HYDROLOGICAL ASSESSMENT FOR THE UIS ML 133 PROJECT, ERONGO REGION, NAMIBIA

VERSION 1

17 OCTOBER 2024

PROJECT NO. ECC-001

HYDROLOGIC CONSULTING

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HYDROLOGICAL ASSESSMENT FOR THE UIS ML 133 PROJECT, ERONGO REGION, NAMIBIA

Prepared For

ENVIRONMENTAL COMPLIANCE CONSULTANCY (PTY) LTD

Prepared By

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1 INTRODUCTION

Hydrologic Consulting has been appointed by Environmental Compliance Consultancy (Pty) Ltd (ECC) to undertake a hydrological assessment of the proposed Uis ML 133 Project, Erongo Region, Namibia. The proponent plans to mine pegmatite-hosted tin and lithium deposits on ML 133 as part of a blast and haul operation (no onsite processing of ore).

ECC requires specialist input into the environmental and social impact assessment (ESIA) that is being conducted for the project to assess impacts on sensitive receptors that the proposed project will have concerning hydrology during construction, operations, and decommissioning.

This report outlines the hydrological baseline with a hydrological (surface water) impact assessment subsequently presented.

The client has not yet provided pit outlines, waste rock dump outlines or haul road locations. This report may as such be considered a preliminary assessment providing an overview of the baseline environment with the identification of sensitive hydrological receptors and associated risks. Should site layout information (once available) deem it necessary for further detailed studies to be done, these may be commissioned at such time.

1.1 SCOPE OF WORK

The scope of work was achieved by undertaking the following:

- Baseline Assessment – sourcing of baseline climatic and hydrological data. This included the interrogation of rainfall data, site-specific design rainfall (depth/duration/frequency), evaporation, soils, and land use, as well as a regional and local hydrological assessment.
- Flooding Assessment – a high-level assessment of possible flooding from the primary Omaruru River (ephemeral) was undertaken to define the 1:50, 1:100 and regional maximum flood (RMF) extents. A buffering approach to flow accumulation (defined by available terrain data) was also undertaken as a qualitative approach to considering flooding for lesser watercourses or flow paths.
- Hydrological Impact Assessment – this was undertaken using ECC's impact assessment methodology developed to enable effective communication of the potential consequences or impacts of activities on the hydrological (surface water) environment; and
- A technical report detailing the achieved scope of work (this report).

The above scope of work is based on a desktop assessment of the site.

1.2 REGIONAL SETTING AND LAYOUT

The proposed pegmatite-hosted tin and lithium mine (hereafter also referred to as the site) is located at 21° 26' 2" S, 15° 4' 41" E The regional setting of the site is illustrated in **Figure 1-1** while the layout of the site is presented in **Figure 1-2**. The site includes the following proposed infrastructure:

500000
600000
700000
7700000
7600000
7500000
7400000
N
Khorixas
Otjiwarongo
Geibigeb
Kalkfeld
Ugab
Omatjete
Omatako
Uis
Zebedeus
Okombahe
Omaruru
Omaruru
Uis, ML-133
Khan
Spitzkoppe
Karibib
Uiba-Oas
Usakos
Okahandja
Omaruru
Swakop
Arandis
Otjimbingwe
Windhoek
Swakop
Kuiseb
Swakopmund
Walvis Bay
Oamites
Primary Road (OSM)
Secondary Road (OSM)
Rehoboth
Overview
Figure 1-1
Regional Setting
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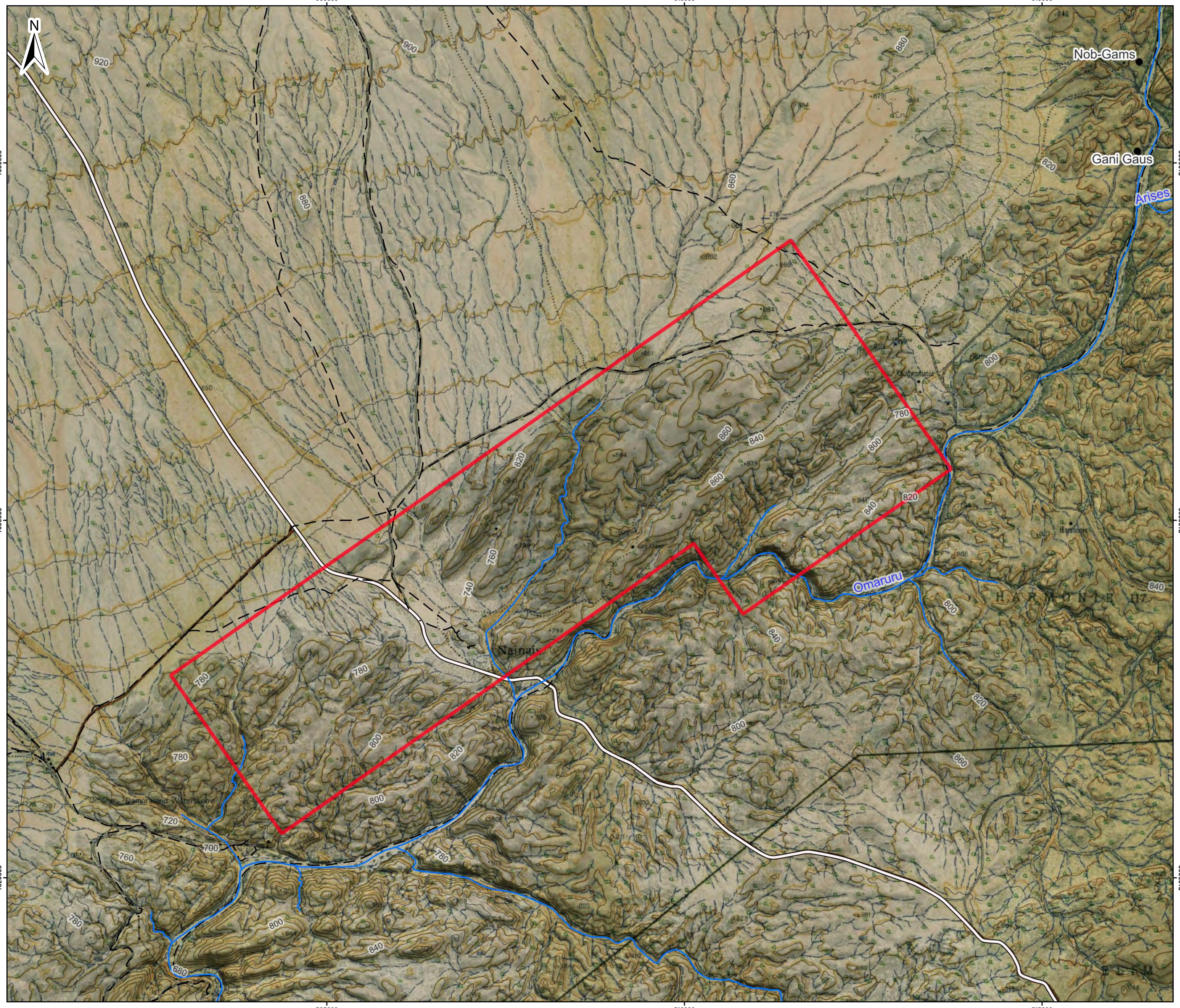
0
25
50 km
Scale - 1:1,600,000 @A4
Coordinate Reference System: WGS 84 / UTM zone 33S
Version 1
08-Oct-2024



Legend

Boundary (Uis, ML-133)

Locality (OSM)

Rivers (OSM)

20m Contour (COP30 Derived)

Roads (OSM)

Tertiary

Track

Figure 1-2

Layout

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0 1 2 3 km

Scale - 1:50,000 @A3	Coordinate Reference System: WGS 84 / UTM zone 33S	Version 1 10-Oct-2024

Per the provided ECC Brief, "*The Project is located within ML 133 that covers an area of approximately 3,288 ha and is located along the banks of the ephemeral Omaruru River, approximately 45 km south of the town Uis, in the Nai Nais community, Dâures Constituency, Erongo Region. The proponent plans to mine pegmatite-hosted tin and lithium deposits on ML 133. The mining method involves open pit mining, blast, load and haul of ore to ML 134 for processing off-site. Waste rock will be stockpiled on waste rock dumps located within ML 133, however, additional infrastructure will be limited as processing will occur off-site*".

A site boundary was the only identifier for the area of the proposed works. No site layout details (e.g. open pit areas or waste rock dumps) were available at the time of writing.

1.2.1 EXPERTISE OF PRIMARY AUTHOR AND DECLARATION OF INDEPENDENCE

Mr Mark Bollaert has over 17 years of experience working as a consulting hydrologist in both the United Kingdom and South Africa, since completing his Master of Science (MSc) degree in Hydrology at the University of KwaZulu-Natal. Mark has supplemented his tertiary education with professional qualifications which represent his ongoing effort toward maintaining a professional approach and continuing in his professional development. These include qualifications from the UK (Chartered Scientist, Chartered Environmentalist and Chartered Water and Environmental Manager) and South Africa (Professional Natural Scientist in Water Resources).

In terms of the requirement to be independent, Hydrologic Consulting and affiliated consultant Mr Mark Bollaert declare that other than fair remuneration for the work undertaken, he has no business, financial, or personal interest in the proposed activity or application and that there are no circumstances that may compromise his objectivity.

2 BASELINE ENVIRONMENT

Baseline information in this section includes discussions on the rainfall, evaporation, design event rainfall, soils and land cover, as well as local terrain and regional and local catchment hydrology.

The Atlas of Namibia (2022) provided much of the data presented in this section.

2.1 RAINFALL

Rainfall data for the site was not readily available and required consideration of alternate datasets. The first of these datasets was sourced from the Atlas of Nambia (2022) and provided a *Climate Hazards Group InfraRed Precipitation with Station data* CHIRPS[1] derived estimate of annual rainfall for the site and surrounds. This data is illustrated in **Figure 2-1**.

Average monthly CHIRPS rainfall data for the site was subsequently extracted and presented in **Table 2-1**.

TABLE 2-1: CHIRPS AVERAGE MONTHLY RAINFALL DISTRIBUTION (MM)

Month	Rainfall (mm)
Jan	23
Feb	26
Mar	27
Apr	9
May	0
Jun	0
Jul	0
Aug	0
Sep	0
Oct	3
Nov	9
Dec	9
Total	**106**

* Estimates sourced at the centre of the site.

Kunz (2004) provides the means to extract observed daily rainfall data up to the year 2001 from rainfall stations within Southern Africa. In considering **Figure 2-1**, there are many rainfall stations in the region of the site. An analysis of daily rainfall was, however, not necessary concerning the scope of this assessment but may be necessary for any future stormwater management or flooding assessments that may be required.

