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Environmental and Social Impact Assessment for the Proposed Rundu Purification Plant Upgrade, Rundu, Kavango East Region

Scoping Report

Version – Final

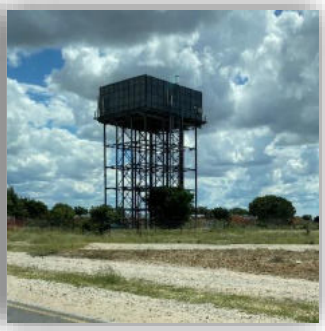
22 September 2022

Namibia Water Corporation Ltd

GCS Project Number: 21-0009

Client Reference: P-NA-E00-005





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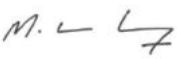
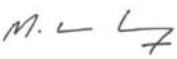
Document Reviewer	Magnus van Rooyen		April 2022
Director	Magnus van Rooyen		April 2022
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NON-TECHNICAL SUMMARY

Rundu is the largest town in the Kavango East Region and is thus also the capital of the region. It is situated on the southern side of the Kavango River (also referred to as the Okavango River) on the border with Angola. Namibia Water Corporation Ltd (NamWater) operates two river water supply schemes, Rundu and Nkarapamwe, to supply the town and a number of surrounding villages. Both schemes abstract raw water from the Kavango River and after treatment and disinfection, potable water is supplied to various consumers, including the Rundu Town Council, the Military Base at the Airport, Government Institutions, Industries, Businesses and Private Consumers. Currently both NamWater schemes have difficulties in coping with the water demand at Rundu Town. The existing schemes are old, and it is running at maximum capacity. As a result, internal NamWater studies suggested the upgrading of the existing Rundu and Nkarapamwe water supply schemes and construction of a new water treatment plant (WTP) at Rundu with an increased capacity of 1 800 m^3/h to eventually meet the ever-growing demand up to 2037. The project will focus on providing the necessary water supply infrastructure (inclusive of a new WTP, water abstraction facilities, reservoirs and conveyance systems) to meet the current and future water demands up to the 2037 horizon for the Rundu town area and a few surrounding villages (Kayengona, Mupini/Sikondo and Masivi).

At present, the total potable water supply capacity of the Rundu and Nkarapamwe schemes is approximately 840 m^3/h. The combined production from the two NamWater schemes have difficulties in coping with the Rundu Town water demand; the reservoirs' levels are at best between 4% and 30%, and that is a concern for a town with a high population growth rate of 5.4% per annum (Martin, Milner, Clarinda, *et al.*, 2018). The population of the area is rapidly increasing and as a result the water demands of the region now significantly exceed the capacity of the existing aging schemes resulting in very low reservoir storage levels and ongoing supply issues. The proposed development is thus needed in order to meet the ever-growing water demand within the town.

The proposed activities will trigger certain activities listed under the EIA Regulations (GN No. 30 of February 2012), and therefore cannot be undertaken without an EIA being undertaken. NamWater (the proponent) has appointed Nicholas O'Dwyer Ltd. ("NOD") in association with GCS Water Environmental Engineering Namibia (Pty) Ltd ("GCS") for the design, tender document preparation, administration and supervision for the construction of the new scheme and decommissioning of the old scheme. GCS will further conduct the Environmental and Social Impact Assessment (ESIA) process for the project.

The main objective of this ESIA is to determine the potential environmental and social impacts emanating from the construction, operation, and decommissioning of the proposed development. The ESIA is required to ensure sound environmental management by NamWater and to meet the international funder standards for environmentally and socially sustainable development, as it is sponsored by the African Development Bank (AfDB). The project must also meet the requirements of the Namibian Environmental Authorities. Relevant environmental and social data have been sourced from primary and secondary sources such as personal observations during site visits, inputs from NamWater officials, inputs from stakeholders and interested and affected parties (I&APs) as well as review of relevant literatures and legal instruments.

This report constitutes the final Scoping Report (FSR), which provides information to enable the Directorate of Water Affairs (DWA) and the Directorate of Environmental Affairs and Forestry (DEAF) to make informed decisions about the project.

The potential impacts that could arise as a result of the proposed project have been identified based on existing sources of information and knowledge of the affected environment. Impacts specifically relating to social aspects, ecology and hydrology will be investigated and analysed in further detail at the ESIA stage. The preliminary list of potential impacts has been used to guide the type of specialist studies required in the ESIA. Mitigation measures have been proposed, however detailed mitigation measures for each impact identified will be outlined in the Environmental and Social Management Plan (ESMP). The following key potential impacts have been preliminarily identified per project phase.

- Pre-Construction - Siting of plant infrastructure, electricity/power availability/sufficiency, traffic flow, climate change and land use.
- Construction - Biodiversity disturbance and loss, surface and groundwater contamination, traffic, soil erosion, archaeological, health and safety, dust, noise, waste generation and disposal, temporary employment creation, disturbance of local residents and interruption of business activities.
- Operation - Soil, surface and groundwater, noise, health and safety, hazardous substance handling and storage, increased water supply, increased energy usage and waste.
- Decommissioning - Noise and dust, health and safety risks, soil, surface and groundwater impacts and waste generation.

The Draft Scoping Report (DSR) was made available to the public and stakeholders for a 14-day comment period. No comments were received on the DSR during the comment period.

The Final Scoping Report is herewith submitted to the Ministry of Environment, Forestry and Tourism: Department of Environmental Affairs and Forestry (MEFT: DEAF) for consideration and decision-making, before commencing with the ESIA phase.

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ABBREVIATIONS AND ACRONYMS	
AfDB	African Development Bank
AWWA	American Water Works Association
BID	Background Information Document
CBD	Convention on Biological Diversity
$C0_2$	Carbon Dioxide
CRR	Comments and Response Report
DAF	Dissolved Air Flotation
EAP	Environmental Assessment Practitioner
ECC	Environmental Clearance Certificate
ESA	Environmental and Social Assessment
ESIA	Environmental and Social Impact Assessment
EIA	Environmental Impact Assessment
EMA	Environmental Management Act (No 7 of 2007)
EMP	Environmental Management Plan
ESAP	Environmental and Social Assessment Procedures
ESMP	Environmental and Social Management Plan
GCS	GCS Water Environmental Engineering Namibia (Pty) Ltd
GRM	Grievance Redress Mechanism
Ha	Hectares
HCL	Hydrochloric Acid
I&AP	Interested and Affected Parties
IUCN	International Union for Conservation of Nature
$KmnO_4$	Potassium Permanganate
LFPR	Labour Force Participation Rate
km	Kilometers
kW	Kilowatt

ABBREVIATIONS AND ACRONYMS	
m	Meters
m^3	Cubic meters
M^3/d	Cubic meter per day
m^3/h	Cubic meter per hour
mm	Millimeters
masl	Meters Above Sea Level
mg/l	Milligrams per liter
MAWLR	Ministry of Agriculture, Water and Land Reform
MCL	Maximum Contaminant Level
MEFT: DEAF	Ministry of Environment, Forestry and Tourism: Department of Environmental Affairs and Forestry
Na_2CO_3	Soda Ash
NaOH	Caustic Soda
NamWater	Namibia Water Corporation
NOD	Nicholas O'Dwyer Ltd
NORED	NORED Electricity (Pty) Ltd
NTU	Nephelometric Turbidity Unit
PPP	Public Participation Process
OKACOM	Okavango River Basin Water Commission
OS	Operational Standards
SADC	Southern African Development Community
SR	Scoping Report
THM	Trihalomethanes
TWL	Top Water Level
UNFCCC	United Nations Framework Convention on Climate Change
UNCCD	United Nations Convention to Combat Desertification
WTP	Water Treatment Plant

ABBREVIATIONS AND ACRONYMS	
WTW	Water Treatment Works

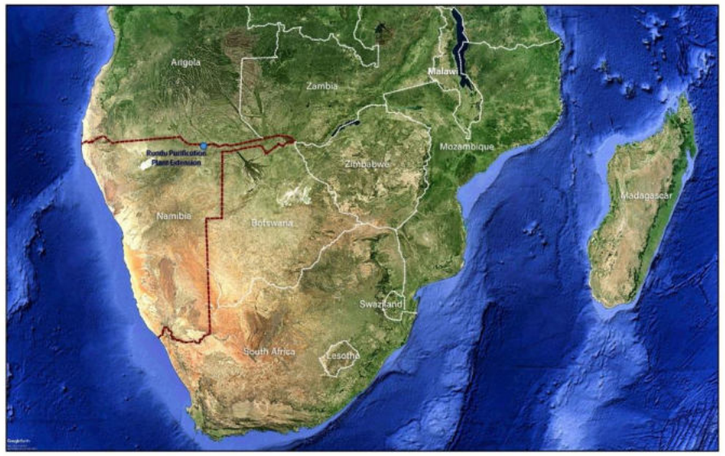
1 INTRODUCTION

Rundu is the largest town in the Kavango East Region and is thus also referred to as the capital of the region. It is situated on the southern side of the Kavango River on the border with Angola. Namibia Water Corporation Ltd (NamWater) operates two river water supply schemes, Rundu and Nkarapamwe, to supply the town. Both schemes abstract raw water from the Kavango River and after treatment and disinfection, potable water is supplied to various consumers, including the Rundu Town Council, the Military Base at the Airport, Government Institutions, Industries, Businesses and Private Consumers. The current total average water supply from both schemes is 824 m^3/h. The water demand calculations indicate that a total supply of 1058 m^3/h is required to meet the current demands. Therefore, there is a supply shortfall of approximately 234 m^3/h at present. The existing schemes are old and are running at maximum capacity. The total production output from both schemes has difficulties in coping with the Rundu Town water demand. As a result, internal NamWater studies suggested the upgrading of the existing Rundu and Nkarapamwe water supply schemes and construction of a new water treatment plant (WTP) at Rundu with an increased capacity of 1 800 m^3/h to eventually meet the ever-growing demand up to 2037.

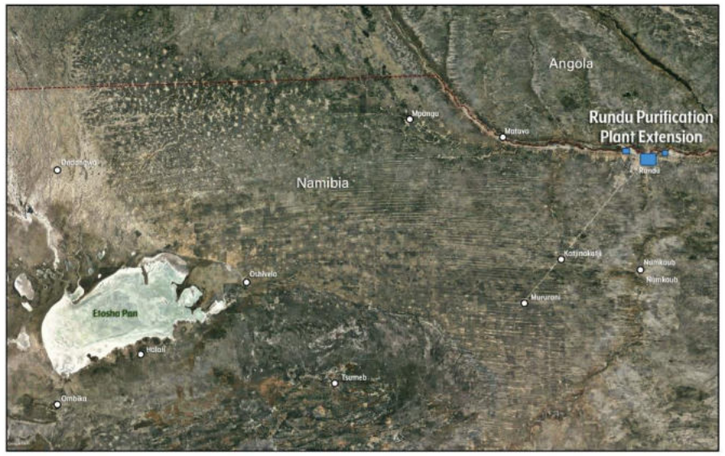
NamWater (the proponent) has appointed Nicholas O'Dwyer Ltd. ("NOD") in association with GCS Water Environmental Engineering Namibia (Pty) Ltd ("GCS") for the design, tender document preparation, administration and supervision for the construction of the new scheme and decommissioning of the old scheme. GCS will further conduct the Environmental and Social Impact Assessment (ESIA) process for the project. The ESIA is required to ensure sound environmental management by NamWater and to meet the international funder standards for environmentally and socially sustainable development, as it is sponsored by the African Development Bank (AfDB). The project must also meet the legal requirements of the Namibian Environmental Authorities.

2 PROJECT DESCRIPTION

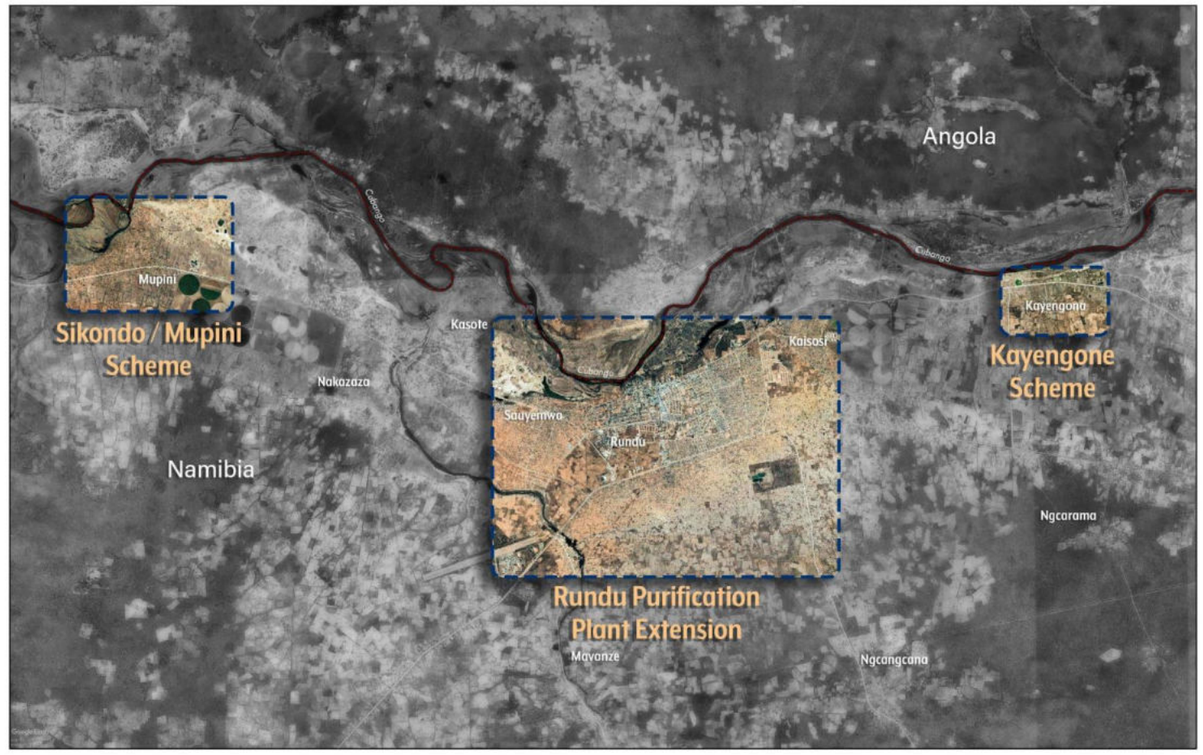
The Proponent proposes to upgrade the existing water supply schemes at Rundu and Nkarapamwe (inclusive of construction of a new WTP at Rundu with a capacity of 1 800 m^3/h, upgrading of water abstraction, reservoirs and conveyance systems) and the decommissioning of associated redundant infrastructure at Rundu and Nkarapamwe. The locality and overview of the existing schemes and proposed infrastructure can be seen on **Figure 2-1** to **Figure 2-4**.



1 Area Location Map
N.T.S.



2 Area Location Map - Site Location
N.T.S.



3 Area Location Map - Scheme
N.T.S.

NOTES

1. ALL DIMENSIONS ARE IN METRES (M) UNLESS NOTED OTHERWISE.

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CLIENT: NAMWATER Namibia Water Corporation Ltd

PROJECT: RUNDU PURIFICATION PLANT EXTENSION

TITLE: AREA LOCATION MAPS

SCALES @ A1	DRAWN	CHECKED	APPROVED
N.T.S.	M. Cheevers	P. Chetty	N. Bhojaram
	DATE 10.02.2022	DATE 14.02.2022	DATE 14.02.2022

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Figure 2-1: Locality of the existing Rundu Purification Plant

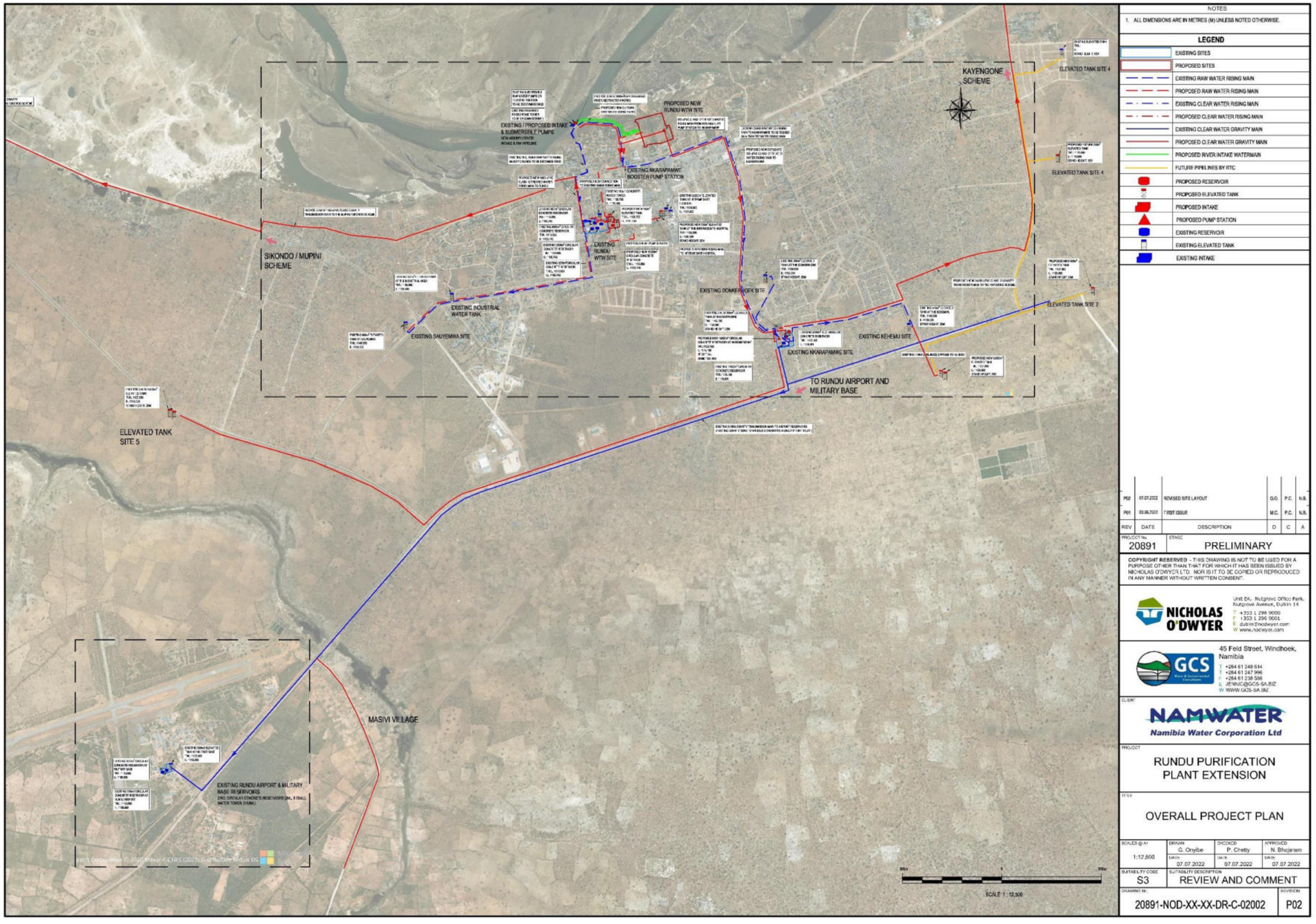


Figure 2-2: Overview of existing Rundu water supply network inclusive of proposed upgrades

