BTE RENEWABLES (PTY) LTD

ESIZAYO WEF EXPANSION

HYDROLOGICAL ASSESSMENT

06 APRIL 2022

DRAFT

ESIZAYO WEF EXPANSION

HYDROLOGICAL ASSESSMENT

BTE RENEWABLES (PTY) LTD

DRAFT

PROJECT NO.: 41103063
DATE: APRIL 2022

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1 INTRODUCTION

WSP in Africa (WSP), a wholly owned affiliate of WSP Global Inc., was commissioned to undertake a Hydrological Assessment for the proposed expansion of the Esizayo Wind Energy Facility (WEF) (herein referred to as the Project).

The Project lies approximately 30km Northwest of Laingsburg in the Western Cape, and falls within the Laingsburg Local Municipality, which is located within the Central Karoo District Municipality (**Figure 1**).

1.1 BACKGROUND

On 14 July 2017, BTE Renewables (Pty) Ltd (BTE) received an EA (DFFE Ref no: 14/12/16/3/3/2/967) for the Esizayo Wind Energy Facility (WEF) proposed to be constructed on the following portions:

- Portion 1 of Aanstoot Farm No 72;
- Annex Joseph's Kraal Farm No 84, and
- Aurora Farm No 285.

BTE now proposes to expand the existing authorised Esizayo WEF extent by adding three new land parcels as listed below:

- Portion 2 of Farm Aanstoot Farm 72 (2/72);
- Portion 1 of Farm Leeuwenfontein 71 (1/71), and
- Remainder of Farm Leeuwenfontein 71 (RE/71).

2 LEGAL CONTEXT

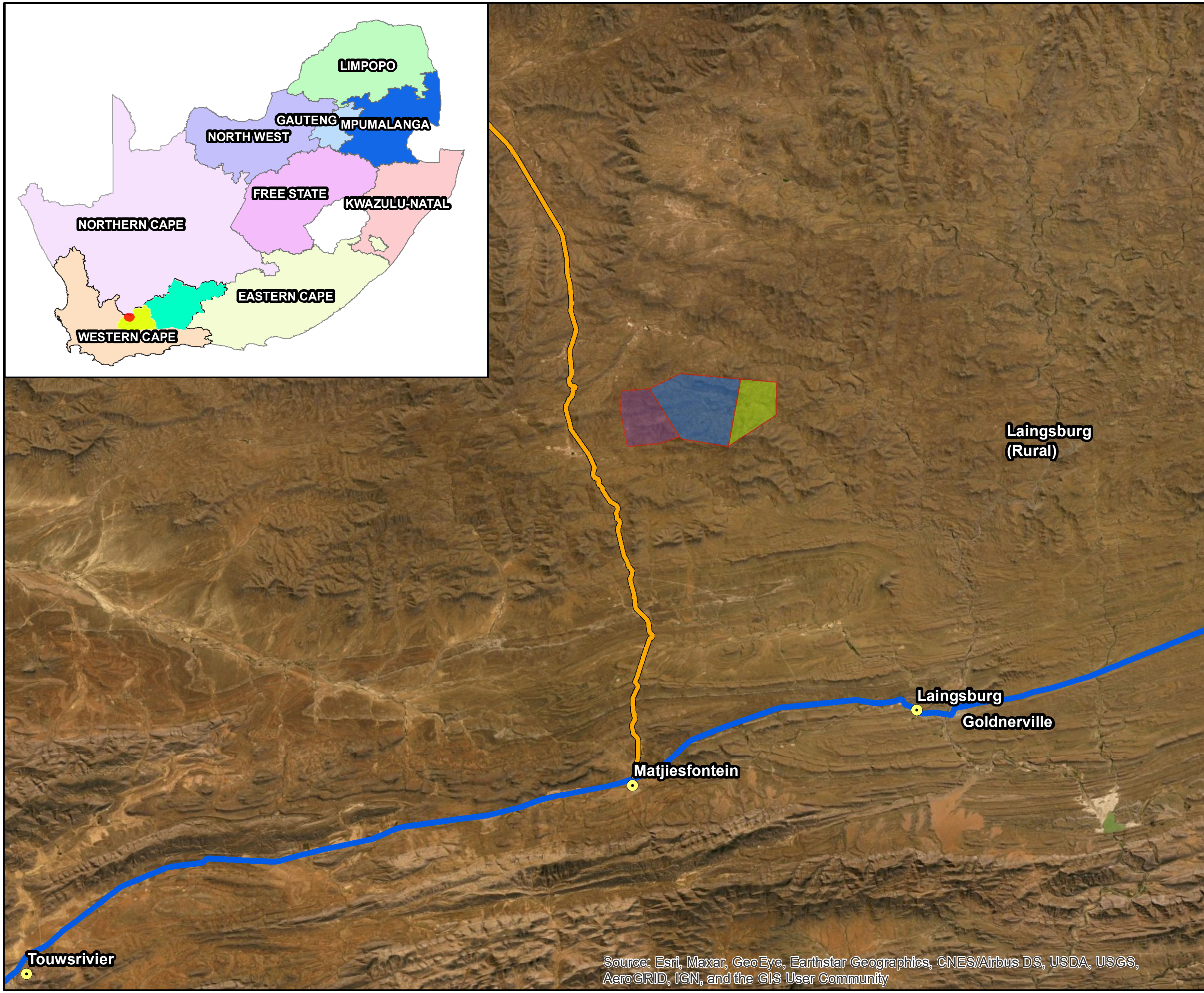
The objective of the Hydrological Assessment is to limit any potential impacts on surface water resources associated with the Project. The South African National Water Act (NWA) was used as the guidance document to meet this objective.

The preamble to the NWA recognises that the aim of water resource management is to achieve sustainable water use for the benefit of all users and that the quality of these resources are protected to ensure ongoing sustainability. The purpose of the NWA is stated, as inter alia:

- Promoting the efficient, sustainable and beneficial use of water in the public interest;
- Facilitating social and economic development;
- Protecting aquatic and associated ecosystems and their biological diversity;
- Reducing and preventing pollution and degradation of water resources; and
- Meeting international obligations.

The NWA presents strategies to facilitate sound management of water resources, provides for the protection of water resources, and regulates use of water by means of Catchment Management Agencies, Water User Associations, Advisory Committees and International Water Management.

