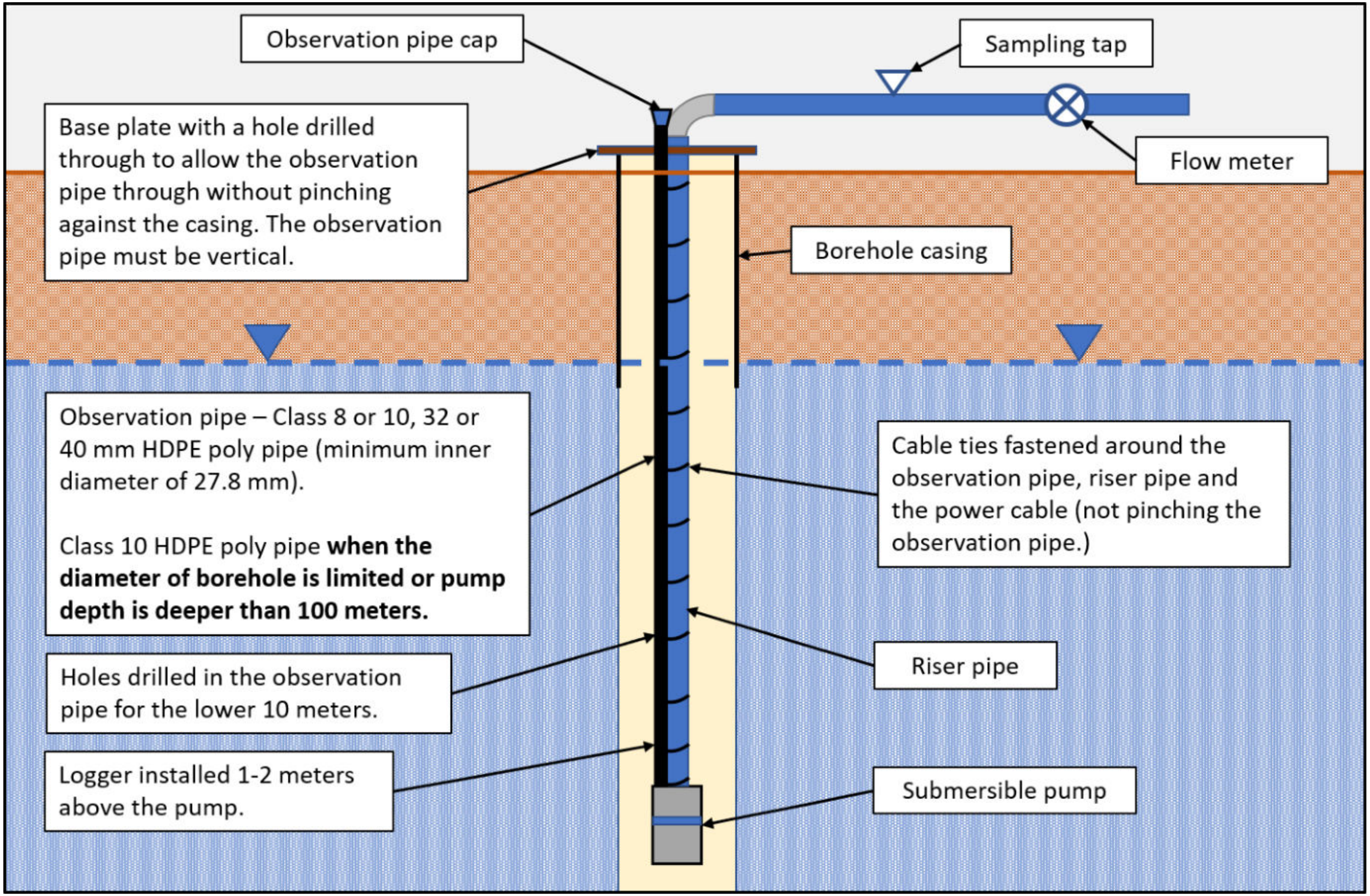
Appendix F: Risk Rating Criteria

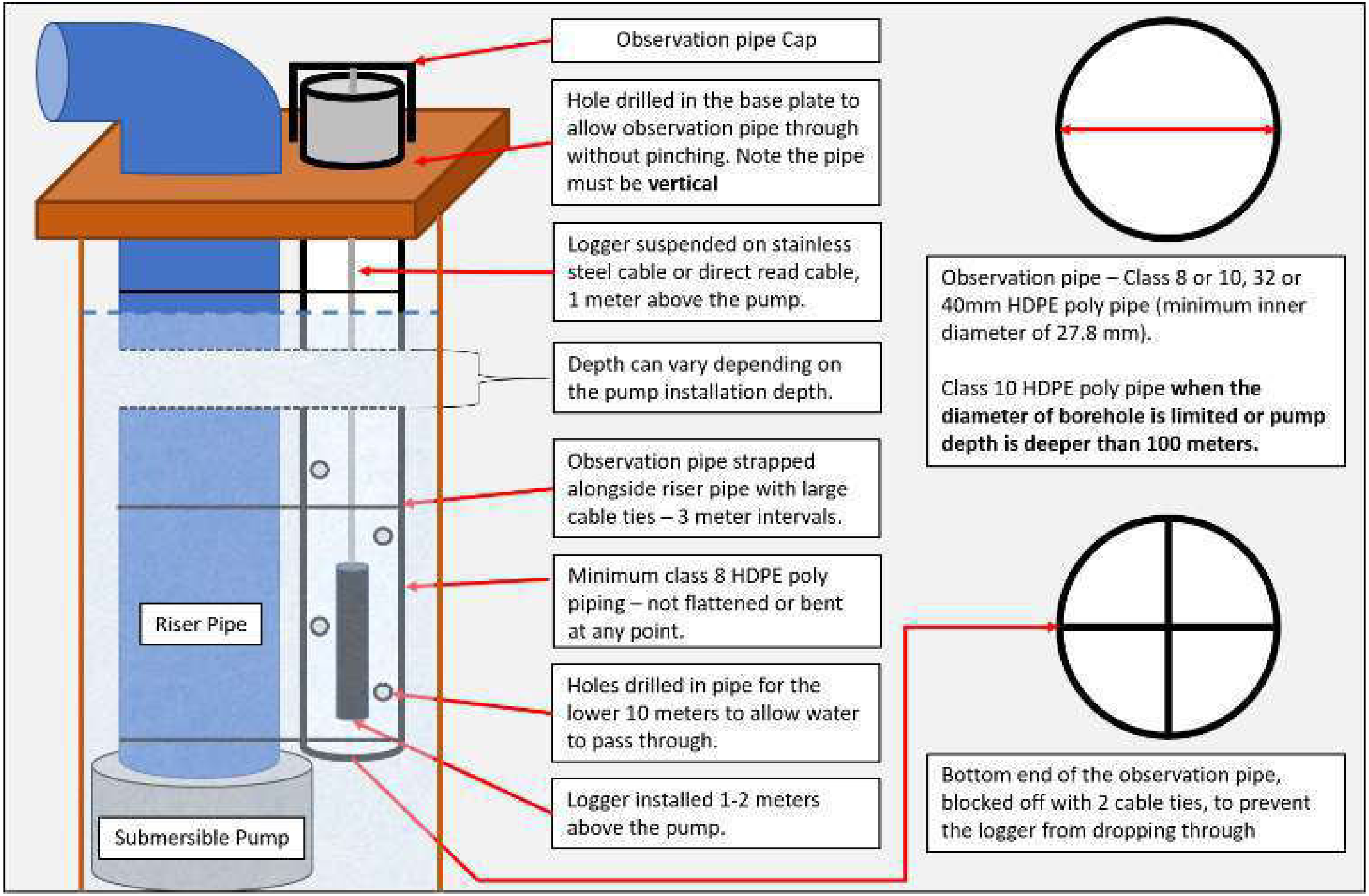
Nature of impact	Description
Positive	Impacts would benefit the receiving environment (including people).
Negative	Impacts would harm the receiving environment (including people).
Type of impact	**Description**
Direct	Impacts that result directly from the causal activity, usually at the same time and in the same space as that activity
Indirect	Secondary impacts may result from direct impacts, generally occurring later in time and may manifest elsewhere in space (e.g. downstream)
Induced	Impacts that may happen as a consequence of the Project (e.g., migration of people along newly created access routes)
Cumulative	Impacts that add to or magnify existing or reasonably foreseeable future impacts on the same receiving environment or specific resource
Extent Rating	**Description**
Site specific	Impact (and implications) limited to the project site.
Local	Impact extends only as far as the activity, limited to the site and its immediate surroundings, and local assets/ resources.
Regional	Impact extends to a regional scale, and affects provincial resources, e.g. District or Province; Western Cape
National	Impact extends to a national scale, and affects national resources; South Africa.
International	Impact extends across national borders, and affects global resources.
Duration Rating	**Description**
Short term	0 - 5 years
Medium term	5 - 15 years
Long term	Where the impact will cease after the operational life of the activity, either because of natural processes or by human intervention. Generally >15 years but <30 years
Permanent	Where the impact will, for all intents and purposes, endure in perpetuity. That is, it would be regarded as 'irreversible'
Intensity Rating	**Description**
Low	Where the impact affects the environment in such a way that a small or negligible proportion of resources and/or beneficiaries would be affected. Receptors in the receiving environment are not threatened or vulnerable, and affected communities have negligible or very low dependence on affected resources for livelihoods, health and safety.
Medium	Where a sizeable proportion of resources and/ or of beneficiaries would be affected, and natural, cultural and social functions and processes would continue, albeit in a modified way. Receptors in the receiving environment are moderately threatened or vulnerable, and/ or affected communities have some dependence on affected resources for livelihoods, health and safety, affected resources could be substituted.
High	Where most/ a major proportion of resources and/ or beneficiaries would be affected, and natural, cultural and social functions or processes are altered to the extent that they would temporarily or permanently cease. Receptors in the receiving environment are highly threatened or vulnerable (i.e. close to environmental or legal thresholds, standards or targets), and affected