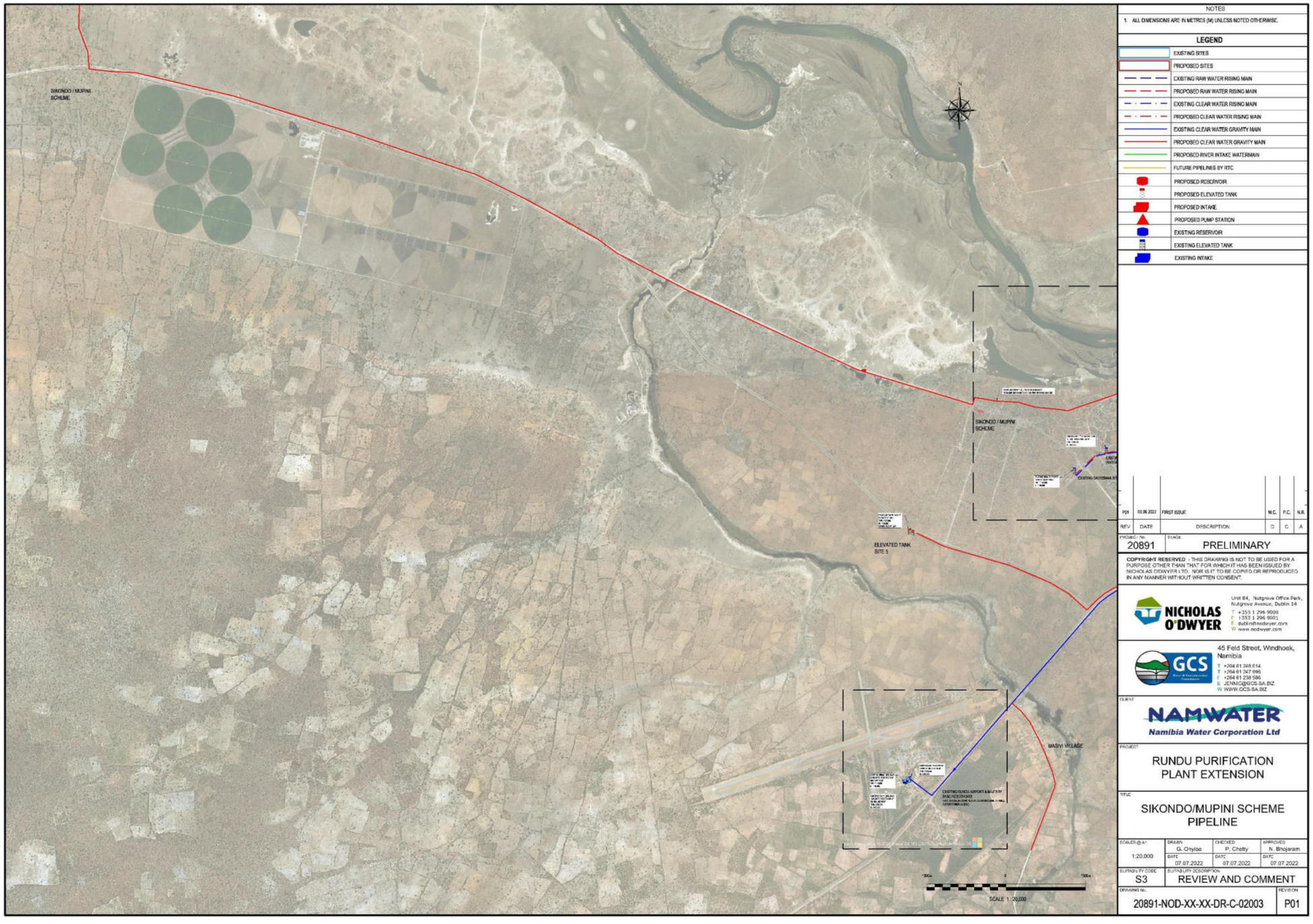


Figure 2-3: Sikondo/Mupini Scheme Pipeline

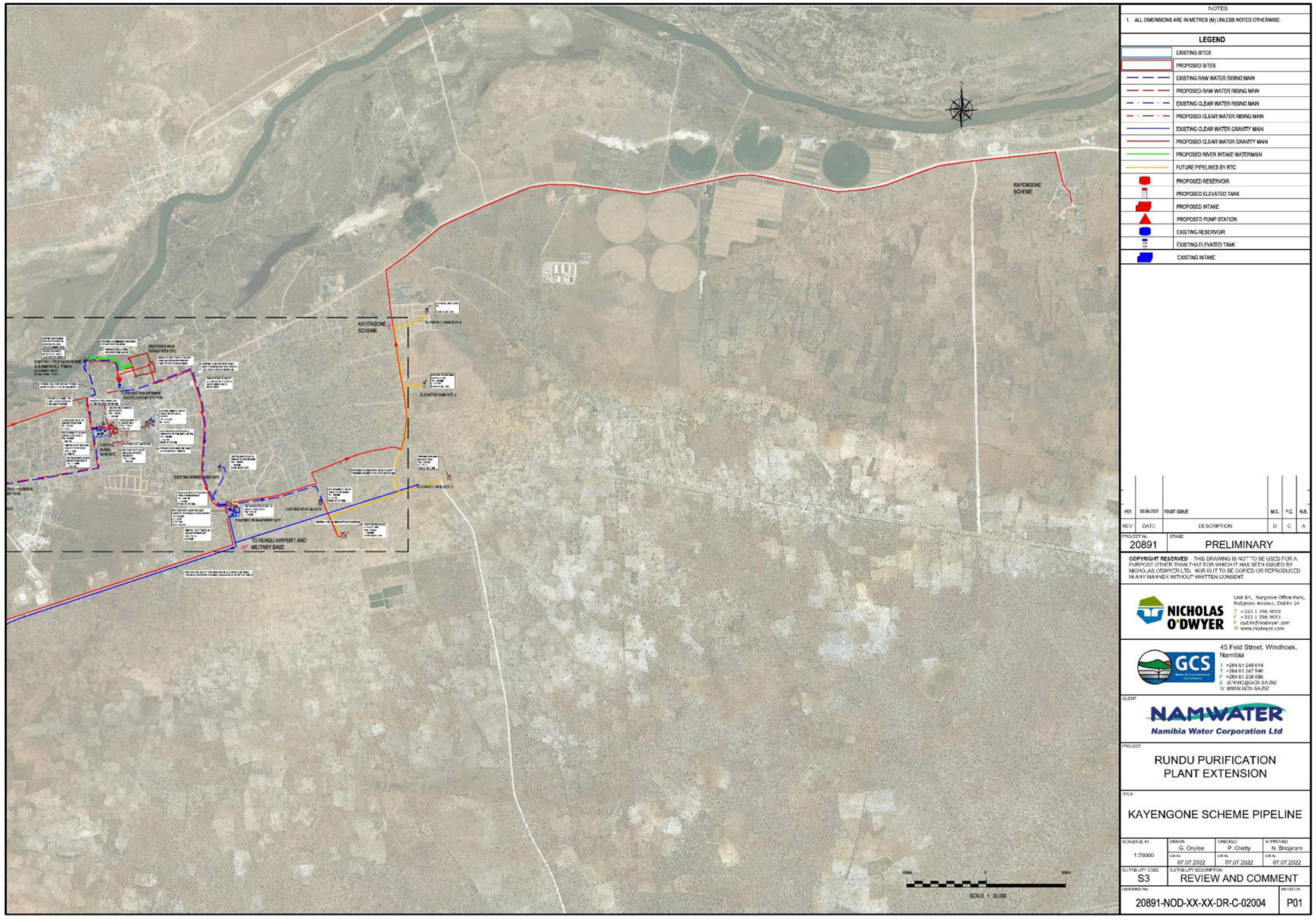


Figure 2-4: Kayengona Scheme Pipeline

The coordinates of the existing and proposed infrastructure are outlined in **Table 2-1** below.

Table 2-1: Coordinates of existing and proposed infrastructure

Infrastructure	Latitude	Longitude
Existing River Intake	-17.909285	19.761674
Proposed River Intake	-17.909144	19.762107
Rundu		
Proposed Rundu WTW	-17.909910	19.768728
Existing Nkarapamwe Booster Pump Station	-17.912553	19.766458
Existing circular 900m^3 concrete Reservoir at Rundu site	-17.917057	19.763379
Existing circular 6000m^3 concrete at Rundu site	-17.917169	19.763894
Existing circular 2500m^3 concrete at Rundu site	-17.917547	19.763369
Existing circular 2270m^3 concrete at Rundu site	-17.917516	19.763648
Proposed circular 16000m^3 concrete at Rundu site	-17.917396	19.765073
Intermediate Hospital		
Existing Elevated Tank Intermediate Hospital	-17.916044	19.768971
Proposed Elevated Tank Intermediate Hospital	-17.916092	19.769053
Donkerhoek		
Existing Elevated Tank Donkerhoek	-17.921568	19.777786
Nkarapamwe		
Proposed new Elevated Tank Nkarapamwe	-17.926215	19.779753
Proposed new circular 16000m^3 concrete reservoir at Nkarapamwe	-17.926772	19.779701
Existing circular 9000m^3 rectangular reservoir at Nkarapamwe	-17.926777	19.779111
Existing circular 12000m^3 concrete reservoir at Nkarapamwe	-17.926143	19.778925
Industrial Area		
Existing Elevated Tank Industrial Area	-17.923172	19.751547
Sauyemwa		
Existing Elevated Tank Sauyemwa	-17.925485	19.747619
Kehemu		
Existing Elevated Tank Kehemu	-17.925692	19.789511
Military Base		
Existing Elevated Tank Military Base	-17.960249	19.728140
Existing circular 200m^3 concrete Reservoir Military Base	-17.960060	19.727754
Existing circular 750m^3 concrete Reservoir Military Base	-17.960488	19.727308

Infrastructure	Latitude	Longitude
New Elevated Tanks		
Proposed new elevated tank at site no. 1	-17.929417	19.792279
Proposed new elevated tanks at site no. 5	-17.928295	19.722855
Villages		
Kayengona	-17.892193	19.878565
Mupini/Sikondo	-17.872411	19.630409
Masivi	-17.976028	19.713845

2.1.1 Overview of the existing water supply scheme

The Nkarapamwe Scheme currently comprises of submersible pumps on floating pontoons in the Kavango River that supplies raw water to sand pressure filters at the Nkarapamwe plant through an intermediate booster pump station. After treatment, the clear water is then stored in two ground level concrete reservoirs (i.e., a 9,000m^3 rectangular reservoir and a 12,000m^3 circular reservoir). A pump station at the Nkarapamwe plant transmits water to the Donkerhoek elevated tanks, Kehemu elevated tanks and pumps into the distribution network; while a gravity main feeds two ground level reservoirs at the Rundu Airport/Military Camp which is then pumped into the Military elevated tanks by a local booster pump station.

The Rundu Scheme currently comprises of a raw water abstraction tower (**Figure 2-5**) that supplies raw water to sand pressure filters at the Rundu plant. The clear water is stored in four ground level circular concrete reservoirs (i.e., 6000m^3, 2500m^3, 2250m^3 and 750m^3). A pump station at the Rundu site transmits the clear water to an elevated concrete tower and elevated tanks at the Industrial Area. A local booster pump station at the industrial tower supplies water to the Sauyemwa elevated tanks.

Figure 2-5: Rundu Abstraction Tower

2.1.2 Overview of the proposed development

The project will focus on providing the necessary water supply infrastructure to meet the current and future water demands up to the 2037 horizon for the Rundu town area and a few surrounding villages (Kayengona, Mupini/Sikondo and Masivi). The proposed new infrastructure will consist of the following:

- **Component 1: The Raw Water Abstraction and Conveyance System** - A new river intake structure on the Kavango River, immediately downstream of the existing intake tower, including new raw water pipelines to the new water purification plant.
- **Component 2: The New Rundu Treatment Plant** - A new water purification plant with sufficient capacity for the 2037 horizon and allowances made for future potential expansion beyond this.
- **Component 3: The Rundu Treatment Plant Product Water Conveyance System** - A new treated water pump station and pipelines to convey treated water from the new water purification plant to the existing Rundu and Nkarapamwe ground level reservoirs.
- **Component 4: Existing Water Supply Schemes** - New pump stations and additional ground level reservoirs at Rundu and Nkarapamwe for storage. New dedicated pipelines to the elevated storage tanks as well as additional new elevated storage tanks within the Rundu town area. In addition, new pipelines supplying potable water to Kayengona, Mupini/Sikondo and Masivi.
- **Component 5: Decommissioning of Redundant Infrastructure** – Decommissioning of any redundant infrastructure.

Each component outlined above is described in more detail below.

2.1.2.1 Component 1: The Raw Water Abstraction and Conveyance System

The current available total raw water abstraction capacity is approximately 715 m^3/h between the existing Kavango River Abstraction Tower Pumps and Submersible River Pumps on Pontoons. The raw water conveyance includes 2 200mm diameter pipelines to Rundu and a 355mm diameter pipeline to Nkarapamwe passing through an intermediate booster pump station. Since the raw water abstraction and conveyance system requires a 2037 capacity of 2000 m^3/h with an ultimate capacity of 4000m^3/h, the existing system is not adequate. Furthermore, the system is unable to cope with the current demand of 1,176 m^3/h.

The new raw water conveyance system will consist of the abstraction pumping system, to abstract the water from the river, and the raw water pipeline to convey the raw water to the new treatment plant in Rundu. The new treatment plant raw water requirement is 2000 m^3/h, which includes 10% treatment plant losses (for 20 hours plant operation), and the raw water conveyance system will be designed to cater for 4000 m^3/h, to accommodate any future expansions. The new plant capacity is 1800 m^3/h.

The alternatives considered in terms of the water abstraction works location and design are discussed in Chapter 6.

2.1.2.2 Component 2: The New Rundu Treatment Plant

The current available total water treatment capacity is approximately 558 m^3/h between the existing facilities at Rundu and Nkarapamwe, which consist of pressure sand filters and chlorination facilities. The potential to upgrade or expand these facilities to the 2037 capacity of 1800 m^3/h is constrained due to the availability of space at the current sites. A new WTP will thus be constructed.

The plant will be designed to ensure a maximum potable water output of 1800m^3/h. A site has been identified (approximately 6 Hectare in size) to the north of the Rundu Police Station for the construction of the new plant. The land was acquired after negotiation with the Rundu Town Council.

Water Quality

The new Rundu WTP will be designed to ensure that the water quality as well as the quality of the effluent adheres to the specified regulations as per the draft Water Resource Management Act, 2013 (Act No.11 of 2013) and its draft regulations.

Process Design Criteria

The raw water quality was analysed and indicated that there are some parameters which have an impact on process and treatment performance. These parameters include turbidity, colour, iron and hardness. It is thus necessary that the water treatment processes be designed to accomplish the following:

- Turbidity control
- Filtration
- Disinfection and trihalomethanes (THM) control
- Iron removal
- Corrosion and scaling control
- Residuals management

Turbidity Control

Based on NamWater's previous experiences, Ferric Chloride performed poor in removing turbidity, and it has some disadvantages such as handling difficulties and safety issues. On the other hand, alum was noted to perform well but only at high dosage rates. Using only polyelectrolyte as coagulant performed good turbidity removal, based on the tests conducted in January 2015, October 2017 and September 2019. Once settled and filtered turbidity concentrations together with floc size were considered, optimum polyelectrolyte dosage rate was noted between 6 and 8 mg/l.

Using polyelectrolyte as coagulant has also further advantage on metal salts besides its performance that no pH adjustment is needed for effective coagulation / flocculation process. Therefore, it is suggested to use:

- Cationic type polyelectrolytes. The awarded works Contractor shall perform jar tests to select the suitable polyelectrolyte in terms of efficiency and cost.

Selection of the polyelectrolyte will be based on its availability and price. The final decision shall be made after discussion with NamWater.

Filtration

Development of an efficient filter design depends on four interrelated design factors: (1) filter rate control, (2) filtration rate and surface area, (3) filter-media selection, and (4) filter backwash, media support, and underdrain system. The selection criteria for key design factors are briefly summarized below:

Filter Rate Control.

Three practical filter rate control systems could be used at the Rundu WTP. These are:

- effluent-controlled constant-rate or constant-level,
- influent-flow-splitting constant-rate,
- variable declining-rate.

Comparison of the three filter rate control systems led to propose an effluent-controlled constant-rate control for the Rundu WTP. The reasons for this selection are; superior filtrate quality throughout a filter run is expected as the filtration rate is kept constant by gradually reducing the head loss at the controller as the filter becomes clogged, and a longer filter run is expected, because head loss through the underdrain system is kept constant which also minimizes the backwash requirement.

Filtration Rate and Surface Area.

Proper filter media selection, and improved backwashing methods enable to design and operate of full-scale plants with a rate of filtration as high as 24 $m^3/m^2.h$. The American Water Works Association (AWWA) Direct Filtration Subcommittee recommended that the nominal filtration rates for direct filtration should range from 9.6 to 15 $m^3/m^2.h$. However, direct filtration is not expected for this design, so a filtration rate of 8 $m^3/m^2.h$ at normal operation, as also recommended by NamWater, and filtrate rate of 10 $m^3/m^2.h$ at n-2 case (i.e., one filter at backwashing and one filter out of operation for maintenance or other reason) will be used to design the filters. The estimated time between the backwashes is 24 hours for each filter, with an estimated maximum head loss of 2.5 m through the dirty media.

Filter Media Selection.

For both high-rate and conventional filter designs, a medium-grained sand layer overlaid by a coarser, but lighter, anthracite coal layer has been used with success. Anthracite shall support removing of taste, odour (if exist), organic matter and colour from the water with its absorption effect. The effective size, uniformity coefficient, and specific gravity of the sand and anthracite should be specified in such a way that the two media are compatible. An anthracite layer with sufficient depth over a sand layer should be provided for an adequate degree of protection and storage volume to accommodate solids for conventional filtration.

Filter Backwash, Media Support, and Underdrain.

The selected backwash method should be capable of removing a large quantity of solids in a reasonable length of time. Using polyelectrolyte as coagulant, it is possible that the solids removed during filtration will be "sticky" and will have a tendency to adhere to the media, thus increasing the potential for mudball formation. Therefore, it is necessary that auxiliary scour systems, such as surface-wash scour, be provided in the design. The auxiliary surface wash should be used during conventional mode. This arrangement will provide the necessary flexibility for fluidization of a dual-media bed.

The media support and underdrain system will consist of double-reserve graded gravel over a precast underdrain designed for backwash. It is estimated that a backwash rate of 36 to 42 $m^3/m^2.h$ will be required for a minimum of 10 minutes.

Disinfection and THM control

The disinfection process will be closely interrelated with THM control at the WTP. Use of free chlorine as the primary disinfectant in the plant (to meet contact time (CT) requirement), followed by chloramines for residual disinfection in the distribution system, will produce water that will consistently meet the maximum contaminant level (MCL) for the THMs. The general disinfection scheme was also shown to be most cost-effective for disinfection, THM control, and maintenance of desired residual in the distribution system. Multiple chlorine and ammonia feed points should be provided to control undesired slime growth and allow flexibility for meeting CT requirements, lower THM formation potentials, and chlorine demand. The chlorine and ammonia feed points should, therefore, include (1) raw water at the flash mix and (2) at the chlorine contract tank to clear water storage.

Iron removal

The iron in raw water occasionally exceeds the maximum acceptable concentration reaching 0.6 mg/l, although average was 0.18 mg/l which is within the standards. An oxidation process needs to be implemented to precipitate and remove the iron as iron hydroxide from water. Potassium permanganate ($KMnO_4$), chlorine or cascade aeration could be used for this purpose. As explained in sub-section C above, chlorine is expected to be dosed in raw water for pre-disinfection and THM control purpose. However, $KMnO_4$ has additional advantages, besides oxidation of iron, there may be slight reduction in taste and odour causing compounds if any exists in raw water, chlorine demand, and THM formation potential.

Best point of $KMnO_4$ application is in the raw water line at the plant property, prior to flash mixing. It is expected that at 0.5 to 1 mg/l $KMnO_4$ dosage will oxidize and precipitate iron.

Corrosion and scaling control

Production and supply of non-corrosive and non-scaling water is essential for water quality control and to prolong the life of the water distribution system. The Kavango River water is not stable and mildly corrosive. The corrosive effect of water is clearly visible in the 2500 m^3 Rundu Reservoir. Water must be stabilized to minimize its adverse effect by adding either of the following chemicals:

- Carbon Dioxide (CO_2)
- Lime (CaO)
- Soda Ash (Na_2CO_3)

- Caustic Soda (NaOH)
- Hydrochloric Acid (HCl)

Soda ash is easier to handle and safer. It is also available in powder form and readily soluble in water. Therefore, it is proposed to use soda ash to stabilize the water.

Residuals management

There are two major residual sources that must be controlled at the WTP. These include the filter-backwash water from the filters and sludge from the sedimentation basins. Two options are proposed to handle and dewater the sludge, as outlined below.

In Option 1, sludge from sedimentation tanks and dirty water from filter backwashes will be transferred to four identical sludge ponds operated as one duty, one standby, one drying and one redundant. Assuming 10% losses in a 2000 m^3/h raw water inlet and 20 hr/day operation period, each pond shall have net volume of 4000 m^3. Sludge depth shall be set as 0.6 m and gross depth will be 1.0 m, giving a total area of 16,000 m^2 (1.6 ha). The footprint of the ponds will occupy a very large area on the site. Therefore, another approach/option on sludge dewatering is herewith proposed.

In Option 2, backwash water recovery tank is introduced to settle the residuals and deliver the supernatant to the inlet of the coagulation – flocculation units. Settled residuals together with the solids withdrawn from the sedimentation tanks will be thickened in gravity thickeners up to 2 to 2.5% dry solids (DS). Overflow from the thickeners will also be returned to system. Estimated total sludge at 95th percentile case and on 24 h/d operation is approximately 1100 kg/d. Considering 2%DS for thickened sludge at the outlet of gravity thickeners, 55 m^3/d thickened sludge flow rate is anticipated.

Assuming a sludge loading rate of 80 kg DS/m^2 and a total of four ponds with an average of 100 days filling cycle and detention per pond, estimated area for each one, including additional area required for berms and access roads, is approximately 2,000 m^2. Therefore, a total of 8,000 m^2 (0.8 ha) area will be required for sludge drying. In addition, it is expected that, water loss will be in the range of 2% if backwash water recovery tank is implemented.

Process Options

- Iron Removal

There are mainly two process alternatives for iron removal, as listed below:

- Aeration
- Oxidation with chemical addition

Aeration

Aeration oxidizes iron, rendering it insoluble form to precipitate and reduces the concentration of taste and odour if it exists in raw water. The most common used type of aeration process is cascade aeration. Besides its advantages, the major disadvantage is head loss of about 1 to 3 m and energy required to raise water.

Oxidation with Chemical Addition

As explained previously, potassium permanganate (KMnO4) together with chlorine is an effective method to remove iron from water. Furthermore, as stated therein, KMnO4 has the ability to reduce taste and odour causing compounds if any exists in raw water, chlorine demand, and THM formation potential.

- Solid Separation

After coagulation and flocculation, solids either tend to settle or float. Two solid separation processes exist that are sedimentation and flotation. Dissolved Air Flotation (DAF) process is the most known flotation process. It introduces pressurized air and water mixture to create floating media for solids to float. Surface scraper is used to remove the solids. The process is widely used in industrial applications where oily water is the source. The process is sensitive to air pressure and air / water mixture ratio, therefore high-tech process control philosophy is required.

Enhanced sedimentation utilizing laminar flow devices, named “lamella sedimentation tanks” are effective in solid separation for municipal drinking water requirements from an engineering perspective. Therefore, for the Rundu WTP, lamella sedimentation tanks are proposed following coagulation and flocculation processes.

Process Train

Optimum turbidity and to some extent of colour removal can be achieved in flash mixing with polymer aid then followed by flocculation, sedimentation, and filtration. Flash mixing can be either accomplished with pipe contraction i.e., in-line mixing or flash mixing tank. The most cost-effective disinfection and THM control method will involve maintaining free chlorine residual in a chlorine contact tank upstream of the clear water tank, followed by chloramines in the tank and distribution system for desired residuals. When the iron concentration is exceeded periodically, potassium permanganate in the raw water line at the plant property will be used for oxidation and conversion into insoluble forms of ferric hydroxide for removal with turbidity. Filter backwash will have a backwash recovery system.

In the sludge stream, as explained above two options are evaluated. In Option 1, sludge from sedimentation tanks and filter backwash will be transferred to sludge lagoons. In Option 2, filter backwash water recovery tank and gravity thickeners are proposed to thicken the sludge hence reduce the sludge flow and minimize the water loss. Sludge lagoons are designed in line with the design criteria and common operational approach.

