SURFACE WATER AND GROUNDWATER STUDY FOR GRINDROD TERMINAL WITHIN CITY OF UMHLATHUZE, KWAZULU-NATAL

Prepared by:

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Prepared for:

RBT Grindrod Terminals – Seamunye Operations

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This document has been prepared by Indaloenhle Environmental Consultants.

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1. INTRODUCTION AND BACKGROUND

Indaloenhle Environmental Consultants (Pty) Ltd (Indaloehle) has been appointed by Grindrod Terminals a Division of Grindrod South Africa (Pty) Ltd (Grindrod) to undertake a Surface and Groundwater Assessment as part of the AEL application and Section 24G regularisation processes.

Grindrod owns and operates the Sea Munye Terminal, an ad hoc bulk materials storage and handling operation/facility. The materials stored on-site could include anthracite, iron ore, clinker, copper concentrate, sulphur, fertilizer, chromium, manganese ore, heavy minerals, copper concentrate, granite, ilmenite, salt, and coal (different grades), amongst others. The facility has been used for this purpose since 2001.

Since the Sea Munye Terminal has the capacity to store more than 100,000 tons of ore and coal, the facility requires an atmospheric emission licence (AEL), in terms of the National Environmental Management Air Quality Act (Act 39 of 2004) (NEM:AQA), and environmental authorisation (EA) in terms of the Environmental Impact Assessment (EIA) Regulations, 2014, published under the National Environmental Management Act (Act 107 of 1998), as amended (NEMA).

1.1. Project Background Information.

According to Grindrod, the facility initially served as a training and storage hub for Alusuf Aluminium in the late 1970s (1976-1978). By the early 2000s, it was sold and repurposed as a bulk storage facility under the name Sea Munye Port Holdings. The presence of coal stockpiles on the site can be traced back to 2004 based on historical imagery from Google Earth.

Grindrod (Kusasa Logistics) acquired the terminal in 2005, by which time it was already operating as a bulk storage and transfer terminal. Primarily utilized for storing commodities, both imported and exported via the Port of Richards Bay, the current volume of materials stored onsite is under 100,000 tons. Nonetheless, the facility is designed to accommodate up to 250,000 tons. Among the materials stored on-site, on an ad hoc basis, are anthracite, iron ore, clinker, copper concentrate, sulphur, fertilizer, and coal of various grades.

1.1.1. Project Infrastructure Components

The Sea Munye Terminal is an ad hoc bulk materials storage and handling operation/facility. The materials stored on site could include anthracite, iron ore, clinker, copper concentrate, sulphur, fertilizer, chromium, manganese ore, heavy minerals, copper concentrate, granite, ilmenite, salt and coal (different grades), amongst others. The facility has been used for this purpose since 2001.

The facility currently includes the following storage and handling areas:

- Northern stockpile.
- Southern stockpile.
- Open area between the warehouse, also known as the “low bay.”
- A-shed.

- B-shed.

The current volume of materials stored on site is less than 100 000 tons (approximately 50 000 tons at present); however, the site has the potential to store up to 250 000 tons.

1.1.2. EXISTING SUPPORT SERVICES OR FACILITIES

The total building area at the Sea Munye Terminal is 20 314.52 m2 and includes the following existing supporting infrastructure:

- Administration offices.
- A canteen.
- Security office.
- Workshop.
- Ablution areas.

1.2. The Goal of this Study:

- To assess the quality condition of surface and groundwater within and around the Project area, and to draft a water monitoring programme for the project site and provide recommendations.
- Environmental impact of the project activities on the hydrological and geohydrological regime of the area.
- Forecasting the effects of the activity on the receiving environment.

1.3. Scope of work

Description of the baseline Surface and groundwater regime:

- Conduct hydrocensus of existing boreholes, including groundwater use type and volume.
- Identification of Surface water and Groundwater monitoring points during which hydrogeological data such as depth to water strike and groundwater quality will be monitored.
- Laboratory testing of hydro-chemical samples.

1.4. Reporting:

- A final Surface and Groundwater report encompassing all work done using the above components was compiled.

2. SITE DESCRIPTION:

1.5. Site locality.

The Sea Munye Terminal is located within the industrial area of Richards Bay on 32 Alugang, Alton South, Richards Bay, 3900, Kwa-Zulu Natal (KZN), approximately 6 km from the Port of Richards Bay (Figure 2-1).

The property on which the Sea Munye Terminal is located is Portion 001, ERF 1854, which is approximately 12.4 hectares (ha) in extent; this is inclusive of all the associated storage areas and railway lines for the transfer of commodities.

The following Infrastructure (e.g. roads, power, and water supply/ storage) is associated with the project site:

- The study area is accessed through Geleiergang, a minor arterial road. There are existing driveways within the facility that provide for transportation/travel within the site.
- Potable water is provided by uMhlathuze Local Municipality.
- Electricity is supplied by the uMhlathuze Local Municipality.
- The site is connected to the uMhlathuze Local Municipality's sewer mains and the stormwater drains through underground stormwater pipes that are managed by the municipality.

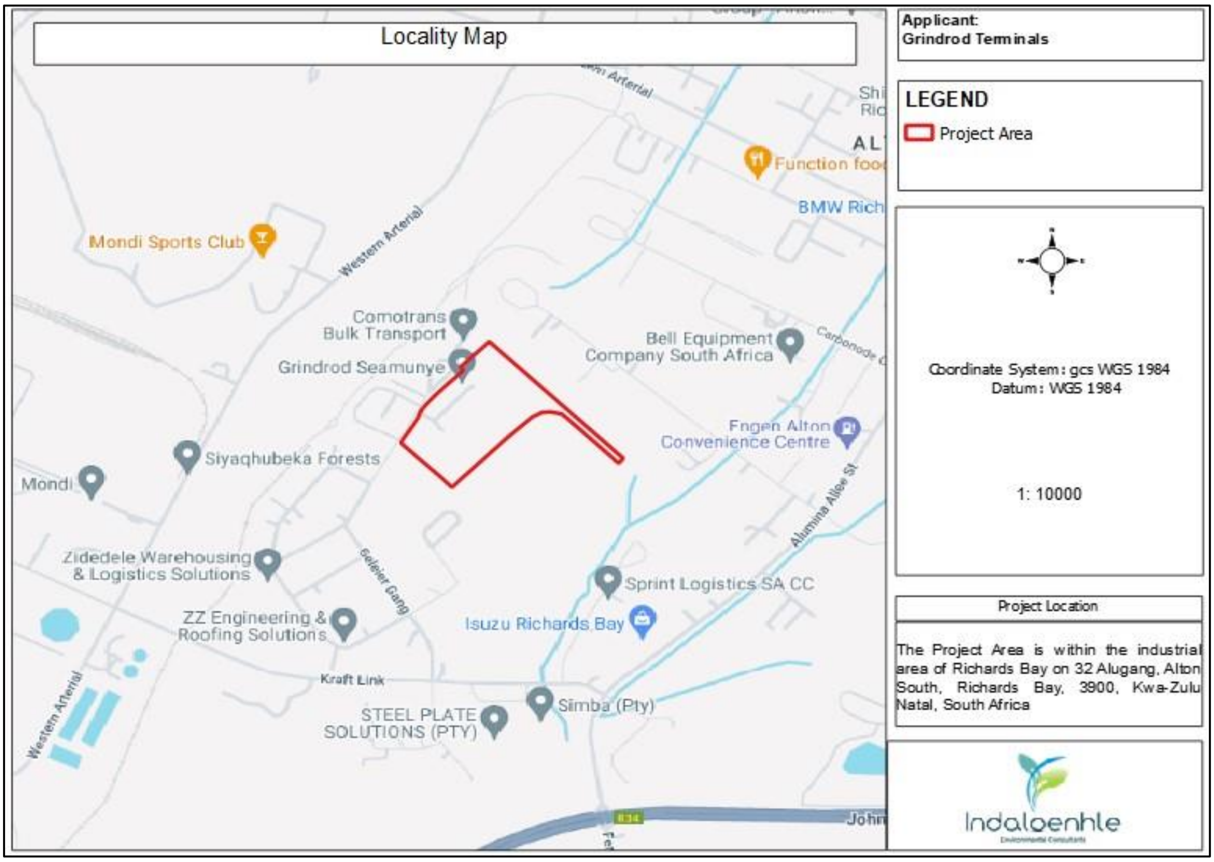

Figure 1-1: Locality Map

1.6. Climate.

The climate in the project area, is classified as tropical, characterized by distinct wet and dry seasons. During summers, the quantity of rainfall exceeds that of winters, aligning with the Aw classification in the Köppen-Geiger climate system. Situated in the southern hemisphere, Richards Bay experiences climatic conditions typical of its geographic position.

(Figure 1-2) illustrates temperature variations, with the "mean daily maximum" (solid red line) depicting the highest temperature recorded on an average day each month, while the "mean daily minimum" (solid blue line) represents the lowest recorded temperature. Additionally, the dashed red and blue lines indicate the average temperature extremes, portraying the hottest days and coldest nights over the past three decades. (Figure 1-3) and (Figure 1-4), illustrates Mean Annual Rainfall and Mean Annual Temperature Successively.