	communities are highly dependent on affected resources for livelihoods, health and safety, and/ or resources are considered to be irreplaceable (if lost they could not be substituted, and/ or their loss would undermine achieving targets, standards).
Probability Rating	**Description**
Improbable	Where the possibility of the impact materializing is very low, but it could occur e.g. in unplanned / upset conditions
Possible	Where there is a possibility that the impact will occur during normal operations.
Probable	Where the impact is expected to occur during normal operations
Definite	Where the impact will undoubtedly occur.
Confidence Rating	**Description**
High	High confidence in predictions.
Medium	Some uncertainty in predictions e.g. due to information gaps, constraints on study
Low	Little confidence in predictions e.g. due to constraints on study, information gaps, inherent uncertainties
Significance Rating	**Description**
Negligible	Where the receiving environment (including people) would not be materially affected by the proposed activity(ies). *There would be no need for mitigation.*
Very Low	Where there would be minimal effect on the environment or human wellbeing, and impacts would be well within environmental quality standards or targets, or legal requirements. *There would be no need for mitigation.*
Low	Where there would be little material effect on the environment or human wellbeing, and impacts would be well within environmental quality standards or targets, or legal requirements. *Minor mitigation measures may be required.*
Moderate	Where the activity (ies) would have a material effect on the receiving environment (including people), legal requirements would still be met but thresholds of potential concern with regard to environmental quality may be crossed. *Mitigation measures – avoidance, minimization and rehabilitation/ restoration, and in some cases offsets/ compensation - would be needed to reduce the impact significance.*
High	Where there would be major effects on the receiving environment to the extent where environmental quality standards or targets may be jeopardized, legal requirements may not be met, and the health, safety, livelihoods and/or wellbeing of affected people could be jeopardized. *Mitigation measures – preferably avoidance/ impact prevention, minimization, rehabilitation/ restoration, and offsets/ compensation – are essential to reduce the impact significance substantially.*