In this context, proposed process units including options for iron removal, is listed below:

Water Stream

- Iron Oxidation Options
    - Option 1: Cascade Aeration
    - Option 2: Chemical Oxidation with Potassium permanganate
- Flash Mixing
    - Option 1: Flash Mixing Tank
    - Option 2: Pipe Contraction (in-line mixing)
- Flocculation
- Lamella Sedimentation
- Rapid Granular Filters Dual Media Filters
- Chlorine Contact Tanks
- Clear Water Tank
- High Service Pump Station

Option 2 is recommended for water stream treatment considering lower CAPEX, less head loss and additional advantages of using KMnO4 as mentioned above in Iron Removal.

Sludge Stream

- Option A
    - 4 pieces, each with 4,000 m^3 (i.e., 4,000 m^2 in area) sludge ponds
- Option B
    - Backwash Water Recovery Tank
    - Gravity Thickeners
    - 4 pieces, each with 2,000 m^3 (i.e., 2,000 m^2 in area) sludge ponds

Option B has lower CAPEX, better sludge supernatant control through separating thick sludge from sedimentation and dirty backwash water, almost half of the land required for sludge drying (when considered very small surface area of gravity thickeners) and capability to doubling the entire plant for future capacity. Therefore, for sludge stream Option B is recommended.

<u>Buildings and Auxiliary Structures</u>

- Administration Building

- Chemical Building
- Chlorine Building

The process options can be summarized as presented in **Table 2-2** below.

Table 2-2: Summary of Process Options

Process	Option 1A	Option 1B	Option 2A	Option 2B
Cascade Aeration	✓	✓		
$KMnO_4$ Dosing			✓	✓
Flash Mixing Tank	✓	✓		
In-line Mixing			✓	✓
Flocculation	✓	✓	✓	✓
Lamella Sedimentation	✓	✓	✓	✓
Dual Media Filtration	✓	✓	✓	✓
Chlorine Contact Tank	✓	✓	✓	✓
Clear Water Tank	✓	✓	✓	✓
Backwash Water Recovery Tank		✓		✓
Gravity Thickener		✓		✓
Sludge Pond	✓	✓	✓	✓

All processes used at the treatment plant are interrelated. As a result, a change in process operation in any one process unit may cause a change in other processes. In addition, the performance and optimum process design parameters of all processes are related to the raw water quality. The operational flexibility under variable raw water conditions will be achieved by providing multiple alternative chemical feed points and equipment with the versatility to accommodate variable raw water conditions.

The process layout utilizes two identical process trains arranged in parallel. This essentially gives two plants, each providing half of the total capacity. There are two flash mixing units, four units of flocculation and sedimentation tanks and 6 units of filters. The plant can thus be operated with any single unit out of service. Furthermore, the plant can also be operated at ¼ and ½ capacity, if necessary. Two circular storage reservoirs with a total storage capacity of 4000 m^3 are provided at the plant site. The treated water will be delivered to the distribution system by means of a high pump station to Rundu and Nkarapamwe.

Operation and Maintenance

Personnel

The treatment facility will be operated by trained operators on a 7-days-per-week basis and in 4 shifts (1 shift for managing annual leaves, sick leaves, etc.). Supporting staff, including mechanics and electricians, will be provided on a 24-hour basis. The laboratory facility, the administration building, and equipment maintenance workshops shall be fully staffed in accordance with the requirements of the Water Resources Management Act Regulations (Annexure 4 and 5).

Electrical Power

Estimated total power requirements are 411 kW and 422 kW for Option 1A and 1B respectively, 398 kW and 409 kW for Option 2A and 2B. The before mentioned power requirement is only for the water treatment works. An additional power requirement of approximately 600kVA is required for the high-lift pump stations and 150kVA for the administration building. Provision for future standby power will be provided to enable the placement of diesel standby generation sets to be placed at the required positions. Please note that no diesel standby generator sets are planned to be placed at the facilities.

Flood Hazard

The entire areas of the proposed raw water pumping station and WTP are well above the 1:100-year flood level which is 1068.50 meters above sea level (masl). Both sites are fully accessible under all weather conditions.

Control Systems

The supervisory control and data acquisition (SCADA) system shall be a fully automated control system to collect key, on-line quality parameters of raw and treated water and flow records of raw, filter feed, treated water, plant internal water use, and sludge lines. The operation of all pumps connected to SCADA system can be able to be selected from the computer in the Main Control Room.

The system implemented shall be able to operate within the control strategy described but shall be flexible enough to be easily changed should the control philosophy change.

2.1.2.3 Component 3: The Rundu Treatment Plant Product Water Conveyance System

The product water conveyance system comprises of a new pump station at the new treatment plant with two groups of pump sets (each group shall incorporate at least three pump sets, of which at least one shall be a stand-by unit) to pump into the existing and proposed storage reservoirs at Rundu and Nkarapamwe. A new rising main is proposed for Rundu and a duplicate main to operate in parallel with the existing main is proposed for Nkarapamwe.

2.1.2.4 Component 4: Existing Water Supply Schemes of Rundu and Nkarapamwe

Rundu Water Supply Scheme

A new pump station is proposed for Rundu with two groups of pump sets, one pumping simultaneously into the existing and proposed elevated tanks at the Rundu site and the hospital and other group to pump into the existing Industrial and Sauyemwa elevated tanks. The elevated tanks will be fed via proposed new dedicated transmission mains. It is also proposed to construct an additional 16 000 m^3 reservoir at Rundu plus 2x 500 m^3 elevated tanks, one at Rundu and one at the hospital. The Sikondo/Mupini area could be supplied under gravity from the Rundu elevated tank.

Nkarapamwe Water Supply Scheme

A new pump station is proposed for Nkarapamwe with three groups of pump sets, one pumping into the proposed elevated tank at the Nkarapamwe site, one group pumping to the proposed tank at Site No. 5 and the other group to pump simultaneously to the elevated tanks at Donkerhoek and Kehemu and proposed elevated tank at Site No. 1. The elevated tanks will be fed via proposed new dedicated transmission mains. It is also proposed to construct an additional 16 000 m^3 reservoir at Nkarapamwe plus 5x 500 m^3 elevated tanks, one at Nkarapamwe, two at Site No. 1 and two at Site No. 5. Kayengona will be supplied from Nkarapamwe elevated tank via a new gravity pipeline.

Masivi Village Scheme

Masivi is an informal settlement along the main road B8. This area is not within the Rundu Town Council supply and its demand has been taken into account in the water demand projections for the scheme. There is currently a 90mm diameter pipeline supplying this area which will be retained.

Kayengona Scheme

The Kayengona scheme is presently a borehole supply scheme. The scheme is operated by NamWater and it has been reported that water quality and availability of water is problematic. The water is pumped to elevated storage tanks (10x10 m^3 tanks) on a support stand about 15.8 m high. It is estimated that the Top Water Level (TWL) of these tanks is about 1090 Meters Above Sea Level (masl). The water demand as reported by NamWater for this area is 30 m^3/hr.

Water could be made available from the proposed new Rundu WTP for the Kayengona area. However, the clear water reservoir level at the water purification works is somewhat lower than the top water level of the existing reservoirs at Kayengona and will require pumps to transfer water to the Kayengona area.

Under the Nkarapamwe scheme the eastern area can be served by the proposed new elevated tank at Nkarapamwe. These elevated tanks will be at a level which could allow a gravity flow from these elevated tanks at Nkarapamwe to the elevated tanks at Kayengona. A new gravity pipeline, 250 mm in diameter and 14 km long will be required along a route which avoids high points.

Sikondo/Mupini Scheme

The Mupini/Sikondo scheme is presently a borehole supply scheme. The scheme is operated by NamWater. The water is pumped to elevated storage tanks on a support stand. The water demand as reported by NamWater for this area is 17 m^3/hr.

Water could be made available from the proposed new Rundu WTP for the Mupini/Sikondo area. However, as with the Kayengona scheme, the clear water reservoir level at the water purification works is somewhat lower than the TWL of the existing elevated tank at Mupini/Sikondo. Pumps will be required to transfer water to the Mupini/Sikondo area.

Under the Rundu scheme the western area can be served by the elevated tanks at Rundu. This elevated tank will be at a level which could allow a gravity flow to the elevated tank at Mupini/Sikondo. A new gravity pipeline, 110 mm in diameter and approximately 14 km long will be required along a route which avoids high points. Whilst this proposal is also a pumped supply scheme to Mupini/Sikondo via the Rundu Purification Works Pump station to Rundu and beyond via the Rundu pumps to Rundu Elevated Tower, it has the advantage of merely upsizing proposed pumping plant which is in any event required for the Sauyemwa and Industrial areas, instead of building an additional pump station.

2.1.2.5 Component 5: Decommissioning of redundant infrastructure

Once the new abstraction and treatment plant with all relevant infrastructure are commissioned, the redundant equipment will be derecognised in accordance with applicable asset derecognition procedure in NamWater and in the end must be de-commissioned and removed.

While some of the equipment will not be re-usable there might be some pumps and motors that NamWater can re-use at other sites and this equipment will thus be transferred to NamWater in Windhoek in accordance with the applicable asset derecognition and transfer procedure.

The decommissioning activities should be conducted in a manner that prevents the pollution of surface or groundwater, air or land as per the Pollution Control and Waste Management Bill and Public and Environmental Health Act, 2015. The main activities during decommissioning will consist of the following:

- Removal of all infrastructure no longer required, from the site.

- Disposal, recycling, relocation, or selling of infrastructure.
- Removal of scrap metal to be recycled.
- Containerize chemical waste which is to be disposed as per the Material Safety Data Sheet (MSDS).
- Collect all windblown litter and debris from the site, the access roads, and from adjacent properties where necessary and to the extent possible.

2.1.3 Land Acquisitions and Wayleaves

A site approximately 6.16 ha in size is in the process of being acquired by NamWater from the Rundu Town Council for the proposed new Rundu WTP i.e., adjacent north of the Rundu Police Station.

It is envisaged that all proposed pipelines will be constructed within municipal road reserves. Wayleaves will be obtained for new pipelines in road reserves once the routes have been confirmed.

The remote elevated tanks proposed at Nkarapamwe and the Intermediate hospital will be constructed on NamWater owned sites. Whereas the additional x7 proposed elevated tanks will be constructed on sites owned by the Rundu Town Council which are zoned for Public Open Space purposes.

For the additional ground level storage required at Rundu and Nkarapamwe, the existing sites at both these locations are not adequate for the proposed new reservoir, elevated tank and pump stations.

NamWater is pursuing the acquisition of privately owned Erf 1200, which is located adjacent to the existing Rundu Water Treatment Works (WTW) site, for the new proposed ground level reservoir, pump station and elevated storage tank at the Rundu site. The land acquisition process is currently has not been finalised yet.

For the Nkarapamwe WTW site, all new infrastructure will be constructed on land owned by NamWater. The existing Nkarapamwe site at present accommodates unoccupied dwellings which will be demolished to accommodate the proposed new works.

2.1.4 Water Abstraction Rights

The Okavango River is a shared water course for the three adjoining countries namely Namibia, Botswana, and Angola. The river starts in Angola, then acts as a border between Angola and Namibia, crosses Namibia and finally enters Botswana. As this river is shared between the countries, therefore all aforementioned countries have a right to abstract from it.

In September 1994 an agreement was signed by the three countries to establish a Permanent Okavango River Basin Water Commission (OKACOM) with its primary focus on the sustainable long-term yield of water from all the potential sources within the Okavango River Basin. All signatories to the agreement are obliged to inform the commission about proposed utilization changes.

NamWater currently has a water abstraction permit in place which is valid until July 2022. NamWater is in the process of engaging the Commission with regards to the key elements of the proposed project as well as with regards to the renewal of their water abstraction permit.

2.2 Project Need and Desirability

At present, the total potable water supply capacity of the Rundu and Nkarapamwe schemes is approximately 840 m^3/h. Total production from both schemes have difficulties in coping with the Rundu Town water demand ; the reservoirs' levels are at best between 4% and 30%, and that is a concern for a town with a high population growth rate of 5.4% per annum (Martin *et al.*, 2018). The population of the area is rapidly increasing and as a result the water demands of the region now significantly exceed the capacity of the existing aging schemes resulting in very low reservoir storage levels and ongoing supply issues. The proposed development is thus needed in order to meet the ever-growing water demand within the town.

2.3 Project Design

The project involves the design of the required water supply infrastructure (inclusive of a new WTP, water abstraction, reservoirs and conveyance systems). The project is currently in the preliminary design stage, after which the detailed designs will be formulated for approval by NamWater.

2.4 Construction Phase

2.4.1 Construction schedule

Construction is expected to take 21 months. Work will not necessarily be undertaken in a linear sequence as most of the activities can happen concurrently and in parallel, depending on the phasing of construction.

2.4.2 Pre-construction activities

The following activities will take place prior to construction once the necessary environmental authorisation, permits and/or licenses are in place:

- Wayleave applications where required;
- Land Acquisition processes (as required);
- Final design of plant and associated infrastructure.

2.4.3 Construction workforce

A mixture of unskilled temporary employees, semi-skilled and highly skilled employees will be required for construction. The unskilled labourers are generally trained by the contractors and sourced from local communities. All staff will be accommodated in rented accommodation in Rundu. The project is to adhere to the AfDB's Operational Standard (OS) No 5 with regards to labour conditions and health and safety.

2.4.4 Construction camps and laydown areas

Construction site camps and laydown areas are to be sited in areas that are mostly disturbed i.e. lowest natural vegetation cover. Sensitive areas such as drainage lines should be avoided.

2.5 Operation and Maintenance Phase

The operational phase refers to the operation of the proposed new treatment plant and associated infrastructure of the various water supply schemes.

2.6 Decommissioning Phase

2.6.1 Decommissioning of existing infrastructure components

The proposed project involves the decommissioning of redundant infrastructure. While some of the equipment will not be re-usable there might be some pumps and motors that NamWater can re-use at other sites and this equipment will thus be transferred to NamWater in Windhoek in accordance with the applicable asset derecognition and transfer procedure. At this stage it is envisaged that the following infrastructure will be decommissioned:

- Raw water abstraction system on completion of the new river intake.
- Raw water rising main from the current intake tower to Rundu.
- Filters at Rundu and Nkarapamwe on completion of the new WTP.
- Pump stations at Rundu and Nkarapamwe on completion of the new pump stations.
- Other infrastructure to be identified as designs progress.

The decommissioning stage will thus consist of the following:

- Dismantling and removal of infrastructure;
- Rehabilitation of disturbed areas;
- Transport and disposal of material off-site; and
- Monitoring (site surveys) may be required after rehabilitation has been completed. The aim of monitoring and maintenance is to ensure that the rehabilitation objectives were met and that the rehabilitation process was successful.

2.6.2 Decommissioning of the proposed new water supply schemes, WTP and associated infrastructure

Additionally, the decommissioning phase refers to if/when the newly constructed infrastructure is decommissioned. Should this infrastructure be decommissioned in future, appropriate investigations and approvals need to be undertaken and obtained in line with the legislative framework at the time and mitigation measures need to be implemented to ensure environmentally friendly disposal of the infrastructure and effective rehabilitation of the affected areas. An EIA for the decommissioning process would have to be undertaken by the proponent. The EMP for the WTP will have to be reviewed at the time of decommissioning to cater for changes made to the site and implement guidelines and mitigation measures.

3 LEGISLATIVE FRAMEWORK

A review of applicable and relevant national and international legislation, policies and guidelines to the proposed development are given in this chapter. This review serves to inform the Proponent (NamWater), Interested and Affected Parties and the decision makers at the DEAF of the requirements and expectations, as laid out in terms of these instruments, to be fulfilled in order to undertake the proposed activities.

3.1 National Legislation, Policies, Guidelines, Plans and Strategies

3.1.1 The Environmental Management Act No. 7 of 2007

This scoping assessment was carried out according to the Environmental Management Act (EMA) and its Environmental Impact Assessment (EIA) Regulations (GG No. 4878 GN No. 30). The EMA has stipulated requirements to complete the required documentation in order to obtain an Environmental Clearance Certificate (ECC) for permission to undertake certain listed activities. Under the Environmental Management Act (2007) and its Regulations (2012), an Environmental Impact Assessment (EIA) is required for:

> ***8.1 The abstraction of ground or surface water for industrial or commercial purposes.***
>
> ***8.3 Any water abstraction from a river that forms an international boundary.***
>
> ***8.5 Construction of dams, reservoirs, levees and weirs.***
>
> ***10.1 The construction of (a) oil, water, gas and petrochemical and other bulk supply pipelines.***

3.1.2 The Water Resources Management Act (No. 11 of 2013)

The Act provides for the management, development, protection, conservation and use of water resources, and established various regulatory and advisory institutions. Relevant principles of the Act include, inter alia:

- Equitable access for all people to safe drinking water is an essential basic human right to support a healthy productive life;
- Harmonisation of human water needs with the requirements of environmental ecosystems and the species that depend on them, while recognising that the water resource quality for those ecosystems must be maintained;
- Promotion of the sustainable development of water resources based on an integrated water resources management plan which incorporates social, technical, economic, and environmental issues;
- Development of the most cost-effective solutions, including conservation measures, to infrastructure for the provision of water; and

- Promotion of water awareness and the participation of persons having interest in the decision-making process should form an integral part of any water resource development initiative.

Furthermore, any watercourse on/or in close proximity to the site and associated ecosystems should be protected in alignment with the principles above. Impacts on water resources should be avoided. Mitigation measures must be included in the EMP to reduce impacts on watercourses that cannot be avoided. If required, the relevant permits must be applied for.

It should be noted that the act has not been promulgated yet. However, the Department of Water Affairs does apply the water quality standards as outlined in the draft Regulations and as such the development is to comply with these standards.

The full list of all applicable national legislation identified and conducted during the EIA process are presented in **Table 3-1** below.

Table 3-1: Applicable national legislation

Legislation/Policy/ Guideline	Relevant Provisions	Implications for this project
Environmental Management Act (EMA) No. 7 of 2007	Requires that projects with significant environmental impacts are subject to an environmental assessment process (Section 27). Details principles which are to guide all EAs.	The EMA and its regulations should inform and guide this EIA process.
Environmental Impact Assessment (EIA) Regulations GN 28-30 (GG 4878)	Details requirements for public consultation within a given environmental assessment process (GN 30 S21). Details the requirements for what should be included in a Scoping Report (GN 30 S8) and an Assessment Report (GN 30 S15).	
The Constitution of Namibia Act No. 1 of 1990	According to Legal Assistance Centre (LAC), there is no clear right to health in the Namibian Constitution. But under the Article 95 of the Namibian Constitution that deals with Principles of State Policy, the Namibian Constitution states, "the state shall enact legislation to ensure consistent planning to raise and maintain an acceptable standard of living for the country's people" and to improve public health.	The Proponent should ensure compliance with the conditions set in the Act.
Water Act No. 54 of 1956	The Water Resources Management Act 11 of 2013 is not yet promulgated; therefore, the Water Act No 54 of 1956 is still in force:	The protection of ground and surface water resources should be a priority during the proposed activities.

Legislation/Policy/ Guideline	Relevant Provisions	Implications for this project
	• Prohibits the pollution of water and implements the principle that a person disposing of effluent or waste has a duly of care to prevent pollution (S3 (k)). • Provides for control and protection of groundwater (S66 (1), (d (ii)). Liability of clean-up costs after closure/abandonment of an activity (S3 (l)). The Guidelines for the Evaluation of drinking-water quality for human consumption with regards to chemical, physical, and bacteriological quality requires that; water supplied for human consumption must comply with the officially approved guidelines for drinking-water quality. For practical reasons, the approved guidelines have been divided into three basic groups of determinants, namely: • Determinants with aesthetic implications: TABLE 1. • Inorganic determinants: TABLE 2. • Bacteriological determinants: TABLE 3. The water quality for human consumption is classified into three groups. The concentration of and limits for the aesthetic, physical and inorganic determinants define the group into which water will be classified.	The treatment plant is to adhere to the standards for water quality for human consumption as per the act.

Legislation/Policy/ Guideline	Relevant Provisions	Implications for this project
	• Group A: Water with an excellent quality • Group B: Water with acceptable quality • Group C: Water with low health risk • Group D: Water with a high health risk, or water unsuitable for human consumption	
Water Resources Management Act No.11 of 2013	The act provides for the management, protection, development, use and conservation of water resources; and provides for the regulation and monitoring of water services and to provide for incidental matters. The objects of this Act are to: Ensure that the water resources of Namibia are managed, developed, used, conserved and protected in a manner consistent with, or conducive to, the fundamental principles set out in Section 66 - protection of aquifers, Subsection 1 (d) (iii) provide for preventing the contamination of the aquifer and water pollution control (Section 68). The draft Regulations of the Act outline the water quality guidelines and standards for potable water and effluent disposal	
Namibia Water Corporation Act 12 of 1997	To establish the Namibia Water Corporation Limited; to regulate its powers, duties, and functions; to provide for a more efficient use and control of water resources; and to provide for incidental matters.	The Proponent is to carry out their functions as per the Act.

Legislation/Policy/ Guideline	Relevant Provisions	Implications for this project
	Without prejudice to the generality of section 5, the Corporation shall perform the following functions in pursuit of its objects under this Act, namely – (a) Explore, develop, and manage water resources for the purpose of water supply. (b) Acquire, plan, design, construct, extend, alter, maintain, repair, operate, control, and dispose of waterworks. (c) Subject to section 7 and notwithstanding any provisions of the Water Act to the contrary, supply water to customers within and outside the borders of the Republic of Namibia. (d) Investigate, research and study matters relating to water resources, waterworks, and the environment. (e) Take such action as the Corporation may consider necessary or as the Minister may direct, for the purposes of conserving or augmenting water resources in Namibia. (f) Render services, provide facilities, and lease rights, subject to the payment of relevant charges. (g) establish training facilities and train personnel; and (h) Perform any other function as may be necessary or expedient for the achievement of the Corporation's objects.	
Soil Conservation Act No. 76 of 1969	The Act makes provision for the prevention and control of soil erosion and the protection, improvement and conservation of soil, vegetation and water supply sources and resources, through directives declared by the Minister.	Duty of care must be applied to soil conservation and management measures must be included in the ESMP.