BTE RENEWABLES
ESIZAYO WEF EXPANSION
REGIONAL SETTING



Legend

- Portion 1 of Farm Leeuwenfontein 71
- Remainder of Farm Leeuwenfontein 71
- Portion 2 of Farm Aanstoot Farm 72
- R354
- N1
- Laingsburg Local Municipality
- Central Karoo District Municipality

N

0 1 500 3 000 6 000 9 000 12 000
Meters

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DATA SOURCE:

SOUTH AFRICAN DEPARTMENT OF RURAL DEVELOPMENT AND LAND REFORM-
CHIEF DIRECTORATE: NATIONAL GEO SPATIAL INFORMATION

PROJECTION: GCS_WGS_1984

PROJECT TITLE:
DNG ENERGY - FEASIBILITY STUDY

SCALE: 1:400 000	DRAWN BY: TUMELO TSEPHE
DATE: 2021/05/19	REVIEWED BY: ZAKARIYA NAKHOODA
FIGURE NO: 1	PROJECT NO: 41103063 — REV: 0

3 PROJECT DESCRIPTION

The Project entails the expansion of the existing Esizayo WEF extent through the addition of three (3) land parcels with a total development infrastructure footprint of approximately 200 ha. (**Figure 2**). To enable the facility to supply a contracted capacity of up to 200 MW, the proposed development will incorporate the following infrastructure (**Figure 2**):

- Up to 23 wind turbines. Each turbine with a foundation of up to 25 m in diameter and up to 4m in depth, compacted hard standing areas of up to 4.5 ha each;
- Internal roads traversing a length of 30 km with a width of 9 m;
- 33 kV underground cables or overhead powerlines;
- 33 kV and/or 132 kV substations;
- Fence around the project development area;
- Site offices and maintenance buildings, including workshop areas for maintenance and storage; and
- Laydown areas.

3.1 PROPOSED PROJECT DEVELOPMENT ACTIVITIES

- The typical steps involved in the construction and operation of a wind energy facility is summarised below:
- Planning Phase
  - Step 1: Surveying of the development area and negotiation with affected landowners; and
  - Step 2: Final design and micro-siting of the infrastructure based on geotechnical, topographical conditions and potential environmental sensitivities.
- Construction Phase
  - Step 3: Vegetation clearing and construction of access roads/tracks (where required);
  - Step 4: Construction of tower structure foundations;
  - Step 5: Assembly and erection of infrastructure on site;
  - Step 6: Stringing of conductors; and
  - Step 6: Rehabilitation of disturbed areas and protection of erosion sensitive areas.
- Operation Phase
  - Step 7: Continued maintenance during operation.

3.1.1 CONSTRUCTION PHASE

CONSTRUCTION SCHEDULE

Construction of the WEF is anticipated for a period of up to 24 months.

The main activities associated with the construction phase of the wind energy project will include the following:

ESTABLISHMENT OF INTERNAL ROADS

Internal road access will be constructed onsite. These roads will be up to 9m in width. The length of the internal road network is approximately 30km.

SITE PREPARATION

Site preparation includes the clearance of vegetation and any bulk earthworks (including blasting if required) within the footprint of each construction area that may be required in terms of the facility design.

ESTABLISHMENT OF A LAYDOWN AREA ON SITE

Construction materials, machinery and equipment will be kept at relevant laydown and/or storage areas. The expansion project will use the authorised Esizayo project's construction laydown area. The laydown area will limit potential environmental impacts associated with the construction phase by limiting the extent of the activities to one designated area.

CONSTRUCT FOUNDATION

Concrete foundations will be constructed at each turbine location. Foundation holes will be mechanically excavated to a depth of 4m, depending on the local geology. Concrete will be at the authorised Esizayo project's cement batching plant.

CONSTRUCTION OF THE TURBINE

A large lifting crane will be brought onto site to lift each of the tower parts into place.

CONSTRUCT IPP SUBSTATION AND INVERTORS

Invertors will be installed to facilitate the connection between the wind turbines and the Eskom Grid. The turbines will be connected to the substation via underground or overhead cabling. The substation will be constructed with a maximum footprint of approximately 150m x 150m. It must be noted that the substation forms part of a separate EA.

ESTABLISHMENT OF ANCILLARY INFRASTRUCTURE

The expansion project will use the authorised Esizayo project's Operations and Maintenance building, storage areas, office and a temporary laydown area for contractor's equipment.

UNDERTAKE SITE REHABILITATION

The site will be rehabilitated once the construction phase is complete and all construction equipment and machinery have been removed from site.

3.1.2 OPERATIONAL PHASE

The proposed WEF Expansion is anticipated to have a minimum life of 20 years. The facility will operate 7 days a week. While the project is self-sufficient, maintenance and monitoring activities will be required. Potable water requirements for permanent staff will be limited and provided by bottled water.

During the operational phase there will be little to no Project-related movement along the servitude as the only activities are limited to maintaining the servitude (including maintenance of access roads and cutting back or pruning of vegetation to ensure that vegetation does not affect the WEF), inspection of the WEF infrastructure and repairs when required. Limited impact is expected during operation since there will not be any intrusive work done outside of maintenance in the event that major damage occurs to site infrastructure.

Operation of the WEF will involve the following activities, discussed below.