Very High	Where there would be severe or substantial effects on the receiving environment to the extent where environmental quality standards or targets would be undermined/ exceeded, there would be non-compliance with legal requirements or commitments, and the health, safety, livelihoods and/or wellbeing of affected people would be jeopardized. *Mitigation measures – avoidance or prevention of impacts as a priority would be required, since impacts are unacceptable. Additional measures to minimize, rehabilitate/ restore, and offset/ compensate for residual impacts would be – are essential to reduce the impact significance substantially*

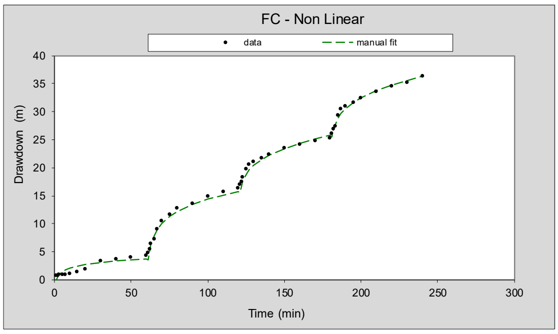
Appendix G: Monitoring Infrastructure


Observation pipe cap
Sampling tap
Base plate with a hole drilled through to allow the observation pipe through without pinching against the casing. The observation pipe must be vertical.
Flow meter
Borehole casing
Observation pipe – Class 8 or 10, 32 or 40 mm HDPE poly pipe (minimum inner diameter of 27.8 mm).
Class 10 HDPE poly pipe **when the diameter of borehole is limited or pump depth is deeper than 100 meters.**
Cable ties fastened around the observation pipe, riser pipe and the power cable (not pinching the observation pipe.)
Holes drilled in the observation pipe for the lower 10 meters.
Riser pipe
Logger installed 1-2 meters above the pump.
Submersible pump


Observation pipe Cap
Hole drilled in the base plate to allow observation pipe through without pinching. Note the pipe must be **vertical**
Logger suspended on stainless steel cable or direct read cable, 1 meter above the pump.
Depth can vary depending on the pump installation depth.
Observation pipe strapped alongside riser pipe with large cable ties – 3 meter intervals.
Minimum class 8 HDPE poly piping – not flattened or bent at any point.
Holes drilled in pipe for the lower 10 meters to allow water to pass through.
Logger installed 1-2 meters above the pump.
Riser Pipe
Submersible Pump
Observation pipe – Class 8 or 10, 32 or 40mm HDPE poly pipe (minimum inner diameter of 27.8 mm).
Class 10 HDPE poly pipe **when the diameter of borehole is limited or pump depth is deeper than 100 meters.**
Bottom end of the observation pipe, blocked off with 2 cable ties, to prevent the logger from dropping through

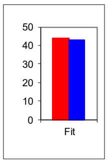
Appendix H: Yield Test Data Analysis

CWA_BH001



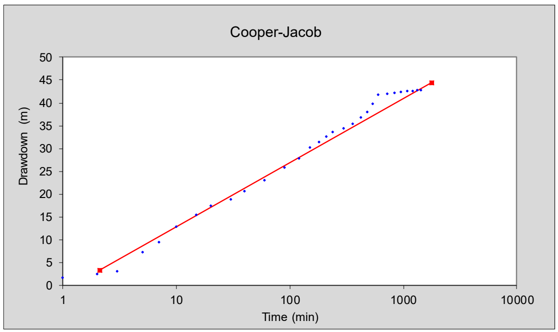
FC - Non Linear Method to estimate Q_Sust

skin effect	Non-Darcian loss		Darcian loss		
A	C	p	B	n	e
7.00E-06	0.00E+00	2.00E+00	4.50E-02	1.82E+00	1.01E+00