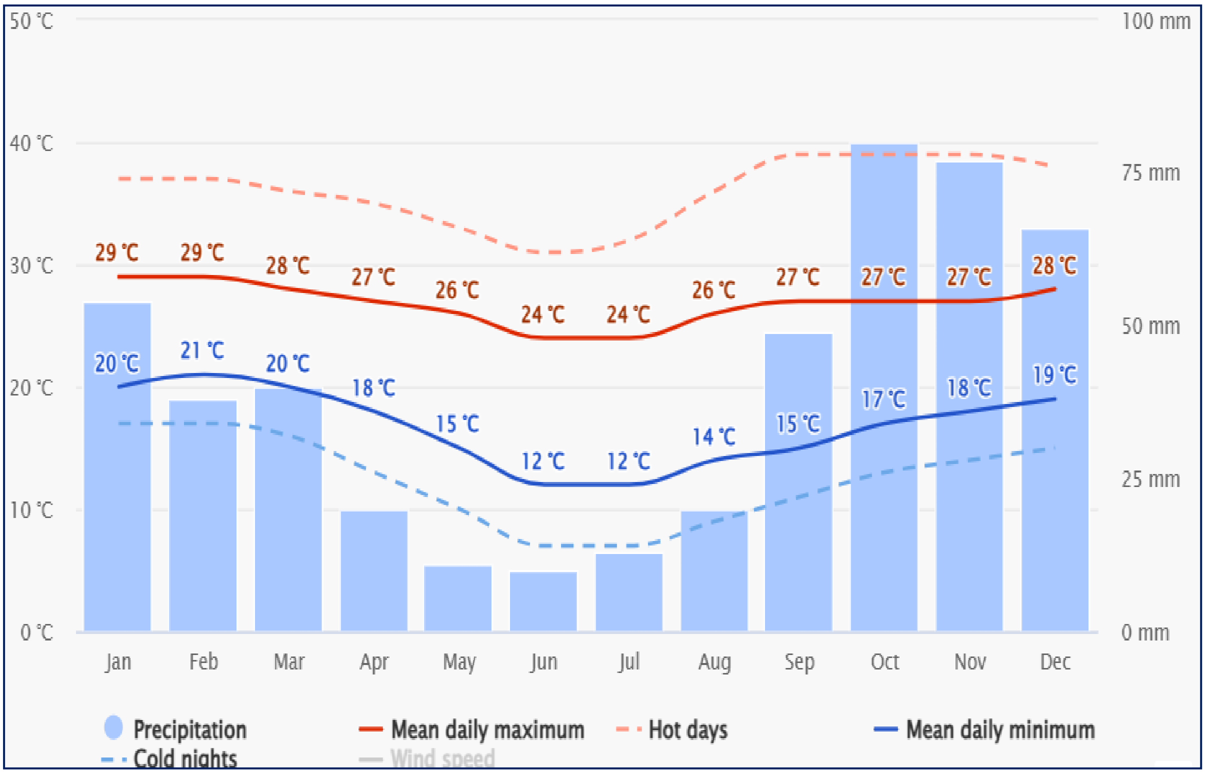

Figure 1-2: Average temperatures and Precipitation.

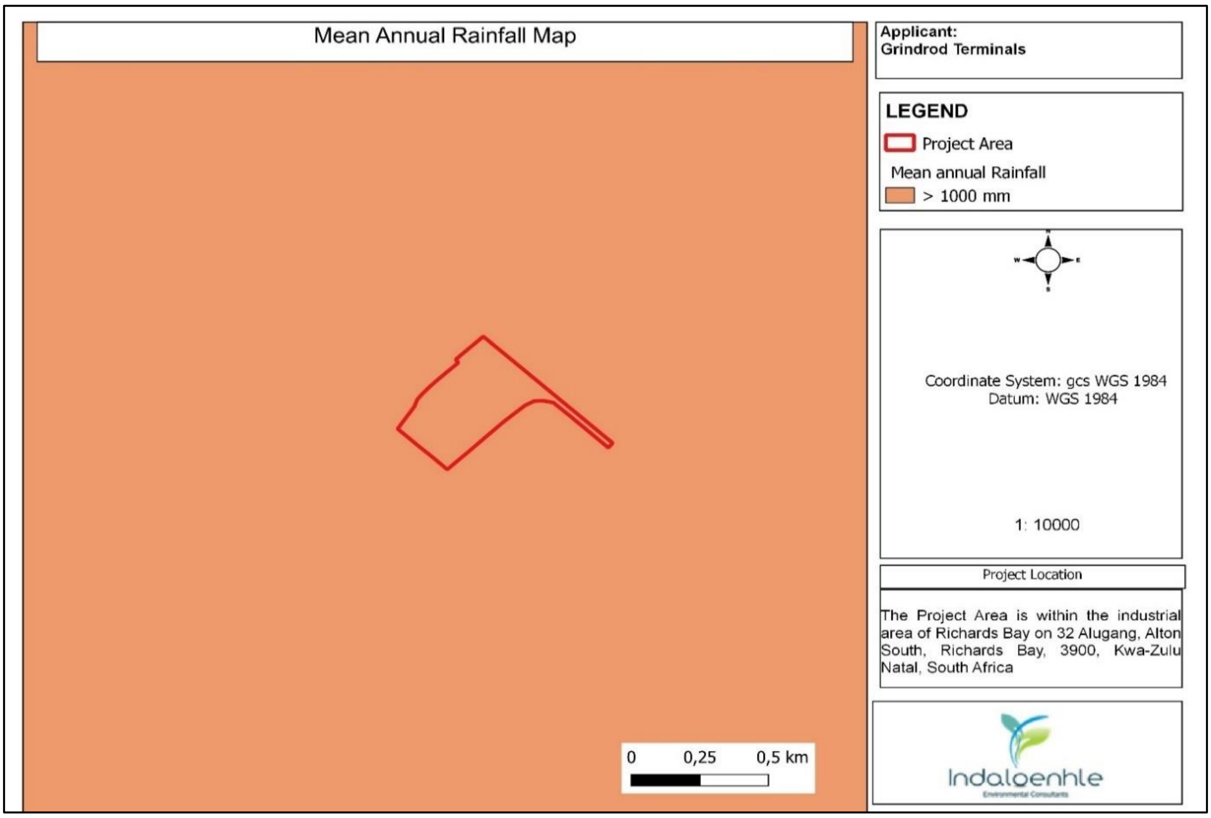

Figure 1-3: Mean Annual Rainfall

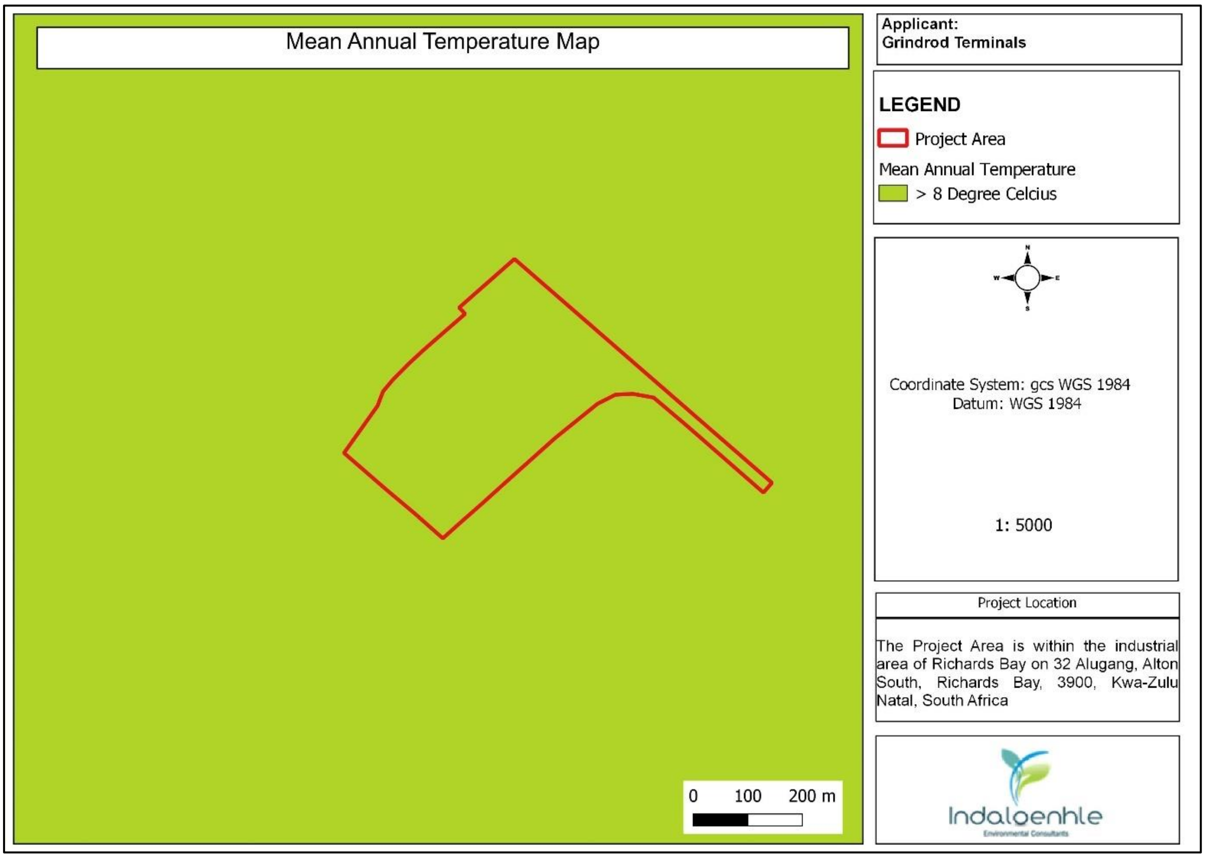

Figure 1-4: Mean Annual Temperature

1.7. Hydrological Description.

The hydrological description of the project area reveals significant features regarding surface water bodies. As depicted in (Figure 1-5), the map shows the presence of various surface water bodies within and near the project vicinity. Notably, within the project area itself, no waterbodies are identified. However, the map illustrates the existence of a perennial river, a non-perennial river, and Channelled valley bottom wetlands within a radius of one kilometre from the project area boundaries.