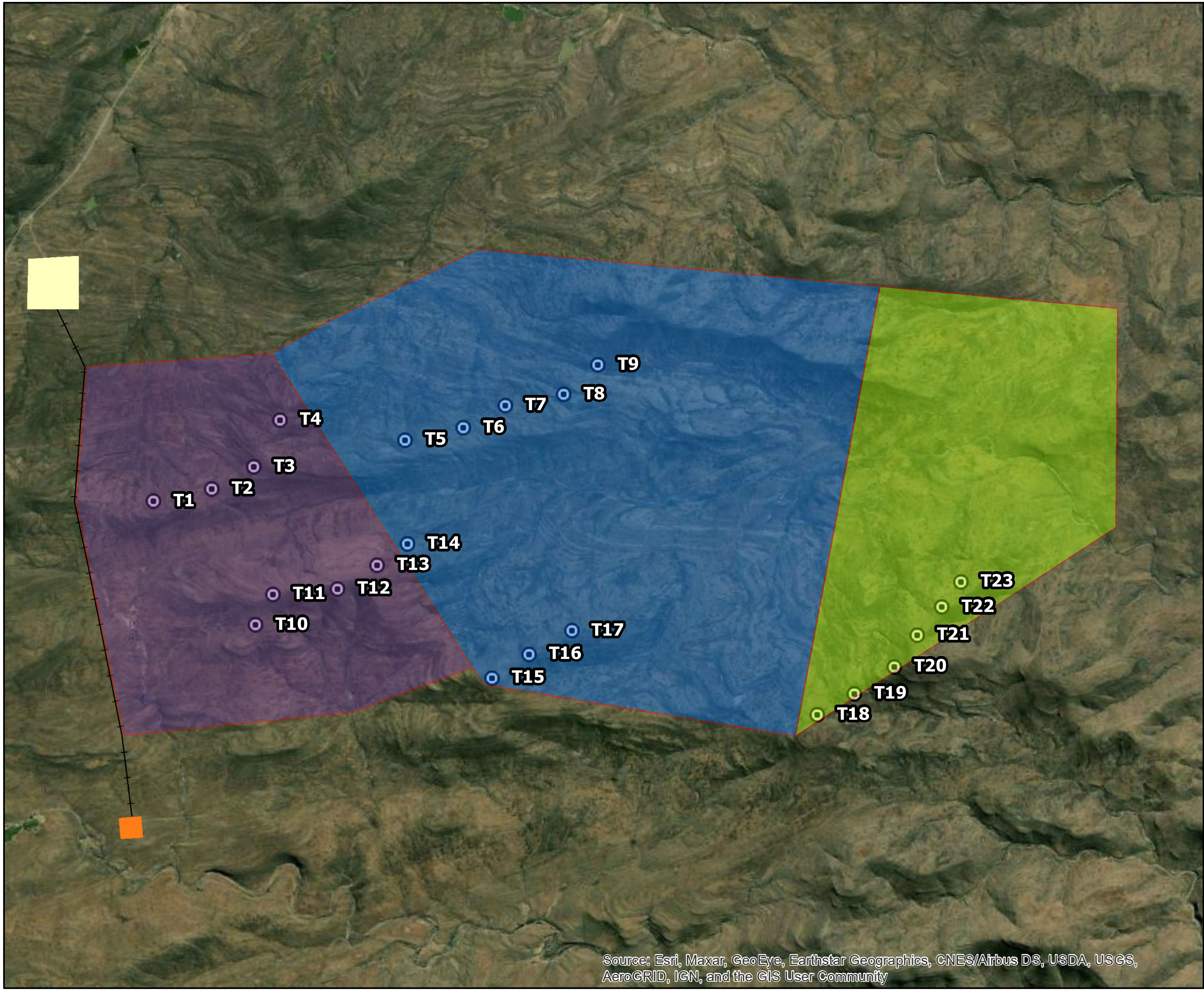
SERVITUDE MANAGEMENT AND ACCESS ROAD MAINTENANCE

Servitude and access road maintenance is aimed at eliminating hazards and facilitating continued access to the WEF. The objective is to prevent all forms of potential interruption of power supply due to overly tall vegetation/climbing plants or establishment of illegal structures within the right servitude. It is also to facilitate ease of access for maintenance activities on the WEF. During the operational phase of the project, the servitude will be maintained to ensure that the functions optimally and does not compromise the safety of persons within the vicinity of the WEF.

WIND ENERGY FACILITY MAINTENANCE AND OPERATIONS

BTE will develop comprehensive planned and emergency programmes through its technical operations during the operation and maintenance phase for the WEF. The maintenance activities will include:

- BTE's Maintenance Team will carry out periodic physical examination of the WEF and its safety, security and integrity.
- Defects that are identified will be reported for repair. Such defects may include defective conductors, flashed over insulators, defective dampers, vandalised components, amongst others.
- Maintenance / repairs will then be undertaken.



BTE RENEWABLES
ESIZAYO WEF EXPANSION

SITE SETTING

Legend

- Portion 1 of Farm Leeuwenfontein 71
- Remainder of Farm Leeuwenfontein 71
- Portion 2 of Farm Aanstoot Farm 72
- Turbines
- Esizayo Collector Substation
- Komsburg Substation
- Proposed 132kV Line Route

N

0 230 460 920 1 380 1 840

Meters

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PROJECTION: GCS_WGS_1984

PROJECT TITLE:
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SCALE: 1:59 987	DRAWN BY: TUMELO TSEPHE	
DATE: 2021/09/19	REVIEWED BY: ZAKARIYA NAKHOODA	
FIGURE NO: 2	PROJECT NO: 41103063	REV: 0

3.1.3 DECOMMISSIONING PHASE

Following the initial 20-year operational period of the wind facility, the continued economic viability will be investigated. If the facility is still deemed viable, the life of the facility will be extended. The facility will only be decommissioned once it is no longer economically viable. If a decision is made to completely decommission the facility, this will be subject to a separate authorisation and impact assessment process, all the components will be disassembled, reused and recycled or disposed. The site would be returned to its current use i.e. agriculture (Grazing).

4 BASELINE RECEIVING ENVIRONMENT

This section describes the baseline environment of the Project, thereby providing an understanding of the Hydrological Assessment.

4.1 CLIMATE

The climate of the region is arid to semi-arid. Rainfall is low and occurs throughout the year but predominantly in the winter months between March and August. Mean annual precipitation is approximately 290mm, ranging from 180 – 410mm rainfall per year. The region experiences dry hot summers and the warmest month of the year is February which averages 23.4°C. The lowest average temperatures in the year occur in July, averaging approximately 9.3°C. The region experiences steady, strong winds between December and April; however the winds calm between the months of June and October.

4.2 LAND COVER

Based on the Mucina and Rutherford (2006) natural vegetation classification map, the area is mostly Central Mountain Shale Renosterveld, with a minor contribution of Koedoesberge-Moordenaars Karoo. The Department of Agriculture, Forestry and Fisheries (DAFF) define the land use within the Site, as predominantly Shrubland and Low Fynbos (DAFF, 2012).

During the site visit, the vegetation was identified as mostly shrub-like vegetation and Fynbos. Patches of cultivated areas were observed; however, these were no longer in use. Indigenous antelope (Springbok) were present within the site boundary.

4.3 GEOLOGY AND SOILS

Based on the information included in the land type maps of South Africa (AGIS, 2007) the soils in the region are mostly classified as the Glenrosa and/or Mispah forms with lime generally present in the landscape and miscellaneous land classes, rocky areas with miscellaneous soils.

The general geological description of the area is based on the 1:1 000 000 geological map for the Northern Cape Province, published by the Trigonometrical Survey Office in 1970 (Schifano *et.al*.,1970). The Site is nested in the Roggeveld Mountains range, in the Larger Cape Fold belt system. The site is located on the Beaufort Series which forms part of the Karoo system. The rock type for the series comprises of shale, mudstone, sandstone and limestone (Schifano et al., 1970). During the site visit it was observed that shale and mudstone were the dominant rock type for the area.

4.4 TOPOGRAPHY

The topography of the area comprises of mountainous hillslopes (part of the Roggeveld Mountain Range) with small patches of open rocky ground in between, and numerous watercourses and drainage channels. The hillslopes have an average gradient of 34.4 % and 1.1% on the open flat ground. The elevation of the area ranges from 984 m to 1 379 m above mean sea level (amsl).