Extrapolation	
Ext_pol time (min)	
1051200	
Q (L/s)	Drawdown (m)
1.6	43.88

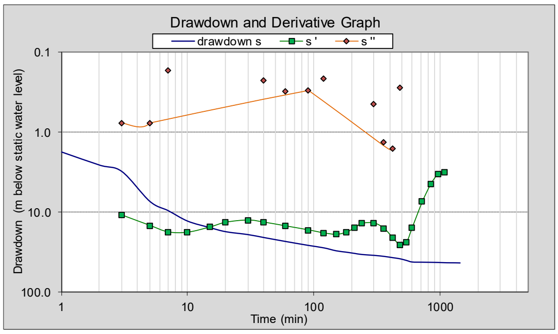
Available drawdown (m) =	43		
No boundaries	1 no-flow	2 no-flow	Closed
1.6	0.8	0.5	0.3
Q_Sust (L/s)=	0.88	std.dev = 0.58	
Boundaries selected	0 - 2		



Cooper-Jacob method

$T(m^2/d)$ =	3.7	r_e (m)=	0.1
S =	######	Q (l/s) =	3.30

	No boundaries	1 no-flow	2 no-flow	Closed
Q_sust	1.70	0.85	0.56	0.43
Avg. Q_sust =		1.04	std. dev =	0.57
Boundaries selected		0 - 2		

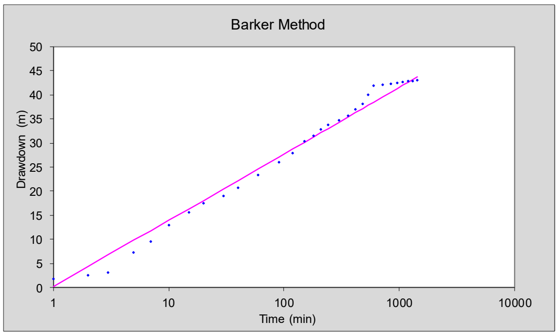


FC method

Extrapolation time in years	2	1051200	Extrapol.time in minutes	
Effective borehole radius (r_e)	40.4355694	40.4355694	Est. r_e	From r(e) sheet
Q (l/s) from pumping test	3.3	3.5229E-05	S-late	Change r_e
s_a (available drawdown), sigma_s	**43**	0	Sigma_s from risk	
Annual effective recharge (mm)	0	43	s_available working drawdown(m)	
t(end) and s(end) of pumping test	1440	42.97	End time and drawdown of test	
Average maximum derivative	**18**	25.5209276	Estimate of average of max deriv	
Average second derivative	**0**	-0.13871276	Estimate of average second deriv	
Derivative at radial flow period	14.2200721	14.2200721	Read from derivative graph	
T-early$[m^2/d]$		3.66924721	Aqui. thick (m)	60
T and S estimates	**T-late $[m^2/d]$**	**2.89872**	Est. S-late	0.0033
	S-late	0.0033		

BASIC SOLUTION

	No boundaries	1 no-flow	2 no-flow	Closed no-flow
sWell (Extrapol.time) =	94.51	146.05	197.59	352.21
Q_sust (l/s) =	1.50	0.97	0.72	0.40
Average Q_sust (l/s) =	**1.02**			
with standard deviation=	0.46			
Boundaries selected: 0 - 2				

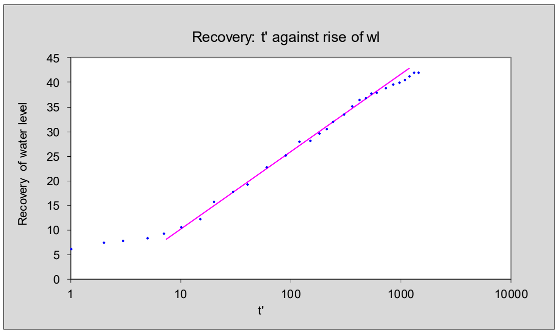


Barker method

	K_f [m/d]	S_f [1/m]	b	n	N
Fit Parameters	1.20	2.00E-02	3.17	2.00	0.0000

	No boundaries	1 no-flow	2 no-flow	Closed
sWell(Extrapol.time)	83.14	186.22	237.76	289.30
Q_sust	1.71	0.76	0.60	0.49