[1] CHIRPS: Rainfall Estimates from Rain Gauge and Satellite Observations | Climate Hazards Center - UC Santa Barbara (ucsb.edu)

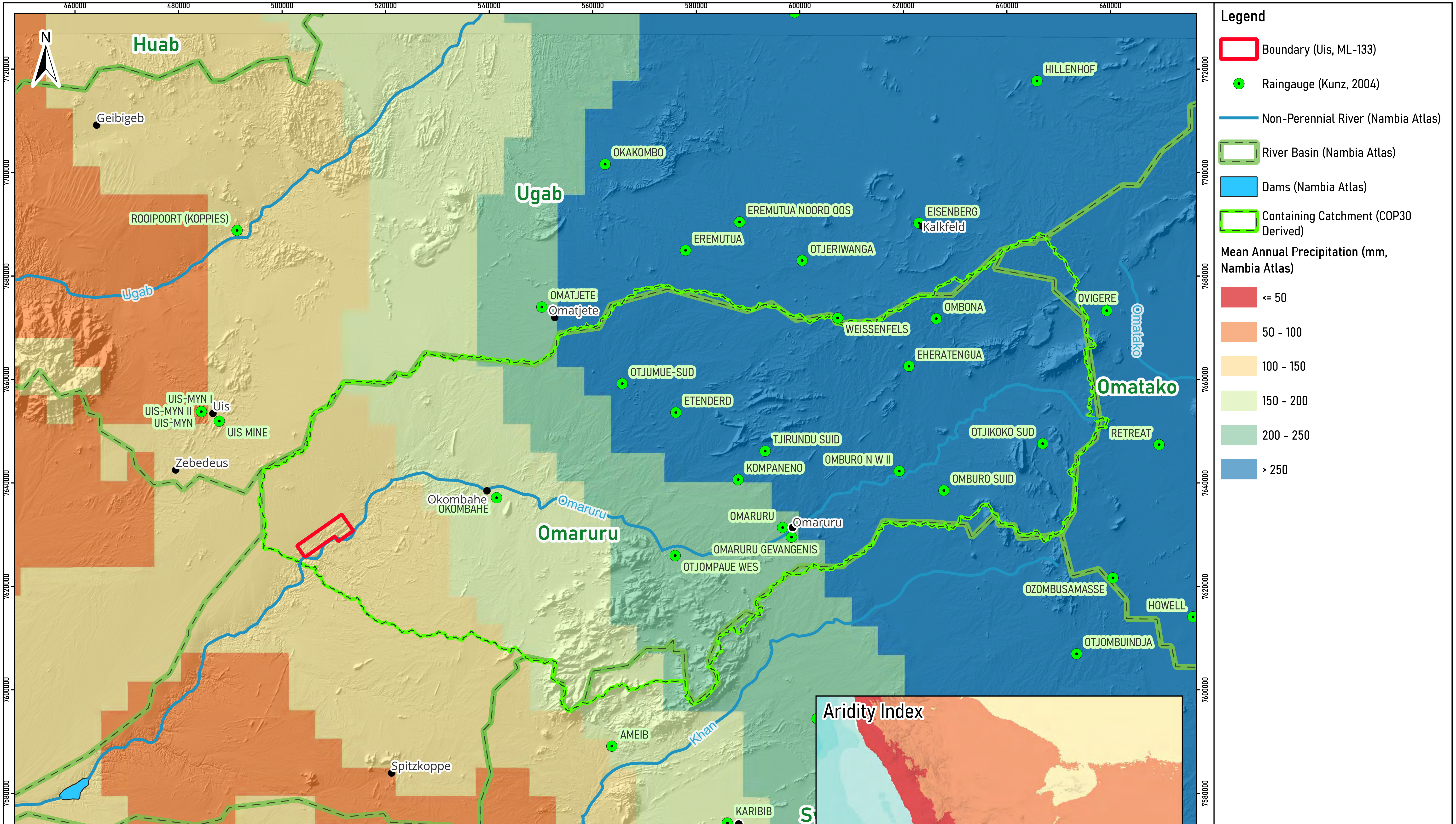

Figure 2-1

Mean Annual Precipitation

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0 10 20 30 km

Scale - 1:700,000 @A3	Coordinate Reference System: WGS 84 / UTM zone 33S	Version 1 16-Oct-2024

2.2 EVAPORATION

Estimates of Reference Evapotranspiration (ET0) were sourced from the FAO's AQUASTAT Tool. The resulting average monthly and annual total ET0 estimates are presented in **Table 2-2**.

TABLE 2-2: FAO AQUASTAT AVERAGE MONTHLY REFERENCE EVAPOTRANSPIRATION

Month	Reference Evapotranspiration (ET0) (mm)
Jan	239
Feb	203
Mar	179
Apr	157
May	162
Jun	158
Jul	185
Aug	167
Sep	206
Oct	246
Nov	255
Dec	248
Total	**2,405**

* Estimates sourced at the centre of the site.

2.3 AVERAGE CLIMATE

Average climate data was derived from the Food and Agriculture Organization's (FAO) Aquastat platform (reference evapotranspiration and temperature) and from (CHIRPS). The average monthly data together is presented in **Figure 2-4**. While evapotranspiration is shown as significantly exceeding rainfall, this is representative of the maximum reference evapotranspiration (ETo) that could occur assuming no limitations are placed on evapotranspiration demand. The combination of rainfall, evapotranspiration and temperature results in a dry hot arid desert climate according to the Köppen-Geiger climate classification[2].

[2] *Namibia - Summary | Climate Change Knowledge Portal (worldbank.org)*

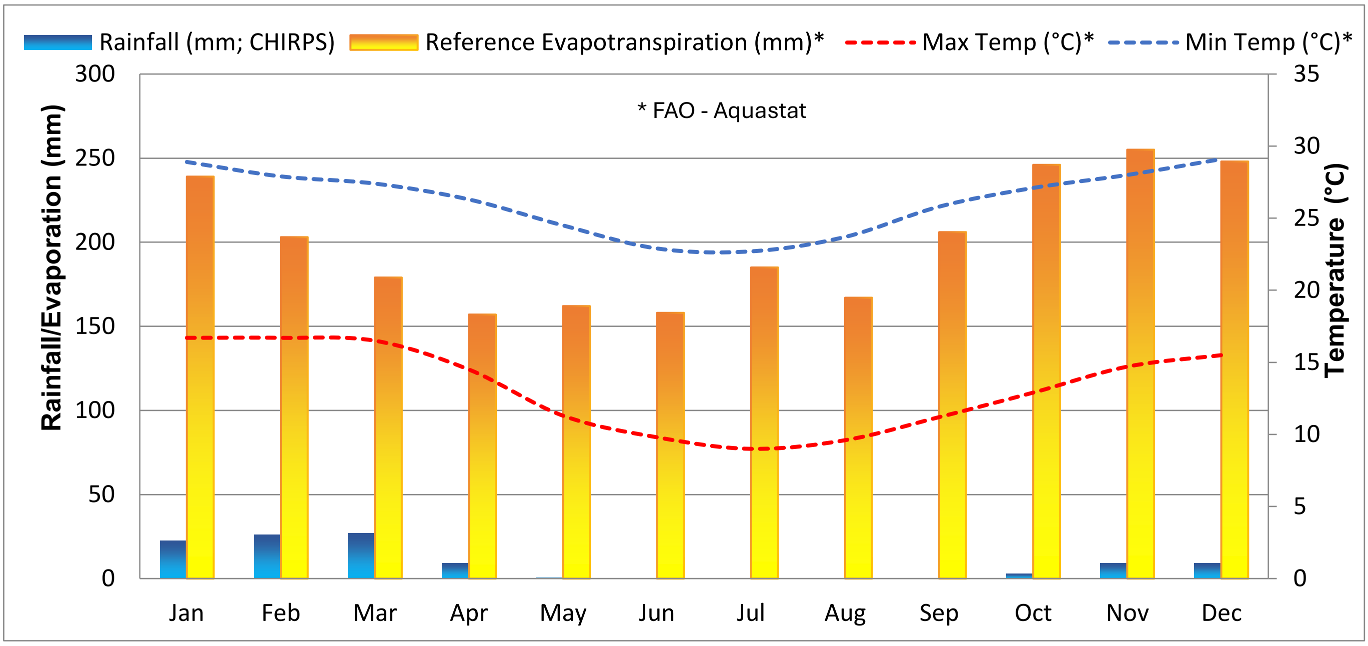


FIGURE 2-2: AVERAGE MONTHLY CLIMATE

2.4 TERRAIN

In assessing the terrain of the site, a single dataset was used in the form of 30m digital surface model (DSM) COP30[3] data. The 30m DSM provides a coarse estimate of the terrain due to both the accuracy/detail of the dataset.

COP30 was selected from among alternative (freely available) 30m terrain datasets due to previous evaluation of this dataset by Hydrologic, which involved the comparison of 30m terrain datasets to higher detail/accuracy terrain data and aerial imagery, with COP30 being found to perform the better (among the available 30m datasets). This is not to say that COP30 is the ideal 30m DSM (when compared to alternate options) in all aspects of terrain variability found at and around the site, however, a single continual dataset was needed on which to base this study.

20m contours were subsequently derived from the COP30 data for use in mapping. **Figure 2-3** presents the terrain of the site with elevation on the site approximating 780m AMSL. Slope (derived from COP30) is also illustrated in **Figure 2-3** with a variation in slope noted given the undulating nature of the site. Slopes range between 0% and 50%, with the majority of the site associated with rocky terrain where slopes are higher.

2.5 HYDROLOGY

Figure 2-1 illustrates the regional hydrological setting of the mine, while **Figure 2-3** presents the local hydrology of the mine.

The mine is within the greater Omaruru Catchment which drains to the Atlantic Ocean. The Omaruru Catchment's primary river is the Omaruru River which passes immediately east of the site, intersecting a small portion of the site's eastern boundary. A containing catchment representative of a portion of the greater Omaruru Catchment was delineated to define the surface water area of influence in this study. This is presented in **Figures 2-1** and **2-3** and approximates 8,426km^2.

[3] Copernicus Digital Elevation Model - Copernicus Contributing Missions Online

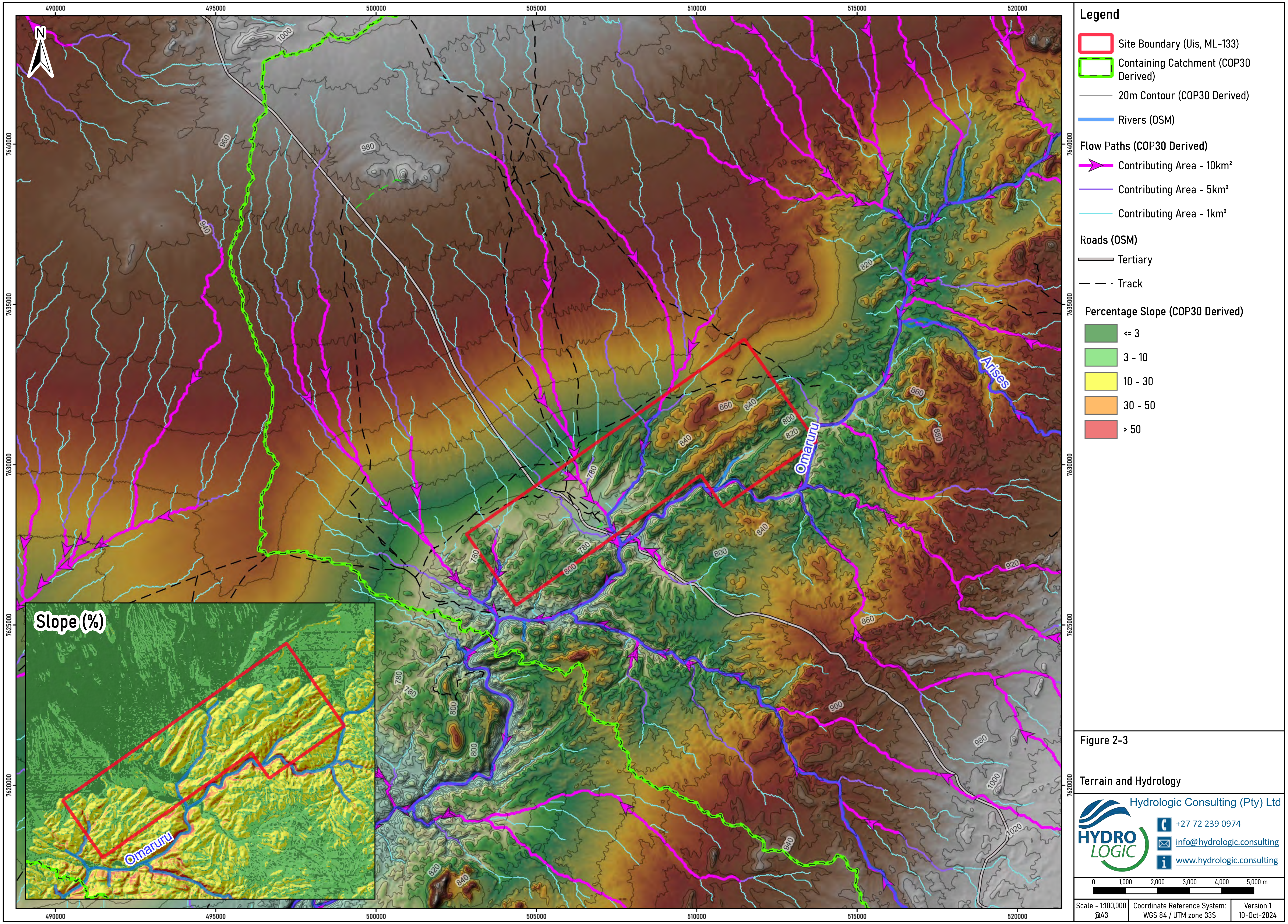


Figure 2-3

Terrain and Hydrology

The Omaruru River is an ephemeral river, only flowing after periods of rain. Tributaries to the Omaruru River were available using OpenStreetMaps (OSM) data and are illustrated in **Figure 2-1**. Three of these defined tributaries intersect the site. Per Nambia's 1:50,000 topographical map data, there are, however, many defined ephemeral rivers intersecting the site. To the north of the site, these rivers are extensive in coverage. To better understand their possible influence, a flow path analysis which considered contributing areas was used with thresholds of $1km^2$, $5km^2$ and $10km^2$. These differing classifications enable a distinction in areas on the site where flows could potentially be more concentrated following rainfall.