Legislation/Policy/ Guideline	Relevant Provisions	Implications for this project
Nature Conservation Ordinance No.4 of 1975	To consolidate and amend the laws relating to the conservation of nature; the establishment of game parks and nature reserves; the control of problem animals; and to provide for matters incidental thereto.	The Proponent should ensure that their activities do not in any way compromise the wildlife in the area of operations and the ordinance requirements are adhered to.
Forestry Act No. 12 of 2001	The Act provides for the management and use of forests and related products / resources. It offers protection to any living tree, bush or shrub growing within 100 metres of a river, stream or watercourse on land that is not a surveyed erven of a local authority area. In such instances, a licence would be required to cut and remove any such vegetation. These provisions are only guidelines.	Should there be a need to remove vegetation on site, a permit to remove protected species will need to be obtained from the Forestry office in Rundu.
Atmospheric Pollution Prevention Ordinance No. 11 of 1976	This ordinance provides for the prevention of air pollution.	Measures should be instituted to ensure that dust emanating from construction activities is kept at acceptable levels.
Public Health Act No. 36 of 1919	Section 119 states that “no person shall cause a nuisance or shall suffer to exist on any land or premises owned or occupied by him or of which he is in charge any nuisance or other condition liable to be injurious or dangerous to health.”	The Proponent and all its employees / contractors should ensure compliance with the provisions of these legal instruments.
Health and Safety Regulations GN 156/1997 (GG 1617)	Details various requirements regarding health and safety of labourers.	

Legislation/Policy/ Guideline	Relevant Provisions	Implications for this project
Labour Act No. 6 of 1992	Ministry of Labour (MOL) is aimed at ensuring harmonious labour relations through promoting social justice, occupational health and safety and enhanced labour market services for the benefit of all Namibians. This ministry insures effective implementation of the Labour Act no. 6 of 1992.	The Proponent should ensure that the proposed activity does not compromise the safety and welfare of workers.
Local Authorities Act No. 23 of 1992	The Local Authorities Act prescribes the manner in which a town or municipality should be managed by the Town or Municipal Council.	The development must comply with provisions of the Local Authorities Act as well as the municipal bylaws and regulations applicable to the project.
National Heritage Act No. 27 of 2004	The Act is aimed at protecting, conserving and registering places and objects of heritage significance.	All protected heritage resources (e.g., human remains etc.) discovered, need to be reported immediately to the National Heritage Council (NHC) and require a permit from the NHC before they may be relocated.
Roads Ordinance 17 of 1972	• Section 3.1 deals with width of proclaimed roads and road reserve boundaries • Section 27.1 is concerned with the control of traffic on urban trunk and main roads • Section 36.1 regulates rails, tracks, bridges, wires, cables, subways or culverts across or under proclaimed roads Section 37.1 deals with Infringements and obstructions on and interference with proclaimed roads.	Adhere to all applicable provisions of the Roads Ordinance.

Legislation/Policy/ Guideline	Relevant Provisions	Implications for this project
Nature Conservation Ordinance no. 4 of 1975	• Chapter 6 provides for legislation regarding the protection of indigenous plants	Indigenous and protected plants must be managed within the legal confines.
Hazardous Substance Ordinance 14 of 1974	To provide for the control of substances which may cause injury or ill-health to or death of human beings by reason of their toxic, corrosive, irritant, strongly sensitizing or flammable nature or the generation of pressure thereby in certain circumstances; to provide for the division of such substances into groups in relation to the degree of danger; to provide for the prohibition and control of the importation, manufacture, sale, use, operation, application, modification, disposal or dumping of such substances; and to provide for matters connected therewith.	Chlorine and other hazardous substances must be handled in accordance with the respective MSDS from suppliers.
Pollution Control and Waste Management Bill	To promote sustainable development; to provide for the establishment of a body corporate to be known as Pollution Control and Waste Management Agency; to prevent and regulate the discharge of pollutants to the air, water and land; to make provision for the establishment of an appropriate framework for integrated pollution prevention and control; to regulate noise, dust and odour pollution; to establish a system of waste planning and management; and to enable Namibia to comply with its obligations under international law in this regard.	The disposal of waste is to adhere to the guidelines as per the bill.
National Policy on Climate Change for Namibia 2010	The main purpose of the national climate change policy of Namibia is to provide the legal framework and overarching national strategy for the development, implementation, monitoring and evaluation of climate change mitigation and	The project is to consider climate change and its impact on water resources.

Legislation/Policy/ Guideline	Relevant Provisions	Implications for this project
	adaptation activities. The policy promotes the enhancement of synergies amongst sectors and stakeholders for effective and efficient mitigation and adaptation responses to climate change in Namibia. In addition, the policy facilitates identification of sector and cross-cutting climate change strategies and actions for implementation to lower Namibia's overall risks, and the risks of the most vulnerable groups and sectors. The policy also provides legal basis for resource mobilisation to address climate change adaptation and mitigation.	
Namibian National Gender Policy 2010-2020	The Namibia National Gender Policy (2010-2020) seeks to create an enabling environment for sectors to mainstream gender in line with National Development Plans (NDPs). It identifies who will be responsible for the implementation of the policy and who will be accountable for gender equality results. The policy further highlights the enhancement of the role and benefits of women in the environment.	The project is to consider the role of women in the environment and to ensure that interested and affected women are represented and consulted.
The Ministry of Environment and Tourism (MET) Policy on HIV & AIDS	MEFT has recently developed a policy on HIV and AIDS. In addition, it has also initiated a programme aimed at mainstreaming HIV and gender issues into environmental impact assessments.	The proponent and its contractor must adhere to the guidelines provided to manage the aspects of HIV/AIDS. Experience with construction projects has shown that a significant risk is created when migrant construction workers interact with local communities.

3.2 International Treaties and Conventions

3.2.1 UN Convention on Biological Diversity of 1992

The Convention on Biological Diversity (CBD) is an international legally binding treaty with three main goals: conservation of biodiversity; sustainable use of biodiversity; fair and equitable sharing of the benefits arising from the use of genetic resources. It regulates or manages biological resources important for the conservation of biological diversity whether within or outside protected areas, with a view to ensuring their conservation and sustainable use. The proposed development activities excavations and civil works of bulk water infrastructure should conserve biodiversity, the removal of vegetation cover and destruction of natural habitats should be avoided and where not possible it should be minimised.

3.2.2 International Union for Conservation of Nature

The International Union for Conservation of Nature (IUCN) provides public, private and non-governmental organisations with the knowledge and tools that enable human progress, economic development and nature conservation to take place together. The mission is to influence, encourage and assist societies throughout the world to conserve the integrity and diversity of nature and to ensure that any use of natural resources is equitable and ecologically sustainable.

3.2.3 United Nations Convention to Combat Desertification

The United Nations Convention to Combat Desertification (UNCCD) addresses land degradation in arid regions with the purpose to contribute to the conservation of biodiversity and the mitigation of climate change. The proposed project activities should be such that they do not contribute to desertification.

3.2.4 African Convention on Conservation of Nature and Natural Resources

This Convention focuses on living resources, calling for the creation of protected areas and for the specific conservation measures for listed species. It also provides the grounds for the conservation of other natural resources such as soil and water, for the consideration of environmental concerns in development plans, and for research and education. The proposed activities will have a direct impact on the natural resources by clearing of vegetation, loosening soils during trenching activities. Thus, the requirements of this convention must be considered in the implementation of the project.

3.2.5 United Nations Framework Convention on Climate Change in 1995

In 1995 Namibia ratified the United Nations Framework Convention on Climate Change (UNFCCC); an international environmental treaty. The ultimate objective of the Convention is to “stabilise greenhouse gas concentrations in the atmosphere at a level that will prevent dangerous human interference with the climate system.” The proposed activities should be such that they do not contribute to climate change impacts.

3.2.6 The Southern African Development Community (SADC) Protocol on Shared Watercourse Systems

The SADC Protocol on Shared Watercourse Systems provides that permits must be acquired before discharging any and all types of wastes into shared waters, provided that the intended discharge will not have a detrimental effect on the watercourse system; member states must furthermore take all measures necessary to prevent the introduction of alien aquatic species into a shared watercourse system which may have detrimental effects on the ecosystem; and agreements should be reached on water control and utilisation in shared watercourse systems including the regulation of the flow and drainage.

3.2.7 The Permanent Okavango River Basin Water Commission

The Permanent Okavango River Basin Water Commission (OKACOM), is a river basin organisation established by the three riparian states of Angola, Botswana and Namibia to jointly manage water resources of the Cubango-Okavango River Basin (OKACOM, 2022a). OKACOM was established by the contracting partiers to advise the Member States on:

- The long term safe yield of water available from the basin;
- Reasonable demand scenarios from all consumers in the basin;
- Conservation, equitable allocation sustainable utilisation of water resources of the basin;
- Planning, separately and jointly, for development of water resources, including the construction, operation and maintenance water infrastructure in the basin;
- Prevention of pollution, prevention and control of aquatic weeds in the basin and;
- Measures for the alleviation of short-term difficulties, such as droughts and floods (OKACOM, 2022b).

The Cubango-Okavango River Basin (CORB) is a transboundary basin with a network of river systems traversing through Angola, Botswana and Namibia. The CORB is internationally important for its biodiversity and biological productivity. The Okavango Delta is the best-known feature of the CORB. It is one of the largest Ramsar Sites in the world. The Delta was declared a World Heritage site under the UNESCO convention in 2014. With its high variety of habitat types which supports high diversity of biological life forms, it remains one of the most important areas for biodiversity conservation in the world (OKACOM, 2022c).

NamWater is in possession of an abstraction permit for the abstraction of water from the Kavango River. The renewal of the abstraction permit is in process and is being facilitated by NamWater.

3.3 International Financial Institution Standards and Policies

3.3.1 The African Development Bank (AfDB) Integrated Safeguards System (ISS) 2013

To better articulate its safeguard policies while improving their clarity, coherence and consistency, the Bank has developed an Integrated Safeguards System (ISS).The Bank Group's Integrated Safeguards System (ISS) and its related Climate Safeguards System (CSS) are the strategic tools to ensure that Bank supported operations are designed in a sustainable manner. The Bank's ISS is composed of Operational Safeguards, ESAP/Business Standards and Guidelines which apply to all Bank financed projects. A basic requirement of the Bank ISS is that all project must comply with the legislation, regulations, national and sub-national requirements and international agreements of project host countries on all issues related to project preparation and implementation.

3.3.1.1 The African Development Bank (AFDB) Environmental and Social Assessment Procedures (ESAP) 2015

The ESAPs purpose is to improve decision making and project results by ensuring that Bank-financed operations conform to the requirements laid out in the Operational Safeguards (OSs) and are thus sustainable. It details the specific procedures that the Bank and its borrowers or clients should follow to ensure that Bank operations meet the requirements of the OSs at each stage of the Bank's project cycle. It is with this goal in mind that the ESAP require that environmental, climate change and social considerations are assessed early in the Project Cycle and are reflected in project selection, site selection, planning and design. To fulfill the environmental and social obligations as defined in financial agreement, and meet both the relevant national borrower and financier (AfDB), and international legal and policy requirements.

The Environmental and Social Assessment (ESA) process outlined in the ESAP provides a way to improve a project environmentally, socially and in relation to climate change and gender as cross cutting issues, thereby enhancing its benefits and – in order of priority – avoiding, minimizing, mitigating or compensating for adverse impacts. The ESA process also seeks to ensure that access to benefits is sufficiently broad, that information in a suitable form is disclosed in a timely manner and that the borrower engages in meaningful consultation (i.e., consultation that is free, prior and informed) with local stakeholders and potentially affected communities; in particular, with vulnerable groups, to enable them to participate actively in decisions about avoiding or managing environmental and social impacts.

3.3.1.2 The African Development Bank (AFDB) Operational Safeguards (OS)

The AfDB ISS requirements is composed of 5 Operational Safeguard (OS) requirements that clients are expected to meet when addressing social and environmental impacts and risks which include:

- OS 1: Environmental and social assessment - governs the process of determining a project's environmental and social category and the resulting environmental and social assessment requirements. Requires the borrower/client to establish a credible, independent and empowered local grievance and redress mechanism to receive, facilitate and follow up on the resolution of the affected people's grievances and concerns regarding the environmental and social performance of the project.
- OS 2: Involuntary resettlement: land acquisition, population displacement and compensation - consolidates the policy commitments and requirements set out in the Bank's policy on involuntary resettlement, and incorporates a number of refinements designed to improve the operational effectiveness of those requirements.
- OS 3: Biodiversity, renewable resources and ecosystem services – aims to conserve biological diversity and promote the sustainable use of natural resources. It also translates the commitments in the Bank's policy on integrated water resources management into operational requirements.
- OS 4: Pollution prevention and control, hazardous materials and resource efficiency - covers the range of key impacts of pollution, waste, and hazardous materials for which there are agreed international conventions, as well as comprehensive industry-specific and regional standards, including greenhouse gas accounting, that other multilateral development banks follow.
- OS 5: Labour conditions, health and safety - establishes the Bank's requirements for its borrowers or clients concerning workers' conditions, rights and protection from abuse or exploitation.

3.3.1.3 The African Development Bank (AFDB) Safeguard Policies and Strategies

The Bank's several related policies and tools indicate its commitment to improving environmental and social sustainability in its investments. The bank policies which were developed prior to the ISS are outlined below:

- Policy on the environment - established the Bank's commitment to integrating environmental considerations into its operations through (i) systematic project categorisation according to the level of environmental risk, and (ii) the application of appropriate types of environmental assessments, with commitments to public consultation and information disclosure.
- Involuntary resettlement policy: The primary goal of the involuntary resettlement policy is to ensure that when a Bank intervention requires people to be displaced, they are treated equitably and share in the benefits of the project that involves their resettlement, improving their living standards.

- Gender policy - to promote gender mainstreaming as a means of fostering poverty reduction, economic development and gender equality on the continent. The policy elaborates a set of guiding principles, which emphasise, among other things, the need to apply gender analysis to all Bank activities. It also recognises that the concept of gender implicitly embodies a culture which entails cooperation and interdependence between women and men.
- Climate risk management and adaptation (CRMA) strategy - The overall goal of the Bank's strategy is to ensure progress towards eradication of poverty and contribute to sustainable improvement in people's livelihoods taking into account CRMA. The specific objectives are: (i) To reduce vulnerability within the Regional Member Countries (RMCs) to climate variability and promote climate resilience in past and future Bank financed development investments making them more effective; (ii) To build capacity and knowledge within the RMCs to address the challenges of climate change and ensure sustainability through policy and regulatory reforms.

4 ESIA PROCESS AND APPROACH

The flow diagram in **Figure 4-1** provides an outline of the ESIA[1] process that is being followed for the proposed project.

4.1 Screening Phase

The screening phase involved a high-level screening and assessment of the general study area to determine constraints and opportunities associated with the project. It further involved assessing whether an EIA is required to be undertaken for the proposed activity. Under the 2012 Environmental Impact Assessment (EIA) Regulations of the Environmental Management Act (EMA) No. 7 of 2007, the proposed development is a listed activity that may not be undertaken without an Environmental Clearance Certificate (ECC). This activity is listed under the following relevant sections:

> *8.1 The abstraction of ground or surface water for industrial or commercial purposes.*
>
> *8.3 Any water abstraction from a river that forms an international boundary.*
>
> *8.5 Construction of dams, reservoirs, levees and weirs.*
>
> *10.1 The construction of (a) oil, water, gas and petrochemical and other bulk supply pipelines.*

4.2 Scoping Phase

The scoping phase involves the identification of significant issues and impacts focusing the impact assessment by refining alternatives; identifying national legal context and financial institution safeguard requirements to ensure that the ESIA meets the requirements of decision-makers and lenders; defining the approach to the ESIA in the Terms of Reference for the ESIA; and gathering stakeholder opinions about the project.

During the scoping phase the draft Scoping Report (SR) was made available to the public for review and comment after which it was updated and finalised, taking cognisance of the comments received from I&APs. The final Scoping Report will be submitted to MEFT: DEAF for review and decision-making, before commencing with the ESIA Phase.

4.3 ESIA Phase

The ESIA Phase assesses the significance of the potential impacts identified during scoping. The assessment process will identify mitigation measures to avoid or reduce negative impacts and enhance positive ones. The public participation process allows the findings of the

[1] ESIA and EIA may be used interchangeably. ESIA is the term used by the AfDB and EIA is the term used in Namibian legislation.

assessment to be presented to stakeholders and ensures that comments are incorporated into the final report.

The objectives of an ESIA are as follows:

- Specialist investigation of all issues identified during the scoping phase and where sufficient information regarding these issues to predict potential impacts, are lacking;
- To ensure that environmental and social considerations are explicitly addressed and incorporated into the decision-making process;
- To anticipate and avoid, minimise or offset significant biophysical and social impacts of the project;
- To optimise positive impacts of the project;
- To ensure protection of the productivity and capacity of natural systems and the ecological processes which maintain their functions; and
- To promote development that is environmentally and socially responsible, assists in meeting sustainable development goals and optimises resource use and management opportunities.

The ESMP[2], which will be appended to the ESIA report, serves as a framework to manage environmental and social impacts identified in the ESIA throughout the project lifecycle.
The terms of reference for the ESIA are discussed in Chapter 9.

[2] ESMP and EMP may be used interchangeably. ESMP is the term used by the AfDB and EMP is the term used in Namibian legislation

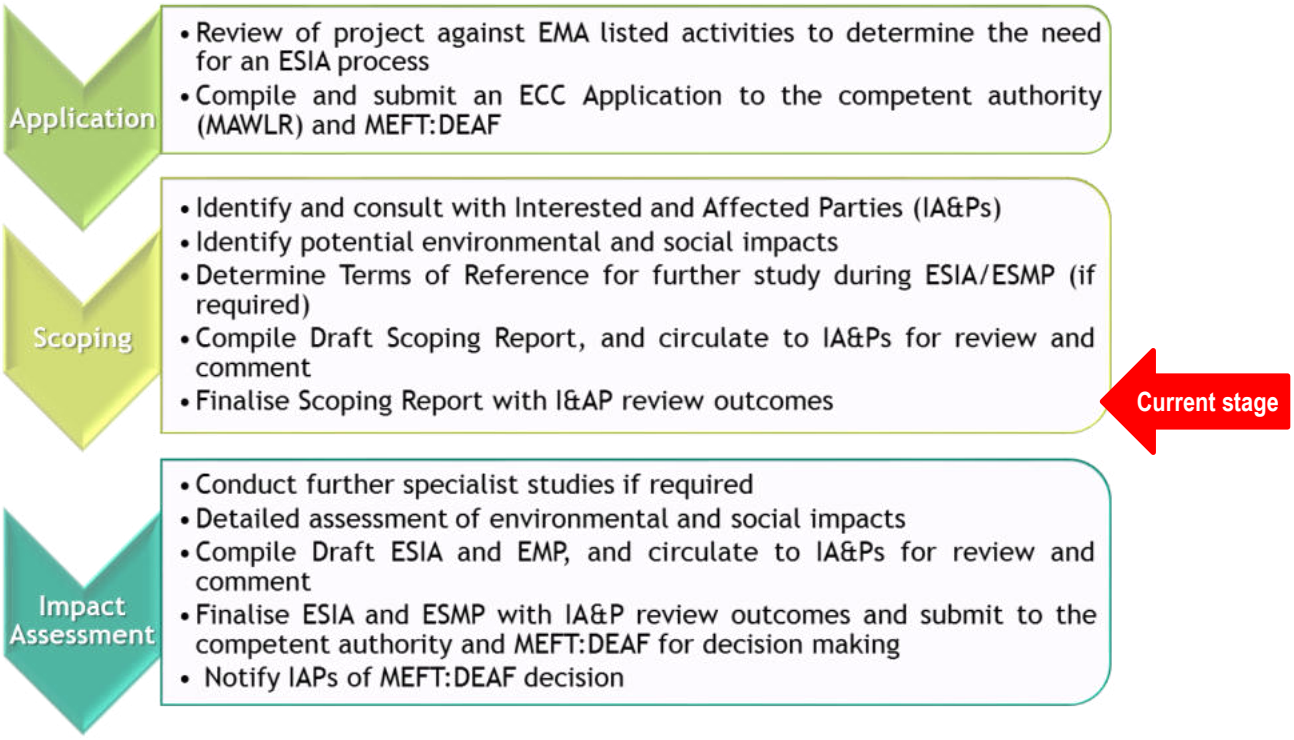


Figure 4-1: ESIA Process

4.4 Assumptions and Limitations

In compiling this SR, the following assumptions and limitations apply:

- It is assumed that the information provided by NOD and NamWater is accurate, adequate and unbiased, and that no information that could change the outcome of the ESIA process has been withheld.
- This report is based on the most up to date information available to date.
- At the time of compiling this report, the project is still in preliminary design phase.
- No specialist studies have been completed to date. The specialist studies will be undertaken during the ESIA Phase.
- The scope of impacts presented in this report could change, should new information become available and once fieldwork is undertaken in the ESIA phase.

5 PUBLIC PARTICIPATION AND DISCLOSURE

5.1 Objective:

Public consultation forms an important component of an ESIA process. Public consultation provides potential Interested and Affected Parties (I&APs) with an opportunity to comment on and raise any issues relevant to the project for consideration as part of the assessment process. Public consultation has been done in accordance with both the EMA and its EIA Regulations. As prescribed from Regulation 21 to 24 of the EIA Regulations and AfDB's Operational Safeguards.

The public consultation process assists the Environmental Assessment Practitioner (EAP) in identifying all potential impacts and to what extent further investigations are needed. Public consultation can also aid in the process of identifying possible mitigation measures.

5.2 Approach:

5.2.1 Interested and Affected Parties (I&APs)

GCS identified specific I&APs, who were considered interested in and/or affected by the proposed activities. The I&APs identified include; applicable organs of state (national, regional, and local) and other interested members of the public. These I&APs were contacted directly and registered as I&APs. In addition, notices regarding the project were placed in widely circulated national newspapers for two consecutive weeks inviting members of the public to register as I&APs. The detailed steps regarding the notification of I&APs are presented in **Section 5.2.2.** A summary of the I&APs identified are presented in **Table 5-1**. The complete list of I&APs is provided in **Appendix C.**

Table 5-1: Summary of Pre-Identified IAPs

	Description
List of IAPs	**Ministry of Environment, Forestry and Tourism**
	Ministry of Agriculture, Water and Land Reform
	Rundu Town Council
	Kavango East Regional Council
	NamWater
	National Heritage Council of Namibia (NHCN)
	National Botanical Research Institute (NBRI)
	Surrounding property/business owners
	Affected communities

5.2.2 Communication with I&APs

Regulation 21 of the EIA Regulations details steps to be taken during a given public consultation process and these have been used in guiding this process.