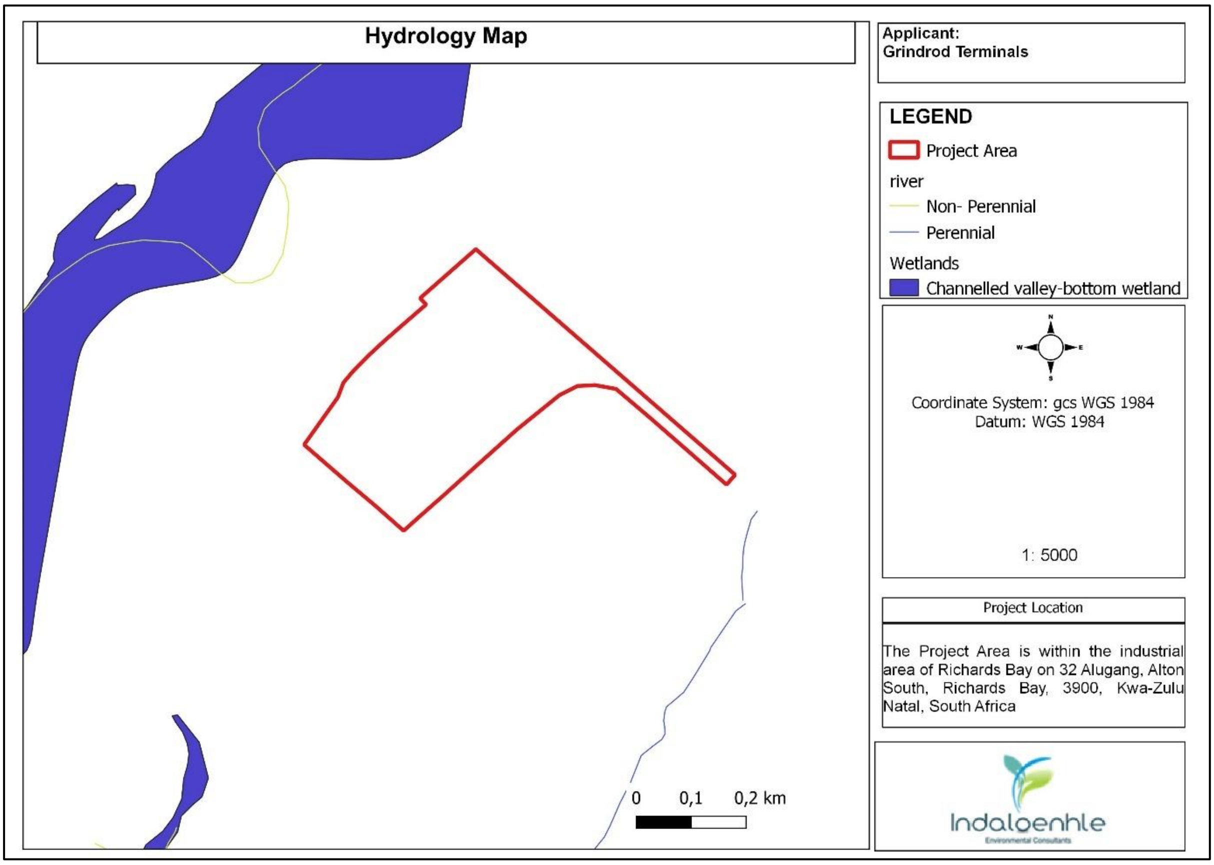

Figure 1-5: Hydrology Map

1.8. Catchment Information

The project area is in the Pongola Mtamvuna Management Area (WMA). The quaternary catchment is W12F (Figure 1-6). The WR2012 study, presents hydrological parameters for each quaternary catchment including area, mean annual precipitation (MAP) and mean annual runoff (MAR). Based on the WR2012 study, the project area falls within the quaternary catchment W12F. The total catchment area of the project Area is 399 km^2 with MAP of 1289 millimetre (mm) (Table 1-1).

Table 1-1: WRS of 2012, Water Management Area, MAP and QC

Water Management Area (WMA or primary catchment W)	Eco Region	Quaternary Catchment	Area of the quaternary catchment (KM2)	MAP (mm)	Evaporation Zone	MAR (WR2012)
Usuthu to Mhlatuze	Natal Coastal Plain	W12F	399	1289	22A	47,61

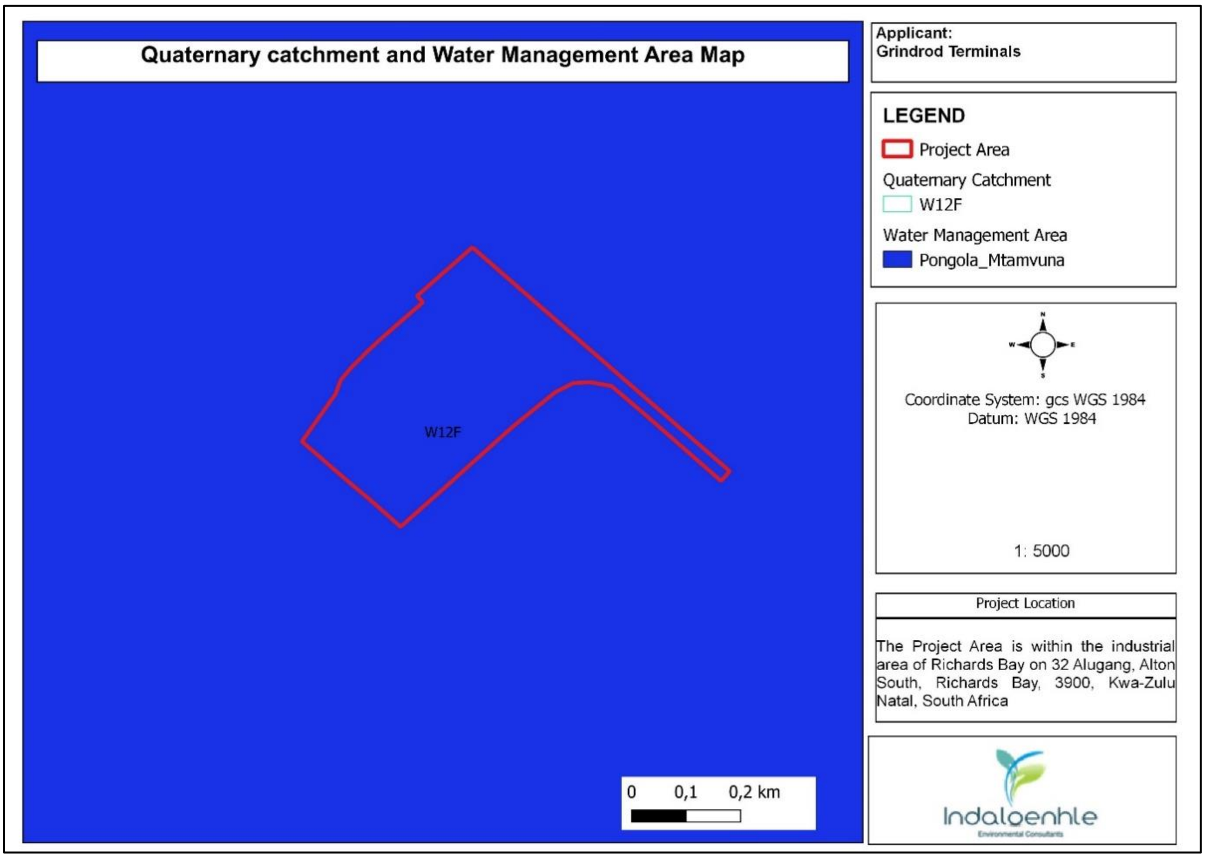

Figure 1-6 Quaternary Catchment and water Management Area

2. STUDY METHODOLOGY:

The methodological approach for the study is described in the sub-sections below.

2.1. Hydrocensus.

2.1.1. Background

The primary goal of the hydrocensus survey is to document the utilization of groundwater within the region. This involves visiting local farmers and villages to identify any operational boreholes they may have, potentially serving as water sources. During this process, we will assess temperature, pH levels, conductivity (EC), dissolved oxygen (DO), and collect water samples.

Prior to commencing the site hydrocensus, we acquire borehole data from the National Groundwater Archive (NGA) of the Department of Water and Sanitation. According to the results from Groundwater Archive, there were no available data of the project area. The hydrocensus records essential information, including:

- Borehole name, co-ordinates,
- Drill date,
- Groundwater level,
- Borehole depth,
- Borehole diameter,
- Borehole elevation
- Borehole usage,
- Borehole status,
- Borehole equipment,
- Groundwater chemistry in the borehole

2.1.2. 3.3.2 Hydrocensus methodology

Indaloenhle consists of experienced groundwater and surface water specialist team. The established water department uses the tools and equipment's as listed below, in all the water related projects to ensure quality work is delivered to the respective clients.

Table 2-1: Hydrocensus Table

Indaloenhle Environmental Hydro census Form

Equipment's

I. Temp, Ph, Conductivity and DO Probes
II. GPS
III. Bailer to Sample Groundwater
IV. Dip Meter to Record Groundwater Level

Project name:				Project number:								
Census date:				Field Technician								
Site information												
Owner:												
Address:				Cell:								
				Tel:								
				Fax:								
Borehole/monitoring well info												
Borehole number:				In use:	Yes			No				
Y-coordinate:(south)				When last pumped	Hours		Days		Currently		N/A	
X-coordinate:(East)				Pump type	Sub		Wind		Mono		None	
Z-coordinate:		mamsl		Depth to water table: (SWL)			mbgl		No access			
Diameter:	165mm		225mm	Sample taken	Yes		No					
Collar height:	Level		mm	Float/pump sample:	None		Pump		Tank			
Water Application												
Garden/Landscape:	Garden		Veg.	Mix	Cotton		Fruits		Grains	Feed	Other	
Area of garden/crop:		ha		ha	ha	ha		ha		ha		ha
Livestock watering:	horses		poultry	pigs	Pigs/goats		cattle		Fish	N/A	Other	
No.of:												
Aqua farming:	yes		No		Volume and no. of tanks							
Domestic:	No. of households						or		No.of people			
Other uses:												
Additional Borehole Information												
Date drilled:				Depth of water strikes								
Depth drilled:				Pump size				Kw				
Casing type	Steel			Yield		Gal			l/h			
	Plastic			Pump to reservoir:	Yes		No		Volume			
Depth of casing		m		How often pumped:	As needed				Daily			
Length of perforated casing		m			Auto level control							
Notes					**Photo**							

2.2. Sampling and Chemical Analysis Methodology

Various tools were utilized for data collection, including a Water level meter, handheld GPS, measuring tape, and bailer, across multiple boreholes on-site. The GPS determined longitudinal, latitudinal, and elevational coordinates of each borehole. The measuring tape assessed collar height measurements, while the water level meter, alongside the measuring tape, determined water levels.

2.2.1. Surface water sampling

Sampling vessels were rinsed on-site with water 3-4 times before sampling to prevent contamination. After gentle submersion, vessels were filled, firmly sealed, and left with 10% expansion room if freezing was anticipated (Singh, 2015)

2.2.2. Groundwater sampling

Bailers were used for groundwater sampling, lowered into the water column with rope or wire and employing a ball check valve for sealing. Materials included polyethylene, PVC, FEP, or stainless steel, with options for disposable or reusable bailers (Singh, 2015). Water level meters ensured accurate water table level measurements, crucial before sampling or purging boreholes, particularly beneficial for open-hole configurations without pump enclosures.

2.3. Impact Assessment Methodology

The significance of each identified impact was determined using the approach outlined below (terminology from the Department of Environmental Affairs and Tourism Guideline document on EIA Regulations, April 1998). This approach incorporates two aspects for assessing the potential significance of impacts, namely occurrence and severity, which are further sub-divided as follows:

Occurrence		Severity	
Probability of occurrence	Duration of occurrence	Scale/extent of impact	Magnitude (severity) of impact

To assess each of these factors for each impact, the following four ranking scales are used:

Magnitude	Duration
10 - Very high / Unknown	5 – Permanent (post closure)
8 – High	4 - Long-term (impact ceases after site closure has been obtained)
6 – Moderate	3 - Medium-term (impact ceases after operational life of the activity)
4 – Low	2 - Short-term (impact ceases after the construction phase)
2 – Minor	1 – Immediate
Scale	Probability
5 – International	5 – Definite / Unknown

4 – National	4 - Highly Probable
3 – Regional	3 - Medium Probability
2 – Local	2 - Low Probability
1 - Site only	1 - Improbable
0 – None	0 – None

Once these factors are ranked for each impact, the significance of the aspects, occurrence and severity, is assessed using the following formula:

SP (significance points) = (Magnitude + Duration + Scale) x Probability

The maximum value is 100 significance points (SP). The impact significance will then be rated as follows:

SP >60	Indicates high environmental significance	An impact which could influence the decision about whether or not to proceed with the project regardless of any possible mitigation.
SP 30 – 60	Indicates moderate environmental significance	An impact or benefit which is sufficiently important to require management, and which could have an influence on the decision unless it is mitigated.
SP <30	Indicates low environmental significance	Impacts with little real effect and which should not have an influence on or require modification of the project design.
+	Positive impact	An impact that is likely to result in positive consequences / effects.