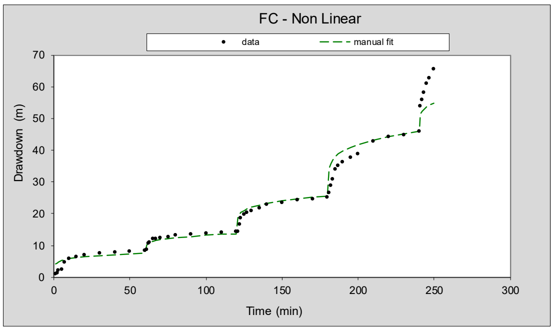
Fractal n = 2.00	**Average Q-sust (l/s)=**	0.92	std. dev =	0.56
	Boundaries selected	0 - 2		



Recovery

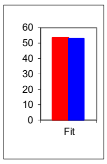
T [m2/d]	3.3
CDT Duration	1440
Recovery Duration	1440
Max % Recovery	97.8

CWA_BH002



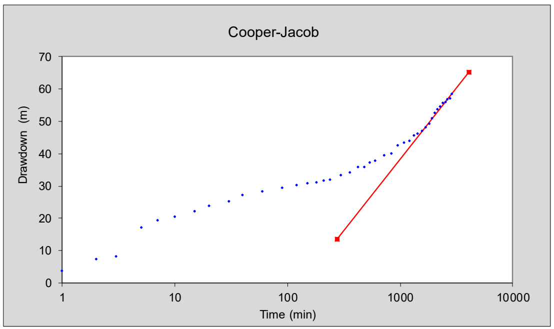
FC - Non Linear Method to estimate Q_Sust

skin effect	Non-Darcian loss		Darcian loss		
A	C	p	B	n	e
7.62E-03	2.56E-06	2.06E+00	1.00E-03	1.00E+00	1.00E+00



Extrapolation	
Ext_pol time (min)	
1051200	
Q (L/s)	Drawdown (m)
11.3	53.18

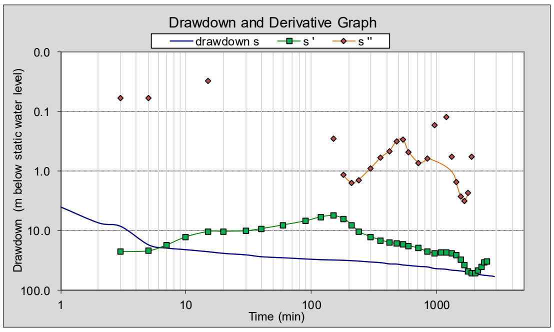
Available drawdown (m) =		53	
No boundaries	1 no-flow	2 no-flow	Closed
11.3	5.7	3.8	1.9
Q_Sust (L/s)=	3.42	std.dev = 4.07	
Boundaries selected	1 - closed		



Cooper-Jacob method

$T(m^2/d)$ =	6.1	r_e (m)=	0.1
S =	1.29E+02	Q (l/s) =	17.00

	No boundaries	1 no-flow	2 no-flow	Closed
Q_sust	5.22	2.61	1.72	1.31
Avg. Q_sust =		2.72	std. dev =	1.76
Boundaries selected	0 - closed			