4.5 QUATERNARY CATCHMENTS

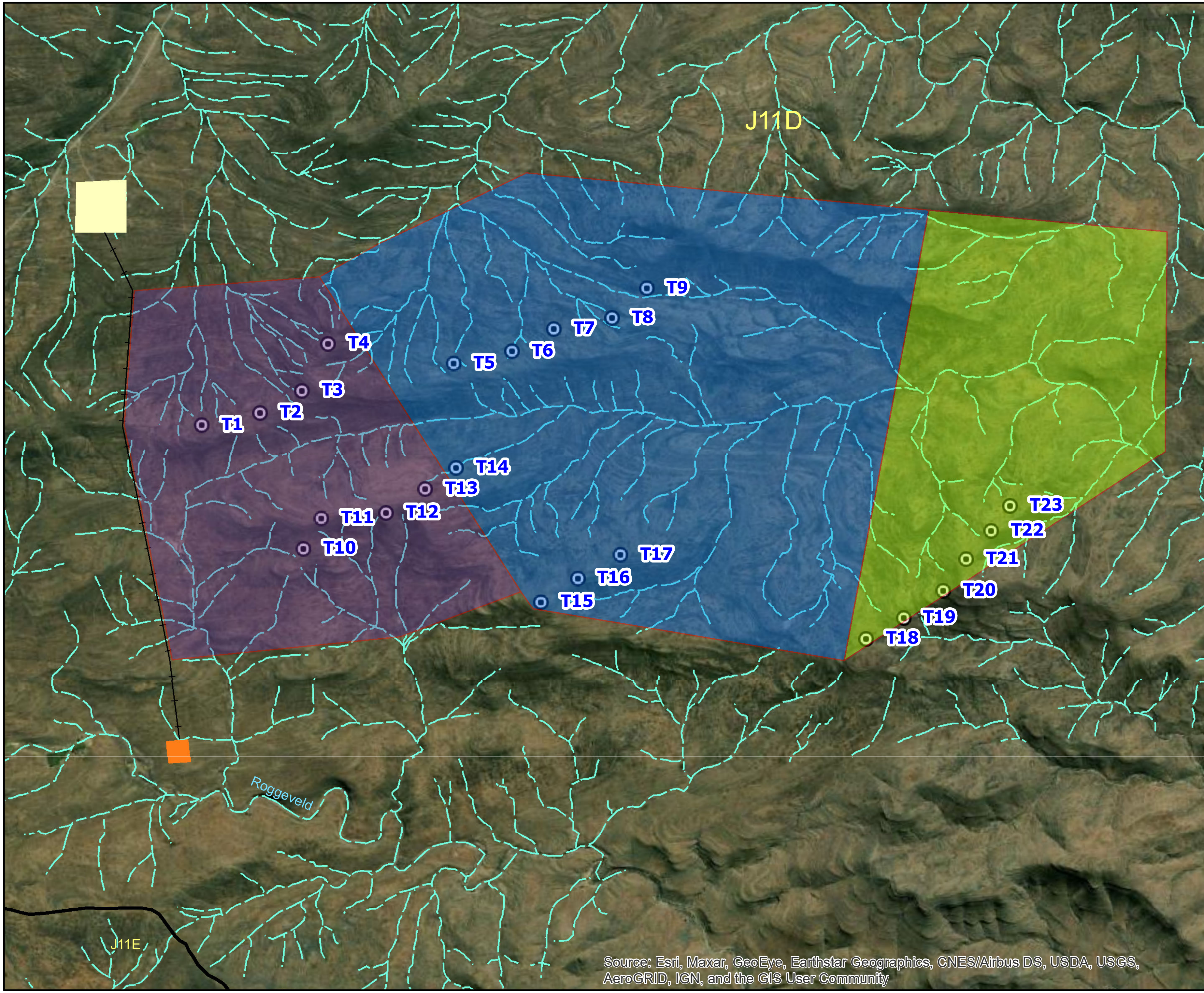
The Project boundary lies within quaternary catchment J11D (**Figure 3**), with the hydrological characteristics are summarised in **Table 1**, including catchment area, Mean Annual Precipitation (MAP), Mean Annual Evaporation (MAE) and Mean Annual Runoff (MAR). The MAE largely exceeds the MAP, reinforcing the arid conditions of the region.

Table 1: Quaternary J11D Hydrological Characteristics

Quaternary	Catchment Area(km^2)	Map (mm)	Mae (mm)	Mar (mcm)
J11D	801	240	2000	5.58

Source: WRC/DWA, 2012

During the site visit there were several watercourses/drainage channels present within the area, the main river being the Roggeveld, which is south of the Project site. During the site visit, all the watercourses were dry with the exception of an un-named tributary, where a shallow pool was observed. Given the arid climatic condition of the region, the majority of the watercourses are ephemeral and are likely to only convey water during infrequent high rainfall events.



BTE RENEWABLES ESIZAYO WEF EXPANSION

HYDROLOGICAL SETTING

Legend

- Portion 1 of Farm Leeuwenfontein 71
- Remainder of Farm Leeuwenfontein 71
- Portion 2 of Farm Aanstoot Farm 72
- Turbines
- Proposed 132kV Line Route
- Esizayo Collector Substation
- Komsburg Substation
- Quatenary_catchm...
- Proposed 132kV Line Route
- Ephemeral Watercourses

N

0 230 460 920 1 380 1 840

Meters

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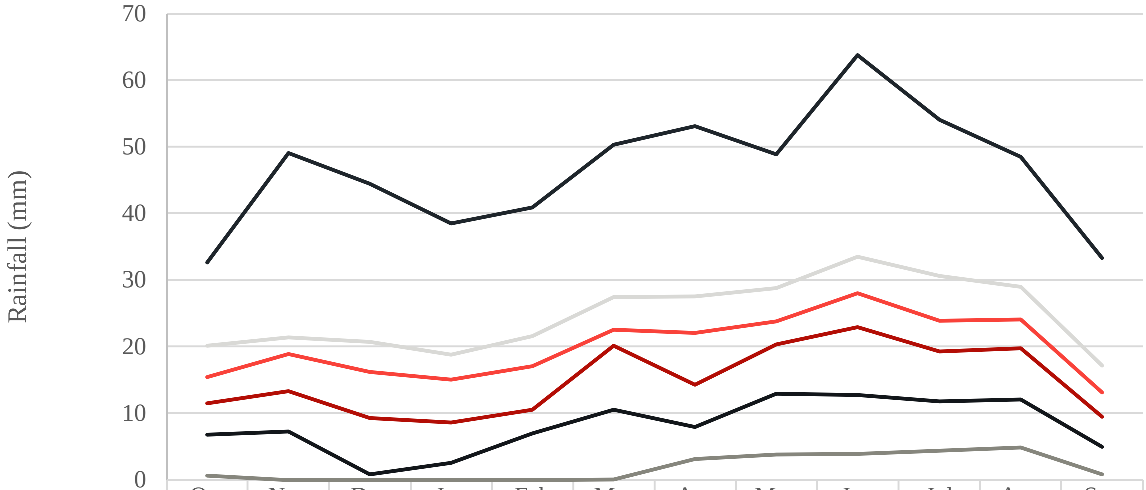
PROJECT NO: 41103063	REV: 0

4.5.1 PRECIPITATION

The site falls within rainfall zone J1A associated with quaternary J11D, with an MAP of 240mm. The monthly rainfall distribution is represented in **Figure 4**. The 'E' values show the probability of non-exceedance, so highlight the likelihood that the specific rainfall event will not be exceeded.



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average	15	19	16	15	17	23	22	24	28	24	24	13
E10	33	49	44	38	41	50	53	49	64	54	48	33
E30	20	21	21	19	22	27	28	29	34	31	29	17
E50	12	13	9	9	11	20	14	20	23	19	20	9
E70	7	7	1	3	7	10	8	13	13	12	12	5
E90	1	0	0	0	0	0	3	4	4	4	5	1

Figure 4: Monthly Rainfall for Quaternary J1A (WR2012, 2021)

4.5.2 EVAPORATION

Evaporation data for the site was extracted from the WR2012 (WRC, 2021) database. The evaporation zone representative of the site is 24A with an MAE of 2 000 mm. The MAE is clearly considerably higher than the MAP, making this a dry area. The monthly evaporation distribution is presented in **Figure 5**.