2.6 SOILS AND LAND-COVER

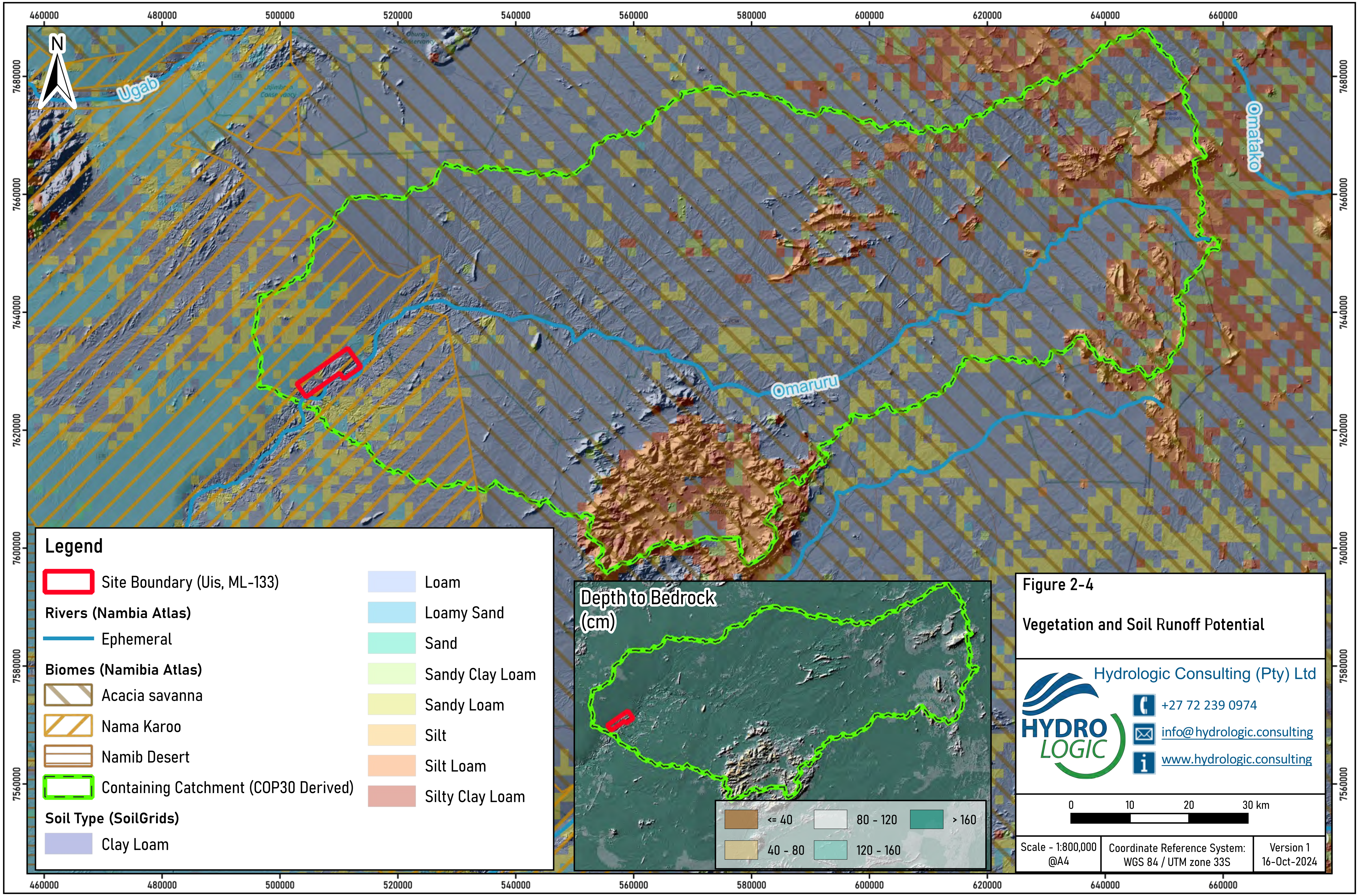
In considering the Atlas of Nambia (2022), a soil texture classification and depth to bedrock for the site and containing catchment were available. This figure illustrates a depth to bedrock that is shallower in regions of more mountainous terrain as is expected. Soil texture over the site is predominantly classified as 'loam'. A secondary dataset HYSOGs250m[4] dataset covering the mine classifies soils as being in hydrological soil group B (moderately low runoff potential; 50-90% sand and 10-20% clay).

The natural vegetation of the site is classified per the Atlas of Namibia (2022) as being Nama Karoo shrubland.

Land-cover of the site as defined by the Atlas of Namibia (2022) is predominantly bare with minor areas of sparse vegetation. There are vegetated areas over the site although these are primarily associated with the Omaruru River.

Figure 2-4 presents the soil and vegetation coverage of the containing catchment while **Figure 2-5** presents the land-cover of the containing catchment.

[4] Ross, C., Prihodko, L., Anchang, J. *et al., 2018,* "*HYSOGs250m global gridded hydrologic soil groups for curve-number-based runoff modelling*". *Sci Data* 5, 180091 (2018).


460000
480000
500000
520000
540000
560000
580000
600000
620000
640000
660000
7680000
7660000
7640000
7620000
7600000
7580000
7560000
N
Ugab
Omaruru
Omatako
Legend
Site Boundary (Uis, ML-133)
Rivers (Nambia Atlas)
Ephemeral
Biomes (Namibia Atlas)
Acacia savanna
Nama Karoo
Namib Desert
Containing Catchment (COP30 Derived)
Soil Type (SoilGrids)
Clay Loam
Loam
Loamy Sand
Sand
Sandy Clay Loam
Sandy Loam
Silt
Silt Loam
Silty Clay Loam
Depth to Bedrock (cm)
<= 40
40 - 80
80 - 120
120 - 160
> 160
Figure 2-4
Vegetation and Soil Runoff Potential
Hydrologic Consulting (Pty) Ltd
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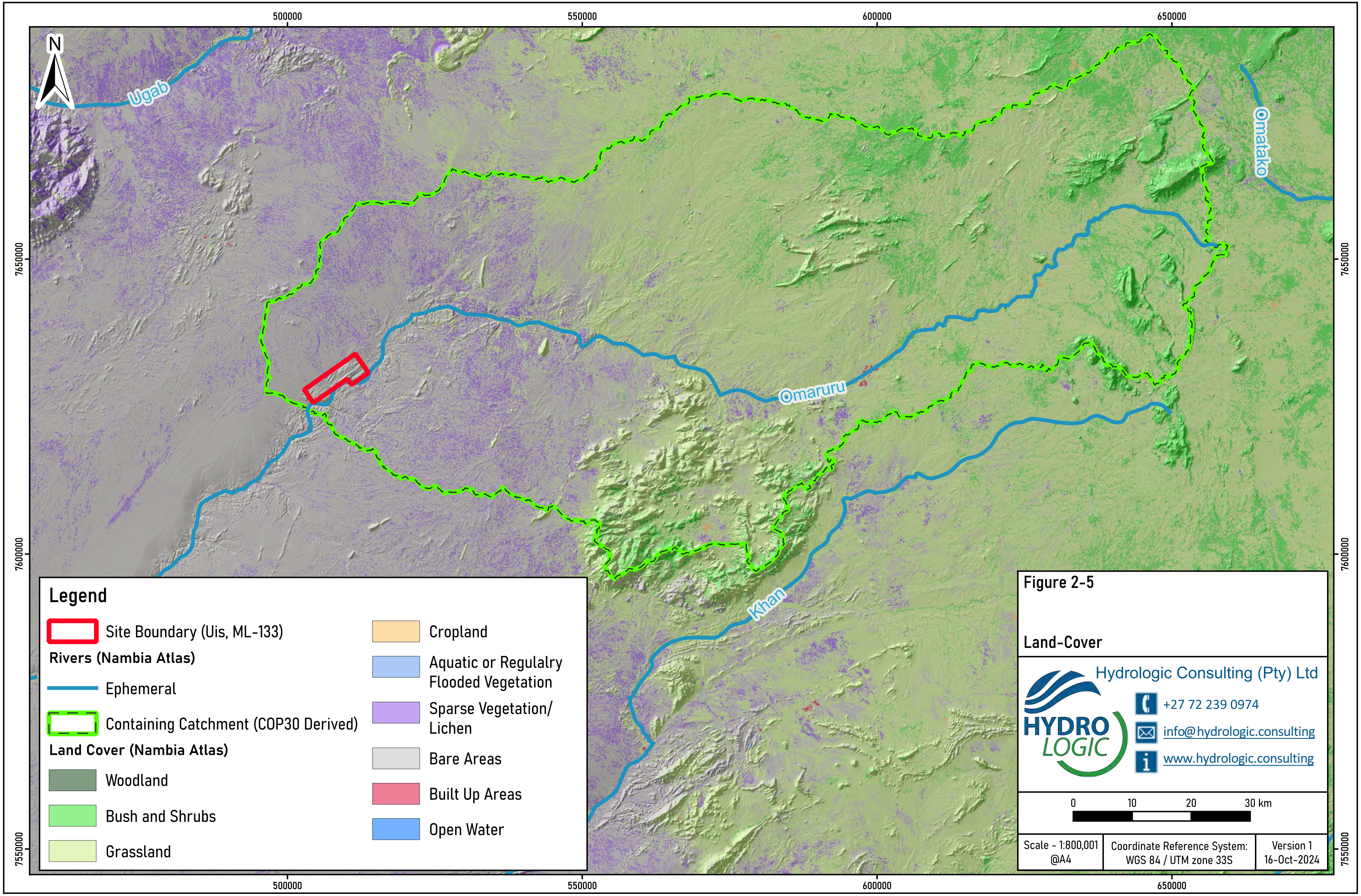
0
10
20
30 km
Scale - 1:800,000 @A4
Coordinate Reference System: WGS 84 / UTM zone 33S
Version 1
16-Oct-2024


500000
550000
600000
650000
7650000
7600000
7550000
N
Ugab
Omatako
Omaruru
Khan
Legend
Site Boundary (Uis, ML-133)
Rivers (Nambia Atlas)
Ephemeral
Containing Catchment (COP30 Derived)
Land Cover (Nambia Atlas)
Woodland
Bush and Shrubs
Grassland
Cropland
Aquatic or Regulalry Flooded Vegetation
Sparse Vegetation/ Lichen
Bare Areas
Built Up Areas
Open Water
Figure 2-5
Land-Cover
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HYDRO LOGIC
+27 72 239 0974
info@hydrologic.consulting
www.hydrologic.consulting
0 10 20 30 km
Scale - 1:800,001 @A4
Coordinate Reference System: WGS 84 / UTM zone 33S
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3 APPLICABLE GUIDANCE

ECC has previously published a "Best Practice Guide – Environmental Principles for Mining in Namibia"[5]. Within this document, the following legislative and regulatory frameworks are identified (focus on the surface water environment):

- THE CONSTITUTION OF THE REPUBLIC OF NAMIBIA, 1990 (AMENDED 1998) states that "*the maintenance of ecosystems, essential ecological processes and biological diversity of Namibia and utilisation of living natural resources on a sustainable basis*"
- MINERALS (PROSPECTING ANDMINING) ACT, NO. 33 OF 1992 which indicates that that a licence holder should apply "good mining practices" concerning environmental protection, natural resource conservation, and the removal of accessory works or other goods that were erected, constructed or brought onto the land for the mining activities.
- MINERALS POLICY OF NAMIBIA, 2002 which stipulates that mine closure should be properly planned and "form part of an integrated land use strategy involving engagement with communities", and encourages the alternative use of land through rehabilitation, as well as the use of remaining infrastructure for ongoing economic benefits
- ENVIRONMENTAL MANAGEMENT ACT, NO. 7 OF 2007 which provides a framework for conducting environmental assessments as well as the implementation of monitoring and auditing measures.
- NAMIBIA'S ENVIRONMENTAL ASSESSMENT POLICY FOR DEVELOPMENT AND ENVIRONMENTAL CONSERVATION, 1994 states that the proponent is required to enter into a binding agreement (based on the procedures and recommendations contained in the EIA report) to ensure that the mitigation and other measures recommended in the EIA, are accepted by all parties and fulfilled. This agreement should address the construction, operational, and decommissioning phases in the mine closure process, as applicable, as well as its monitoring and auditing.
- WATER RESOURCES MANAGEMENT ACT, NO. 11 OF 2013 (Government Gazette No. No. 5367 and 8187) which includes aspects such as the licencing of water use, prevention of water pollution, protection of water resources, efficient use of water, water conservation measures, and the safety of dams.
- BIODIVERSITY-RELATED LEGISLATION Some key principles endorsed in Namibia include: the protection of sensitive habitats; the maintenance of species and ecological processes, such as surface hydrology and groundwater movement; the prevention of secondary impacts and unnecessary collateral damage; monitoring; the avoidance of adverse impacts on biodiversity, wherever possible; and rehabilitation where avoidance is not possible.