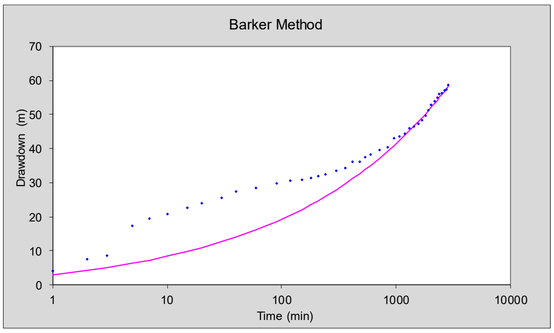


FC method

Extrapolation time in years	2	1051200	Extrapol.time in minutes	
Effective borehole radius (r_e)	51.8207113	51.8207113	Est. r_e	From r(e) sheet
Q (l/s) from pumping test	17	0.00060935	S-late	Change r_e
s_a (available drawdown), sigma_s	**52.87**	0	Sigma_s from risk	
Annual effective recharge (mm)	0	52.87	s_available working draw down(m)	
t(end) and s(end) of pumping test	2880	58.55	End time and draw down of test	
Average maximum derivative	**50.5**	51.4900559	Estimate of average of max deriv	
Average second derivative	**0.1**	0.1225678	Estimate of average second deriv	
Derivative at radial flow period	12.4864471	12.4864471	Read from derivative graph	
T-early$[m^2/d]$		21.5265719	Aqui. thick (m)	60
T and S estimates	**T-late $[m^2/d]$**	**5.32258218**	Est. S-late	0.0033
	S-late	0.0033		

BASIC SOLUTION

	No boundaries	1 no-flow	2 no-flow	Closed no-flow
sWell (Extrapol.time) =	188.27	317.67	447.07	835.25
Q_sust (l/s) =	4.77	2.83	2.01	1.08
Average Q_sust (l/s) =	**2.32**			
with standard deviation=	1.57			
Boundaries selected: 0 - closed				

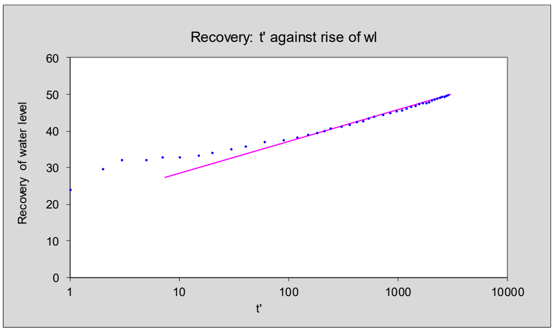


Barker method

	K_f [m/d]	S_f [1/m]	b	n	N
Fit Parameters	3.60	2.00E-02	7.04	1.38	0.3100

	No boundaries	1 no-flow	2 no-flow	Closed
sWell(Extrapol.time)	373.58	632.37	761.76	891.16
Q_sust	2.41	1.42	1.18	1.01

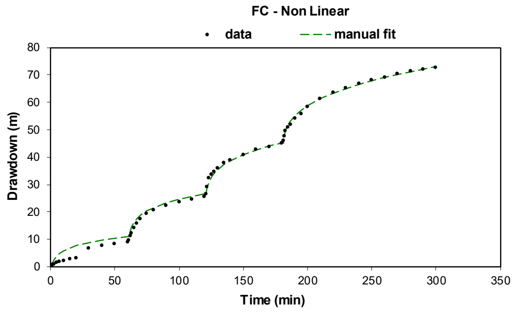
Fractal n = 1.38	**Average Q-sust (l/s)=**	1.42	std. dev =	0.62
	Boundaries selected	0 - closed		



Recovery

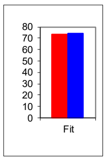
T [m2/d]	31.0
CDT Duration	2880
Recovery Duration	1440
Max % Recovery	97.8

CWA_BH003



FC - Non Linear Method to estimate Q_Sust

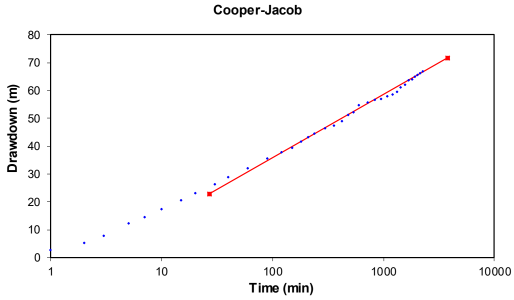
skin effect	Non-Darcian loss		Darcian loss		
A	C	p	B	n	e
2.47E-03	0.00E+00	2.03E+00	1.40E-02	1.56E+00	1.13E+00



Extrapolation	
Ext_pol time (min)	
1051200	
Q (L/s)	Drawdown (m)
3.4	73.31

Available drawdown (m) =		74	
No boundaries	1 no-flow	2 no-flow	Closed
3.4	1.7	1.1	0.6
Q_Sust (L/s)=	**1.39**	std.dev = 1.22	