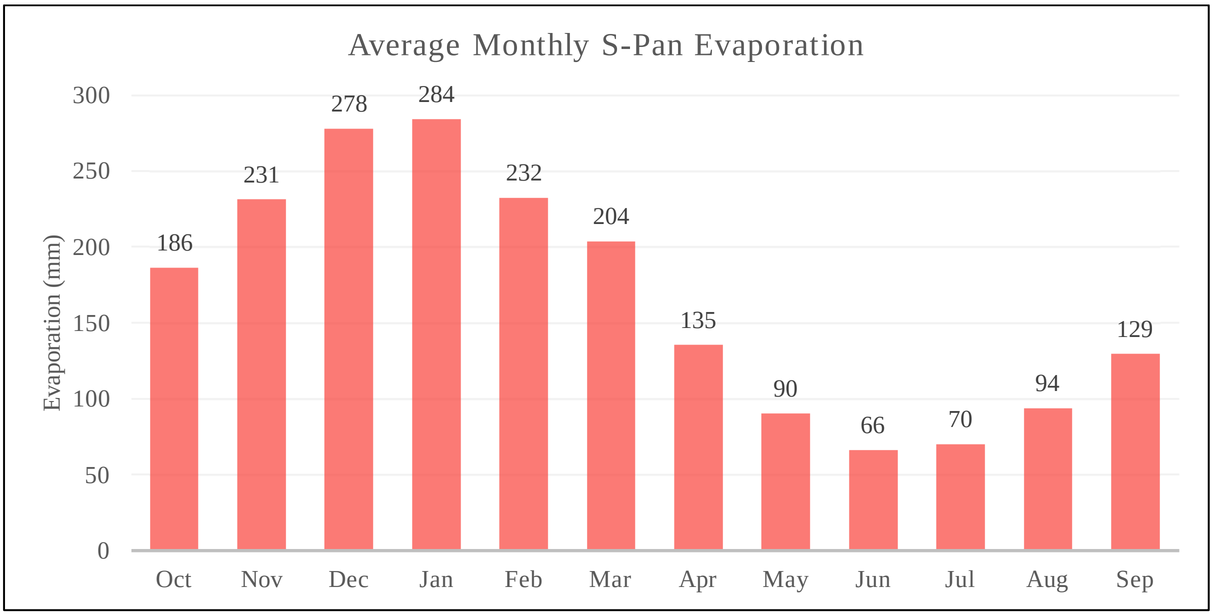
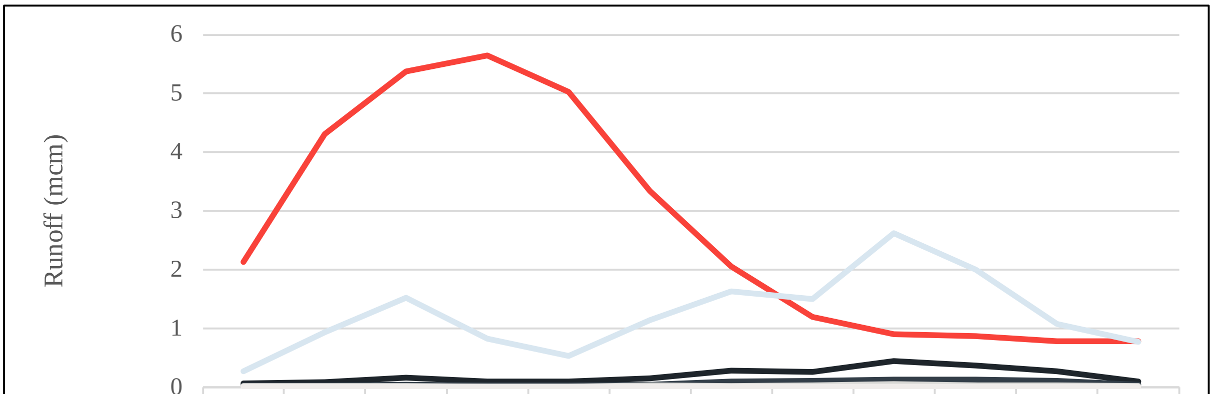


Figure 5: Monthly S-Pan Evaporation for Evaporation Zone 24A (WR2012, 2020)

4.5.3 NATURALISED RUNOFF

WR2012 (WRC, 2019) simulates average runoff of this quaternary at 5.58 mcm per annum. The monthly runoff is presented in **Figure 6**. The 'E' values show the probability of non-exceedance.



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Average	2.13	4.3	5.37	5.65	5.02	3.33	2.05	1.19	0.9	0.87	0.78	0.78
E10	0.276	0.933	1.521	0.818	0.524	1.138	1.623	1.5	2.62	1.998	1.076	0.762
E30	0.067	0.08	0.154	0.09	0.087	0.147	0.274	0.257	0.441	0.367	0.267	0.09
E50	0.03	0.03	0.04	0.03	0.03	0.04	0.09	0.105	0.12	0.135	0.1	0.04
E70	0.02	0.02	0.02	0.01	0.01	0.03	0.02	0.03	0.05	0.03	0.03	0.02
E90	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.011	0.01	0.01	0.01

Figure 6: Naturalised Runoff for Quaternary Catchment J11D (WR2012, 2019)

4.6 SITE SPECIFIC DATA

4.6.1 DAILY RAINFALL

The Daily Rainfall Extraction Utility, developed by the Institute for Commercial Forestry Research (ICFR) in conjunction with the School of Bio-resources Engineering and Environmental Hydrology (BEEH) at the University of KwaZulu-Natal, Pietermaritzburg, was used to obtain summary data for all rainfall stations within the vicinity of the site (**Table 2**). This data was assessed in terms of length of record, completeness of the data set, MAP and location of the rainfall station with respect to the site and the catchment.

Table 2: Rainfall Gauging Station Summary (Kunz, 2003)

Rainfall Station	Station Number	Latitude	Longitude	Distance from site (km)	Record (years)	Reliable data (%)	MAP (mm)
LAINSBURG SAAIPLAAS	0066204 W	32.901	20.617	9.242	3	98.9	221
DWARS-IN-DIE-WEG	0045184 W	33.067	20.584	9.753	122	64.3	156
DUMURE	0066027 W	32.951	20.517	10.053	120	56.5	259
SAAIPLAAS	0066668 A	32.884	20.617	11.090	5	84.8	222

The DWARS-IN-DIE-WEG rain gauge station (0045184 W) was considered representative of the area, which was primarily due to the reliability of the dataset, the distance of the station from the site and the record length. This dataset is presented in **Figure 7** for the period 1878 to 2002.