3.1 SURFACE WATER-SPECIFIC GUIDANCE

Mining operations will alter the natural environment, thereby affecting the generation of stormwater on the site. It is of particular importance to identify the effect the mining operations will have on stormwater production and to manage this water accordingly. Volumes of stormwater generated are expected to increase as a result of both mining operations and the reduction of natural vegetation. The quality of the stormwater generated is expected to decrease due to the nature of mining operations. The ultimate objective of stormwater management on a mine is to ensure that no dirty water (contaminated through mining operations) enters the natural environment.

[5] ECCBest Practice Guide – Environmental Principles for Mining in Namibia

The following presents published legislation and/or guidance that should be considered concerning the development of the mine and the

3.1.1 WATER RESOURCES MANAGEMENT ACT 11 OF 2013 (GOVERNMENT GAZETTE NO. 5367)

The Act provides legislation related to the management, protection, development, use and conservation of water resources; to provide for the regulation and monitoring of water services.

Per the Act a "watercourse" is defined as:-

(a) a river or spring, including the base flow of an ephemeral river when there is no surface flow;
(b) a natural channel in which water flows regularly or intermittently;
(c) an estuary, wetland, lake or dam into which, or from which, water flows;
(d) any collection or body of water declared under section 5(s) to be a watercourse; and includes the water in, and the bed and banks of, the watercourse.

Some specific guidance arising from this act includes the following.

Per Clause 68 (Pollution Control):

(1) A person may not by any act or omission cause a water resource to be polluted, either directly or indirectly, unless authorised to do so by or under this Act or any other law, and in accordance with that authorisation.

Per Clause 69 (Obligation to provide and operate systems for discharge of effluent, wastewater and waste):

(5) A lessor of land or premises where any industrial, mining or other activity is carried on by the lessee, that may cause water pollution, is responsible to remedy the effects of any pollution caused by such activity in the event that the lessee fails to remedy the effects of such pollution.

Per Clause 92 (Obstruction of a watercourse)

(1) A person may not engage in any construction work or other activity that causes, or is likely to cause, the natural flow conditions of water in, to or from a watercourse to be modified, unless the Minister has granted prior written approval for the work or activity to be carried out.

Per Clause 100 (Prevention of flood risk)

(1) A person may not engage in any construction work or other activity that causes, or is likely to cause, the natural flow conditions of water in, to or from a watercourse to be modified, unless the Minister has granted prior written approval for the work or activity to be carried out.

  (d) by notice in writing given specifically to any person, or by regulation, prohibit the growing of crops, the building of structures or the placing of deposits on land located between a watercourse and any protective dykes, embankments or levees;

  (e) consult with any regional council or local authority in determining the geographic extent of floodplain areas in its region or local authority area, as the case may be, and assist any such councils in regulating the development and use of land within a floodplain area; or

(f) prescribe measures for the control and management of storm and flood risk within local authority areas.

3.1.2 COMMENCEMENT OF WATER RESOURCES MANAGEMENT ACT 11 OF 2013 (GOVERNMENT GAZETTE NO. 8187)

The Act extends the Water Resources Management Act 11 of 2013 and includes the definition of a "riparian area" as:

- the historically, occasionally or seasonally flooded banks and floodplains along both sides of a watercourse.

Per Clause 138 (Prohibition on removal of riparian species, filling or excavation of riparian zone or erection of structural development within riparian zone without licence). A person may not:

(a) remove any riparian species;
(b) fill or excavate a riparian zone; or
(c) erect any structural development within a riparian zone,

without a licence issued by the Minister

Per Clause 141 (Conditions relating to licence to remove riparian species, fill or excavate riparian zone or erect structural development within riparian zone).

Subject to regulation 140(4)(a) and (b), a licence to remove riparian species, fill or excavate a riparian zone or erect a structural development within a riparian zone is subject to the following conditions:

(a) where there is a reasonable threat to the ecological integrity of any body of water a person may not
  i. remove riparian species from the riparian zone of that body of water;
  ii. excavate or fill the riparian zone of the body of water; or
  iii. erect any structural development within the riparian zone the body of water;
(b) a person may not remove a protected plant species;
(c) a person may not erect any structural development on the stream or river bank;
(d) a buffer zone of 100 metres from the stream or river bank must be maintained to protect streams and river banks from soil erosion and reduces flooding;
(e) a person may not remove rocks, sand or gravel within 100 metres of the riparian zone from the stream or river bank;
(f) a licence holder who removes rocks, sand or gravel must ensure that such removal does not expose the roots of indigenous trees in any watercourse;
(g) precautionary measures to prevent damage to riverbanks or riparian zones and prevent the pollution or reduction of water resource quality must be implemented by the licensee;
(h) the licence excludes the right of access to private properties, and if applicable, the holder of the licence must separately obtain permission from a particular landowner; and

(i) the Minister or his or her authorised representative reserves the right to carry out periodic inspections to determine whether the conditions of the licence are adhered to.

There is, however, no guidance on the design requirement of stormwater containment facilities or diversions. For this International Finance Corporation (IFC) and South African guidelines have been considered.

3.1.3 IFC ENVIRONMENTAL, HEALTH AND SAFETY GUIDELINES – MINING (2007)

The IFC Environmental, Health and Safety Guidelines - MIning (2007), indicate that the following should be applied:

- Stormwater should be separated from process and sanitary wastewater streams in order to reduce the volume of wastewater to be treated prior to discharge.
- Surface runoff from process areas or potential sources of contamination should be prevented.
- Where this approach is not practical, runoff from process and storage areas should be segregated from potentially less contaminated runoff.
- Runoff from areas without potential sources of contamination should be minimized (e.g. by minimizing the area of impermeable surfaces) and the peak discharge rate should be reduced (e.g. by using vegetated swales and retention ponds).
- Where stormwater treatment is deemed necessary to protect the quality of receiving water bodies, priority should be given to managing and treating the first flush of stormwater runoff where the majority of potential contaminants tend to be present.
- When water quality criteria allow, stormwater should be managed as a resource, either for groundwater recharge or for meeting water needs at the facility.
- Oil water separators and grease traps should be installed and maintained as appropriate at refuelling facilities, workshops, parking areas, fuel storage and containment areas.
- Sludge from stormwater catchments or collection and treatment systems may contain elevated levels of pollutants and should be disposed in compliance with local regulatory requirements, in the absence of which disposal has to be consistent with protection of public health and safety and conservation and long term sustainability of water and land.

Furthermore, the IFC Environmental, Health and Safety Guidelines for Mining (2007) identifies the following:

- Dirty Water Areas include beneficiation plants, workshops (where oil is handled), residue disposal facilities, haul roads, opencast pits, and pollution control dams.
- Separation of clean and dirty water areas is required, while minimising runoff, avoiding erosion of exposed ground surfaces, avoiding sedimentation of drainage systems and minimising exposure of polluted areas to stormwater.

From exploration onwards, the management strategies include:

- Reducing exposure of sediment-generating materials to wind or water (e.g. proper placement of soil and rock piles);

- Divert run-off from undisturbed areas around disturbed areas - including areas that have been graded, seeded, or planted. Such drainage should be treated for sediment removal;
- Reducing or preventing off-site sediment transport (e.g. use of settlement ponds, silt fences);
- Stormwater drains, ditches and stream channels should be protected against erosion through a combination of adequate dimensions, slope limitation techniques and use of rip-rap and lining. Temporary drainage installations should be designed, constructed and maintained for Recurrence Intervals (RIs) of at least a 25-year/24-hour event, while permanent drainage installations should be designed for a 1:100-year/24-hour event. Design requirements for temporary drainage structures should additionally be defined on a risk basis considering the intended life of diversion structures, as well as the RI of any structures that drain into them.

From construction onwards, recommended management strategies include:

- Establishing riparian zones;
- Timely implementation of an appropriate combination of contouring techniques, terracing, slope reduction / minimization, runoff velocity limitation and appropriate drainage installations to reduce erosion in both active and inactive areas;
- Access and haul roads should have gradients or surface treatment to limit erosion. Road drainage systems should be provided;
- Facilities should be designed for the full hydraulic load, including contributions from upstream catchments and non-mined areas;
- Stormwater settling facilities should be designed and maintained according to internationally accepted good engineering practices, including provision for capturing of debris and floating matter. Sediment control facilities should be designed and operated for a final Total Suspended Solids (TSS) discharge of 50 mg/l and other applicable effluent guidelines, taking into consideration background conditions and opportunities for overall improvement of the receiving water body quality.

From operations onwards, recommended management strategies include:

- Final grading of disturbed areas, including preparation of overburden before application of the final layers of growth medium, should be along the contour as far as can be achieved in a safe and practical manner;
- Re-vegetation of disturbed areas including seeding should be performed immediately following application of the growth medium to avoid erosion.

3.1.4 GN 704

The principles of the South African National Water Act (Act 36 of 1998), and more particularly Government Notice 704 (GN 704) provide a thorough and useful reference to the management of the mine’s stormwater. GN 704 deals with the separation of clean and dirty water and governs the management thereof. These regulations conform to international best practices.

GN 704 was established to provide regulations on the use of water for mining and related activities aimed at the protection of water resources. There are important definitions in the regulation which provide useful background to the management of stormwater.

- **Clean water system**: This includes any dam, other form of impoundment, canal, works, pipeline and any other structure or facility constructed for the retention or conveyance of unpolluted water.
- **Dam**: This includes any settling dam, slurry dam, evaporation dam, catchment or barrier dam and any other form of impoundment used for the storage of unpolluted water or water containing waste (i.e. polluted water).
- **Dirty area**: This refers to any area at a mine or activity which causes, has caused or is likely to cause pollution of a water resource (i.e. polluted water).
- **Dirty water system**: This includes any dam, other form of impoundment, canal, works, pipeline, residue deposit and any other structure or facility constructed for the retention or conveyance of water containing waste

The three main principles in GN 704 of particular applicability to this project are set out in the following:

- Condition 4, which defines the area in which mine workings or associated structures may be located concerning a watercourse and its associated flooding. The 50-year flood-line and 100-year flood-line are used for defining suitable locations for mine workings (prospecting, underground mining or excavations) and associated structures respectively. Where the flood-line is less than 100 metres away from the watercourse, then a minimum watercourse buffer distance of 100 metres is required for both mine workings and associated structures
- Condition 6, which deals with the capacity requirements of clean and dirty water systems. Clean and dirty water systems must be kept separate and must be designed, constructed, maintained and operated such that these systems do not spill into each other more than once in 50 years.
- Condition 7, which describes the measures which must be taken to protect water resources. All dirty water or substances which cause or are likely to cause pollution of a water resource either through natural flow or by seepage.

4 HIGH-LEVEL EVALUATION OF FLOOD POTENTIAL

As per **Section 3.1.2**, numerous activities (including fill and excavation) are prohibited within riparian zones without a licence. A buffer zone of 100 metres from the stream or river bank is applicable. This implies that flooding is relevant which is the focus of this section.