For the methodology outlined above, the following definitions were used:

- ***Magnitude*** is a measure of the degree of change in a measurement or analysis (e.g., the severity of an impact on human health, well-being, and the environment), and is classified as none/negligible, low, moderate, high, or very high/unknown.
- ***Scale/Geographic*** extent refers to the area that could be affected by the impact and is classified as site, local, regional, national, or international.
- ***Duration*** refers to the length of time over which an environmental impact may occur i.e. immediate/transient, short-term, medium term, long-term, or permanent.

- ***Probability*** of occurrence is a description of the probability of the impact occurring as improbable (less than 5% chance), low probability (5% to 40% chance), medium probability (40% to 60% chance), highly probable (most likely, 60% to 90% chance) or definite (impact will definite occur).

3. Aquifer Characterization

3.1.1. Groundwater vulnerability

Groundwater vulnerability is described as a relative, non-measurable property, according to the International Association of Hydrogeologists (IAH, 1994), based on the notion that certain land areas are more susceptible to groundwater contamination (Vrba and Zaporozec, 1994).

The potential for groundwater contamination from the Project activities centres around two primary concerns:

- During operation, heavy machinery presence raises the risk of Total Petroleum Hydrocarbon (TPH) contamination through spillages impacting soil and groundwater.
- During operations, erosion poses a risk of contaminating nearby water resources.

The aquifer vulnerability from possible pollution sources is classed as "Most". A most potential or likelihood for possible contaminated fluids originating from the site to reach the groundwater table exists (Vegter, JR; Seymour , AJ, 2013). A maximum aquifer protection level is therefore recommended.

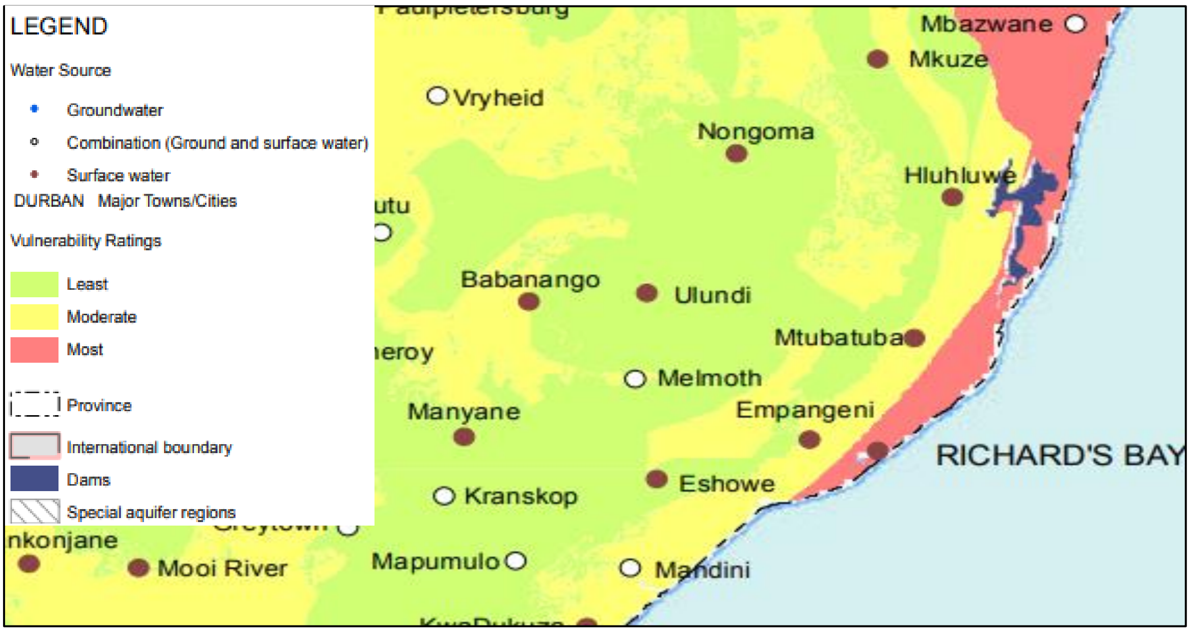

Figure 3-1: Aquifer Vulnerability of the study area.

3.1.2. Aquifer classification

The (Figure 3-2) below illustrates aquifer classification of different areas in South Africa. It can be deduced that the project area at Richards Bay comprises of major aquifers and the dominant water source is surface water (Vegter & Seymour, 2012). (Table 3-1) interprets the meaning of the aquifer classification and when an area is said to have major aquifer it means that the aquifer is High-yielding aquifer of acceptable quality water.

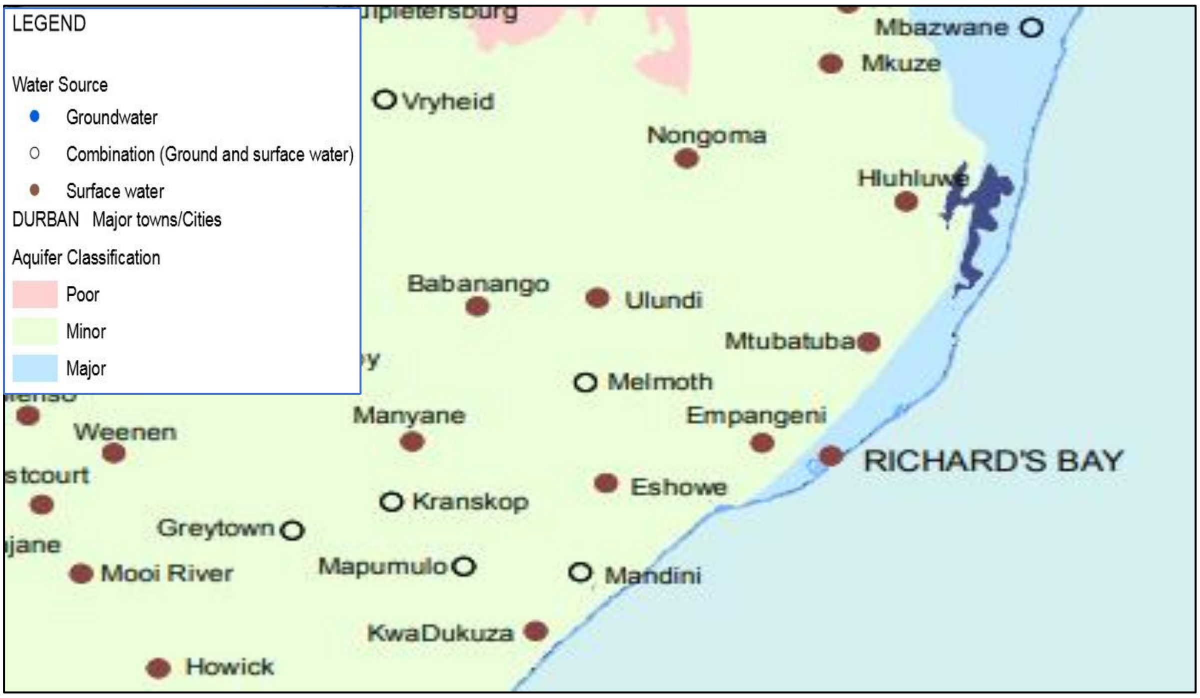

Figure 3-2: Aquifer Classification

Table 3-1: Aquifer characterization

Sole source aquifer	An aquifer used to supply 50% or more of urban domestic water for a given area, for which there are no reasonably available alternative sources should this aquifer be impacted upon or depleted.
Major aquifer region	High-yielding aquifer of acceptable quality water.
Minor aquifer region	Moderately yielding aquifer of acceptable quality or high yielding aquifer of poor-quality water.
Poor aquifer region	Insignificantly yielding aquifer of good quality or moderately yielding aquifer of poor quality, or aquifer that will never be utilised for water supply and that will not contaminate other aquifers.

4. Water Quality

Water sampling was conducted by a qualified Specialist from Indaloenhle Environmental at various locations within the project area, adhering to the Standard Operating Procedure (SOP) for surface water sampling. Additionally, water samples were collected from boreholes within the project area for subsequent laboratory analysis to assess water quality. To interpret groundwater chemistry data, the Piper diagram is frequently employed.

The Seamunye Bulk Terminal currently does not have a Water Use Licence. However, since 2017, regular surface and groundwater sampling has been carried out, involving one (1) surface water monitoring point and five (5) groundwater monitoring points (Table 4-1). Water quality sampling has been conducted bi-annually during this period.

Table 4-1: Groundwater and Surface water Points

Site ID	Type	Latitude (WGS84)	Longitude (WGS84)	Description
SEA1	Groundwater	-28.75825	32.01012	Monitoring- Up-gradient, next to the office entrance
SEA2	Groundwater	-28.75897	32.01312	Monitoring- Up-gradient, northeast of northern stockpiles
SEA3	Groundwater	-28.75955	32.01230	Monitoring- Down-gradient, east of the maintenance workshop
SEA5	Groundwater	-28.75698	32.01138	Monitoring- Up-gradient, northwest of northern stockpiles
SEA6	Groundwater	-28.75985	32.00881	Monitoring- Down-gradient, west of southern stockpiles
SEASW1	Surface Water	-28.75843	32.00998	Stormwater- Upgradient, within the parking area of Sea Munye.

4.1. Groundwater Results

Groundwater quality results were compared to DWAF TWQL (1996), and a piper diagram (Figure 4-1) was created (Triplo4 sustainable Solution & GCS, 2023). No samples were taken from SEA1, SEA2, and SEA3 due to dry conditions. The results are as follows:

- Samples from SEA5 and SEA6 displayed pH levels in the acidic range (< 5), rendering them non-compliant with DWAF (1996) TWQL standards.
- Electrical conductivity (EC) at SEA6 exceeded DWAF (1996) TWQL thresholds.
- Ammonia (NH_3) levels surpassed DWAF (1996) TWQL standards at SEA6.
- Calcium (Ca) levels were notably high at SEA6, surpassing DWAF (1996) TWQL limits.
- Sulfate (SO_4) concentrations at SEA6 exceeded DWAF (1996) TWQL chronic limits.
- Magnesium (Mg) and fluoride (F) concentrations were elevated at SEA6, surpassing DWAF (1996) TWQL criteria.
- Aluminum (Al), iron (Fe), and manganese (Mn) concentrations at SEA6 were notably high, exceeding DWAF (1996) TWQL thresholds.
- All other parameters subject to limits were found to be compliant.