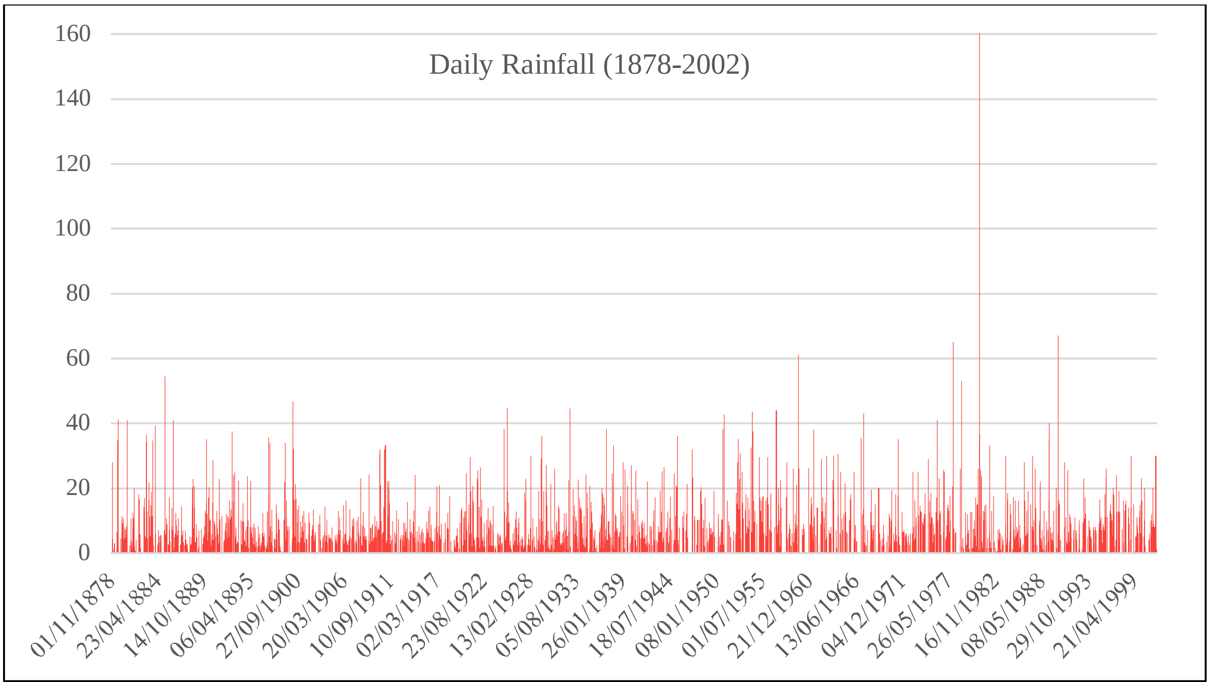


Figure 7: Daily Rainfall plot of the DWARS-IN-DIE-WEG Rain Gauge

4.6.2 DESIGN RAINFALL

The design rainfall depths for the centroid of the site were extracted using the Design Rainfall Estimation software for South Africa (Smithers and Schulze, 2003). The design rainfall depths (mm) for the 1:2-year, 1:5-year, 1:10-year, 1:20-year, 1:50-year, 1:100-year and 1:200-year return periods were extracted (**Table 3**).

Table 3: Design Rainfall Depths (mm)

Duration	Return Period						
	2	5	10	20	50	100	200
5 m	6.7	9.8	12.1	14.6	18.2	21.3	24.6
10 m	9.7	14.2	17.6	21.2	26.4	30.7	35.5
15 m	12	17.6	21.8	26.3	32.7	38.2	44.1
30 m	15.3	22.4	27.8	33.5	41.7	48.6	56.2
45 m	17.6	25.8	32	38.6	48.1	56	64.7
1 h	19.5	28.6	35.4	42.6	53.2	61.9	71.6
1.5 h	22.4	32.9	40.8	49.1	61.3	71.4	82.5
2 h	24.8	36.4	45.1	54.3	67.7	78.9	91.2
4 h	28.7	42.2	52.3	63	78.5	91.5	105.7
6 h	31.3	46	57	68.7	85.6	99.8	115.2
8 h	33.3	48.9	60.6	73	91	106.1	122.5
10 h	34.9	51.3	63.5	76.6	95.5	111.2	128.5
12 h	36.3	53.3	66.1	79.6	99.2	115.6	133.6
16 h	38.6	56.7	70.2	84.6	105.5	123	142
20 h	40.5	59.4	73.7	88.8	110.7	128.9	149
24 h	42.1	61.8	76.6	92.3	115	134.1	154.9
1 d	33.4	49.1	60.8	73.3	91.3	106.4	123
2 d	41	60.1	74.5	89.8	111.9	130.4	150.7
3 d	46.2	67.7	83.9	101.1	126.1	146.9	169.8
4 d	48.6	71.3	88.4	106.5	132.8	154.8	178.8
5 d	50.6	74.3	92	110.9	138.3	161.1	186.1
6 d	52.3	76.8	95.1	114.6	142.9	166.5	192.4
7 d	53.8	78.9	97.8	117.8	146.9	171.2	197.8

4.7 HYDROLOGY

The hydrology of the area is shown in **Figure 3.** There are numerous dry natural channels which drain the area of water from a westerly to easterly direction. The water courses are generally ephemeral in nature which seldom shows evidence of surface water runoff due to the arid conditions of the area. The Project footprint drains into the Maintjiesplaas and Roggeveld Rivers, which flow into the Buffels River.

5 SITE WALKOVER

A site walkover was undertaken by WSP on the 20th and 21st of March 2022 to determine the site characteristics. A photographic log highlighting the main features of the site visit is shown in **Table 4** and expanded on below:

- Photograph 1 illustrates an ephemeral tributary located on site. There were numerous ephemeral tributaries located across the site (**Figure 3**), all of which drain to the much larger ephemeral rivers (Photograph 2).
- Photograph 2 illustrates a larger ephemeral river located on site.
- Photograph 3 illustrates pools of water located within the ephemeral river.
- Photograph 4 illustrates the Mispah soil type identified on site.
- Photograph 5 illustrates the Glenrosa soil type found on site.
- Photograph 6 illustrates the shrub-like vegetation found on site.

Table 4: Photographic Log of the Site Assessment

Photograph 1

Photograph 2

Photograph 3

Photograph 4

Photograph 5

Photograph 6

6 IMPACT ASSESSMENT

6.1 METHODOLOGY

This Hydrological impact assessment used a methodological framework developed by WSP to meet the combined requirements of international best practice and NEMA, Environmental Impact Assessment Regulations, 2014, as amended (GN No. 326) (the "EIA Regulations").

As required by the EIA Regulations (2014) as amended, the determination and assessment of impacts was based on the following criteria:

a) The nature; a description of what causes the effect, what will be affected and how it will be affected.

Table 5: Nature or Type of Impact

Nature or Type of Impact	Definition
Beneficial / Positive	An impact that is considered to represent an improvement on the baseline or introduces a positive change.
Adverse / Negative	An impact that is considered to represent an adverse change from the baseline, or introduces a new undesirable factor.
Direct	Impacts that arise directly from activities that form an integral part of the Project (e.g. new infrastructure).
Indirect	Impacts that arise indirectly from activities not explicitly forming part of the Project (e.g. noise changes due to changes in road or rail traffic resulting from the operation of Project).
Secondary	Secondary or induced impacts caused by a change in the Project environment (e.g. employment opportunities created by the supply chain requirements).
Cumulative	Impacts are those impacts arising from the combination of multiple impacts from existing projects, the Project and/or future projects.

b) The physical extent.

Table 6: Physical Extent Rating of Impact

Score	Description
1	the impact will be limited to the site;
2	the impact will be limited to the local area;
3	the impact will be limited to the region;
4	the impact will be national; or
5	the impact will be international;

c) The duration, wherein it is indicated what the lifetime of the impact will be:

Table 7: Duration Rating of Impact

Score	Description
1	of a very short duration (0 to 1 years)
2	of a short duration (2 to 5 years)
3	medium term (5–15 years)
4	long term (> 15 years)
5	permanent

d) Reversibility: An impact is either reversible or irreversible. This value indicates how long it will take for impacts on receptors cease to be evident.