Communication with I&APs about the proposed development was facilitated in English (unless indicated otherwise) through the following means and in this order:

- Registration of the project with MEFT and MAWLR through submission of ECC Application and copy of the BID dated 14 April 2022 (MEFT Application number APP-003745);
- A Background Information Document (BID) containing descriptive information about the proposed activities was compiled (**Appendix D**) and sent out to all identified and registered I&APs per email dated 14 April 2022;
- Notices were placed in *The Namibian and New Era* newspapers dated 14 and 21 April 2022, briefly explaining the activity and its locality, inviting members of the public to register as I&APs (**Appendix E**);
- Site notices were fixed at the relevant sites (Site proposed for the new WTP, Nkarapamwe, Rundu, Kehemu, Donkerhoek, Industrial and Sauyemwa sites) (**Appendix G**).
- Radio announcements were made in English and the local language (Rukwangali and Rumanyo) on Wato Fm and Rapids Fm (**Appendix F**).
- A public meeting was held in Rundu on 27 April 2022 (**Appendix H**).
- Meetings with the Authorities were held in Rundu with the Rundu Town Council and the Kavango East Regional Council (Rundu Urban and Rural Constituencies) on 27 April and 28 April 2022 respectively (**Appendix H**).

The scoping report was made available to all I&APs for public review from **25 July 2022 until 8 August 2022.** An electronic copy of the report was available for review on the GCS website (https://www.gcs-sa.biz/public-documents/).Furthermore, a hard copy of the report was available to the public for review and comment at the Reception Desk of the NamWater office in Rundu (Eugene Kakuru Street, Rundu, Namibia). I&APs were notified as follows on the availability of the report:

- Email notification sent out to all identified and registered I&APs per email dated 25 July 2022 (**Appendix F**);
- Notification sent out to identified and registered I&APs per sms dated 25 July 2022 (**Appendix F**);

- Radio announcement was made in English and Rukwangali on Rapids Fm on 2 August 2022 (**Appendix F**).

I&APs had until **8 August 2022** to submit their comments on the project. The comments received during each comment period is presented in the Comments and Response Report (**Appendix I**). The comment period will remain open until the final scoping report is submitted to MEFT.

6 ALTERNATIVES

Alternatives are defined as: “different means of meeting the general purpose and requirements of the activity” (Environmental Management Act (2007) of Namibia [and its regulations (2012)]. This chapter will highlight the different ways in which the project can be undertaken and to identify the alternatives that will be the most practical but least damaging to the environment and local communities.

Various alternatives have been identified in terms of the proposed development and its related activities. The most significant alternatives considered are:

- No-go option
- Site alternatives
    - Water abstraction works location
    - Pipeline routes
- Design alternatives
    - Raw water abstraction works
- Effluent Discharge

The above-mentioned alternatives considered for the proposed activity are discussed in the following subchapters.

6.1 No-Go Option

The “No-Go” alternative is the option of not proceeding with the activity, which typically implies a continuation of the status quo. Should the proposed upgrade of the Rundu Purification Works not commence none of the potential impacts (positive and negative) identified would occur. Furthermore, given the fact that the capacity of the existing water supply schemes of Rundu and Nkarapamwe are not sufficient to meet the current water demand at Rundu, the additional water treatment capacity is required to respond to the current and future water demand of safe drinking water for the Rundu town and surrounding communities. The No-go action would not be an ideal alternative. Hence, adopting the no action alternative will mean that the existing shortfall in water supply will continue to prevail unabated and the future water security in Rundu and the surrounding areas will be compromised.

6.2 Site Alternatives

6.2.1 Water abstraction location

Alternative locations for the proposed raw water abstraction works were considered and investigated. A preferred site location for the new abstraction works has been identified downstream of the existing abstraction works. The following aspects were considered for the site selection of the proposed new abstraction works:

- Natural stable bend in the river with a site on the outside bend. This will limit the course sediment (bedload) abstraction due to the spiral flow created by the secondary current.
- Steep right bank near the riverbank so that the concrete structure/wall on the bank is not too long (to ensure floods cannot bypass the abstraction works).
- Sufficient depth for low flow conditions so that the invert of the intake could be as high as possible above the riverbed (no weir is provided to save cost).
- Availability of bedrock to limit scouring.
- Access road to site.
- Access/Safety for the workers during construction.
- Area without any settlement or livelihood activities.

The preferred site location for the new abstraction works is downstream of the existing abstraction works is shown in **Figure 6-1** below.

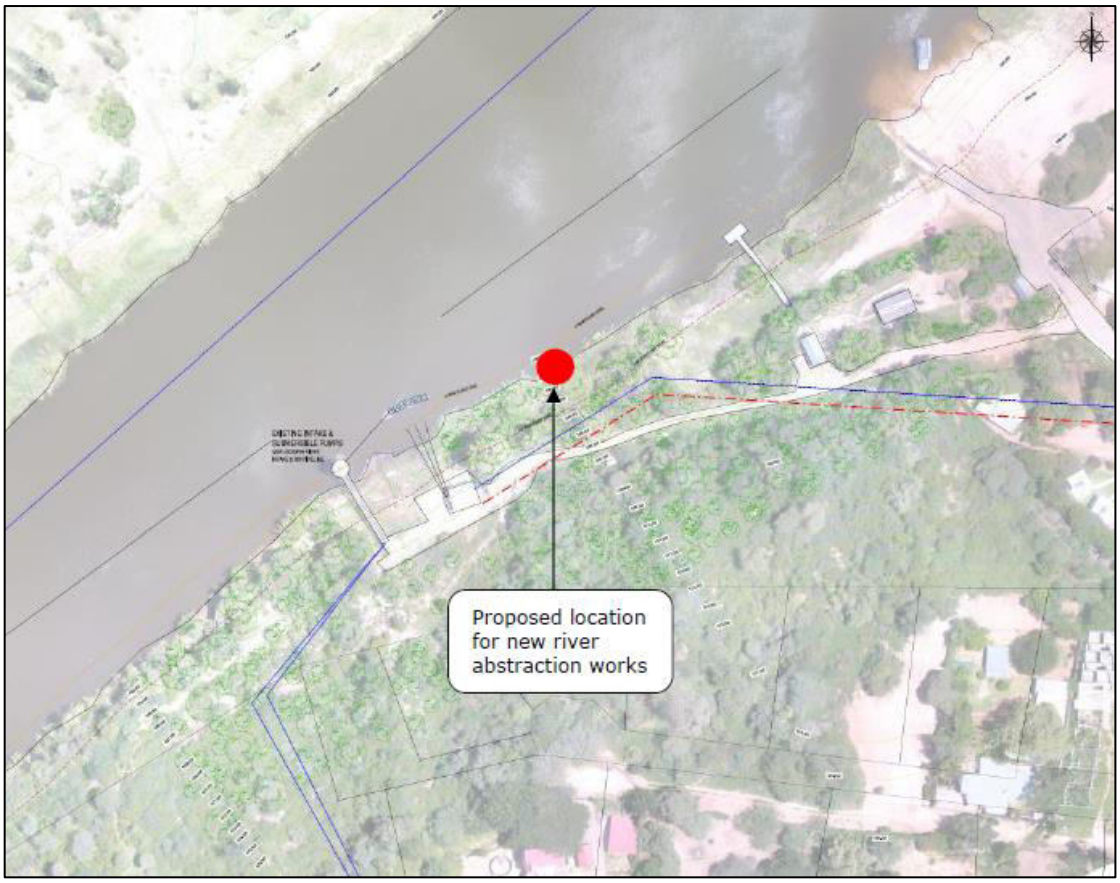


Figure 6-1: Proposed location of new river abstraction works

6.2.2 Pipeline Routes

The pipelines proposed to be constructed are to be constructed within municipal road reserves. Alternatives in terms of pipeline routes being considered are indicated on **Figure 6-2**.

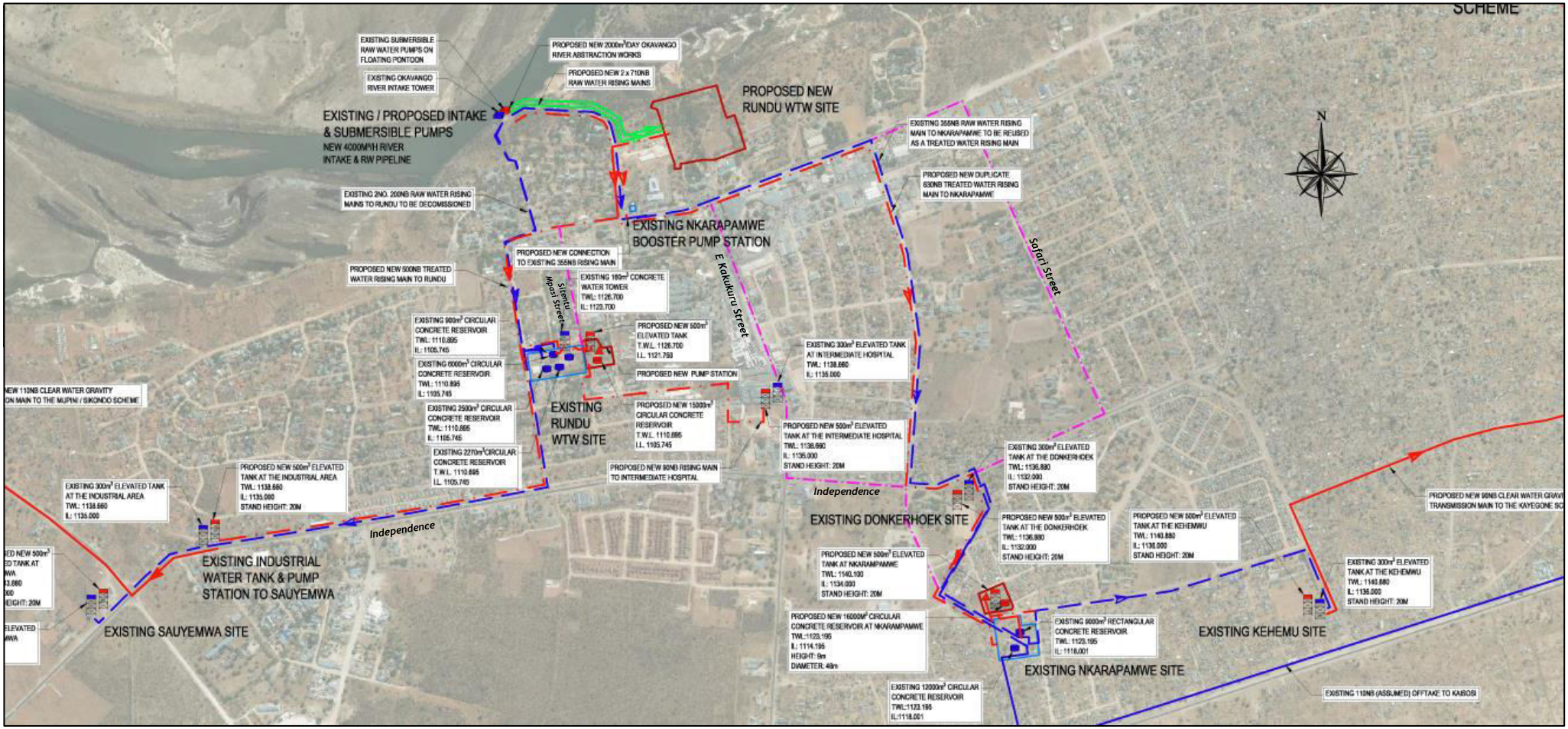


Figure 6-2: Pipeline Route Alternatives

6.3 Design Alternatives

6.3.1 Raw water abstraction

Five potential raw water abstraction options were identified which are to be assessed as potential options to be used in the project.

Option 1: Abstraction with the construction of a weir

A low weir is required to create sufficient water depth at the pump intakes during low river flow conditions and to guide the low flow towards the intakes. The abstraction works is normally placed on the outside bend in the river and orientated to use secondary currents during a flood to limit coarse sediment abstraction. The local area at the intake (gravel trap) can be flushed by using a gate to remove deposited sediment, and debris will be prevented by a trash rack from reaching the pumps. The weir will be constructed high enough to provide sufficient head to flush the gravel trap. The gravel trap should be self-scouring during medium to large floods, with the flushing gate closed. Sand transported beyond the trash racks towards the pumps can be flushed out by opening gates downstream of the pumps during small river flood conditions. This design for an abstraction works ensures a low maintenance and robust design, with a high assurance of supply. This type of abstraction works will consist of a gravel trap, trash racks, pump canals which could be flushed, and a weir.

Option 2: Floating Pontoon

Floating abstraction works are commonly used in small scale schemes. They are suited to stable channel/rivers with small water level fluctuations. A floating pontoon will be used to house the pumps. Upon selection of the pumps the floating pontoon would be sized to allow for the pumps to be soundly founded on the pontoon and the suction pipe would be positioned underneath the pontoon. The delivery lines would go from the pontoon to the banks of the river. They would need to be flexible to accommodate the movement of the pontoon as the water levels fluctuate. The delivery pipe would need to be placed up to a certain point where it will connect to the fixed rising main or discharge in the settler. The pontoon would be anchored on the riverbanks by cables.

Option 3: Pumps and pipes mounted on a rail

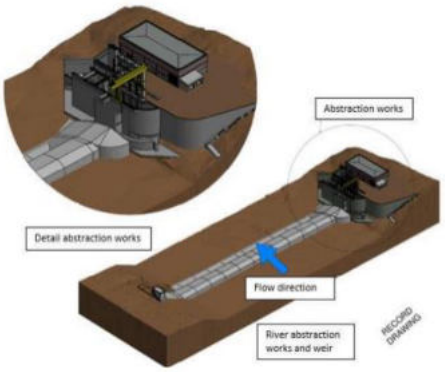
This type of abstraction consists of the construction of a concrete base and rail on which an inline pump or a fixed floating pontoon could be mounted. This would allow the pumps to move up and down with the fluctuation of the water levels in the river up until the limitations of the installed railing are reached. The fixed railing allows for a secure connection and stability against wave action. Flexible delivery pipes are required for this option and monitoring of the connection point to the main delivery pipeline is also required as, depending on the changes in water level, portions of the pipe may need to be added or removed.

Option 4: Submerged in-line pumps fixed to the embankment

The installation of the submerged in-line pumps allows for multiple pumps to be installed in series. These pumps are lowered into the river and their delivery lines can be part of a permanent and non-flexible installation. The installation requires a solid foundation (concrete) on which the mountings for the pipes and pumps can be installed.

Option 5: Intake Structure with a dry or wet well

The arrangement for this type of abstraction works consists of a wet well with hoppers and either a dry well with high lift pumps or a wet well with submerged pumps. The hoppers allow for the settling of larger sediment particles. Typically, these hoppers will be equipped with jet pumps to allow removal of the sediment. The pumps will pump directly into the rising main which links to the water treatment works.



Option 1: Abstraction works with the weir

Option 2: A floating pontoon

Option 3: Pumps on rails

Option 4: Submerged in-line pumps fixed to the embankment abstraction works

Option 5: Schematic of a dry well configuration

The preferred option will be determined with input from the specialist studies to be undertaken as part of the ESIA.

6.4 Effluent Discharge

Sludge will be generated from the backwash cycles on the filters as well as during desludging of the sedimentation tanks. The sedimentation tank sludge contains almost all the solids generated by the WTP, while the backwash water contains mostly water. Sludge is produced in the liquid and solid form. According to Verlicchi & Masotti (2000) the options for disposal often used include the following:

Solid Sludge:

- agricultural reuse
- ecological reuse
- landfilling
- brick and cement production

Liquid sludge

- hauling by truck to a central wastewater plant
- conveying with a dedicated pipe to a central wastewater plant
- discharge in a public sewage system
- recovery of coagulants
- discharge into surface waters

The management of water treatment sludge is of environmental concern and requires careful consideration. The recovery, recycling and reuse is an optimal solution for water treatment sludge management. The chemical composition of the water treatment sludge depends on the coagulant composition, raw water quality and the dose of coagulant used.

In terms of the Water Resources Management Act No 11 of 2013 regulations effluent discharged into an international water course may not exceed a 12 Nephelometric Turbidity Unit (NTU) threshold. A discharge permit would need to be applied for by NamWater to the Ministry of Agriculture, Water and Land Reform (MAWLR).

Alternatively, the supernatant can be channelled back into the inlet work, which enables the recycling of the supernatant.

7 DESCRIPTION OF THE AFFECTED ENVIRONMENT

The proposed activities will be undertaken in an environment with specific conditions. Prior to any development in an area and as part of an environmental assessment process, it is vital to firstly understand the pre-project/development conditions. This is also important to form a baseline understanding of the area and make reasonable conclusions on certain issues that may arise years later during or after the project's operations. The environmental and social baseline for the project area is presented under the subchapters below.

7.1 Bio-physical Environment

7.1.1 Climate

The climate of Rundu is sub-tropical, tempered by the altitude, with a hot, rainy season from November to March and a long dry season from April to October (Cecchini, 2021).

Situated in north-eastern Namibia, the Kavango East Region enjoys generally more rainfall than the rest of the country to the south and west. Annual average rainfall varies between about 450 and 600 mm, with a clear increasing trend from south to north. Rains fall almost entirely in summer, with the months from May to September usually being dry, and the first early rains coming to the region in October and November. Highest rainfalls usually occur in January and February (Stubenrauch Planning Consultants, Geocarta Namibia, SAIEA, AHT Group AG, 2015).

The Kavango East is usually warm to hot. Average maximum temperatures are above 30°C for nine months of the year, and average minimums are below 10 °C during the coolest months June, July and August. Temperatures below freezing are occasionally recorded but are rare and are usually only experienced in low-lying valleys such as found along the Kavango River and Omurambas (Stubenrauch Planning Consultants, Geocarta Namibia, SAIEA, AHT Group AG, 2015).

The warm dry conditions mean that evaporation is high. Rundu, for example, can expect to receive 590 mm of rain (the annual average), with a potential evaporation of about 2000 mm/a. Wind speeds are generally very low, and in most months, it is completely calm for over half the time.

7.1.2 Air Quality

Air quality in Rundu is considered to be good. The major current atmospheric dust emissions in the area are primarily generated by the vehicles travelling on gravel roads.

7.1.3 Topography, Soils and Geology

The Kavango East Region is a gently undulating plain of unconsolidated sands, sloping gradually down northwards to the Kavango River and eastwards to the lowest areas along the river before it enters Botswana (Ministry of Lands and Resettlement, 2015). The sandy plain is incised by the Kavango River and other smaller ephemeral river channels, the most prominent one being the Omuramba-Omatako that runs roughly northwards to meet the Kavango River east of Rundu.

Rundu can be defined as predominantly flat with a topographic ridge line sweeping around the north of the town along the edge of the flood plain and turning back into the town as it follows the ephemeral water course (Stubenrauch Planning Consultants, 2013).

7.1.4 Hydrology and Hydrogeology

Surface water in Namibia is generally very limited and regarded as precious resources where they are available all year round.

The most important water source in the Kavango East Region is the perennial Kavango River, which is the major source of water for the rural communities concentrated along the river (Ministry of Lands and Resettlement, 2015). Boreholes and dug-wells are concentrated along the Kavango River, the Omatako Valley and the main roads from Grootfontein to Rundu (Ministry of Agriculture Water and Rural Development, 2011). In addition, abstraction from the Kavango River provides water to Rundu Town, other smaller towns and agricultural schemes within the region.

Historical flow data from the gauging station 2511M01 – Okavango River at Rundu (-17.9° latitude and 19.75° longitude) was obtained. This gauging station is located at the existing abstraction works and the datum for the level indicator was given as 1060 m. The historical flow data that was recorded at the gauging station from November 1945 to April 2020 indicate large fluctuations in the river flow rates. The observed flows range between 16 m^3/s and 962 m^3/s as depicted in **Figure 7-1** below.

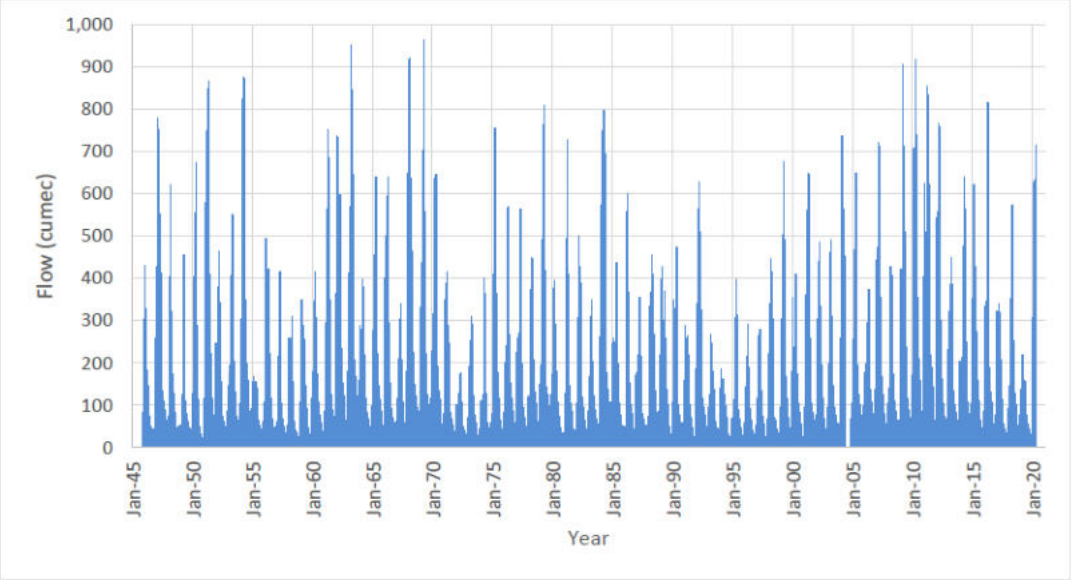


Figure 7-1: The observed peak flow rates at 2511M01 gauging station in the Kavango River

The flow regime of the river can be affected in two ways:

- the average quantity of the flow or the Mean Annual Runoff (MAR) can be changed through water abstractions and changes in land-cover and
- abstractions, impoundments and land cover changes can affect the timing or the seasonality of the flow regime such as the onset, peak, volume and duration of the dry season or flood events (OKACOM, 2011).