Furthermore, (Figure 4-1) illustrates a piper plot for groundwater, offering insights into the hydrochemistry signatures observed (Triplo4 sustainable Solution & GCS, 2023):

- Samples are positioned towards the left of the left ternary diagram, suggesting dominance of calcium (Ca) and sodium (Na) as cations.
- Samples cluster towards the upper right corner of the right ternary diagram, indicating dominance of sulfate (SO4) anions, with chloride (Cl) anions accounting for the remaining samples.
- Based on the total ion load, the samples are situated towards the right corner of the centre rhombus. Consequently, the groundwater at the site can be categorized as Ca-SO4 type waters, characteristic of groundwaters influenced by inadequate quality seepage from coal and mineral stockpiles abundant in sulfur-bearing minerals. Evidently, leaching of salts is occurring at the site, with the low pH indicating further impact metallurgical drainage on the groundwater.

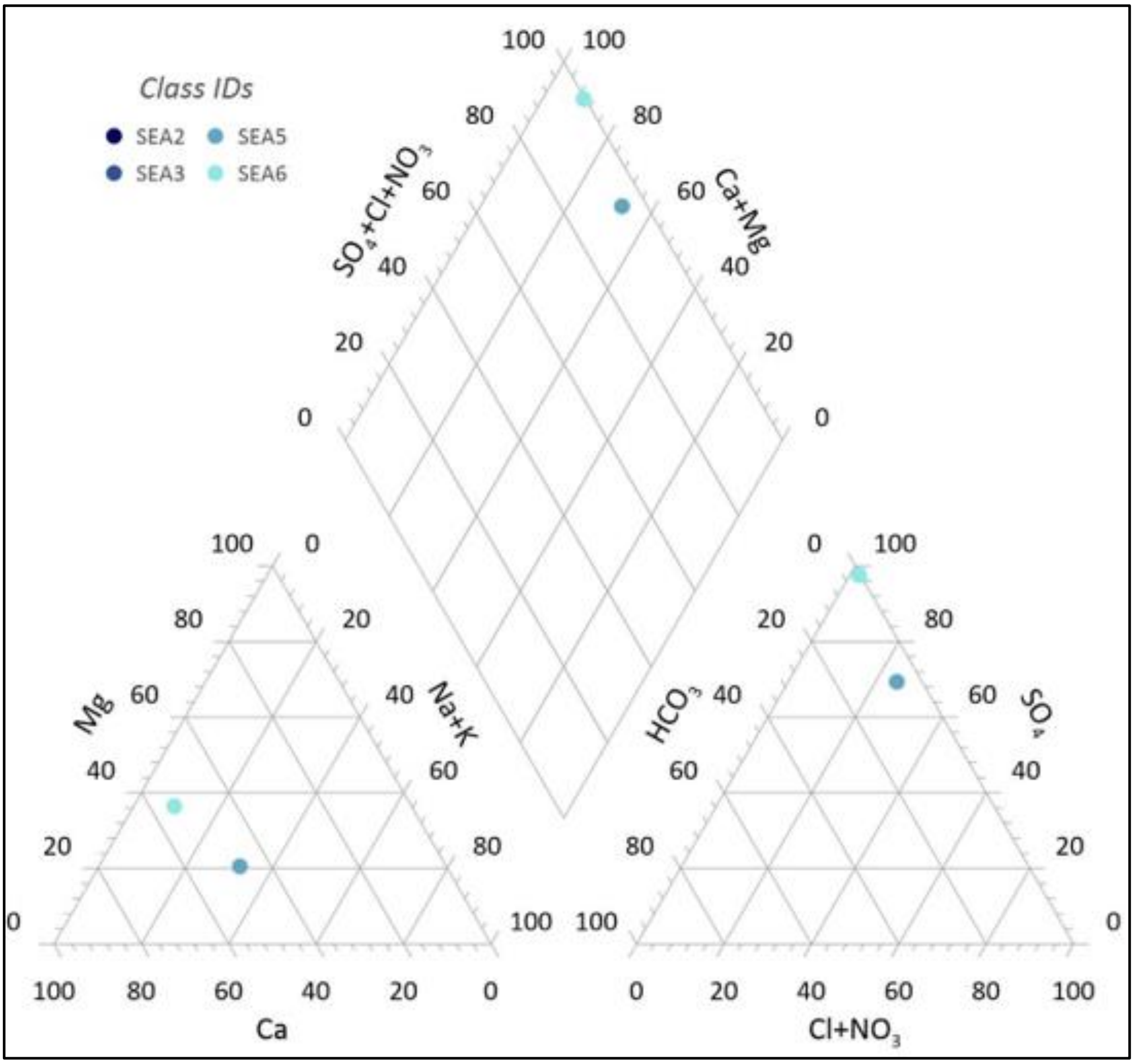

Figure 4-1: Piper diagram.

Table 4-2 shows the results from the Seamunye surface water, and groundwater laboratory results (Figure 4-2 and Figure 4-3), which have been screened against DWAF (1996) limits. The results which do not fall within the limits are highlighted in red.

Table 4-2: Seamunye Surface water and Groundwater sample results

Parameter		pH	EC	TALK	TSS	NH3	Ca	Mg	Na	K	Cl	F	SO_4	NO_3-N	P	Al	Cd	Cr	Fe	Pb	Mn	Si	Ti
Site ID	**Type**	**pH units**	**mS/m**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**
SEA5	Groundwater	5.57	30.2	<10	4604	<0.2	25.4	6.7	18.8	<2.00	24.3	<0.5	93.9	0.97	<1.00	<0.1	<0.001	0.00606	<0.05	<0.003	0.146	8.48	<0.005
SEA6	Groundwater	3.27	297	<10	11092	2.7	407	166	69.1	19	27.9	15.4	1939	3.58	<1.00	>1.2	<0.001	0.0131	1.11	<0.003	>2	16.9	<0.005
DWAF (1996) TWQL		6-9	0-70	NS	NS	<1	<32	<30	<100	<50	<100	<1	<200	<6	NS	<0.15	<0.05	<0.05	<0.1	<0.001	<0.05	NS	NS

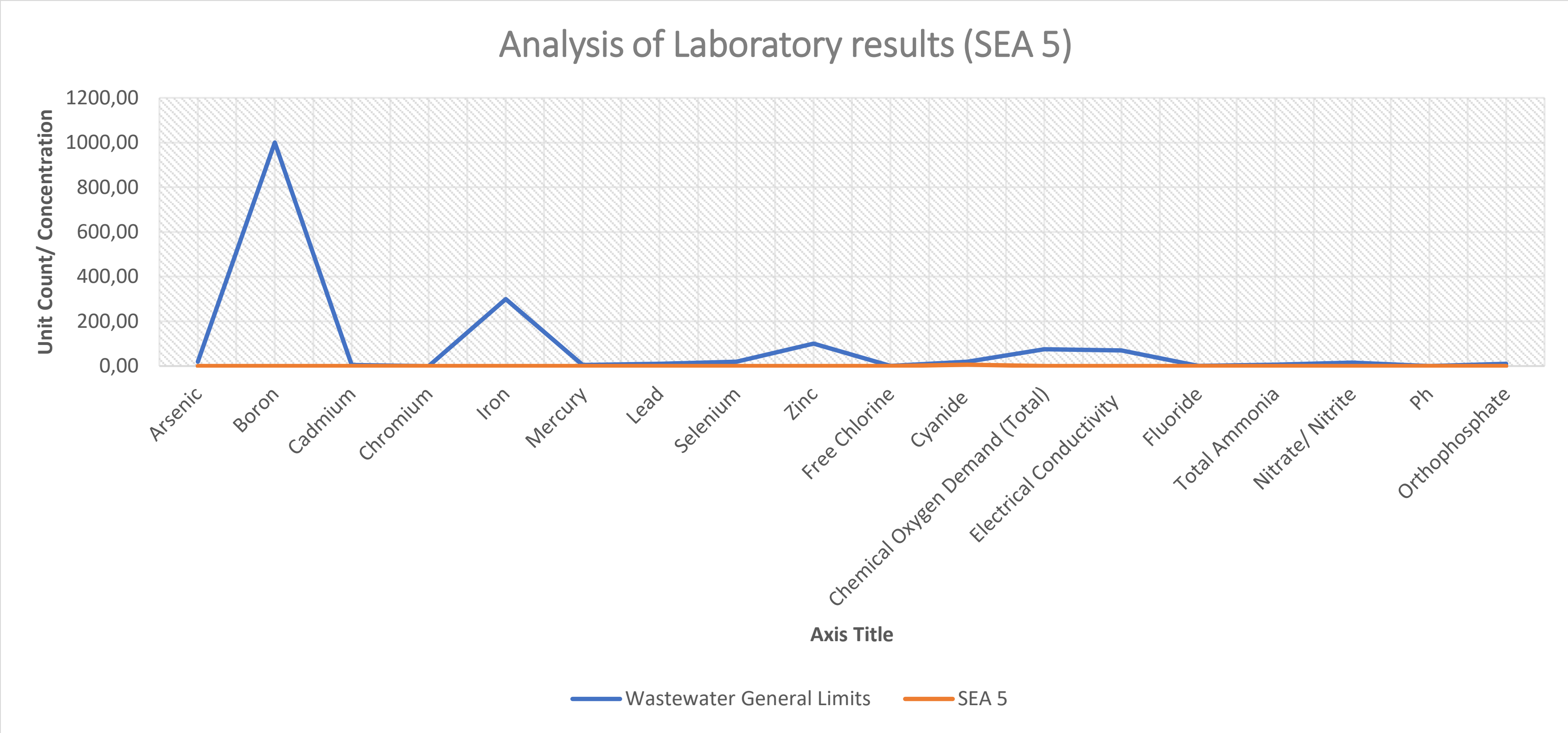

Figure 4-2: Analysis of Laboratory results (SEA 5)