4.1 ASSESSMENT OF FLOODING

The approach to the assessment of flooding adopted two strategies:

1. The primary Omaruru River is a major watercourse with the potential to route substantial flood waters past the site. A simulation of the flooding on this watercourse was consequently adopted to illustrate the 1:50 year recurrence interval (RI), 1:100 year RI and the regional maximum flood (RMF). The detail within this model was limited and the results of simulated flooding on the Omaruru River should be considered a high-level estimate.
2. For the remaining rivers (or flow paths) on the site, a threshold catchment area analysis had been previously undertaken per **Figure 2-3**, with three flow path classifications produced. A buffering approach to these defined flow paths was subsequently undertaken to suggest exclusion areas.

4.1.1 FLOODING ON THE OMARURU RIVER

Since the modelling of flooding is (as undertaken), an approximation of reality, various assumptions and limitations are relevant (when considering the results presented in this section).

To undertake a high-level estimate of flooding on the Omaruru River, it was first necessary to estimate the flood flow (peak flow) that would be possible for specific events of interest. This was achieved through the adoption of the procedure developed by Francou-Roudier and adapted for Namibia and South Africa by Zoltan Kovács who reviewed recorded flood peaks. The key flood event produced by this procedure is the regional maximum flood (RMF) flood, however, downscaling to smaller flood events such as the 1:100 recurrence interval (RI) flood is possible. The application of the RMF (Kovacs) method to the site amounted to the following peak flows being estimated based on the containing catchment area of 8,426 km^2:

- Regional Maximum Flood = 6,312 m^3/s;
- 1:100 year RI Event = 4,934 m^3/s; and
- 1:50 year RI Event = 4,080 m^3/s.

HEC-RAS 6.6 was selected to model flood hydraulics (movement of flood waters over the surface, using the flood peaks outlined above) using a 2D model approach. HEC-RAS is designed to perform one-dimensional and two-dimensional calculations for a full network of natural and constructed channels. The software is used worldwide and has been thoroughly tested (USACE, 2016, 2018).

Flood modelling utilised the 30m (COP30) terrain data was provided a coarse estimate of terrain for the Omaruru River. Given the size of the river and its incised channel (which is large), the 30m terrain data nevertheless showed a well-defined channel for the Omaruru River.

The availability of continuous DTM data allowed for the adoption of a 2D flood model approach using HEC-RAS. Unlike a 1D approach (using cross-sections) which samples the DTM at set cross-section locations, a 2D model approach uses a continuous model grid. The advantage of a 2D model is consequently its ability to account for more variation in the topographic data since no gaps are present in the model geometry (as is the case with cross-sections). The extent of the flood model covered approximately 6.6km and 10.7km of the Mooi River and Mooi River Loop, respectively.

No river crossings or hydraulic controls were considered. No significant crossings or hydraulic controls are expected based on a review of aerial imagery. Additionally, the flood modelling was simplified to keep it to a minimum (concerning detail). Flood results should consequently not be considered definitive.

The results of the flood modelling for the Omaruru River are presented in **Figure 4-1**. This figure illustrates that for the 1:50 RI and 1:100 RI flood events, the flood response is similar, with flooding for the 1:100 RI event (yellow colour) barely visible given the overlapping 1:50 RI event results (green colour). The regional maximum flood despite a substantial increase in flows is also similar in flood extent to the smaller two events. This is largely due to the well-defined Omaruru River channel which has incised itself into the terrain. The result is that flood waters are largely contained by the river channel with the primary exception being the area about Nainais where flood waters escape the river channel.

Overall, the influence of flooding caused by the Omaruru River on the site is limited to the site's eastern boundary. Defined areas of flood should ideally be avoided (with regards to planned works) given the risk that exists due to this watercourse and its large upstream area which can generate substantial flows.

4.1.2 BUFFERING APPROACH TO FLOOD SENSITIVITY

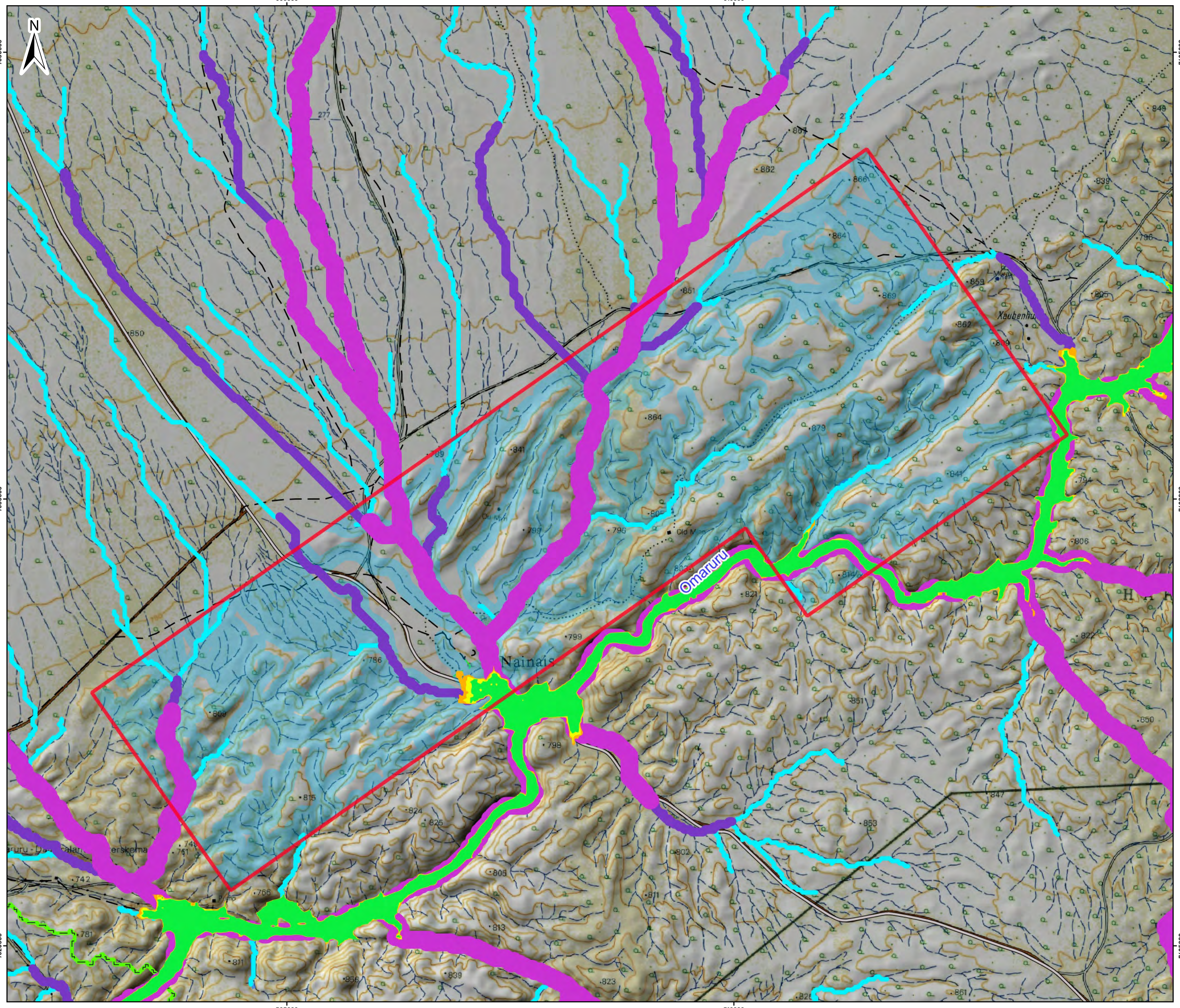
To account for the variability in flooding that could be produced from a smaller or larger catchment area, the flow path analysis outlined in **Section 2.5** considered contributing areas with thresholds of $1km^2$, $5km^2$ and $10km^2$. These contributing areas would be associated with an increase in potential flood risk (respectively).

To factor in this increasing flood risk, a buffering approach to the defined flow paths was undertaken. It should be noted that due to the available terrain data (30m cell size), the results of the flow path analysis have the potential for error (due to the coarse terrain data used). Nevertheless, a simple buffering analysis provides some indication of areas of possible flood risk (as well as areas in which stormwater would be concentrated. Where works intersect flow paths (whether illustrated in this report or as evidenced by on-site observations), flood protection or stormwater management may be necessary.

The evaluation of flooding based on flow paths used the following classification (this classification is simplistic as river floodplains vary along a particular river reach):

- Contributing area > $1km^2$: A 25m buffer was applied;
- Contributing area > $5km^2$: A 50m buffer was applied; and
- Contributing area > $10km^2$: A 100m buffer was applied.

Figure 4-1 presents the results of the buffering workflow. The buffer classification used in the above is not precise. It is instead a simplistic approach that attempts to illustrate greater flood risk as flood peak potential increases (based on contributing area alone).



Legend

Site Boundary (Uis, ML-133)

Containing Catchment (COP30 Derived)

Flood Results (Omaruru River Only)

Inundation Boundary (1:50 RI Event; High-Level)

Inundation Boundary (1:100 RI Event; High-Level)

Inundation Boundary (RMF Event; High-Level)

Flow Path Analysis

100m Flow Path Buffer (>10km²; COP30 Derived)

50m Flow Path Buffer (>5km²; COP30 Derived)

25m Flow Path Buffer (>1km²; COP30 Derived)

100m Buffer (1:50,000 Rivers)

Figure 4-1

Flood Sensitivity

Hydrologic Consulting (Pty) Ltd
HYDRO LOGIC
+27 72 239 0974
info@hydrologic.consulting
www.hydrologic.consulting

0 500 1,000 1,500 m

Scale - 1:40,000 @A3	Coordinate Reference System: WGS 84 / UTM zone 33S	Version 1 16-Oct-2024

The site is noted as having 5 reaches associated with the more substantial 100m buffer, 6 reaches associated with the 50m buffer and 15 reaches associated with the 25m buffer. Due to the potential for larger peak flows, the emphasis on flood protection should be from in the following order of priority; 100m, to 50m to 25m buffered flow paths.

4.2 RIPARIAN BUFFER

The 100m buffer is relevant to defining the riparian zone with a riparian zone defined by the Water Resources Management Act 11 of 2013 as:

- The historically, occasionally or seasonally flooded banks and floodplains along both sides of a watercourse.

Wherein a watercourse is defined as:

- a river or spring, including the base flow of an ephemeral river when there is no surface flow; or
- a natural channel in which water flows regularly or intermittently.

While the buffer distance (25m to 100m) presented in **Section 4.1.2** is intended to provide some variability in the assessment of flood sensitivity to the site, from a legislative perspective, the 100m buffer still applies to all watercourses.

The 1:50,000 topographical map dataset for Namibia includes various watercourses that have been delineated, whether perennial or non-perennial (including ephemeral watercourses). These watercourses have consequently been understood to qualify as riparian zones. As such, a 100m buffer zone is relevant given the applicability of Clause 141 of the Water Resources Management Act 11 of 2013 which outlines the conditions relating to a licence to remove riparian species, fill or excavate riparian zone or erect structural development within the riparian zone.

To understand the influence riparian zones (the 100m watercourse buffer) have, the watercourses for the 1;50,000 topographical map dataset over the site were digitised and buffered to 100m. The result of this process is presented in **Figure 4-1**.

As illustrated in the figure, the majority of the site is associated with riparian areas. An exemption to mine on the site is consequently likely required.

5 HYDROLOGICAL IMPACTS AND MITIGATION MEASURES

An impact is essentially any change (positive or negative) to a resource or receptor brought about by the presence of the project component or by the execution of a project-related activity.

The potential impacts of the project have been evaluated using a recognised risk assessment methodology provided by ECC. This methodology was developed to enable communication of the potential consequences or impacts of activities on the hydrological (surface water) environment as set out in the Environmental Management Act, No. 7 Of 2007.

5.1 METHOD OF ASSESSING IMPACTS

ECC provided their impact assessment methodology as outlined in **Figures 5-1** and **5-2**. The assessment of impact concludes with a scoring of the impact with a score from 1 (low) to 12 (major), based upon the intersection of impact sensitivity and impact significance. Sensitivity is a single variable with three options which rank sensitivity from 1 to 3. Significance considers a combination of factors.

5.1.1 DETERMINATION OF SIGNIFICANCE

The significance of an impact was determined by evaluating the nature (N), frequency (F), duration (D) reversibility (R) and probability (P) which are collectively considered under the heading "Nature and Characteristics -of the Impact". The magnitude of the change (M) is the final factor which influences impact significance.