Table 8: Reversibility of Impact

Score	Description
1	The impact is immediately reversible.
3	The impact is reversible within 2 years after the cause or stress is removed; or
5	The activity will lead to an impact that is in all practical terms permanent.

e) The magnitude of impact on ecological processes, quantified on a scale from 0-10, where a score is assigned.

Table 9: Magnitude Rating of Impact

Score	Description
0	small and will have no effect on the environment.
1	minor and will not result in an impact on processes.
2	low and will cause a slight impact on processes.
3	moderate and will result in processes continuing but in a modified way.
4	high (processes are altered to the extent that they temporarily cease).
5	very high and results in complete destruction of patterns and permanent cessation of processes.

f) The probability of occurrence, which describes the likelihood of the impact actually occurring. Probability is estimated on a scale where:

Table 10: Probability Rating of Impact

Score	Description
1	very improbable (probably will not happen.
2	improbable (some possibility, but low likelihood).
3	probable (distinct possibility).
4	highly probable (most likely).
5	definite (impact will occur regardless of any prevention measures).

g) The significance, which is determined through a synthesis of the characteristics described above (refer formula below) and can be assessed as low, medium or high;

h) The status, which is described as either positive, negative or neutral;

i) The degree to which the impact can be reversed;

j) The degree to which the impact may cause irreplaceable loss of resources; and,

k) The degree to which the impact can be mitigated.

The significance is determined by combining the above criteria in the following formula:

Significance = (Extent + Duration + Reversibility + Magnitude) x Probability

$$[S= (E+D+R+M) \times P]$$

Where the symbols are as follows:

Symbol	Criteria	Description
S	Significance Weighting	-
E	Extent	Refer to **Table 10**
D	Duration	Refer to **Table 11**
R	Revrseibility	Refer to **Table 12**
M	Magnitude	Refer to **Table 13**
P	Probability	Refer to **Table 14**

The significance weightings for each potential impact are as follows:

Overall Score	Significance Rating (Negative)	Significance Rating (Positive)	Description
< 30 points	Low	Low	where this impact would not have a direct influence on the decision to develop in the area
31 - 60 points	Medium	Medium	where the impact could influence the decision to develop in the area unless it is effectively mitigated
> 60 points	High	High	where the impact must have an influence on the decision process to develop in the area

The impact significance without mitigation measures will be assessed with the design controls in place. Impacts without mitigation measures in place are not representative of the proposed development's actual extent of impact, and are included to facilitate understanding of how and why mitigation measures were identified. The residual impact is what remains following the application of mitigation and management measures, and is thus the final level of impact associated with the development. Residual impacts also serve as the focus of management and monitoring activities during Project implementation to verify that actual impacts are the same as those predicted in this report.

6.2 IMPACT ASSESSMENT

The risk level was determined based on an understanding of the nature of the potential impact, potential mitigatory measures that can be implemented and changes in potential risk profile as a result of implementation of these mitigatory measures. These potential impacts were assessed using the aforementioned methodology and are presented in **Tables 11** and **12** below for the construction and operational phases.

Table 11: Construction Phase Impact Assessment

<table>
<tr><th>Impact</th><th colspan="12">Alteration of the natural flow regime</th></tr>
<tr><td>Impact description</td><td colspan="12">The construction of phase of the Project and associated infrastructure, including temporary laydown areas and access roads may result in alterations to the natural flow regimes through increased runoff, water abstractions or flow diversions.</td></tr>
<tr><td>Mitigation</td><td colspan="12">– No water should be abstracted from the watercourses. Ideally water required during the construction phase must be sourced from an external source (i.e. outside of the wetland contributing area).
– Existing access routes should be utilised. Should access roads need to traverse watercourse, these should be perpendicular to the watercourse with appropriately designed culverts.
– Should any powerlines or roads need to traverse a watercourse, these should be perpendicular to the watercourse. The associated foundations should be located outside the extent of the watercourse.
– It is recommended that, where possible, laydown areas and construction camps are to be developed outside the extent of the watercourse.
– The construction site should be contoured to allow for surface water to readily drain away (as it would under natural conditions) and to prevent ponding of water within areas where it would not have ponded before the construction activities.
– Vegetation clearing, soil stripping and major earthmoving activities must be phased to minimise the extent of bare soils surfaces exposed at any one time. Ideally, this should be undertaken during the dry season.
– If possible, construction activities should be undertaken during the dry season.</td></tr>
<tr><td>Ease of mitigation</td><td colspan="12">Moderate</td></tr>
<tr><td rowspan="4">Significance rating</td><td colspan="6">Pre-Mitigation</td><td colspan="6">Post-Mitigation</td></tr>
<tr><td>(M+</td><td>E+</td><td>R+</td><td>D)x</td><td>P=</td><td>S</td><td>(M+</td><td>E+</td><td>R+</td><td>D)x</td><td>P=</td><td>S</td></tr>
<tr><td>4</td><td>3</td><td>3</td><td>2</td><td>4</td><td>48</td><td>2</td><td>2</td><td>1</td><td>2</td><td>3</td><td>21</td></tr>
<tr><td colspan="6">N3 - Moderate</td><td colspan="6">N2 - Low</td></tr>
<tr><td>Impact</td><td colspan="12">Soil erosion and sedimentation</td></tr>
<tr><td>Impact description</td><td colspan="12">Construction activities will result in soil disturbance, resulting in a higher potential for soil erosion and sedimentation</td></tr>
<tr><td>Mitigation</td><td colspan="12">– During the construction phase sediment control measures must be adopted in order to prevent sediment entering the watercourses. These include: limiting the area of disturbance, the use of silt fences and the covering of stockpiles.
– Vegetation clearing, soil stripping and major earthmoving activities must be phased to minimise the extent of bare soils surfaces exposed at any one time. Ideally, this should be undertaken during the dry season.</td></tr>
</table>

<table>
<tr><td></td><td>

Traffic of construction vehicles should be kept to a minimum to reduce soil compaction, and limited to existing or proposed roadways where practical.
Soils excavated during construction of the infrastructure should be appropriately stored in stockpiles which are protected from erosion (i.e. through use of vegetation cover in the case of long-term stockpiles).
Upon completion of construction, the laydown areas and construction camp sites are to be rehabilitated.
Gabions or Reno Mattresses should be used where evidence of erosion is present.