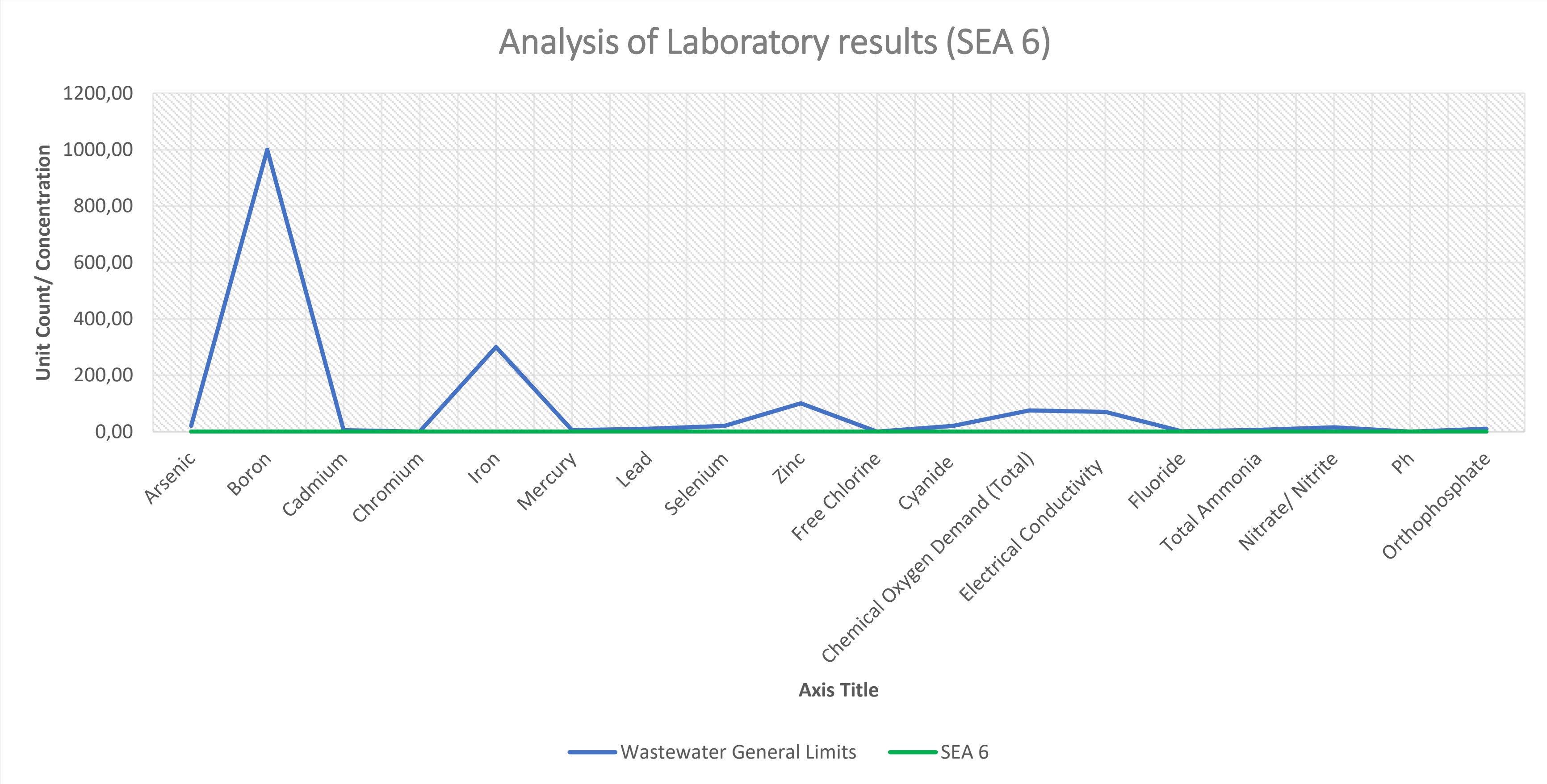

Figure 4-3: Analysis of Laboratory results (SEA 6)

The stormwater results have been compared to the General Limits for Wastewater as specified by the Department of Water and Sanitation (DWS), as well as guidelines defined for protection of the Natural Marine Environment as per the *South African Water Quality Guidelines for Coastal Marine Waters, Volume 1* (DWAF, 1995) (Table 4-3, and Figure 4-4). The results which do not fall within the limits are highlighted in red.

Table 4-3: Analytical results of SW1 Stormwater.

Determinants	Unit	Waste Water General Limits	SW1
Chemical Oxygen Demand (Total)	mg O_2/ℓ	75	97.56
Free Chlorine	mg Cl_2/ℓ	0.25	0.00
Orthophosphate	mg P/ℓ	10	0.02
Total Ammonia	mg N/ℓ	6	1.13
Nitrate	mg N/ℓ	15	6.5
Electrical Conductivity at 25°C	mS/m	70	77.4
pH at 25°C	pH units	5.5- 9.5	6.89
E. coli	MPN/100mℓ	0	0
Suspended Solids at 105°C	mg/ℓ	25	67

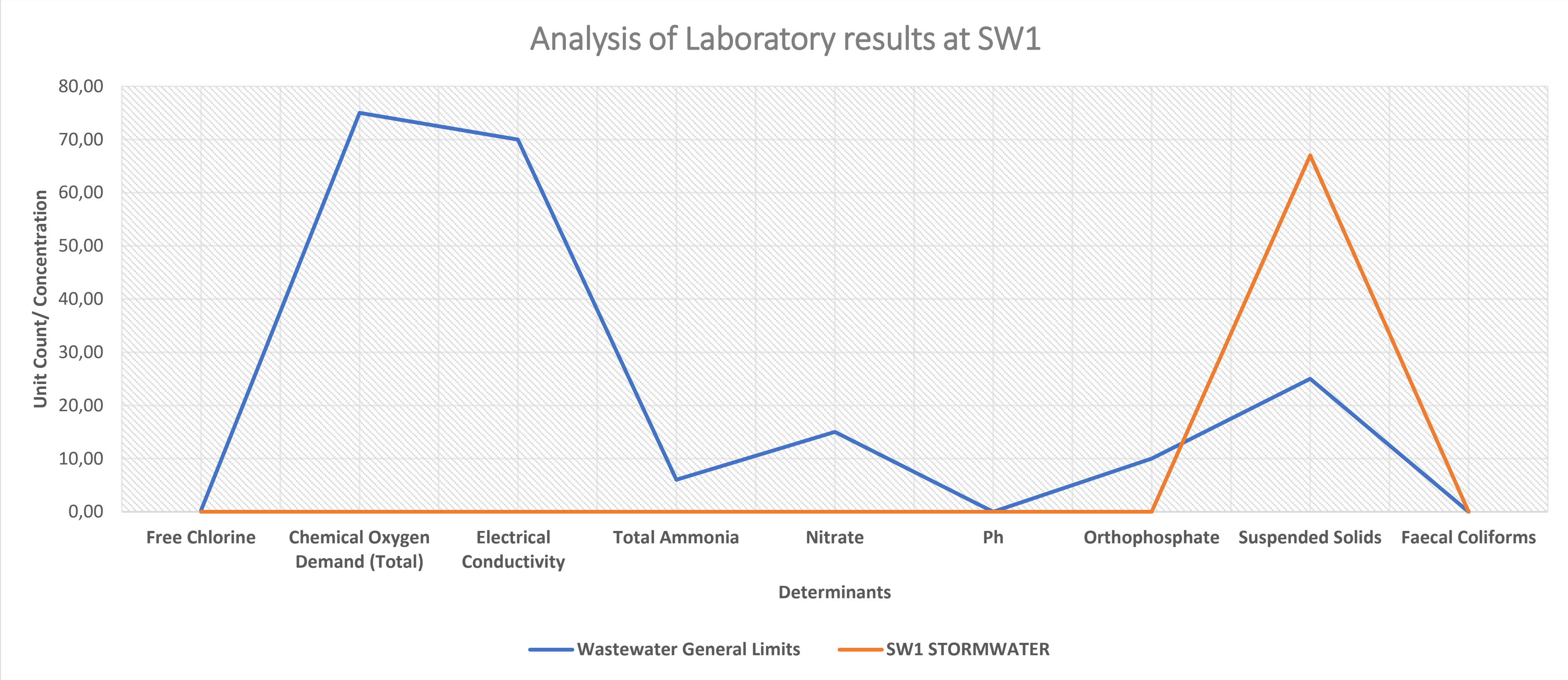

Figure 4-4:Analysis of Laboratory Results for SW1

5. Surface and Groundwater Water Impact Assessment

The impacts to Surface and groundwater quantity for the Seamunye Bulk Terminal can be discussed according to the operational phase. The activities on site are shown on Table 5-1,

Table 5-1: Activities on site

Hauling and Transportation of Chemicals	The stockpiles include various Metallic Minerals, Non-Metallic Minerals, Coal, and Fertilizer
	
Transportation of Chemicals and Metals	Ponding of rainwater near Old Coal Stockpiles
	

5.1. Operational phase

5.1.1. Impacts on Surface water quantity

- Release of hazardous materials into surface water, leading to contamination and potential harm to aquatic life.

- Alteration of pH levels due to chemical runoff, affecting water quality and aquatic life.
- Leaching of pollutants from stored materials or runoff, leading to contamination of surface water resources.
- Truck oils and fuel leakages that can contaminate water resources.
- Alteration of water flow and direction, impacting aquatic ecosystems and sediment transport.

5.1.2. Impacts on Groundwater quantity

- Leakage of diesel and/or chemicals from storage tanks into groundwater, posing risks to human health and ecosystems.
- Potential impact on groundwater due to on-site accidental fuel spills and leaks/ leachate and infiltration of dirty water.
- Leaching of chemicals from stored materials into groundwater, contaminating drinking water sources.
- Decreased groundwater recharge of water into aquifers due to impermeable surfaces, leading to lowered water tables.
- Discharge of untreated sewage or wastewater containing pathogens into groundwater, posing health risks.
- Leaching of heavy metals from stored materials into groundwater, posing risks to human health and ecosystems.
- Changes in groundwater quality due to leaching of chemicals or natural processes, impacting water usability.

5.1.3. Cumulative impacts

The cumulative impacts due to the Project could be of a quantitative and qualitative nature. The aquifers within the region are classified as major aquifer systems and their main function is a domestic and industrial water supply source as well as supplying base flow to the surface water environment. This will result in a positive impact locally and could see the importance of groundwater increasing as a potential source within the catchment.

However, the water quality within the workings could be good or deteriorate depending on the geochemical characteristics of the material. The cumulative impact on the catchment will have to be considered for Industrial, agriculture and the remainder of the current surface and groundwater uses in the Richards Bay.

The regional hydrological setting of the project site is indicated in Figure 5. The project area is in the Pongola Mtamvuna Management Area (WMA). The quaternary catchment is W12F. The WR2012 study, presents hydrological parameters for each quaternary catchment including area, mean annual precipitation (MAP) and mean annual runoff (MAR). Based on the WR2012 study, the project area falls within the quaternary catchment W12F. The total catchment area of W12F is 399 km2 with MAP of 1289 millimetre (mm).