To calculate the rating of significance (from 1 to 4), the following formula was applied:

$$Significance = \frac{(E + D + R + P) \times \ N}{4} \times M$$

All variables in the above except for nature (N) are ranked 1 to 5 in the ECC methodology. Nature (N) is either +1 (beneficial) or -1 (adverse). The resulting significance rating is between -25 and +25. The translation of this scoring to an ECC significance rating of between 1 and 4 requires the division of the rating by 6.25.

With significance calculated, it was possible to compare the impact rating to the sensitivity rating to arrive at the final impact scoring (1 to 12; low to major).

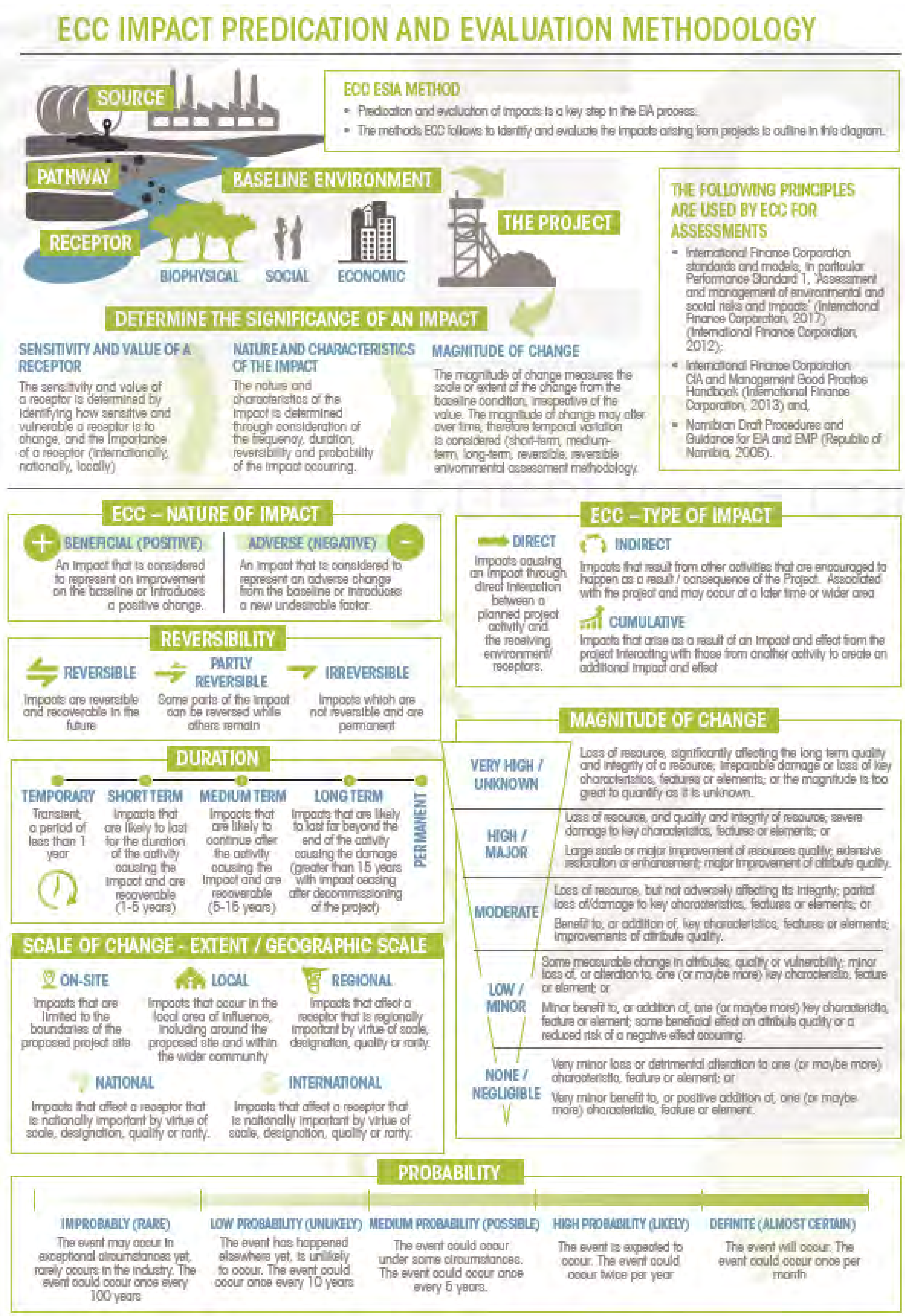


FIGURE 5-1: ECC IMPACT METHODOLOGY – PART 1

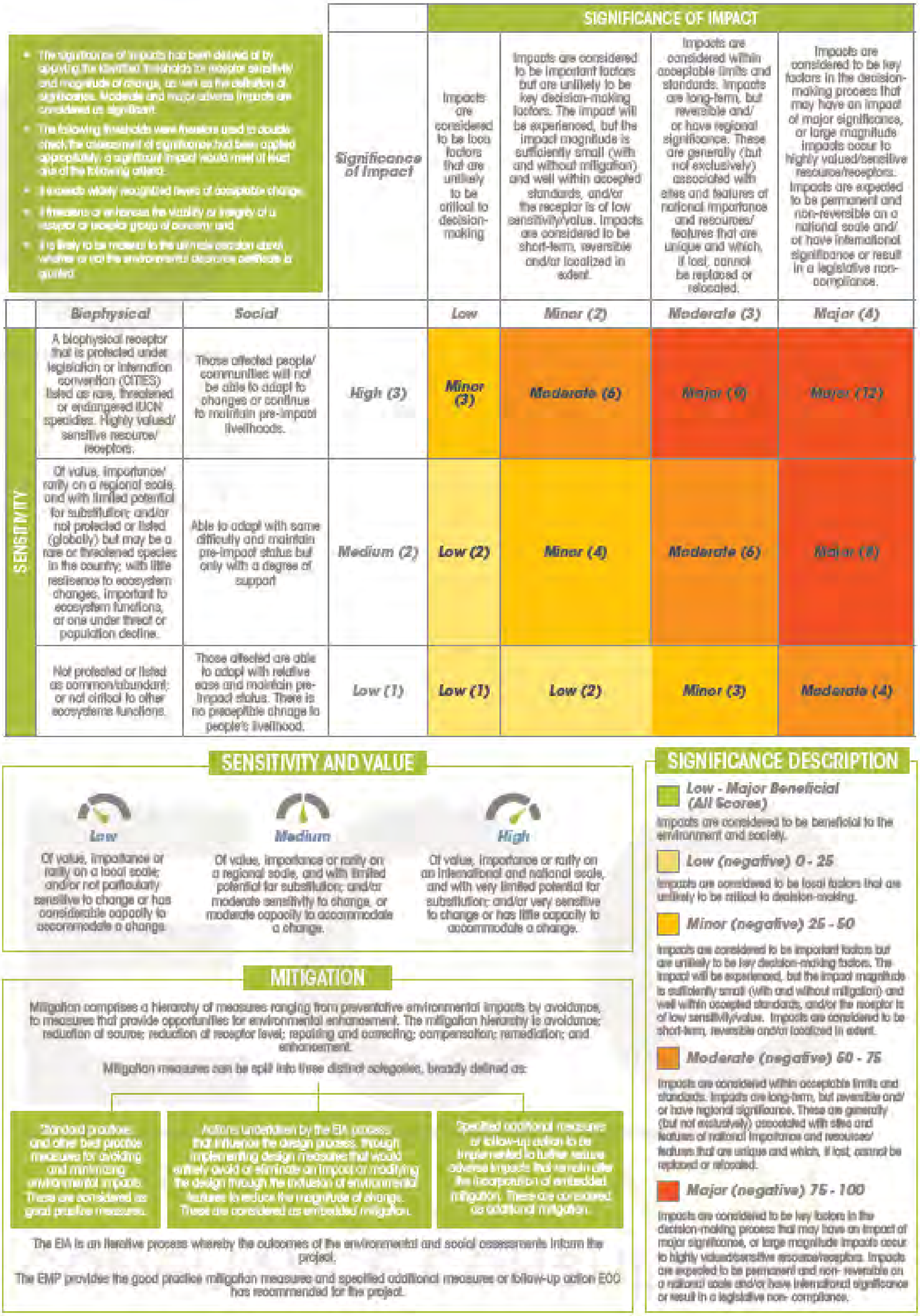


FIGURE 5-2: ECC IMPACT METHODOLOGY – PART 2

5.2 PROJECT PHASES

This impact assessment has been developed on the understanding that the project is comprised of the following phases:

- Construction – surface infrastructure will be built on land cleared for that purpose;
- Operation – the mining operation will commence inclusive of opencast pit and waste rock dump development; and
- Decommissioning – all operations will cease with certain surface infrastructure removed and disturbed areas rehabilitated.

Impacts are assessed collectively for the project, and include those of the proposed opencast pits, waste rock dumps and haul roads. No layout of the mine was available at the time of writing and impacts are conceptualised as occurring over the full mine boundary presented in **Figure 1-2**.

No alternatives are relevant to this report.

5.3 IDENTIFIED IMPACTS

The impacts reviewed in this report present the impact and mitigation options. The scoring of the impact (per the following tables) is based on the pre-mitigation scoring. The proposed mitigation will reduce the impact in most instances.

5.3.1 EROSION OF SOILS

Eroded soils have the potential to cause sedimentation of downstream watercourses. The construction/expansion of infrastructure will lead to new areas being disturbed, resulting in the potential for soil erosion to occur during times of rainfall, while the decommissioning of this infrastructure will result in the same. If not mitigated, erosion could continue during the operational phase, although it is expected soils would settle to a degree, reducing the potential volume of erosion for any given rainfall event. The decommissioning phase (inclusive of rehabilitation) may have an overall positive impact on any existing erosion without formal erosion mitigation in place, although there could also be some increase in erosion due to earthworks.

Disturbed areas should consequently be stabilised, with erosion control methods used where stabilisation is not possible. A rehabilitation plan for the site should be developed inclusive of topsoil replacement where possible. A re-vegetation strategy including maintenance/aftercare should likewise be developed for disturbed areas. The arid nature of the site may mean re-vegetation is challenging. Naturally occurring plant species should be prioritised.

TABLE 5-1: EROSION OF SOILS (CONSTRUCTION PHASE)

Impact Name	**Erosion of Soils**		
Phase	Construction		
Significance (Factors)			
Attribute	**Pre-mitigation**	**Attribute**	**Pre-mitigation**
Nature	Adverse	Probability	Likely
Type of Impact	Direct	Magnitude	Low/Minor
Extent	Local	Reversibility	Partly Reversible
Duration	Short Term	Confidence	Moderate
Significance (Pre-mitigation)			Low

Sensitivity	Low
Scoring	Low
Mitigation Measures	

- *Implement a compliant (based upon IFC or possibly South African (GN704) guidance) stormwater management plan.*
- *Suitable erosion control should be utilised.*
- *The disturbed footprint should be minimised as far as practically possible.*
- *Clearing of vegetation and associated excavation should be kept to a minimum, particularly in areas where soils are unstable.*
- *Construction should, where possible, be scheduled to take place during the dry season when rainfall and associated erosion potential are at their lowest. For longer construction periods of more than six months, construction should be scheduled such that exposure of soils (before the addition of hardstanding or rehabilitation) occurs mostly within the dry season as far as possible.*
- *All disturbed areas must be rehabilitated (as soon as practically possible) to represent the previous undisturbed environment (soil, land-cover, slope) to limit the impact on receiving water resources (by limiting soil erosion).*
- *Disturbed areas or areas rehabilitated with soils should be stabilised as soon as possible using plants (e.g. grass) or other mechanical methods (e.g. profiling or erosion control blankets).*
- *Where erosion is nevertheless likely to occur, it is recommended to use settling facilities or silt fences.*
- *Rehabilitation should include topsoil replacement, re-vegetation and maintenance/aftercare for disturbed areas.*

TABLE 5-2: EROSION OF SOILS (OPERATION AND DECOMMISSIONING PHASE)

Impact Name	**Erosion of Soils**		
Phase	Operation and Decommissioning		
Significance (Factors)			
Attribute	**Pre-mitigation**	**Attribute**	**Pre-mitigation**
Nature	Adverse	Probability	Likely
Type of Impact	Direct	Magnitude	Moderate
Extent	Local	Reversibility	Partly Reversible
Duration	Short Term	Confidence	Moderate
Significance (Pre-mitigation)			Minor
Sensitivity			Low
Scoring			Low
Mitigation Measures			

- *Maintain a compliant (based upon IFC or possibly South African (GN704) guidance) stormwater management plan.*
- *Suitable erosion control should be utilised.*
- *The disturbed footprint should be minimised as far as practically possible.*
- *Clearing of vegetation and associated excavation should be kept to a minimum, particularly in areas where soils are unstable.*
- *All disturbed areas must be rehabilitated (as soon as practically possible) to represent the previous undisturbed environment (soil, land-cover, slope) to limit the impact on receiving water resources (by limiting soil erosion).*
- *Disturbed areas or areas rehabilitated with soils should be stabilised as soon as possible using plants (e.g. grass) or other mechanical methods (e.g. profiling or erosion control blankets).*
- *Where erosion is nevertheless likely to occur, it is recommended to use settling facilities or silt fences.*
- *Rehabilitation should include topsoil replacement, re-vegetation and maintenance/aftercare for disturbed areas.*

5.3.2 POLLUTANTS ENTERING THE SURFACE WATER ENVIRONMENT

Operation of earthmoving machinery or maintenance of vehicles on-site during construction, operation and decommissioning (including the possible storage or handling of hydrocarbons) poses a potential source of hydrocarbon contamination concerning the surface water environment. An emergency response plan for unforeseen hydrocarbon spills should be developed.