The available water for people may be adequate during most years, but during drier years the non-perennial parts of the system tend to dry out, with implications also for groundwater, and even the perennial parts may have extremely shallow flows, causing problems for drinking water, irrigation, navigation, water quality and the biota (OKACOM, 2011).

Where the Kavango runs along the border, it is a large, sluggish, low-gradient river. Summer floods, starting from about September in Angola, usually reach Namibia in January or February and inundate large areas within the valley. The floodwaters continue to rise until April, and then take several months to recede. High water is usually three to four times higher than the lowest levels in November, and the river carries 4 - 6 times more water at this time than in the winter months (Bethune, 1991). During low flow periods the water is confined to the main channel which is seldom more than 100 m wide and less than one metre deep in places (Ministry of Lands and Resettlement, 2015).

The Okavango-Epukiro groundwater region encompasses the Kavango Regions, the eastern part of the Otjozondjupa Region and the northern Omaheke Region as depicted in **Figure 7-2** below. Groundwater reserves in the Kavango and north west parts of the Otjozondjupa Regions are hosted in Kalahari aquifers which hold water in intergranular pore spaces (Ministry of Agriculture Water and Rural Development, 2011).

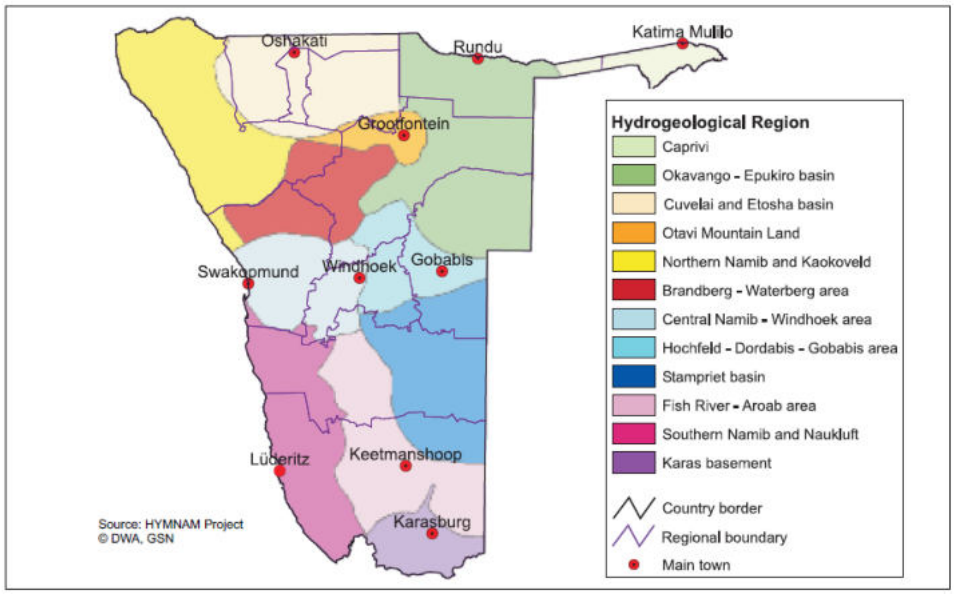


Figure 7-2: Groundwater basins and hydrogeological regions in Namibia (Ministry of Agriculture Water and Rural Development, 2011).

Rundu is situated in an area characterised by a productive porous aquifer. About 40 boreholes were drilled before Namibia's Independence within a 15 km radius of Rundu. The water levels range from 12 to 45 m depth with yields varying from 3 to 14 m^3/h. The original water supply for Rundu was by means of 2 boreholes that were drilled in the early 1950s near the government offices of Rundu (Stubenrauch Planning Consultants, 2013).

7.1.5 Fauna and Flora

The Rundu area falls within the Broadleaved Tree-and-Shrub Savanna Biome. The town of Rundu is situated on the wall of the Kavango River in the Okavango valley. The area is known to be of Namibia's most densely vegetated areas composed of floodplain grasslands and lush woodlands. Broadly speaking, relatively larger deep-rooted trees such as teak and mangetti dominate on deep sands, while shallower soils in valleys support shrubs and grasses of various species.

The larger trees such as kiaat (*Pterocarpus angolensis*), teak (*Baikaea plurijuga*), silver terminalia (*Terminalia sericea*) and red seringa (*Burkea Africana*) constitute a valuable resource of timber that is used for furniture, construction, carvings and firewood. A number of species are valued for food, such as false mopane (*Guibourtia coleosperma*), mangetti (*Schinziophyton rautanenii*) and monkey oranges (*Strychnos cocculoides*) – these are important resources for rural livelihoods. Tall grasses in the woodlands are harvested for thatching.

The banks of the Kavango River originally supported forests with distinctive trees such as knobthorn (*Acacia nigrescens*), weeping wattle (*Peltophorum africanum*) and jackalberry (*Diospyros mespiliformis*), and a dense shrubby undergrowth. However much of the riverine forest has disappeared with only a few localised patches of this vegetation type remaining, almost entirely within the protected area of Bwabwata National Park (Ministry of Lands and Resettlement, 2015).

Along the river some areas are seasonally inundated with floodplains, where large areas of reeds grow in the river margins when water levels rise. There are also permanently swamped areas (e.g. near the Cuito confluence) with meanders, oxbow lakes and waterlogged floodplains, fringed with papyrus and other reeds and swamp vegetation (Ministry of Lands and Resettlement, 2015).

The Rundu area boasts an overall high terrestrial diversity of plants and animals. Plant diversity is estimated to be between 400 and 499 species. A total of 658 bird species has been recorded in Namibia. Rundu has a bird diversity of between 171 to 200 species. One endemic plant is recorded to occur in the Kavango Valley which is the Ringwood tree, *Maerua schinzii,* which grows along riverbanks and water courses. Protected plants include the African protea (*Protea gaguedi*), the orchid (*Eulophia hereroensis*) and two aloes found specifically in the vicinity of Andara (*Aloe esculenta* and *A. zebrina*) (Bethune, 1991).

Rundu has a reptile diversity of 51-60 species and a frog diversity of between 24 -27 species. The diversity of frogs closely follows the patterns of rainfall, which reflects the dependence of frogs on standing water for breeding and for survival. Thirty different species have been recorded along the Kavango River alone. Protected reptile species in the Kavango wetland area include the Nile crocodile (*Crocodylus niloticus*), two tortoises (Kalahari tent tortoise and leopard tortoise) and the African rock python (*Python sebae*) (Bethune, 1991). Mammal diversity of between 76-90 species, with many tropical species abundant in then north and east of Namibia and are associated with wetlands and forests.

The Kavango River is recorded to have a freshwater fish diversity of 79 species. There are approximately 115 species of freshwater fish in Namibia. Not all species occur along the entire course of the river. 40-50 species have been found to occur on the confluence of the Kavango and Cuito rivers, compared to approximately 60 species below. Two fish species which occur in the Kavango River, the ocellated spinyeel (*Aethiomastacembelus vanderwaali*) and the broadhead catfish (*Clariallabes platyprosopos*) has previously been listed as red data species (Bethune, 1991) with the broadhead catfish more recently listed as a species of least concern.

7.2 Socio-economic environment

Rundu is the capital and largest town of the Kavango East and West Regions located in the northeast of Namibia along the Kavango River, which forms the border between Namibia and Angola. It is located 715 km northeast from Windhoek the capital city of the country. Not only is it the capital of the Kavango Region, but it is also the second largest town in Namibia, in terms of population size.

It lies in an important strategic position as the gateway linking a number of important Southern Africa Development Community (SADC) countries with Namibia's port of Walvis Bay. As such it is believed to be a frontier town, as it is a hub for trade and development in the north of the country.

All road traffic from Namibia's neighbouring countries of Angola, Zambia, Zimbabwe and Botswana must route through Rundu to reach the port of Walvis Bay (Rundu Town Council, 2006).

7.2.1 Population

Rundu's population is estimated at 63,431 residents excluding those living in nearby villages that are not part of the jurisdiction of the town, with an annual population growth of 5.4 percent (Martin *et al.*, 2018). With a 5.4 percent population growth, Rundu's population is increasing at a rate much higher than the national urban population mean growth rate (4.2 percent). The Kavango Region had a population density of 4.6 people per square kilometer in 2011. This is significantly higher than the national population density of 2.6 people per square kilometer (Namibia Statistics Agency, 2011). Regionally, females outnumber males at 88 males per 100 females.

Table 7-1: Kavango Region Population by age **Source:** (Namibia Statistics Agency, 2011)

Age	2001	2011
0-14 years	15 %	16 %
15- 59 years	29 %	27 %
60 + years	6 %	7 %

As per **Table 7-1** above, the larger proportion of the population are those within working age in the age bracket of 15-59 years of age (27%). Others between the ages 0 and 14 years of age, make up 16% of the population as of 2011(Namibia Statistics Agency, 2011). The regional population shows a small percentage of those above the age of 60 (7%), which indicates a relatively low life expectancy for the area.

7.2.2 Education

Much like other rural areas in Southern Africa, education levels for the Kavango Region are relatively low. According to the Namibian Statistics Agency, the literacy rate amongst the population older than 15 years is 79% as of 2011, this is an increase of 9% since 2001. Although there has been an improvement in this regard, there is still a large need for basic education amongst the population.

Table 7-2: School attendance **Source:** (Namibia Statistics Agency, 2011)

Attendance	2001	2011
Never attended school	26 %	21 %
Currently attending school	19 %	18 %
Left School	51 %	58 %

Table 7-2 above, shows the statistics for school attendance according to the Namibian Statistics Agency. A large proportion of the population left school without completing (58%) or had no schooling at all (21%) thus there is a general lack of skills necessary to develop at the rate needed to improve socio economic conditions of the region. At 2011, 18% of the population was enrolled at school (Namibia Statistics Agency, 2011) .

There are five tertiary Institutions in Rundu, namely: University of Namibia Rundu campus, Institute of Open Learning (IOL), Rundu Vocational Training Centre, Namibia College of Open Learning (NAMCOL) and Triumphant College. Additionally, Namibia University of Science and Technology (NUST) has a center in Rundu that provides support for students who are studying on distance. There are 13 primary schools, 10 secondary schools and 3 combined schools. Among the primary schools, 12 are government schools with no hostel, while 1 is a private school with a hostel. However, there are 4 government secondary schools with no hostels and 2 government secondary schools with hostels. Private secondary schools are 4, all with hostels including the highly reputable St Boniface College, a Roman Catholic Church school located 33km east of Rundu, which has been ranked the best-performing school in Namibia for the eighth consecutive year (Martin *et al.*, 2018).

7.2.3 Health

Rundu has 7 health facilities made up of 1 state hospital, 1 private hospital and 5 clinics serving the town. It is estimated that only 12 percent (17,538) of the population in Rundu and surrounding villages are using private medical services while 88 percent (128,6130) use public health facilities (Martin *et al.*, 2018).

The Kavango East Region has an 11 percent prevalence rate of individuals estimated to suffer from one or a combination of chronic diseases. Chronic diseases include blood pressure, diabetes, cancer, joint inflammations, cardiac/heart diseases, respiratory diseases (e.g. Asthma), chronic kidney diseases, anemia, epilepsy and psychological/mental health illness among others (Martin *et al.*, 2018).

Among adults aged 15-64 years, prevalence of HIV varies geographically across Namibia, ranging with the lowest rate of 7.6% in the Kunene Region and the highest rate of and 22.3% in the Zambezi Region. Regions with higher than national prevalence tended to have higher HIV prevalence among females than males. The regions with the lowest prevalence were Kunene and Khomas. The Kavango East Region recorded an HIV prevalence of 14.5% in 2017 (NAMPHIA, 2018).

Malaria remains a public health concern in Namibia and it is endemic in many regions, including Kavango east region. The Kavango East Region recorded 499 malaria cases for the period January to April 2022, with 146 of the cases being recorded in Rundu (Muronga, 2022).

7.2.4 Income and livelihood

The Kavango region is the poorest region in Namibia in term of the Human Development Index (HDI). The HDI concentrates in the three essential factors of human life; longevity, knowledge, and a decent standard of living. The HDI of the region is 0.4, but the town Rundu is geographically located at a strategic crossroad and has, since peace and stability returned to Angola, developed into a significant border town.

The labour force size for Rundu is estimated at 33,114, representing a Labour Force Participation Rate (LFPR) of 69 percent. Lower LFPR indicates high dependence rate. In the case of Rundu, low LFPR can be viewed as an opportunity since the dependent population or economically inactive are mainly composed of young school going population who are likely to benefit the local economy with better skills in future (Martin *et al.*, 2018).

In 2011, the employment rate in the Kavango Region for the labour force (61% of those 15+) was 50% employed and 50% unemployed. For those 15+ year old not in the labour force (29), 29% were students, 14% home-makers and 30% retired. A total of 60 percent of the labour force in Rundu are employed (Martin *et al.*, 2018). Rundu is estimated to have an unemployment rate of 40% which is above the 34% national unemployment rate of 2011.

Agricultural activities are common in the Kavango East region with mostly crop and livestock farming taking place. Rundu and its surrounding rural areas is conducive for crop production due to its suitable soil type for crops, high rainfall, conducive weather conditions and its rich water resources. The common crops produced in the region are wheat and maize while Mahangu production is only concentrated to communal farming. The most common livestock in Kavango East region includes cattle and goats with some farmers also owning sheep (Martin *et al.*, 2018). Besides livestock farming, there are five wildlife farming conservancies within Kavango East region namely the Joseph Mbambangandu, Muduva Nyangana, George Mukoya, Shamungwa and Kapinga Kamwale Conservancies which have both direct and indirect benefits to the local economy of the region's administrative capital city (Martin *et al.*, 2018).

Table 7-3: Primary source of Income Kavango Region **Source:** (Namibia Statistics Agency, 2011)

Main Source of Income	2001	2011
Farming	52 %	43 %
Salaries/wages	21 %	22 %
Remittances	4 %	6 %
Business	14 %	12 %
Pension	5 %	13 %

As indicated in **Table 7-3** above, in terms of household's main sources of income in the Kavango Region in 2011, 43% derived income from farming, 22% from wages and salaries, 6% cash remittances, 12% from business or non-farming activities, and 13% from pensions.

7.2.5 Administration and Governance

Urban areas fall under the direct jurisdiction of the applicable Local Authority and are governed by the Local Authorities Act. On the other hand - settlement areas fall under the jurisdiction of the Regional Council in terms of the Regional Councils Act. The Kavango East Region has five constituencies namely Mashare, Mukwe; Ndiyona, Ndonga Linena, Rundu Rural and Rundu Urban (Ministry of Lands and Resettlement, 2015).

Rundu is currently the only proclaimed town within the region while Ndiyona and Divundu are declared settlements, which means that these settlements will most likely receive Village status in the future. Kayengona; Mabushe; Mukwe; Muroro-Mashare and Omega has all been identified by the then Ministry of Regional, Local Government and Housing and Rural Development (MRLGHRD) as identified settlements/ growth points, which proven feasible, might be upgraded to settlement status in the future.

7.2.6 Land use and ownership

Land tenure in Namibia is based on three main categories of land ownership: private ownership (freehold land), central government (communal areas, resettlement farms and protected parks) and local authorities (urban land) (Ministry of Lands and Resettlement, 2015).

Within the Kavango East Region 38.3% of land is privately owned whereas 5.7% is communal land (**Figure 7-3**). Communal land refers to land being available for communal grazing and cropping areas that is still under jurisdiction of the Traditional Authority and the communal land board with no other land uses occupying the land (Ministry of Lands and Resettlement, 2015).

LAND COVER TYPE	TOTAL AREA KM²	PERCENTAGE COVER %
SSCF – Private	9,199.90	38.3%
Community forest	2,887.68	12%
Communal conservancies	3,086.66	12.8%
National Parks (MET)	7,146.48	29.7%
Tourism enterprises	2.00	0.008%
Local Authorities	170.10	0.7%
NDC farms (Parastatal)	N/A	N/A
Irrigation schemes	81.83	0.3%
Quarantine camp	28.31	0.1%
State forest	N/A	N/A
Communal land (Traditional Authorities)	1,387.61	5.7%
Total Area/Percentage	**23,988.57**	

Note: Data extracted from GIS data obtained from various line Ministries

Figure 7-3: Administration of land within the Kavango East Region

A large portion of the proposed development falls within the Rundu Townlands, which is mostly developed and consists of Residential, Business, Industrial and Public Open Space areas.

7.2.7 Archaeology

In Namibia, heritage resources are protected under the National Heritage Act (No 27 of 2004). In the past, little was known of the archaeological knowledge of the Kavango Region due to lack of research. However, the extent and richness of the archaeological record was uncovered during the last decade. The expansions of known archaeological sites identified along the banks of the Kavango River and its floodplains to Omatako and Khaudom areas was revealed. The archaeological heritage of the Kavango Region is characterised by remnants on history, sacred cultural sites as well as present-day community graves and cemeteries (Welwitschia Archaeological Heritage Solutions, 2019). The subject sites are not expected to be rich in archaeological finds.

7.2.8 Infrastructure and Services

7.2.8.1 Water Supply

Potable water supply to the town is managed by NamWater and the distribution is done by the Town Council, which sells to residents. Water supplied to the town is extracted from the Kavango River on the border between Namibia and Angola and is transported to the two purification plants all situated within 5km distance from the river. The two purification plants supply water as follows: Nkarapamwe purification plant supplies to Rundu Army base, villages, Kehemu, Kaisosi, Safari, New Millennium, Nkarapamwe and Ndama and Rundu Town purification plant supplies to hospitals, schools, industrial area and Sauyemwa, Kasote, Tutungeni and Rainbow locations.

The surrounding villages Mupini/Sikondo, Kayengona and Masivi are supplied with water via boreholes. These schemes are operated by NamWater.

7.2.8.2 Electricity

Electricity supply in the town of Rundu is managed by the Northern Regional Electricity Distributor Company (NORED). Electricity costs in the town are subject to the tariffs charged by NORED in distributing electricity to the town. The average usage of electricity in the country for individual customers is 4-megawatt hour per annum equivalent to 333-kilowatt hour per month. Individuals in the northern regions where Rundu is included uses 3.5-megawatt hour of electricity per annum (292-kilowatt hour per month), which is slightly below the national average of 4-megawatt hour (333-kilowatt hour per month). According to Martin *et al*. (2018), the estimated average electricity usage in Rundu is 3.6 megawatt hour equivalent to 300 kilowatt hour per month.

7.2.8.3 Information and Communication

Access to information is made effective with the population having access to communication Devices. In Rundu, radio and mobile phone remains the most common forms of communication assets owned by households. Approximately 59% and 80% of households in Rundu own radio and mobile phones respectively.

8 PRELIMINARY IMPACT IDENTIFICATION

The potential impacts that could arise as a result of the proposed project have been identified based on existing sources of information and knowledge of the affected environment. Impacts specifically relating to hydrology, social aspects and ecology will be interrogated and analysed in further detail at the ESIA stage. The preliminary list of potential impacts has been used to guide the type of specialist studies required in the ESIA. These preliminary impacts are discussed in **Table 8-3** to **Table 8-24**. Mitigation measures have been outlined, however detailed mitigation measures for each impact identified will be outlined in the ESMP.

8.1 Proposed Assessment Methodology

In assessing the impact of the proposed development, rating scales should be considered. Each issue identified should be evaluated in terms of the most important parameter applicable to environmental management. These include the extent, intensity, probability, and significance of the possible impact on the environment and whether such effects are positive (beneficial) or negative (detrimental). The rating scales to be used are as follows:

Table 8-1: Impact Assessment Rating Scales

CRITERIA	DESCRIPTION			
EXTENT	**National (4)** The whole country	**Regional (3)** Kavango East region and neighbouring regions	**Local (2)** Within a radius of 2 km of the development site.	**Site (1)** Within the development site
DURATION	**Permanent (4)** Mitigation either by man or natural process will not occur in such a way or in such a time span that the impact can be considered transient	**Long-term (3)** The impact will continue/last for the entire operational life of the development but will be mitigated by direct human action or by natural processes thereafter.	**Medium-term (2)** The impact will last for the period of the project phase, where after it will be entirely negated	**Short-term (1)** The impact will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase
INTENSITY	**Very High (4)** Natural, cultural, and social functions and processes are altered to extent that they permanently cease	**High (3)** Natural, cultural, and social functions and processes are altered to extent that they temporarily cease	**Moderate (2)** Affected environment is altered, but natural, cultural, and social functions and processes continue albeit in a modified way	**Low (1)** Impact affects the environment in such a way that natural, cultural, and social functions and processes are not affected
PROBABILITY	**Definite (4)** Impact will certainly occur	**Highly Probable (3)** Most likely that the impact will occur	**Possible (2)** The impact may occur	**Improbable (1)** Likelihood of the impact materialising is very low

CRITERIA	DESCRIPTION
SIGNIFICANCE	Is determined through a synthesis of impact characteristics. Significance is also an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

Table 8-2: Description of the significance of impacts

Low impact	A low impact has no permanent impact of significance. Mitigation measures are feasible and are readily instituted as part of a standing design, construction, or operating procedure
Medium impact	Mitigation is possible with additional design and construction inputs.
High impact	The design of the site may be affected. Mitigation and possible remediation are needed during the construction and/or operational phases. The effects of the impact may affect the broader environment.
Very high impact	Permanent and important impacts. The design of the site may be affected. Intensive remediation is needed during construction and/or operational phases. Any activity which results in a "very high impact" is likely to be a fatal flaw.
Status	Denotes the perceived effect of the impact on the affected area.
Positive (+)	Beneficial impact
Negative (-)	Deleterious or adverse impact.
Neutral (/)	Impact is neither beneficial nor adverse
It is important to note that the status of an impact is assigned based on the status quo. Therefore, not all negative impacts are equally significant.	
Significance Rating Scale Points 1-4 Insignificant/low Points 5-8 Significant /Moderate Points 9-12 Very significant/High. Points 13-16 Highly significant /Very high	

The significance of each impact will be rated before and after mitigations measures.