Table 5-2: Impact Assessment and mitigation measures table.

Activity	POTENTIAL IMPACT *(e.g. dust, noise, drainage surface disturbance, fly rock, surface water contamination, groundwater contamination, air pollution etc….etc …)*	ASPECTS AFFECTED	PHASE In which impact is anticipated *(e.g. Construction, commissioning, operational Decommissioning, closure, post-closure)*	Size and Scale of Disturbance *(volumes, tonnages, and hectares, or m²)*	Magnitude	Duration	Scale	Probability	Significance	Significance without Mitigation	Magnitude	Duration	Scale	Probability	Significance	Significance with Mitigation	Detailed Mitigation Measures	Mitigation Type (Modify, remedy, control or stop) *e.g. Modify through alternative method; Control through noise control; Control through management and monitoring; Remedy through rehabilitation*	Time period for implementation *(time period when the measures in the environmental management programme must be implemented Measures must be implemented when required)*	Standards to be Achieved *(Impact avoided, noise levels, dust levels, rehabilitation standards, end use objectives etc)*	Compliance with Standards *(A description of how each of the recommendations made, will comply with any prescribed environmental management standards or practices that have been identified by Competent Authorities)*	Responsible person
Operational Phase																						
Alteration of pH Levels	Surface water quality	Aquatic life	Operational	EA Application area - 12.4 ha	4	3	2	4	36	Moderate	2	3	2	4	28	Low	Conduct regular monitoring of water pH levels. Implement measures to neutralize acidic or alkaline runoff. Use environmentally friendly chemicals.	Monitoring	Implemented at planning and operation stage. Audit report on management systems and annual review of monitoring data and model updates	Impact avoided	Compliance with EMPr	Environmental Manager
Leaching of sewerage systems	**Groundwater contamination**	**Surface water and Groundwater quality**	**Operational**	**EA Application area -12.4 ha**	**2**	**3**	**2**	**4**	28	Low	**2**	**3**	**2**	**4**	28	Low	**Implement runoff management infrastructure. Regularly inspect and maintain storage areas to prevent leaks. Implement best management practices.**	**Control through management and monitoring**	**Implemented at planning and operation stage. Audit report on management systems and annual review of monitoring data and model updates**	**Impact avoided**	**Compliance with EMPr**	**Environmental Manager**
Fuel & hydrocarbons spillages from transporting vehicles	Surface water and Groundwater contamination	Surface water quality	Operational	EA Application area - 12.4 ha	4	3	2	4	36	Moderate	2	3	2	4	28	Low	Implement spill containment systems for fueling stations. Conduct regular inspections for leaks. Train personnel on proper handling and containment procedures.	Control through management and monitoring	Implemented at planning and operation stage. Audit report on management systems and annual review of monitoring data and model updates	Impact avoided	Compliance with EMPr	Environmental Manager
Discharge of Untreated Sewage or Wastewater	**Surface water and Groundwater contamination**	**Surface water and Groundwater quality**	**Operational**	**EA Application area - 12.4 ha**	**2**	**2**	**2**	**4**	**24**	**Low**	**2**	**2**	**2**	**4**	**24**	**Low**	**Implement wastewater treatment systems. Regularly monitor effluent quality. Ensure compliance with discharge permits and regulations.**	**Control through management and monitoring**	**Implemented at planning and operation stage. Audit report on management systems and annual review of monitoring data and model updates**	**Impact avoided**	**Compliance with EMPr**	**Environmental Manager**
Oil spillages from Storage Drums	Groundwater contamination	Groundwater quality	Operational	EA Application area - 12.4 ha	2	2	2	4	24	Low	2	2	2	4	24	Low	The storage facility must be lined and Monitoring of groundwater	Control through management and monitoring	Implemented at planning and operation stage. Audit report on management systems and annual review of monitoring data and model updates	Impact avoided	Compliance with EMPr	Environmental Manager
Leaching of stockpiled Chemicals and Metals	**Groundwater contamination**	**Groundwater quality**	**Operational**	**EA Application area - 12.4 ha**	**4**	**2**	**2**	**4**	**32**	**Moderate**	**2**	**2**	**2**	**4**	**24**	**Low**	**Implement runoff management infrastructure. Regularly inspect and maintain storage areas to prevent leaks. Implement best management practices.**	**Control through management and monitoring**	**Implemented at planning and operation stage. Audit report on management systems and annual review of monitoring data and model updates**	**Impact avoided**	**Compliance with EMPr**	**Environmental Manager**
Haul Roads and service road	Decrease in water quality due to increased sediment load	Surface water quality	Operational	EA Application area - 12.4 ha	2	2	2	4	24	Low	2	2	2	4	24	Low	To avoid and control sediment transport, a maintenance plan must be drawn up for road maintenance. a soil erosion evaluation must be performed	Control through management and Maintanance	Implemented at planning and operation stage. Audit report on management systems and annual review of monitoring data and model updates	Impact Avoided	Compliance with EMPr	Environmental Manager

6. GROUNDWATER AND SURFACEWATER MONITORING PLAN

Groundwater management strategies for this project activities emphasises mostly on pollution prevention rather than on treatment. Early detection of contamination is the key to react and effectively manage any possible sources of pollution. This will assist in identifying potential future impacts from the operations on the groundwater and surface water environment.

6.1. Water monitoring System

6.1.1. Current monitoring taking place.

Groundwater and surface water monitoring is currently taking place at Seamunye Bulk Terminal project Area. The following are the onsite pictures during Site Assessment made in April 2024 and location of the water bodies (Table 6-2).

There are no wetlands inside the project area, only the stormwater during rainy seasons, that Sea Munye Terminal was Sampling biannually. The Monitoring Boreholes are located within the project Area boundaries and are currently utilised as groundwater monitoring points. (Figure 6-1) show the location of Monitoring Points which are currently being monitored.

Table 6-1: Current monitored groundwater and surface water bodies

Site ID	Type	Latitude (WGS84)	Longitude (WGS84)	Description
SEA1	Groundwater	-28.75825	32.01012	Monitoring- Up-gradient, next to the office entrance
SEA2	Groundwater	-28.75897	32.01312	Monitoring- Up-gradient, northeast of northern stockpiles
SEA3	Groundwater	-28.75955	32.01230	Monitoring- Down-gradient, east of the maintenance workshop
SEA5	Groundwater	-28.75698	32.01138	Monitoring- Up-gradient, northwest of northern stockpiles
SEA6	Groundwater	-28.75985	32.00881	Monitoring- Down-gradient, west of southern stockpiles
SEASW1	Surface Water	-28.75843	32.00998	Stormwater- Upgradient, within the parking area of Sea Munye.

Table 6-2: Pictures showing Groundwater Sampling within the Project Area

	

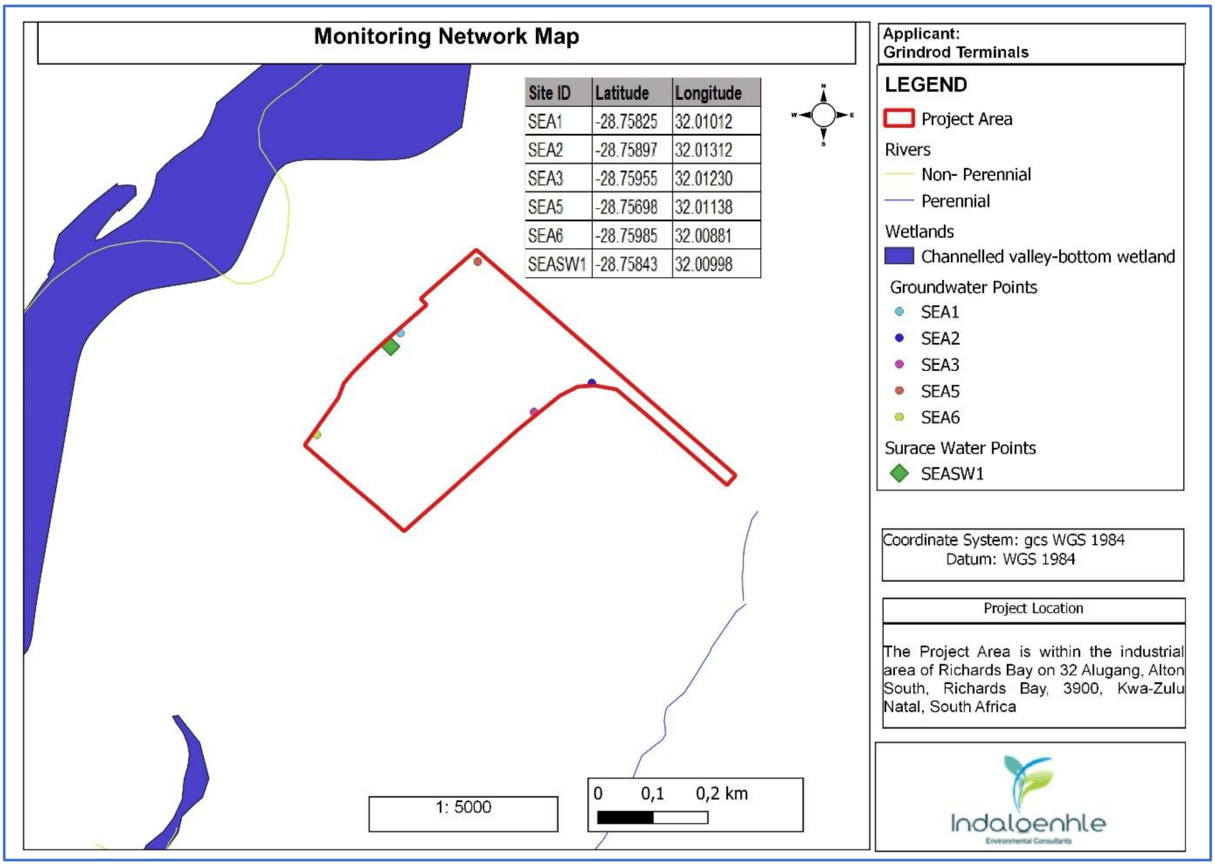

Figure 6-1: Map Indicating the location of surface water and groundwater monitoring Points.

6.2. System response monitoring network

6.2.1. Groundwater contamination

Groundwater levels and quality will be recorded monthly. Water levels can be measured using an electrical contact tape or pressure transducer to detect any changes or trends in groundwater flow direction. Contamination from the stockpiles and other surface infrastructure which can contaminate the underlying aquifers. To prevent contaminants from seeping into the underlying aquifers, surface infrastructures must be fully sized and lined according to the engineering designs and normal practices.