</td></tr>
<tr><td>Ease of mitigation</td><td>Moderate</td></tr>
<tr><td>Significance rating</td><td>
<table>
<tr><th colspan="6">Pre-Mitigation</th><th colspan="6">Post-Mitigation</th></tr>
<tr><td>(M+</td><td>E+</td><td>R+</td><td>D)x</td><td>P=</td><td>S</td><td>(M+</td><td>E+</td><td>R+</td><td>D)x</td><td>P=</td><td>S</td></tr>
<tr><td>4</td><td>3</td><td>3</td><td>3</td><td>3</td><td>39</td><td>3</td><td>2</td><td>1</td><td>2</td><td>2</td><td>16</td></tr>
<tr><td colspan="6">N3 - Moderate</td><td colspan="6">N2 – Low</td></tr>
</table>
</td></tr>
<tr><td>Impact</td><td>Water quality degradation</td></tr>
<tr><td>Impact description</td><td>Potential spillage of hazardous substances such as oils, fuel, grease from construction vehicles and machinery.</td></tr>
<tr><td>Mitigation</td><td>

Areas for waste disposal should be clearly demarcated and should be bunded and on hard standing. These areas should be located outside the extent of the watercourse.
Ensure that no equipment is washed in the streams and wetlands of the area, and if washing facilities are provided, that these are outside the extent of the watercourse.
Procedures for containment of leaks/spills (spill response plan) as well as associated emergency response plans should be developed.
Machinery and equipment must be inspected regularly for faults and possible leaks. If required, servicing of these should occur off outside the extent of the watercourse.
Potential contaminants used and stored at the proposed project site should be stored and prepared on bunded surfaces to contain spills and leaks.
Adequate ablution facilities should be developed and located outside the extent of the watercourse.

</td></tr>
<tr><td>Ease of mitigation</td><td>Moderate</td></tr>
<tr><td>Significance rating</td><td>
<table>
<tr><th colspan="6">Pre-Mitigation</th><th colspan="6">Post-Mitigation</th></tr>
<tr><td>(M+</td><td>E+</td><td>R+</td><td>D)x</td><td>P=</td><td>S</td><td>(M+</td><td>E+</td><td>R+</td><td>D)x</td><td>P=</td><td>S</td></tr>
<tr><td>4</td><td>3</td><td>3</td><td>2</td><td>4</td><td>48</td><td>2</td><td>2</td><td>1</td><td>2</td><td>3</td><td>21</td></tr>
<tr><td colspan="6">N3 - Moderate</td><td colspan="6">N2 - Low</td></tr>
</table>
</td></tr>
</table>

Table 12: Operational Phase Impact Assessment

<table>
<tr><th>Impact</th><th>Alteration of the natural flow regime</th></tr>
<tr><td>Impact description</td><td>During the operational phase of the project, maintenance of the infrastructure may be undertaken. Additional infrastructure may also be added.</td></tr>
<tr><td>Mitigation</td><td>

No water should be abstracted from the watercourses. Ideally water required during the operational phase must be sourced from an external source (i.e. outside of the watercourse contributing area).

</td></tr>
</table>

<table>
<tr><td></td><td>

Existing access routes should be utilised. Should additional access roads need to traverse watercourse, these should be perpendicular to the watercourse with appropriately designed culverts.
Should any additional powerlines or roads need to traverse a watercourse, these should be perpendicular to the watercourse. The associated foundations should be located outside the extent of the watercourse.

</td></tr>
<tr><td>Ease of mitigation</td><td>Moderate</td></tr>
<tr><td>Significance rating</td><td>
<table>
<tr><td colspan="6">Pre-Mitigation</td><td colspan="6">Post-Mitigation</td></tr>
<tr><td>(M+</td><td>E+</td><td>R+</td><td>D)x</td><td>P=</td><td>S</td><td>(M+</td><td>E+</td><td>R+</td><td>D)x</td><td>P=</td><td>S</td></tr>
<tr><td>4</td><td>2</td><td>3</td><td>2</td><td>4</td><td>44</td><td>2</td><td>2</td><td>1</td><td>2</td><td>3</td><td>21</td></tr>
<tr><td colspan="6">N3 - Moderate</td><td colspan="6">N2 - Low</td></tr>
</table>
</td></tr>
<tr><td>Impact</td><td>Water quality degradation</td></tr>
<tr><td>Impact description</td><td>Potential spillage of hazardous substances such as oils, fuel, grease from vehicles, and sewage from on-site sanitation systems. Spillages from onsite dirty water containment facilities.</td></tr>
<tr><td>Mitigation</td><td>

Areas for waste disposal should be clearly demarcated and should be bunded and on hard standing. These areas should be located outside the extent of the watercourse.
Ensure that no equipment is washed in the streams and wetlands of the area, and if washing facilities are provided, that these are located outside the extent of the watercourse.
Procedures for containment of leaks/spills as well as associated emergency response plans should be developed.
Stormwater management should be in line with the stormwater management plan.
Dirty water retention facilities must be designed to adequately capture contaminated water. Should this water be released, provisions for adequate treatment must be made.
Machinery and equipment must be inspected regularly for faults and possible leaks. If required, servicing of these should occur off outside the extent of the watercourse.
Potential contaminants used and stored at the proposed project site should be stored and prepared on bunded surfaces to contain spills and leaks.
Adequate ablution facilities should be developed and located outside the extent of the watercourse.

</td></tr>
<tr><td>Ease of mitigation</td><td>Moderate</td></tr>
<tr><td>Significance rating</td><td>
<table>
<tr><td colspan="6">Pre-Mitigation</td><td colspan="6">Post-Mitigation</td></tr>
<tr><td>(M+</td><td>E+</td><td>R+</td><td>D)x</td><td>P=</td><td>S</td><td>(M+</td><td>E+</td><td>R+</td><td>D)x</td><td>P=</td><td>S</td></tr>
<tr><td>4</td><td>2</td><td>3</td><td>2</td><td>4</td><td>48</td><td>3</td><td>2</td><td>1</td><td>2</td><td>2</td><td>16</td></tr>
<tr><td colspan="6">N3 - Moderate</td><td colspan="6">N2 - Low</td></tr>
</table>
</td></tr>
<tr><td>Impact</td><td>Soil erosion and sedimentation</td></tr>
<tr><td>Impact description</td><td>Maintenance activities will result in soil disturbance, resulting in a higher potential for soil erosion and sedimentation</td></tr>
<tr><td>Mitigation</td><td>

During the construction phase sediment control measures must be adopted in order to prevent sediment entering the watercourses. These include: limiting the area of disturbance, the use of silt fences and the covering of stockpiles.

</td></tr>
</table>

	– The project site should be contoured to allow for surface water to readily drain away (as it would under natural conditions) and to prevent ponding of water within areas where it would not have ponded before the construction activities. – The use of rock mattresses at the culver discharge points. – The use of supporting structures such as gabions around the foundations of any pipeline or powerline crossings to prevent any scouring of the base.
Ease of mitigation	Moderate
Significance rating	

Pre-Mitigation						Post-Mitigation					
(M+	E+	R+	D)x	P=	S	(M+	E+	R+	D)x	P=	S
4	2	3	2	3	33	3	1	1	2	2	14
N3 - Moderate						N1 – Very Low					

7 CONCLUSION

The development of the Project may result in negative impacts on the environment. To reduce these impacts, adequate mitigation and management procedures are to be adhered to. Water quality, alteration of the natural flow regimes and possibly erosion and sedimentation have been identified as the predominant negative impacts from the proposed Project. Should the recommended mitigative measure be implemented during and after construction, the risk to the surface watercourses may be minimized. Implementation of these measures is not only good practice to ensure the minimisation of degradation, but also necessary to ensure further compliance with the necessary legislative requirements.