8.2 Anticipated Impacts: Planning and Design Phase

The first step in avoiding and preventing any possible negative impacts associated with any project, should start with the planning and designing phase. Issues to be considered at the planning and design phase of the proposed development are as follows.

8.2.1 Siting of plant infrastructures

The siting of plant infrastructure needs to be carefully considered as some areas such as the area proposed for the new abstraction works as well as the site for the new treatment plant are vegetated and would need to be cleared.

Vegetation should be cleared only where absolutely necessary and if cleared, numbers of protected, endemic and near endemic species removed should be documented. The trees to be protected need to be identified and marked by a specialist in consultation with the contractor. Trees and plants protected under the Forest Act No 12 of 2001 are not to be removed without a valid permit from the local Department of Forestry.

8.2.2 Electricity/power availability/sufficiency

The electricity requirement under the scheme will increase at the four main locations. The total estimated power requirement for the scheme is 1027 kW. Applications for additional power supply will be made by the proponent to NORED.

8.2.3 Traffic flow

Traffic is expected to increase once construction commences on site. Due to the pipeline routes being sited within existing road reserves of the Rundu Town Council there will be an impact on traffic flow in the area during construction. Mitigation measures need to be followed to ensure that traffic impacts remain minimal. Wayleaves would need to be applied for by NamWater for the pipelines from the Rundu Town Council.

8.2.4 Land use

Infrastructure such as the proposed new reservoirs which cannot be accommodated on existing NamWater owned sites would require additional land to be acquired for these sites as discussed in Section 2.1.3. The proponent should consult with the landowners and/or traditional authorities or relevant land users to obtain a written land use/leasehold agreement prior to constructing infrastructure. All relevant land permits and leaseholds documents should be obtained from the landowners or authorities prior to commencing with the project.

8.2.5 Climate Change

Namibia is one of the countries which are believed to be hit hardest in terms of climate change induced drought, the country has witnessed devastating effects of climate change in terms of socio-economic impacts on communities. The project must thus ensure that it does not exacerbate the risks of climate change but rather mitigate them. The uncontrolled or unregulated abstraction of water is an example of a potential risk to climate change. The project must thus ensure that adaptation measures are put in place in order to increase the resilience of the infrastructure to be built or rehabilitated to withstand the impacts of climate change.

8.3 Anticipated Impacts: Construction Phase

The construction phase is mostly concerned with the impacts on the biophysical and socio-economic environment that is likely to occur during the construction phase of the development. These potential impacts are likely to be temporary in duration but may have longer lasting effects.

8.3.1 Impact Assessment of Biodiversity Disturbance and Loss

The preparation of the site for the proposed development involves clearing of certain areas on site. These areas to be cleared include the site proposed for the Rundu Purification Plant (6 ha in size) as well as the site at which the new water abstraction works will be located. This may impact the existing biodiversity on these proposed sites. Both sites accommodate large trees and possibly some fauna. During site preparation it should be ensured that only the areas applicable to the project site area are cleared. The trees to be protected need to be identified and marked by a specialist in consultation with the contractor. The layout of the proposed plant should incorporate existing protected trees which may not be removed without a valid permit from the local department of Forestry in Rundu. The impact is not expected to be of such a magnitude and/ or significance that it will have irreversible impacts on the biodiversity and endemism of the area and Namibia at large. The assessment of this impact is presented in **Table 8-3.**

Table 8-3: Assessment of the impacts of the proposed activities on biodiversity disturbance and loss

	Impact Type	Ratings				Significance
		Extent	Duration	Intensity	Probability	
Pre-mitigation	**Negative**	**1**	**3**	**3**	**3**	**10**
Post-mitigation		**1**	**3**	**2**	**3**	**9**

8.3.1.1 Mitigations and recommendation to biodiversity disturbance and loss

- Vegetation should be cleared only where absolutely necessary and if cleared, numbers of protected, endemic and near endemic species removed should be documented and submitted to the local Department of Forestry.
- All development footprint areas to remain as small as possible and vegetation clearing to be limited to what is essential.
- Trees and plants protected under the Forest Act No 12 of 2001 are not to be removed without a valid permit from the local Department of Forestry.
- The local Department of Forestry in Rundu should be consulted with regards to the proper disposal of cleared trees.
- Suitable locations for the contractors lay-down areas and materials camp should be identified and the following should be considered in selecting these sites:

- Previously disturbed areas should be used as far possible.
- Second option should be degraded land.
- Avoid sensitive areas (e.g. rivers/drainage lines).

8.3.2 Impact Assessment of potential pollution to Surface and Groundwater

Improper handling, storage and disposal of hydrocarbon products and hazardous materials at the site may lead to surface and groundwater contamination, in case of spills and leakages. Leakages from vehicles and machines during construction may also contribute to surface and groundwater contamination. Furthermore, the following activities which may take place during construction will likely contribute to groundwater impacts:

- Site preparation, including placement of contractor laydown areas and storage (i.e., temporary stockpiles, bunded areas etc.) facilities.
- In-situ placement of new soils, altering existing soil-flow processes (i.e., infilling of wetlands or cut-and-fill areas).
- Soil compaction.
- Soil & surface water contamination and sedimentation from the following activities:
  - Leakages from vehicles and machines, and seepage from building materials/stockpiles.
  - Erosion and sedimentation if excavations are left open due to unforeseen circumstances (i.e., bad weather, heat, construction downtime).

The assessment of this impact is presented in **Table 8-4.**

Table 8-4: Assessment of the impacts of the proposed activities on surface and groundwater

	Impact Type	Ratings				Significance
		Extent	Duration	Intensity	Probability	
Pre-mitigation	**Negative**	**2**	**2**	**2**	**3**	**9**
Post-mitigation		**1**	**2**	**1**	**2**	**6**

8.3.2.1 Mitigations and recommendation to surface and groundwater

- Careful storage and handling of hydrocarbons on site is essential.
- Workers responsible for the storage and handling of hydrocarbons should be suitably trained to do so and trained on spill prevention (e.g., the use of drip trays) and the handling of potential spills should they occur to be able to ensure implementation on site.

- Potential contaminants such as wastewater should be contained on site and disposed of in accordance with municipal wastewater discharge standards so that they do not contaminate surrounding soils and eventually groundwater.
- Contaminants such as hydrocarbons should be stored, handled, and managed appropriately. These must be collected on site and disposed at an appropriate facility that is licenced to receive such waste.
- Only excavate areas applicable to the project area.
- Backfill the material in the same order it was excavated to reduce contamination of deeper soils with shallow oxidised soils.
- Cover excavated soils with a temporary liner to prevent contamination.
- Keep the site clean of all general and domestic wastes.
- Exposed soils to be protected using a suitable covering or revegetating.
- Existing roads should be used as far as practical to gain access to the site.
- Have emergency fuel & oil spill kits on site.
- Visual soil assessment for signs of contamination at vehicle holding, parking and activity areas.
- Place oil drip trays under parked construction vehicles.
- Above ground fuel tanks should be located on an impermeable surface that is bunded – with a volume of 120% of the total volume stored.

8.3.3 Impact Assessment of Soil Erosion Impacts

Soil erosion is likely to occur on site given the characteristics of the site. The assessment of this impact is presented in **Table 8-5.**

Table 8-5: Assessment of the impacts of the proposed activities on soil erosion

	Impact Type	Ratings				Significance
		Extent	Duration	Intensity	Probability	
Pre-mitigation	**Negative**	**1**	**2**	**2**	**2**	**7**
Post-mitigation		**1**	**1**	**1**	**1**	**4**

8.3.3.1 Mitigations and recommendation to soil erosion

- Erosion control measures as outlined in the ESMP should be implemented to ensure that the topsoil is not washed away.
- Checks must be carried out at regular intervals to identify areas where erosion is occurring.

- Appropriate remedial actions as outlined in the ESMP are to be undertaken wherever erosion is evident.

8.3.4 Impact Assessment of Archaeological and Heritage Impacts

The proposed activity is not taking place in an area that has significant archaeological or heritage resources. However, should these be encountered during the construction activities, mitigation measures need to be in place to ensure that these resources are not harmed. The assessment of this impact is presented in **Table 8-6.**

Table 8-6: Assessment of the impacts of the proposed activities on Archaeological and Heritage Impacts

	Impact Type	Ratings				Significance
		Extent	Duration	Intensity	Probability	
Pre-mitigation	**Negative**	**1**	**2**	**2**	**1**	**6**
Post-mitigation		**1**	**1**	**1**	**1**	**4**

8.3.4.1 Mitigations and recommendation to Archaeological and Heritage Impacts

- All works are to be immediately ceased in an affected area should an archaeological or heritage resource be discovered.
- The National Heritage Council of Namibia (NHCN) should advise with regards to the removal, packaging, and transfer of the potential resource.
- Should a heritage site or archaeological site be uncovered or discovered during the construction phase of the project, a "chance find" procedure should be applied as outlined in the ESMP.

8.3.5 Impact Assessment of Health and Safety

Construction activities may cause health and safety risks to people operating on the site. These may include safety risks as a result of construction works as well as the potential spread of HIV/AIDS from contractors during construction. Furthermore, it may result in potential public safety concerns associated with the excavation works for the installation of the water supply network. The assessment of this impact is presented in **Table 8-7.**

Table 8-7: Assessment of the impacts of the proposed activities on health and safety

	Impact Type	Ratings				Significance
		Extent	Duration	Intensity	Probability	
Pre-mitigation	**Negative**	**1**	**2**	**2**	**2**	**7**
Post-mitigation		**1**	**1**	**1**	**1**	**4**

8.3.5.1 Mitigations and recommendation to health and safety

- Construction workers should be provided with awareness training about the risks associated with the proposed construction work such as hydrocarbon handling and storage, the handling of heavy machinery etc.
- During the works conducted, workers should be properly equipped with personal protective equipment (PPE) such as coveralls, gloves, safety boots, safety glasses etc.
- The contractors should comply with the provisions with regards to health and safety as outlined in the Labour Act (No. 6 of 1992).
- Construction sites should be demarcated and fenced, and public access should not be allowed to the construction sites to prevent injury or accident due to entry onto a construction site.

8.3.6 Impact Assessment of Noise Generation Impacts

Construction activities and the presence of construction vehicles may lead to the generation of noise which could impact the local surrounding residents negatively, if not properly handled. This may pose a disturbance on the surrounding residents. The assessment of this impact is presented in **Table 8-8.**

Table 8-8: Assessment of the impacts of the proposed activities on noise generation

	Impact Type	Ratings				Significance
		Extent	Duration	Intensity	Probability	
Pre-mitigation	**Negative**	**1**	**2**	**2**	**3**	**8**
Post-mitigation		**1**	**2**	**1**	**2**	**6**

8.3.6.1 Mitigations and recommendation to noise generation

- Construction activities should be limited to daytime hours (between 07h00 and 17h00) unless otherwise arranged with community members and businesses in the area.
- No amplified music should be allowed on site.
- Technology such as silencers should be installed on construction machinery, as needed.
- The use of horns as a general communication tool should not be allowed, they should only be used, when necessary, as a safety measure.

8.3.7 Impact Assessment of Dust Generation Impacts

Construction activities and the presence of construction vehicles may lead to the generation of dust which could impact the local residents negatively, if not properly handled. The assessment of this impact is presented in **Table 8-9.**

Table 8-9: Assessment of the impacts of the proposed activities on dust generation

	Impact Type	Ratings				Significance
		Extent	Duration	Intensity	Probability	
Pre-mitigation	**Negative**	**1**	**2**	**2**	**3**	**8**
Post-mitigation		**1**	**2**	**1**	**2**	**6**

8.3.7.1 Mitigations and recommendation to dust generation

- Dust abatement techniques should be implemented e.g., spraying of water on site to reduce dust levels to an acceptable standard.
- The local community should be continuously consulted to ensure that the dust levels are acceptable.
- Residents should be informed prior to construction commencing so that they are aware of the planned construction.
- During high wind conditions the contractor must make the decision to cease works until the wind has settled.
- Stockpiles and sand being transported should be covered with plastic to reduce windblown dust.
- Workers should be provided with dust masks.
- Ensure that drivers adhere to speed limits and that speed limits are strictly enforced particularly for driving on gravel roads (suggested 30 km/h).

8.3.8 Impact Assessment of Waste Generation (Domestic/General and Hazardous) Impacts

Construction activities usually generate wastes which leads to environmental pollution, if not properly handled. This may result in blocked waterways should waste be blown into water pipelines; animals may choke on waste when ingested and additionally it may pose a negative visual impact on the surrounding environment. The assessment of this impact is presented in **Table 8-10.**

Table 8-10: Assessment of the impacts of the proposed activities on waste generation

	Impact Type	Ratings				Significance
		Extent	Duration	Intensity	Probability	
Pre-mitigation	**Negative**	**1**	**2**	**2**	**3**	**8**
Post-mitigation		**1**	**2**	**1**	**2**	**6**

8.3.8.1 Mitigations and recommendation to waste generation

- The construction site should be kept tidy at all times.

- All domestic and general construction waste produced on a daily basis should be cleared and contained.
- No waste may be buried or burned on site or anywhere else.
- Waste containers (bins) should be emptied during and after the construction and the waste removed from site to the municipal waste disposal site.
- Separate waste containers (bins) for hazardous and domestic / general waste must be provided on site.
- Construction labourers should be sensitised to dispose of waste in a responsible manner and not to litter.
- No waste may remain on site after the completion of the project.
- The recycling of waste should be considered and implemented as far as possible.
- Hazardous waste:
    - All heavy construction vehicles and equipment on site should be provided with a drip tray.
    - All heavy construction vehicles should be maintained regularly to prevent oil leakages.
    - Maintenance and washing of construction vehicles should take place only at a designated workshop area.
    - Hazardous waste, including emptied chemical containers should be safely stored on sites where they cannot be reached and used by the unsuspecting and uniformed locals for personal use. No waste should be improperly disposed of on sites or its surroundings, i.e., unapproved waste sites
    - A comprehensive list of all potentially hazardous wastes and estimated volumes shall be compiled for all activities. A hazardous materials inventory shall be kept and be readily available for inspection by implementing agencies and relevant authorities.
    - Specifications for storing and handling of all hazardous waste and substances (e.g., fuel and chemicals) shall be adhered to. Specific attention shall be paid to designing the fuel storage sites and control during filling to manage pollution risks.
    - All hazardous waste that cannot be handled safely shall be temporarily stored before being removed to a hazardous waste disposal site by authorised service providers.

- Material Safety Data Sheets (MSDS) shall be used in all cases in assisting in assessing the possible risk and best approach to handling and disposal methods. These shall be available at locations/sites where chemicals are stored and used.
- Hazardous waste is to be disposed at a Hazardous Waste Facility which is licenced to receive such waste.

8.3.9 Impact Assessment of Temporary Employment Creation

The proposed activity may provide employment opportunities for the local people during construction. The assessment of this impact is presented in **Table 8-11**.

Table 8-11: Assessment of the impacts of the proposed activities on temporary employment creation

	Impact Type	Ratings				Significance
		Extent	Duration	Intensity	Probability	
Pre-mitigation	**Positive**	**2**	**2**	**1**	**2**	**7**
Post-mitigation		**2**	**2**	**1**	**2**	**7**

8.3.9.1 Mitigations and recommendation to temporary employment creation

- Should any job opportunities result, they should be made available to the local people in the area as far as reasonably possible.

8.3.10 Impact Assessment of Disturbance of local residents

Construction activities will result in disturbance to local residents within the areas in which construction will be taking place. The assessment of this impact is presented in **Table 8-12.**

Table 8-12: Assessment of the impacts of the proposed activities on disturbance of local residents

	Impact Type	Ratings				Significance
		Extent	Duration	Intensity	Probability	
Pre-mitigation	**Negative**	**2**	**2**	**2**	**3**	**9**
Post-mitigation		**1**	**2**	**1**	**2**	**6**

8.3.10.1 Mitigations and recommendation to disturbance of local residents

- Surrounding residents are to be informed in advance of the intended construction commencement dates.
- Construction should only take place during working hours (07h00 to 17h00).
- Should construction need to take place outside of working hours residents are to be informed in writing (via hand delivered letters to the immediate neighbours) 1 week in advance.

8.4 Anticipated Impacts: Operational Phase

The potential impacts associated with the operational phase of the activities have been identified and assessed in this subchapter. The main impacts identified are; surface and groundwater, noise, waste, health and safety and hazardous substance handling and storage.

8.4.1 Impact Assessment of Soil, Surface and Groundwater

Surface and groundwater impacts may be encountered during the operational phase, especially if development takes place within the rainy season. The operational activities on site should be conducted in a manner to avoid the contamination of surface and groundwater. The assessment of this impact is presented in **Table 8-13**.

Table 8-13: Assessment of the impacts of the activities on soil, surface, and groundwater

	Impact Type	Ratings				Significance
		Extent	Duration	Intensity	Probability	
Pre-mitigation	**Negative**	**2**	**2**	**2**	**3**	**9**
Post-mitigation		**1**	**1**	**1**	**1**	**4**

8.4.1.1 Mitigations and recommendation to soil, surface, and groundwater

- Ensure that surface water accumulating on-site are channelled and captured through a proper storm water management system.
- Monitoring of stormwater systems to ensure that the system operates as per design specifications.
- Ensure the sewer system is monitored for leakages.
- Routine visual inspections of sewer infrastructure and parking areas for signs of soil contamination.
- Have emergency fuel and oil spill kits on site.
- All hazardous substances shall be appropriately stored and secured within well ventilated and covered areas.
- Appropriate bunding whereby the bund can accommodate 120% of the content of the stored materials will also be provided where required.
- Bunding, concrete slabs and/or other protective measures should be installed where hazardous materials are handled.
- Ensure that the staff are informed and have information pertaining to the management of spills or ingestion.

8.4.2 Impact Assessment of Noise

The operational activities may result in associated noise production. The assessment of this impact is presented in **Table 8-14**.

Table 8-14: Assessment of the impacts of the activities on noise

	Impact Type	Ratings				Significance
		Extent	Duration	Intensity	Probability	
Pre-mitigation	**Negative**	**1**	**2**	**1**	**2**	**6**
Post-mitigation		**1**	**1**	**1**	**1**	**4**

8.4.2.1 Mitigations and recommendation to noise

- Noise levels during operational activities should be kept within the allowable standards for urban areas.
- Noise levels should adhere to the South African National Standards (SANS) restrictions on noise.
- Work hours should be restricted to between 07h00 and 17h00 where the use of heavy equipment, power tools and the movement of heavy vehicles is required.
- Noisy equipment should be shut down when not in use (when not needed) to avoid unnecessary noise on site.
- Workers performing noisy tasks should be rotated regularly (work on shifts) to avoid exposing them to excessive noise for a long period of time in a day.
- Workers should be equipped with personal protective equipment (PPE) such as earplugs to reduce noise exposure.
- Workers should ensure that they wear the necessary PPE at all times on work sites

8.4.3 Impact Assessment of Waste Solid and liquid

Various types of wastes will be produced from the site. These wastes will include general/domestic waste as well as sludge which will be produced from the plant. The sludge should be treated and disposed of in an appropriate manner to reduce the risk of pollution on site. The assessment of this impact is presented in **Table 8-15**.

Table 8-15: Assessment of the impacts of the activities on waste

	Impact Type	Ratings				Significance
		Extent	Duration	Intensity	Probability	
Pre-mitigation	**Negative**	**1**	**2**	**1**	**2**	**6**
Post-mitigation		**1**	**1**	**1**	**1**	**4**

8.4.3.1 Mitigations and recommendation to waste

- The solid sludge produced should be disposed at a registered waste landfill site.
- All domestic and hazardous waste will be removed to an appropriate waste site that is suitable to receive such waste.
- No waste should be buried or burned.
- General Waste: Includes waste paper, plastic, cardboard, harmless organic (e.g. vegetables) and domestic waste.
- No littering will be allowed. The plant area will be kept free of waste at all times.
- Provide sufficient waste bins at worksites. Make sure that all waste is removed from the worksites.
- Hazardous Substances include: sewerage, fuels, lubrication oils, hydraulic and brake fluid, solvents, paints, anti-corrosives, insecticides and pesticides, chemicals, acids etc. It should be disposed of at designated hazardous disposal sites.
- Contaminated soil should be stored in drums and taken to the nearest appropriate waste dumpsite.
- Do not change oil on uncovered ground. Drip trays will be used to catch oil when vehicles are repaired in the field.
- Used oil and hydraulic fluids will not be discarded on the soil or buried. It will be removed from site and taken back to an appropriate waste site.
- In the event of a hazardous spill:
    - Immediately implement actions to stop or reduce the spill.
    - Contain the spill.
    - Arrange implementation of the necessary clean-up procedures.
    - Collect contaminated soil, water and other materials and dispose it at an appropriate waste dumpsite.
    - Used solvents and grease should be stored in drums or other suitable containers. It should be sealed and recycled or disposed at an appropriate disposal site.
- Hazardous waste should not be burnt.

8.4.4 Impact Assessment of Health and Safety

Operational activities may cause health and safety risks to people operating on the site. The assessment of this impact is presented in **Table 8-16.**

Table 8-16: Assessment of the impacts of the proposed activities on health and safety

	Impact Type	Ratings				Significance
		Extent	Duration	Intensity	Probability	
Pre-mitigation	**Negative**	**1**	**2**	**1**	**2**	**6**
Post-mitigation		**1**	**1**	**1**	**1**	**4**

8.4.4.1 Mitigations and recommendation to health and safety

- Operators at the site should be provided with awareness training about the risks associated with the associated operational activities.
- During the works conducted, workers should be properly equipped with personal protective equipment (PPE) such as coveralls, gloves, safety boots, safety glasses etc.
- All open water structures that are on ground level should be fitted with handrails to prevent the possibility of operators falling into these structures.
- Chlorination equipment must be contained in the appropriate way in a separate building away from other chemicals.
- Chlorine gas should be stored in accordance with the MSDS for example storage within a well-ventilated area.
- All relevant safety signage and equipment must be available on site.