Boundaries selected	**0 -closed**

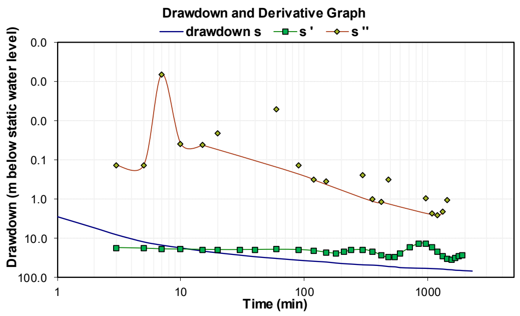


Cooper-Jacob method

T(m²/d) =	4.3	r_e (m)=	0.1
S =	1.78E+00	Q (l/s) =	6.13

	No boundaries	1 no-flow	2 no-flow	Closed
Q_sust	3.56	1.78	1.18	0.89
Avg. Q_sust =		**1.85**	std. dev =	1.20

Boundaries selected	**0 -closed**

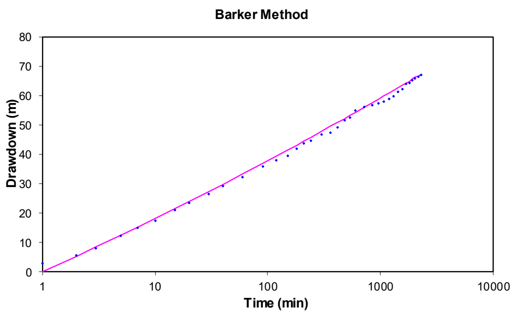


FC method

Extrapolation time in years	2	1051200	Extrapol.time in minutes	
Effective borehole radius (r_e)	43.4680469	43.46804688	Est. r_e	From r(e) sheet
Q (l/s) from pumping test	6.13	5.67579E-05	S-late	Change r_e
s_a (available drawdown), sigma_s	**74**	0	Sigma_s from risk	
Annual effective recharge (mm)	0	74	s_available working drawdown(m)	
t(end) and s(end) of pumping test	2280	66.96	End time and drawdown of test	
Average maximum derivative	**25.84**	33.45366835	Estimate of average of max deriv	
Average second derivative	**1.04**	0.039859876	Estimate of average second deriv	
Derivative at radial flow period	18.4510323	18.45103228	Read from derivative graph	
T-early[m²/d]		5.252966584	Aqui. thick (m)	60
T and S estimates	**T-late [m²/d]**	**3.75087678**	Est. S-late	0.0033
	S-late	0.0033		

BASIC SOLUTION

	No boundaries	1 no-flow	2 no-flow	Closed no-flow
sWell (Extrapol.time) =	139.48	208.31	277.14	483.64
Q_sust (l/s) =	3.25	2.18	1.64	0.94
Average Q_sust (l/s) =	**1.82**			
with standard deviation=	0.98			
Boundaries selected	**0 -closed**			

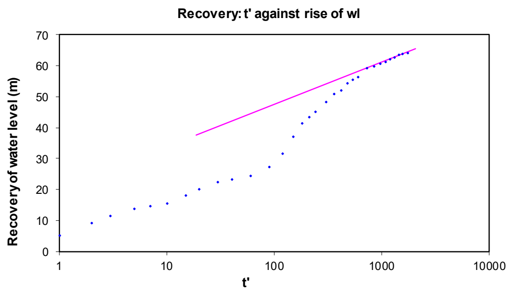


Barker method

	K_f [m/d]	S_f [1/m]	b	n	N
Fit Parameters	0.20	1.21E-03	22.66	1.93	0.0350

	No boundaries	1 no-flow	2 no-flow	Closed
sWell(Extrapol.time)	135.21	272.87	341.70	410.54
Q_sust	3.35	1.66	1.33	1.10

Fractal n =	1.93	Average Q-sust (l/s)=	1.69	std. dev =	1.02
		Boundaries selected	**0 -closed**		



Recovery

T [m2/d]	7.13
CDT Duration	2280
Recovery Duration	1740
Max % Recovery	95.6