A stormwater management plan is a necessary part of the development of the expansion (as per the Water Resources Management Act 11 of 2013 and IFC guidance) and will form an integral mitigation measure concerning the management of dirty areas.

Important. This section only considers the surface water impact from the proposed surface activities. It is expected that the groundwater specialist assess the potential impact of possible seepage of contaminated groundwater into surface water resources.

TABLE 5-3: POLLUTANTS ENTERING THE SURFACE WATER ENVIRONMENT (CONSTRUCTION PHASE)

Impact Name	**Pollutants Entering the Surface Water Environment**		
Phase	Construction		
Significance (Factors)			
Attribute	**Pre-mitigation**	**Attribute**	**Pre-mitigation**
Nature	Adverse	Probability	Likely
Type of Impact	Direct	Magnitude	Low/Minor
Extent	Local	Reversibility	Partly Reversible
Duration	Short Term	Confidence	Moderate
Significance (Pre-mitigation)			Low
Sensitivity			Low
Scoring			Low
Mitigation Measures			

- *Implement a compliant (based upon IFC or possibly South African (GN704) guidance) stormwater management plan.*
- *Keep activity within the managed dirty water footprint where possible.*
- *Store hydrocarbons off-site where possible, or otherwise implement hydrocarbon storage with adequate bunding.*
- *Handle hydrocarbons carefully to limit spillage.*
- *Ensure vehicles are regularly serviced so that hydrocarbon leaks are limited.*
- *Use drip trays for stationary vehicles or otherwise park over areas suited to their storage (e.g. with an oil interceptor)*
- *Refuel vehicles away from watercourses/waterbodies.*
- *Designate a single location for refuelling and maintenance away from watercourses/waterbodies.*
- *Keep a spill kit on site to deal with any hydrocarbon leaks.*
- *Remove soil from the site which has been contaminated by hydrocarbon spillage.*
- *Undertake surface water monitoring where possible to enable change detection related to contaminants originating from the site.*

TABLE 5-4: POLLUTANTS ENTERING THE SURFACE WATER ENVIRONMENT (OPERATION PHASE)

Impact Name	**Pollutants Entering the Surface Water Environment**		
Phase	Operation		
Significance (Factors)			
Attribute	**Pre-mitigation**	**Attribute**	**Pre-mitigation**
Nature	Adverse	Probability	Likely
Type of Impact	Direct	Magnitude	Moderate
Extent	Regional	Reversibility	Partly Reversible
Duration	Short Term	Confidence	Moderate
Significance (Pre-mitigation)			Minor
Sensitivity			Low
Scoring			Low
Mitigation Measures			

- *Maintain a compliant (based upon IFC or possibly South African (GN704) guidance) stormwater management plan.*
- *Keep activity within the managed dirty water footprint where possible.*
- *Store hydrocarbons off-site where possible, or otherwise implement hydrocarbon storage with adequate bunding.*
- *Handle hydrocarbons carefully to limit spillage.*
- *Ensure vehicles are regularly serviced so that hydrocarbon leaks are limited.*
- *Use drip trays for stationary vehicles or otherwise park over areas suited to their storage (e.g. with an oil interceptor)*
- *Designate a single location for refuelling and maintenance away from watercourses/waterbodies.*
- *Keep a spill kit on site to deal with any hydrocarbon leaks.*
- *Remove soil from the site which has been contaminated by hydrocarbon spillage.*
- *Undertake surface water monitoring where possible to enable change detection related to contaminants originating from the site.*

TABLE 5-5: POLLUTANTS ENTERING THE SURFACE WATER ENVIRONMENT (DECOMMISSIONING PHASE)

Impact Name	Pollutants Entering the Surface Water Environment		
Phase	Decommissioning		
Significance (Factors)			
Attribute	Pre-mitigation	Attribute	Pre-mitigation
Nature	Adverse	Probability	Likely
Type of Impact	Direct	Magnitude	Moderate
Extent	Local	Reversibility	Partly Reversible
Duration	Short Term	Confidence	Moderate
Significance (Pre-mitigation)			Minor
Sensitivity			Low
Scoring			Low
Mitigation Measures			
• *Maintain a compliant (based upon IFC or possibly South African (GN704) guidance) stormwater management plan.* • *Keep activity within the managed dirty water footprint where possible.* • *Store hydrocarbons off-site where possible, or otherwise implement hydrocarbon storage with adequate bunding.* • *Handle hydrocarbons carefully to limit spillage.* • *Ensure vehicles are regularly serviced so that hydrocarbon leaks are limited.* • *Use drip trays for stationary vehicles or otherwise park over areas suited to their storage (e.g. with an oil interceptor)* • *Designate a single location for refuelling and maintenance away from watercourses/waterbodies.* • *Keep a spill kit on site to deal with any hydrocarbon leaks.* • *Remove soil from the site which has been contaminated by hydrocarbon spillage.* • *Undertake surface water monitoring where possible to enable change detection related to contaminants originating from the site.*			

5.3.3 DECREASE IN RUNOFF

An increase in runoff could be expected due to the proposed construction of infrastructure which will increase impermeable hardstanding and compaction from the movement of machinery and use of laydown areas. The necessary introduction of a stormwater management plan (which will adopt a containment philosophy) and the nature of the mining (opencast pits) will, however, likely result in a net reduction in runoff.

A decrease in runoff is a typical impact associated with the containment of dirty areas on mines and the mitigation of this impact is often not practical or possible with a reduction in mean annual runoff as an expected outcome.

Once site layout details are available the anticipated decrease in runoff may be estimated with increased certainty. However, based on the scale of the operation to the Omaruru River, the reduction in runoff to the Omaruru River is expected to be minor.

Important. This section only considers the surface water impact from the proposed surface activities. It is expected that the groundwater specialist will assess the potential impacts of any dewatering (if relevant).

TABLE 5-6: DECREASE IN RUNOFF (CONSTRUCTION PHASE)

Impact Name	Decrease in Runoff		
Phase	Construction		
Significance (Factors)			
Attribute	Pre-mitigation	Attribute	Pre-mitigation
Nature	Adverse	Probability	Unlikely
Type of Impact	Direct	Magnitude	None/Negligible
Extent	On-Site	Reversibility	Reversible
Duration	Short Term	Confidence	High
Significance (Pre-mitigation)			Low
Sensitivity			Low

Scoring	Low
Mitigation Measures	

- *Keep the contained dirty area to a minimum thereby limiting this impact.*
- *Discharge excess water of an acceptable quality back into the surface water environment (river).*

TABLE 5-7: DECREASE IN RUNOFF (OPERATION AND DECOMMISSIONING PHASE)

Impact Name	**Decrease in Runoff**		
Phase	Operation and Decommissioning		
Significance (Factors)			
Attribute	**Pre-mitigation**	**Attribute**	**Pre-mitigation**
Nature	Adverse	Probability	Definite
Type of Impact	Direct	Magnitude	Low/Minor
Extent	Local	Reversibility	Irreversible
Duration	Permanent	Confidence	High
Significance (Pre-mitigation)			Minor
Sensitivity			Low
Scoring			Low
Mitigation Measures			

- *Keep the contained dirty area to a minimum thereby limiting this impact.*
- *Discharge excess water of an acceptable quality back into the surface water environment (river).*

5.3.4 ALTERED DRAINAGE

The altering/removal of watercourses is an impact by the establishment of the opencast pits and waste rock dumps. Not all rivers are expected to be altered simultaneously, assuming a sequential pit and waste rock dump development is undertaken; the impact will occur during construction, and operation (effectively ongoing development) and remain in the decommissioning phase.

The assumed sequential opencast pit and waste rock dump development mining approach may allow for the reinstation of watercourses. The re-establishment of the watercourses altered/removed by the mining operation would require an approach that attempts to replicate the pre-development hydrology. The diversion or removal of a watercourse would require a licence application to the Department of Water Affairs, from which more specific detail with regards to the required rehabilitation of reinstation of the watercourse (post-mining) would be provided.

TABLE 5-8: ALTERED DRAINAGE (CONSTRUCTION PHASE)

Impact Name	**Altered Drainage**		
Phase	Construction		
Significance (Factors)			
Attribute	**Pre-mitigation**	**Attribute**	**Pre-mitigation**
Nature	Adverse	Probability	Definite
Type of Impact	Direct	Magnitude	None/Negligible
Extent	On-Site	Reversibility	Reversible
Duration	Short Term	Confidence	Moderate
Significance (Pre-mitigation)			Low
Sensitivity			Medium
Scoring			Low
Mitigation Measures			

- *The minimal extent of watercourses/flow paths reasonably possible should be disturbed.*
- *Altered watercourses should be modified in such a way that allows upstream areas to route back into the natural watercourse downstream of works.*
- *Ideally, the pre-existing hydrology (surface water environment) should be replicated or re-instated as soon as mining over a removed/altered watercourse is completed.*

TABLE 5-9: ALTERED DRAINAGE (OPERATION AND DECOMMISSIONING PHASE)

Impact Name	**Altered Drainage**		
Phase	Operation and Decommissioning		
Significance (Factors)			
Attribute	**Pre-mitigation**	**Attribute**	**Pre-mitigation**
Nature	Adverse	Probability	Definite
Type of Impact	Direct	Magnitude	Moderate
Extent	On-Site	Reversibility	Reversible
Duration	Permanent	Confidence	Moderate
Significance (Pre-mitigation)			Minor
Sensitivity			Medium
Scoring			Minor
Mitigation Measures			
• *The minimal extent of watercourses/flow paths reasonably possible should be disturbed.* • *Altered watercourses should be modified in such a way that allows upstream areas to route back into the natural watercourse downstream of works.* • *Ideally, the pre-existing hydrology (surface water environment) should be replicated or re-instated as soon as mining over a removed/altered watercourse is completed.*			

5.3.5 FLOODING

Flood risk is largely an impact on the proposed mine and not the environment as with the other impacts identified in this report. This flood risk (from rivers/flow paths) is expected to be present during the construction, operational and decommissioning phases due to the existence of infrastructure/works that could be flooded and the presence of personnel who might be caught in floodwaters.

Various locations over the proposed mine are intersected by rivers/flow paths identified in **Section 4** which also outlines the flood risk from the primary Omaruru River. Additional flood risk is also present in the form of surface water flooding (i.e. .flooding from runoff before entering a defined river). This risk will largely be managed through a suitability-designed stormwater management plan (not assessed in this study).

The consequence of flooding is potentially severe, particularly for the Omaruru River where flood peaks reach over 6,000m^3/s for the RMF flood (4,934m^3/s for the 1:100 RI flood). The standard of design for the cutoffs/channels and additional infrastructure (flood or stormwater) will dictate the level of protection with a residual risk determined on the level of protection and the presence of works within areas prone to flooding.