6.3. Sampling Methods and Preservation

6.3.1.1. Required apparatus:

- Plastic bottles (1L)
- Glass bottles
- Dip meter
- Steel bailer
- Cooler box

- EC and Ph meter
- Marking pens

6.3.1.2. Methods and preservation

One litre plastic bottles with unlined plastic caps are required for most sampling exercises; however, in cases where organic constituents are to be tested for, glass bottles are required. Sample bottles must be marked clearly with the borehole name, date of sampling, water level depth and the sampler's name. Water levels (mbgl) should be measured prior to taking the sample, using a dip meter. Purging must be done on each borehole that needs to be sampled, this is to ensure sampling of the aquifer and not stagnant water in the casing. Purging is done using a submersible pump or a clean disposable polyethylene bailer in the event of a small diameter borehole. During purging and continuous water quality monitoring, at least three borehole volumes of water should be removed until the electrical conductivity value stabilizes. Metal samples must be filtered in the field to remove clay suspensions. The pH and EC meter used for field measurements should be calibrated daily using standard solutions obtained from the instrument supplier. Samples should be kept cool in a cooler box in the field and kept cool prior to being submitted to the laboratory in order to maintain proper preservation thereof.

6.3.1.3. Sampling Locations

The main objectives in positioning the monitoring boreholes are to:

- Monitoring of groundwater migrating away from operation area and
- Monitoring the lowering of the water table and the radius of influence

6.4. Data Management

Good hydrogeological decisions require sound information developed from raw data. The production of good, relevant, and timely information is the key to achieving qualified long-term and short-term plans. It is necessary to utilize all relevant groundwater data to minimize groundwater contamination. Monitoring results will be captured in an electronic database as soon as results become available, which allows for:

- Data presentation in tabular format,
- Time-series graphs with comparison abilities,
- Graphical presentation of statistics,
- Presentation of data, statistics and performance on diagrams and maps,
- Comparison and compliance to legal and best practice water quality standards.

6.5. Monitoring frequency

Drastic changes in groundwater composition are not normally detected within days, as groundwater is a slow-moving medium; therefore, groundwater monitoring should be conducted monthly. Samples should be collected by an independent groundwater consultant, using the stipulated best practice guidelines, and should be analysed by a SANAS accredited laboratory. Groundwater levels must be recorded within an accuracy of 0.1m on a quarterly basis, using an electrical contact tape, float mechanism or pressure transducer to detect any changes or trends in the groundwater levels.

6.6. Monitoring parameters

Table 6-3: Groundwater monitoring

Class	Parameter	Frequency	Motivation
Physical	Static groundwater levels	Monthly	Time dependent data is required for transient calibration of numerical flow models. Changes in static water levels may give early warnings of dewatering in the area.
	Rainfall	Daily	Recharge to the saturated zone is an important parameter for assessing groundwater vulnerability. Time dependent data is required for transient calibration of numerical flow models.
	Groundwater abstraction rates (if present)	Monthly	Response of groundwater levels to abstraction rates can be used to calculate aquifer storativity, which is important for groundwater management.
Chemical	Major chemical parameters: Ca, Mg, Na, K, NO3, SO4, Cl, Fe, Alkalinity, pH, EC TPH (Total Petroleum Hydrocarbons)	Monthly	Background information is crucial to assess impacts during and after operations. Changes in chemical composition may indicate areas of groundwater contamination and can be used as an early warning system to implement management/remedial actions. Legal requirement. Groundwater chemistry forms an integral part of the development of conceptual models.
	Minor chemical constituents Full scan of trace metals	Monthly	Changes in chemical composition may indicate areas of groundwater contamination and can be used as an early warning system to implement management/remedial actions. Legal requirement

	Other Stable isotopes	Ad-hoc basis	The monitoring program should allow for research and refinement of the conceptual geohydrological model. This may, from time to time, require special analyses like stable isotopes (O^{18}/O^{16}, H).

6.7. Reporting

Based on the recorded water quality data, the data management functions will be carried out and reported to the Environmental manager management monthly. The contents of the report should include the monthly water monitoring results and trends at surface points, as well as comments on the effectiveness of the mitigation measures and monitoring program. Reporting to the authorities should be as specified in the permitting/licensing conditions, and any accidental release of pollutants or possible polluting substances should be reported to the relevant authorities.

7. CONCLUSIONS AND RECOMMENDATIONS

7.1. Conclusion

- A perennial river, non-perennial river and Channelled Valley bottom exists within 1 kilometres of the Project Area.
- The project area falls within the quaternary catchment W12F. The total catchment area of the project Area is 399 km2 with MAP of 1289 millimetre (mm).
- It is not expected that the Project activities will have a significant impact on the water resources mostly since the activities are located more than 100 m from the nearest water resource.
- Groundwater monitoring will be implemented to assist in detecting the groundwater contamination as soon as possible. Buffer Zones will apply, and no activities should occur within 100m from the wetlands and river.
- The project area is dominated by Surface water sources, and comprised of major aquifers, which are High-yielding aquifers with acceptable water quality.
- The aquifer vulnerability from possible pollution sources was classed as “Most”. A most potential or likelihood for possible contaminated fluids originating from the site to reach the groundwater table exists. A maximum aquifer protection level is therefore recommended.
- The potential for groundwater contamination from the Project activities centres around two primary concerns:
  - During operation, heavy machinery presence raises the risk of Total Petroleum Hydrocarbon (TPH) contamination through spillages impacting soil and groundwater.
  - During operations, erosion poses a risk of contaminating nearby water resources.

7.2. Recommendations

Aspect	Recommendation
Monitoring	Conduct water monitoring and implement remedial actions as required. It is recommended that the monitoring network be implemented at project area. The monitoring must be overseen by a qualified Hydrogeologist to monitor pollution. A monitoring network should be dynamic. This means that the network should be extended over time to accommodate the migration of contaminants through the aquifer as well as the expansion of infrastructure and/or addition of possible pollution sources. An audit on the monitoring network should be conducted annually.

Water contamination	Prevention of pollution of surface water resources and impacts on other surface water users by training of workers to prevent pollution, equipment and vehicle maintenance, fast and effective clean-up of spills, effective waste management, manage clean and dirty water in accordance.
Flow of water	The disturbance of surface drainage patterns must be mitigated through careful design that minimizes impacts on the downstream environment, by implementation of storm water management plans.
Water Use License (DWS)	According to section 21(S21) of the National Water Act 36 of 1998, if a proposed project triggers any of the listed S21 activities, a water use license must be applied for. For this project, It is recommended that a water use license be applied for.

8. REFERENCES

Department of Environmental Affairs, Department of Mineral Resources, Chamber of Mines, South African Mining and Biodiversity Forum, & South African National Biodiversity Institute. (2013). *Mining and Biodiversity Guideline: Mainstreaming biodiversity into the mining sector.* Pretoria.

Department of Water Affairs and Forestry. (1999). *South African Version 1.0 of Resource Directed Measures for Protection of Water Resources.*

Department of Water Affairs and Forestry. (2005). *A practical field procedure for the identification and delineation of wetlands and riparian areas.* Pretoria: DWAF.

Department of Water Affairs and Forestry. (2008). *Updated manual for identification and delineation of wetlands and riparian areas.* Pretoria: DWAF.

Driver, A., Nel, J., Snaddon, K., Murray, K., Roux, D., & Hill, L. (2011). *Implementation Manual for Freshwater Ecosystem Priority Areas. Draft Report for the Water Research Commission.* Retrieved from http://www.wrc.org.za/Knowledge Hub D

Kotze, D., & Ellery, W. (2009). *WET-Outcome Evaluate: an evaluation of the rehabilitation outcomes at six wetland sites in South Africa.* Pretoria: WRC: TT 343/09.

Kotze, D., & Marneweck, G. (1999). *Guidelines for delineating the wetland boundary and zones within a wetland under the South African Water Act.*

Kotze, D., Ellery, W., Macfarlane, D., & Jewitt, G. (2012). *A rapid assessment for coupling anthropogenic stressors and wetland ecological condition.* Ecological Indicators.

Kotze, D., Macfarlane, D., & Edwards, R. (2020). *WET-EcoServices (Version 2): A technique for rapidly assessing ecosystem services supplied by wetlands and riparian areas.* WRC Project K5/2737.

Kotze, D., Marneweck, G., Batchelor, A., Lindley, D., & Collins, N. (2009). *Wetland-EcoServices: A rapid assessment procedure for describing wetland benefits.* Pretoria: WRC: TT339/09.

Macfarlane, D., Bredin, I., Adams, J., Zungu, M., Bate, G., & Dickens, C. (2014). *Preliminary Guideline for the Determination of Buffer Zones for Rivers, Wetlands and Estuaries: Consolidated Report (WRC Report No. TT 610/14, September 2014).*

Macfarlane, D., Kotze, D., & Ellery, W. (2009). *WET-Health: A technique for rapidly assessing wetland health (TT 340/09).* WRC Report.

Macfarlane, D., Ollis, D., & Kotze, D. (2020). *WET-Health (Version 2.0): A Refined Suite of Tools for Assessing the Present Ecological State of Wetland Systems.* WRC Report No. TT 820/20.

Mackay, F.m Weerts, S and Cooper, A. (2014). Coastal Lakes. *Ugu Lwethu- Our Coast. A profile of Coastal.*, 37- 39.

Mucina, L., & Rutherford, M. C. (2012). *The Vegetation of South Africa, Lesotho and Swaziland.* Pretoria: South African National Biodiversity Institute.

Nel, J., Murray, K., Maherry, A., Petersen, C., Roux, D., Driver, A., . . . Nienaber, S. (2011). *Technical Report for the National Freshwater Priority Areas project.* WRC: 1801/2/11.

Ollis, D., Snaddon, C., Job, N., & Mbona, N. (2013). *Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland Systems.* South African National Biodiversity Institute, Pretoria: SANBI Biodiversity Series 22.

Rountree, M., Malan, H., & Weston, B. (2013). *Manual for the Rapid Ecological Reserve Determination of Inland Wetlands (Version 2.0).*

SANBI and DWS. (2016). *Wetland Offsets: A Best Practice Guideline for South Africa.* WRC.

Singh, P. K. (2015). Water sampling methods and tools. 1-22. Department of Environmental Science Central University of Rajasthan .

Solist. (n.d.). Retrieved from https://www.solinst.com/products/groundwater-samplers/bailers.php

Triplo4 sustainable Solution & GCS. (2023). *Groundwater and Surface Water Monitoring RBT Grindrod Terminals - Seamunye Operations.* Richards Bay.

Vegter, J., & Seymour, A. (2012). *Aquifer Classification of South Africa.* Hydrological Services.

Vegter, JR; Seymour , AJ. (2013). *Aquifer Vulnerability of South Africa.* Hydrological Services.