Important. It should, however, be noted that the potentially severe impact of flood risk is not adequately conveyed by the impact table below since the probability and duration of extreme flooding is low while sensitivity is low, resulting in the impact appearing less significant than may be warranted.

TABLE 5-10: FLOODING (CONSTRUCTION, OPERATIONAL AND DECOMMISSIONING PHASE)

Impact Name	**Flooding**		
Phase	Construction, Operation, and Decommissioning		
Significance (Factors)			
Attribute	**Pre-mitigation**	**Attribute**	**Pre-mitigation**
Nature	Adverse	Probability	Rare
Type of Impact	Cumulative	Magnitude	Very High/Unknown
Extent	National	Reversibility	Irreversible
Duration	Temporary	Confidence	High
Significance (Pre-mitigation)			Moderate
Sensitivity			Low
Scoring			Minor

Mitigation Measures
• *Maintain a compliant (based upon IFC or possibly South African (GN704) guidance) stormwater management plan that may provide a secondary benefit of flood protection.* • *Where works/infrastructure is at risk of flooding, acceptable flood protection measures should be adopted.* • *Consider the results of the flood modelling presented in **Section 4** in the development of the site.* • *Flood buffers have been presented in **Section 4**. Works should ideally not take place in these defined buffer areas, or within the 1:100 year flood-line (although this is a high-level estimate of flooding)*

5.4 ASSUMPTIONS, UNCERTAINTIES AND GAPS IN KNOWLEDGE

- Flooding and pollutants entering the surface water environment (post-mitigation) are poorly represented in the impact assessment due to their probability of occurrence (improbable).
- The impact assessment undertaken within this study is based on a desktop assessment.
- The proposed mining operation includes opencast pits, haul roads, waste rock dumps and other surface infrastructure (albeit limited). The position of activities on the site is not known and is assumed to be occurring over the whole site. This impact assessment is, however, a collective assessment. This results in some impacts being diluted by the generalised assessment (compared to an assessment focusing on a particular facility or process)

6 SURFACE WATER MONITORING

Regular surface water quality monitoring to enable change detection resulting from the potential contamination of surface water by unexpected leaks/spills or operational oversights is a typical recommendation. In the case of the proposed mine, local water resources are ephemeral. It may consequently be challenging to undertake regular surface water monitoring. Monitoring may, however, be possible in some locations during periods of rainfall and this section has suggested locations in which water may be more common.

Surface water monitoring points have consequently been proposed as per **Figure 6-1** where more substantial rivers/flow paths are present, with upstream and downstream monitoring locations (from proposed works) preferred.

Table 6-1 presents the coordinates of these points.

TABLE 6-1: SAMPLING COORDINATES

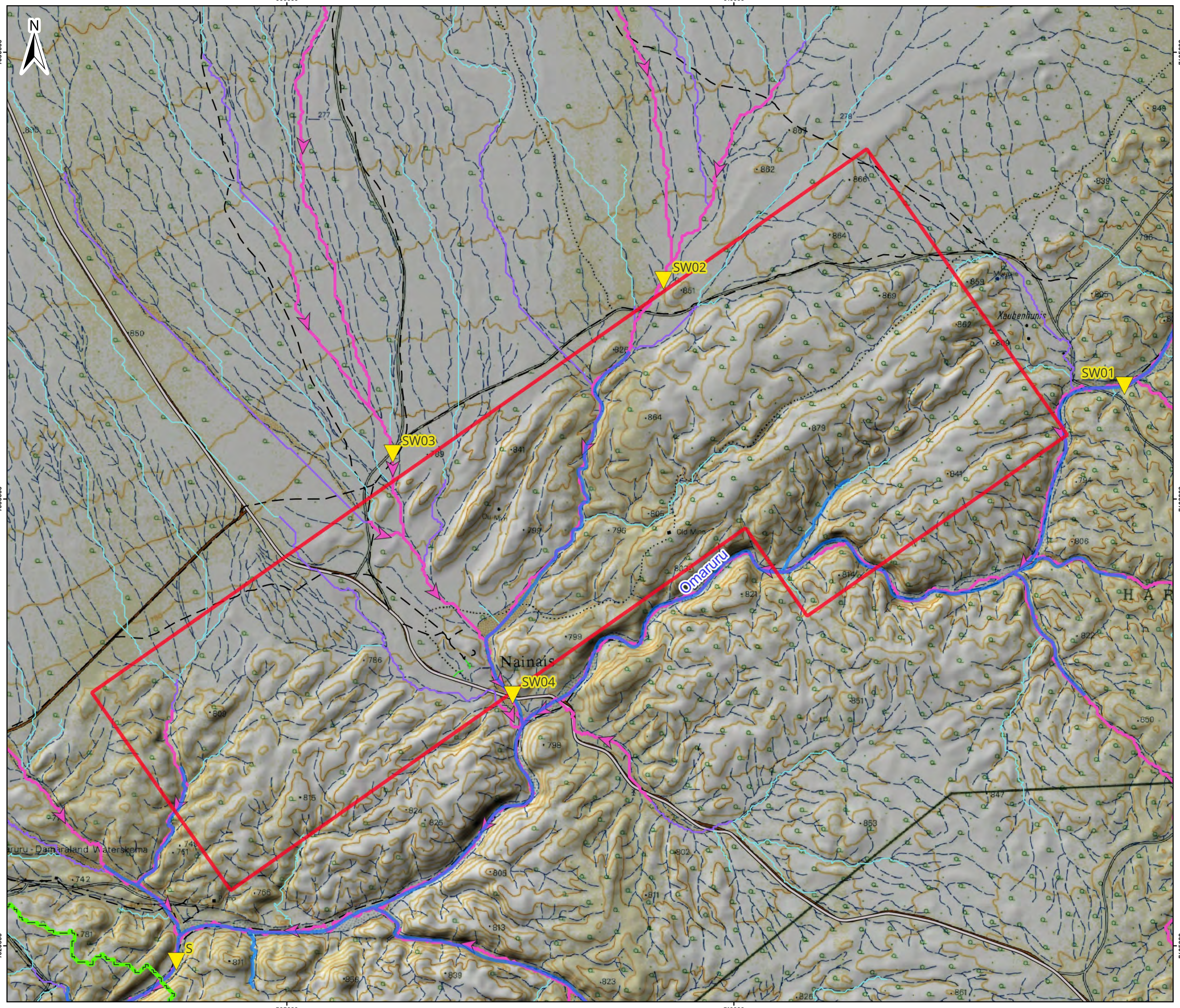
Month	Coordinates
SW01	21° 25' 14" S, 15° 8' 19" E
SW02	21° 24' 42" S, 15° 5' 18" E
SW03	21° 25' 47" S, 15° 3' 37" E
SW04	21° 27' 8" S, 15° 4' 21" E
SW05	21° 28' 45" S, 15° 2' 11" E

Sampling locations within the site boundary and as close as possible to the area of works are preferential due to the potential for dilution the further away a sample point is located and the possibility of influence from other land uses limiting the potential for change detection resulting from the water quality changes at the site alone.

6.1 MONITORING PROGRAMME

Sampling should ideally take place every quarter although the frequency of streamflow due to the ephemeral nature of rivers means that monitoring may be irregular. Any water that will be discharged into the natural environment must be tested and comply with the relevant water quality limits and regulations. Any mine intending to discharge waste or effluent water should also apply for a discharge permit under the Water Resources Management Act 11 of 2013 (Clause 66 and 67).

Parameters that need to be monitored should include (but are not limited to) those in **Table 6-1**. This table can be refined through the focus on contaminants of concern if presently known or as they become identified over time For example, if a potential contaminant is shown to be constantly below effluent limits, then its monitoring can be reduced/excluded in favour of more relevant contaminants. Alternatively, known parameters of concern (such as may be evident given past monitoring or familiarity with pegmatite-hosted tin and lithium deposits) should be added to **Table 6-1** (which is not exhaustive in its list of monitoring parameters).



Legend

- Site Boundary (Uis, ML-133)
- Roads (OSM)
  - Tertiary
  - Track
- Rivers (OSM)
- Possible Surface Water Monitoring Point
- Flow Path (Contributing Area > 5km²)
- Flow Path (Contributing Area > 1km²)
- Flow Path (Contributing Area > 10km²)
- Containing Catchment (COP30 Derived)

Figure 6-1

Possible Surface Water Monitoring Locations

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0 500 1,000 1,500 m

Scale - 1:40,000 @A3	Coordinate Reference System: WGS 84 / UTM zone 33S	Version 1 16-Oct-2024

TABLE 6-2: MONITORING PARAMETERS

Infield measurements		
pH	Electrical conductivity	Total dissolved solids
Laboratory analysis		
Alkalinity as CaCO3	Chromium	Nitrate
Aluminum	Cobalt	pH
Ammonium	Copper	Phosphate
Arsenic	Electrical conductivity	Potassium
Barium	Fluoride	Selenium
Bicarbonate	Iron	Silver
Boron	Lead	Sodium
Cadmium	Lithium	Sulphate
Calcium	Magnesium	Tin
Chloride	Manganese	Total dissolved solids (TDS)
Chrome	Mercury	Zinc
Chrome VI	Nickel	

Where possible, bi-annual surface water monitoring report should be completed and, as a minimum, include the following:

- Comparison of water samples to differentiate seasonal variations and general trends due to the historic mining activities;
- Comparison of water samples to standards and guidelines set by the Namibian Authorities; and
- Analysis of parameters over time so that trends can be established.

7 RECOMMENDATIONS AND CONCLUSION

Hydrologic Consulting were appointed by Environmental Compliance Consultancy (Pty) Ltd (ECC) to undertake a hydrological assessment of the proposed Uis ML 133 Project, Erongo Region, Namibia. The proponent plans to mine pegmatite-hosted tin and lithium deposits on ML 133.

Baseline information including rainfall, evaporation, design event rainfall, soils, vegetation and land-cover, as well as site terrain, flooding and regional and local catchment hydrology have been considered for the proposed mine.

Applicable Guidance

The primary guidance applicable to this assessment is as follows:

- Environmental Management Act, No. 7 of 2007 which provides a framework for conducting environmental assessments as well as the implementation of monitoring and auditing measures.
- Water Resources Management Act, No. 11 of 2013 which includes aspects such as the licencing of water use, prevention of water pollution, protection of water resources, efficient use of water, water conservation measures, and the safety of dams.
- IFC Environmental, Health And Safety Guidelines – Mining (2007) guides the management of surface water with regards to mining including the management of stormwater (and by association the management of flooding).

Flood Modelling

The approach to the assessment of flooding adopted two strategies:

1. The primary Omaruru River is a major watercourse with the potential to route substantial flood waters past the site. A simulation of the flooding on this watercourse was consequently adopted to illustrate the 1:50 year recurrence interval (RI), 1:100 year RI and the regional maximum flood (RMF). The detail within this model was limited and the results of simulated flooding on the Omaruru River should be considered a high-level estimate.
2. For the remaining rivers (or flow paths) on the site, a threshold catchment area was undertaken with three flow path classifications produced. A buffering approach to these defined flow paths was subsequently undertaken to suggest exclusion areas.

The 100m buffer is relevant to defining the riparian zone with a riparian zone defined by the Water Resources Management Act 11 of 2013 as historically, occasionally or seasonally flooded banks and floodplains along both sides of a watercourse. The 1:50,000 topographical map dataset for Namibia includes various watercourses over the site. These watercourses have consequently been understood to qualify as riparian zones. As such, a 100m buffer zone was defined given the applicability of Clause 141 of the Water Resources Management Act 11 of 2013. The result is that most of the site is associated with riparian areas. An exemption to mine on the site is consequently likely required.

Identified Impacts

Flooding and pollutants entering the surface water environment are the two primary impacts whether or not indicated by the impact assessment. Both impacts are poorly represented in the impact assessment due to their probability of occurrence (improbable). In the case of flooding, the primary impact is not from the project but to the project. The flood risk from the Omaruru River is of particular relevance to the proposed operation of the mine.

Surface Water Monitoring

Regular surface water quality monitoring to enable change detection resulting from the potential contamination of surface water by unexpected leaks/spills or operational oversights is a typical recommendation. In the case of the proposed mine, local water resources are ephemeral. It may consequently be challenging to undertake regular surface water monitoring. Monitoring may, however, be possible in some locations during periods of rainfall and monitoring locations were recommended where water may be more common.

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8 REFERENCES

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