8.4.5 Impact Assessment of Hazardous Substance Handling and Storage

Hazardous substances to be used on site such as Potassium Permanganate (granule), Polyelectrolyte (granule), Soda Ash (granule), Chlorine (gas), Ammonium Sulphate (granule) must be used and stored in accordance with the relevant health and safety standards. The assessment of this impact is presented in **Table 8-17.**

Table 8-17: Assessment of the impacts of the proposed activities on Hazardous Substance Handling and Storage

	Impact Type	Ratings				Significance
		Extent	Duration	Intensity	Probability	
Pre-mitigation	**Negative**	**1**	**3**	**2**	**2**	**8**
Post-mitigation		**1**	**2**	**1**	**1**	**4**

8.4.5.1 Mitigations and recommendation to Hazardous Substance Handling and Storage

- Emergency preparedness plans, safety equipment and emergency clean up procedures must be in place in case of a spillage.

- All hazardous substances shall be appropriately stored and secured within well ventilated and covered areas. Appropriate bunding whereby the bund can accommodate 110% of the content of the stored materials will also be provided where required.
- Hazardous waste, including emptied chemical containers (e.g., liquid chlorine, sodium hypochlorite) and other chemicals used for disinfection in the operational phase should be safely stored on site where they cannot be reached and used by the unsuspecting and uninformed locals for personal use.
- No waste should be improperly disposed of on site or its surroundings, i.e., unapproved waste sites.
- A full list of all hazardous fuels and chemicals stored on site should be kept by the site supervisor, including accompanying volumes, locations and MSDSs.
- All hazardous substances should be stored and handled in accordance with the MSDSs.

8.4.6 Impact Assessment of Increased energy usage

The new infrastructure to be constructed will have an increased electricity demand. The assessment of this impact is presented in **Table 8-18.**

Table 8-18: Assessment of the impacts of the proposed activities on increased energy usage

	Impact Type	Ratings				Significance
		Extent	Duration	Intensity	Probability	
Pre-mitigation	**Negative**	**1**	**2**	**1**	**2**	**6**
Post-mitigation		**1**	**1**	**1**	**1**	**4**

8.4.6.1 Mitigations and recommendation to increased energy usage

- The proponent is to investigate the feasibility of use of alternative forms of energy such as solar power.

8.4.7 Impact Assessment increased water supply to the town and surrounding villages

The proposed development will result in an increase of water supply to the town and surrounding villages. This may result in a number of benefits including improved health, time availability for other chores instead of fetching water. Reduced incidences of human-crocodile conflict or interaction as the residents do not need to fetch water from the river. The assessment of this impact is presented in **Table 8-19.**

Table 8-19: Assessment of the impacts of the proposed activities on increased water supply to the town and surrounding villages

	Impact Type	Ratings				Significance
		Extent	Duration	Intensity	Probability	

Pre-mitigation	**Positive**	**2**	**3**	**1**	**2**	**8**
Post-mitigation		**2**	**3**	**1**	**2**	**8**

8.4.7.1 Mitigations and recommendation on increased water supply to the town and surrounding villages

- No mitigation measures proposed.

8.5 Anticipated Impacts: Decommissioning Phase

The decommissioning impacts are assessed for the proposed infrastructure that will be decommissioned as part of the project as well as in the case where the newly constructed facilities become decommissioned in future. The impacts identified are outlined below.

8.5.1 Impact Assessment of Noise Generation Impacts

Decommissioning activities and the presence of vehicles and machinery may lead to the generation of noise which could impact the local surrounding residents negatively, if not properly handled. This may pose a disturbance on the surrounding residents. The assessment of this impact is presented in **Table 8-20.**

Table 8-20: Assessment of the impacts of the proposed activities on noise generation

	Impact Type	Ratings				Significance
		Extent	Duration	Intensity	Probability	
Pre-mitigation	**Negative**	**1**	**2**	**1**	**2**	**6**
Post-mitigation		**1**	**1**	**1**	**1**	**4**

8.5.1.1 Mitigations and recommendation to noise generation

- Decommissioning activities should be limited to daytime hours (between 07h00 and 17h00) unless otherwise arranged with community members and businesses in the area.
- No amplified music should be allowed on site.
- Technology such as silencers should be installed on construction machinery.
- The use of horns as a general communication tool should not be allowed, they should only be used, when necessary, as a safety measure.

8.5.2 Impact Assessment of Dust Generation Impacts

Decommissioning activities and the presence of vehicles may lead to the generation of dust which could impact the local residents negatively, if not properly handled. The assessment of this impact is presented in **Table 8-21.**

Table 8-21: Assessment of the impacts of the proposed activities on dust generation

		Ratings	Significance

	Impact Type	Extent	Duration	Intensity	Probability	
Pre-mitigation	**Negative**	**1**	**2**	**1**	**2**	**6**
Post-mitigation		**1**	**1**	**1**	**1**	**4**

8.5.2.1 Mitigations and recommendation to dust generation

- Dust abatement techniques should be implemented e.g., spraying of water on site to reduce dust levels to an acceptable standard.
- The local community should be continuously consulted to ensure that the dust levels are acceptable.
- Residents should be informed prior to decommissioning commencing so that they are aware of the planned construction.
- During high wind conditions the contractor must make the decision to cease works until the wind has settled.
- Stockpiles and sand being transported should be covered with plastic to reduce windblown dust.
- Workers should be provided with dust masks.

8.5.3 Impact Assessment of Waste Generation Impacts

Decommissioning activities may generate wastes which leads to environmental pollution, if not properly handled. This may result in blocked waterways should waste be blown into water pipelines; animals may choke on waste when ingested and additionally it may pose a negative visual impact on the surrounding environment. The assessment of this impact is presented in **Table 8-22.**

Table 8-22: Assessment of the impacts of the proposed activities on waste generation

	Impact Type	Ratings				Significance
		Extent	Duration	Intensity	Probability	
Pre-mitigation	**Negative**	**1**	**2**	**1**	**2**	**6**
Post-mitigation		**1**	**1**	**1**	**1**	**4**

8.5.3.1 Mitigations and recommendation to waste generation

- The site should be kept tidy at all times.
- All domestic and general waste produced on a daily basis should be cleared and contained.
- No waste may be buried or burned on site or anywhere else.

- Waste containers (bins) should be emptied during and after the construction and the waste removed from site to the municipal waste disposal site.
- Separate waste containers (bins) for hazardous and domestic / general waste must be provided on site.
- Labourers should be sensitised to dispose of waste in a responsible manner and not to litter.
- No waste may remain on site after the completion of the project.
- The recycling of waste should be considered and implemented as far as possible.
- Different types of waste i.e. general, hazardous, e-waste is to be disposed of at the appropriate facilities that are registered to receive that kind of waste.

8.5.4 Impact Assessment of Soil, Surface and Groundwater

Surface and groundwater impacts may be encountered during the decommissioning phase, especially if development takes place within the rainy season. The operational activities on site should be conducted in a manner to avoid the contamination of surface and groundwater. The assessment of this impact is presented in **Table 8-23**.

Table 8-23: Assessment of the impacts of the activities on soil, surface, and groundwater

	Impact Type	Ratings				Significance
		Extent	Duration	Intensity	Probability	
Pre-mitigation	**Negative**	**2**	**2**	**2**	**3**	**9**
Post-mitigation		**1**	**1**	**1**	**1**	**4**

8.5.4.1 Mitigations and recommendation to soil, surface, and groundwater

- Contaminated runoff from the various decommissioning activities should be prevented from entering any surface or ground water bodies.
- Disposal of waste from the various activities should be properly managed.
- Contain the newly exposed soil using soil bags, soil savers or suitable geotextile.
- Vegetate areas where heavy machinery was used to excavate the soils to prevent erosion.
- Establish where excavated soils will be placed, and if the area is suitable to receive the excavated soils.
- Cover excavated soils with a suitable cover / temporary liner to prevent contamination.
- Only excavate areas applicable to the project area.

- Have emergency fuel and oil spill kits on site.

8.5.5 Impact Assessment of Health and Safety

Decommissioning activities may cause health and safety risks to people operating on the site. The assessment of this impact is presented in **Table 8-24.**

Table 8-24: Assessment of the impacts of the proposed activities on health and safety

	Impact Type	Ratings				Significance
		Extent	Duration	Intensity	Probability	
Pre-mitigation	**Negative**	**1**	**2**	**1**	**2**	**6**
Post-mitigation		**1**	**1**	**1**	**1**	**4**

8.5.5.1 Mitigations and recommendation to health and safety

- Workers should be provided with awareness training about the risks associated with the proposed decommissioning activities.
- During the works conducted, workers should be properly equipped with personal protective equipment (PPE) such as coveralls, gloves, safety boots, safety glasses etc.
- The contractors should comply with the provisions with regards to health and safety as outlined in the Labour Act (No. 6 of 1992).
- Sites should be demarcated, and public access should not be allowed to the construction sites to prevent injury or accident due to entry onto a construction site.

9 TERMS OF REFERENCE FOR THE ESIA

This Terms of Reference for the ESIA have been compiled in terms of the content requirements listed in Section 9 of EIA Regulations (2012), and includes:

(a) A description of all tasks to be undertaken as part of the assessment process, including any specialist to be included if needed;

(b) An indication of the stages at which the Environmental Commissioner is to be consulted;

(c) A description of the proposed method of assessing the environmental issues and alternatives; and

(d) The nature and extent of the public consultation processes to be conducted during the assessment process.

(f) A thorough capacity assessment of the public entities in charge of ESA enforcement and oversight, including how they are decentralized in the project implementation regions/jurisdictions.

(g) Comprehensive Culturally appropriate and accessible Grievance redress mechanisms including the cost estimates.

(h) Evidence of stakeholder's consultation

In addition, this section provides the proposed contents of the ESIA.

9.1 Tasks proposed to be undertaken during the ESIA phase

9.1.1 Specialist Studies

During the ESIA Phase, specialist assessments will be undertaken, wherein the significance of the potential impacts will be assessed, and recommendations will be made for mitigation measures. They will compile standalone specialist reports. The specialist disciplines that have been identified as relevant to the project are discussed below:

- Social – The positive impact associated with the project includes the improved availability of water of increased quantity and quality to the residents of the town and associated surrounding villages. The potential negative social impacts of the construction phase will impact on the livelihoods of the businesses operating along and people living along the proposed pipeline routes. The cumulative impact on the disruption of business activities and the resultant livelihoods is proposed to be assessed in more detail in the assessment phase.

- Biodiversity (terrestrial and aquatic ecology) – The Kavango River is rich in diverse biota which is essential to the rural economy of the population. The ecosystem is dependent on the hydrological cycle. It is proposed that the impact of increased abstraction related to the fauna and flora of the river be assessed in more detail in the assessment phase.
- Hydrological assessment – The project involves the increase in abstraction of water from the Kavango River. Namibia has an obligation under OKACOM to protect the quality and quantity of the river water supply in particular with regards to the Okavango Delta in Botswana. It is proposed that the impacts associated with the total abstraction volumes in relation to the flow of the river as well as the cumulative impact of the increased abstraction on the Okavango Delta be assessed in more detail in the assessment phase.

Should additional specialist studies be required due to comments and information received during the Draft Scoping Report comment period, the relevant specialists will be appointed to undertake these studies.

The general terms of reference that apply to the specialist studies are as follows:

- Describe the receiving environment and baseline conditions of the existing study area and identify sensitive areas that would need special consideration.
- Review the Scoping phase Comments and Response Report to ensure that all relevant issues and concerns raised by I&APs, relevant to fields of expertise, are addressed.
- Confirm all environmental and social aspects have been identified in the scoping report. Assess the potential impacts of the proposed project activities and facilities, including any associated cumulative impacts.
- Describe the legislative, permit, policy and planning requirements including requirements by AfDB applicable to the project.
- Identify areas where issues could combine or interact with issues likely to be covered by other specialists, resulting in aggravated or enhanced impacts.
- Indicate the reliability of information utilised in the assessment of impacts as well as any constraints to which the assessment is subject (e.g. any limitations and assumptions).
- Identify and assess alternatives that could avoid or minimise impacts.
- Specialists shall use the assessment methodology for impact prediction and assessment as outlined in Section 8.1.

- Specialists need to consider all (relevant) project execution phases when conducting their respective assessments – i.e. construction, operations and decommissioning phases.
- Specialist reports to include an Executive Summary.

The methodologies to be followed by specialists are as follows:

Terrestrial and Aquatic ecology	• The scope includes both vertebrate fauna and flora (aquatic and terrestrial). Vertebrate fauna would include amphibians, reptiles, mammals (small and large) and birds. Flora would include grass, trees and shrubs. • Perform a comprehensive literature review on the existing as well as "recent" relevant publications pertinent to the project. It will include vertebrate fauna and flora (aquatic and terrestrial) known or expected to occur within and along the Kavango River site. This would include rare and endangered (R&E), threatened, protected, endemic, etc. species as determined by the national and International legal status for such species. • Identify important species (vertebrate fauna and flora) of conservation value – i.e. endemic, rare, threatened and endangered species, and Species of Conservation Concern. • Identify vulnerable, threatened or endangered ecological communities and/or habitats. • Compile an Impact Assessment Report, including an assessment of the local natural capital and ecosystem services. • Compile Biodiversity Management Plan to be included in the ESMP
Social	• Delimitation of the study area of the project (geographical scope), based on the typology and nature of the project, and the characteristics of the receiving social environment where it will be developed

	• Secondary data collection (literature review) will be based upon a comprehensive review and analysis of existing information of the following sources: (i) project design information; (ii) research of varied thematic bibliography, including data collected from ESIAs for other projects in the same regions, and other relevant studies and municipal plans; (iii) analysis of topographic and thematic cartography available (such as project specific LiDAR data, land use, cartography produce in the scoping study); and (iv) other data, such as statistic data. The purpose of this survey should not be only to gather a preliminary baseline data about the study area in order to understand the sensitivity of the affected social environment, but also to prepare the basic information that will be used for the field work. The following tasks are proposed: • Interviews will be carried out with local, regional and district authorities, and community leaders. These will be in the form of semi-structured interviews around the following topics (without prejudice to other topics that may be identified and/or substituted in the course of work): population and demographic data, population´s socio-professional structure; economic relations, health and gender issues, symbolic relations, and other relations, between the populations and the territory; current forms of use of natural resources in access to services; and current and potential sources of conflict over the use of natural resources. • Interviews held with a diverse set of key stakeholders from the local population. These interviews will be organised in a collaborative manner with regional and local authorities as well as with local traditional authorities and will seek to ensure the views of all groups, including the most vulnerable (in terms of gender, age and socio-occupational occupation), main health issues and the indigenous peoples. The information to be collected will be organised into a questionnaire following a logical structure, but sufficiently open to accommodate new information that the respondents consider relevant. Updated information will be sought by introducing specific questions to support especially the social and community baseline, understanding the current energy context and communities' expectations about the project. • Analysis of data at both the macro level - with respect to (i) population and population dynamics; (ii) economic activities; (iii) access to water; (iv) cultural aspects (i) identification of the land use; (ii) identification of infrastructures that may be directly affected by the project, such as road network, power lines, etc.

	• Impact assessment and recommendations. • Input with regards to the Grievance Redress Mechanism.
Hydrology	• A thorough investigation of all available literature pertaining to the site hydrology will be gathered. This will include, but not be limited to, the following: • Technical reports and studies carried out on the site. • Meteorological data for the site such as rainfall, runoff and evaporation. • Academic studies pertaining to the hydrology of the site. • Acquirement of any existing topographical survey data of the site. • The layout of the new development will be studied and assessed. • Municipal and National legislation applicable to the project will be obtained and reviewed. • A publicly available digital elevation model (DEM) of the site will be obtained from the Advanced Land Satellite Observation (ALSO) database • A site visit will be carried out by the hydrologist that will be executing the hydrological analysis. • The following will be assessed on the site visit: o Topography of the area and prominent topographical features. o Surface characteristics of the catchment such as slope, land use, surface cover, soils, and vegetation. o All drainage lines, streams and rivers will be examined to understand baseflow, streamflow, channel profile, slope and linings. o Any surface water features within the vicinity of the site will be investigated such as pans and dams. o All existing stormwater management infrastructure will be measured and recorded. o The footprint of the proposed development will be walked over and assessed • All hydrological risks from construction and operational phases will be identified. • Mitigations to reduce the risks will be proposed.

9.1.2 Consultation with Environmental Commissioner

The table below outlines the key stages of consultation with the Environmental Commissioner.

Submission of Application to Environmental Commissioner	The Application for Environmental Clearance Certificate for the proposed development was submitted to the Environmental Commissioner on 14 April 2022.
Comment on Draft Scoping Report	The MEFT: DEAF and MAWLR will be notified of the release of the Draft Scoping Report for public comment.
Comment and decision on Final Scoping Report	In terms of Regulation 12 of GN 30, the Environmental Commissioner must either accept or reject the Scoping Report. The Environmental Commissioner must also decide if the proposed listed activity requires a detailed assessment. If so, the Environmental Commissioner must in writing notify the Proponent to prepare an assessment report, and also notify the MAWLR.
Comment on Draft ESIA	Should the Final Scoping Report and Terms of Reference for ESIA be accepted, the Draft ESIA will be compiled. MAWLR will be requested to approve the Draft ESIA after it was made available for public comment. This is to ensure that the Final ESIA contains sufficient information for MEFT: DEAF to make an informed decision.
Comment and decision on Final ESIA	In terms of Regulation 18 of GN 30, the Environmental Commissioner must within 7 days from the date of reviewing the application - (a) in writing notify the proponent and the competent authority of the decision on the application; and (b) on payment of the fee prescribed in Appendix 2 to the regulations, and subject to conditions, if any, issue the Environmental Clearance Certificate.

9.1.3 Reporting and Public Participation

The draft ESIA report and ESMP including specialist recommendations and findings, will be compiled once the Scoping Report has been accepted by Ministry of Environment, Forestry and Tourism: Department of Environmental Affairs and Forestry (MEFT: DEAF). The Assessment Report will incorporate comments and/or changes recommended by the authority. The contents of the Draft Assessment Report are proposed in Section 9.2. The Draft ESIA Report will be circulated for a 14-day public comment period. The ESIA Report and ESMP will be finalised based on input received during the public comment period, and responses will be circulated to all registered I&APs. The ESIA Report and ESMP, will be submitted to the MEFT: DEAF for decision-making. A copy will also be submitted to the Ministry of Agriculture, Water and Land Reform (MAWLR) for consideration. Once a decision has been made, registered I&APs will be notified whether an Environmental Clearance Certificate has been granted or refused.

9.2 ESIA Report Content

It is proposed that the Assessment Report will have the following contents:

- Preliminaries
    - Non-Technical Summary
    - Cover page with name of project, reference number and date
    - Client's name and contact details
    - List of authors and credentials
    - Executive summary
    - List of abbreviations, acronyms
    - Glossary of terms
    - Acknowledgements
    - Table of contents, including appendices, tables, figures.
- Introduction
    - Description of proposed project
    - Motivation, rationale for the project
    - General environmental background
    - Structure of the DESIA Report (road map)
- Approach and methodology

  - Terms of reference for the DESIA
  - DESIA process followed
  - Public participation process followed
  - Assumptions, limitations and constraints
- Public issues and concerns
  - Group and summarise stakeholder issues and concerns
  - Provide detailed issues and responses report in an appendix.
- Legal and Planning framework
  - Expand on Scoping Report
- Description of project and alternatives
  - Location, site, power line routes, pipeline routes, road routes and alternatives;
  - Major project components and alternatives;
  - Major inputs – raw materials e.g., power, water, construction materials, chemicals, labour, traffic, etc.;
  - Major outputs – solid and liquid wastes, gaseous emissions, dust, noise, products, etc.;
  - Project timetable per phase.
- Description of affected biophysical and socio-economic environments.
- Impact assessment (for each project phase)
  - Direct, indirect; positive, negative;
  - Nature of impact – temporary, permanent; reversible/irreversible; synergistic, antagonistic, cumulative;
  - Magnitude and scale – sphere of influence/impact;
  - Duration – once-off, construction, life of project, persistent;
  - Probability of occurrence;
  - Significance;
  - Confidence limits;
  - Residual impact – after mitigation applied;
  - Comparative evaluation of alternatives;

- Cumulative impacts;
- Stakeholder concerns

- Recommended mitigation measures
  - Provide suggestions for mitigation that are feasible, practical, realistic and agreed with NamWater. The recommended mitigation measures will form the basis of the ESMP.

- Conclusions
  - Compare alternatives and trade-offs;
  - Summarise the main impacts and residual effects after applying mitigation;
  - List the risks and uncertainties relating to the findings and the implications for decision-making;
  - Recommendation to issue Environmental Clearance Certificate.

- Supporting information
  - List of references

- Appendices – all specialist studies, public participation documentation.

10 CONCLUSION

The proposed project aims to meet the ever-growing demand for water in Rundu town. This Final Scoping Report has been compiled to meet the requirements of the EMA (2007). This report discusses the ESIA process and identifies the alternatives under consideration and provides an overview of the baseline environment of the study area.

The Plan of Study for the ESIA is presented in Chapter 9 and outlines how the ESIA is proposed to be undertaken. Specialist studies have been identified on the key potential impacts associated with the project for which sufficient information is not available to assess the impacts in detail. Should any additional specialist studies be required due to comments I&APs, these studies will be undertaken during the ESIA phase.

The Final Scoping Report is herewith submitted to MEFT: DEAF for consideration and decision-making, before commencing with the ESIA phase.

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APPENDIX A

CV OF ENVIRONMENTAL ASSESSMENT PRACTITIONER

APPENDIX B

PROJECT REGISTRATION/ECC APPLICATION

APPENDIX C

LIST OF INTERESTED AND AFFECTED PARTIES

APPENDIX D

BACKGROUND INFORMATION DOCUMENT

APPENDIX E

NEWSPAPER ADVERTS

APPENDIX F

NOTIFICATIONS OF INTERESTED AND AFFECTED PARTIES

APPENDIX G

SITE NOTICES

APPENDIX H

MEETING PRESENTATION, ATTENDANCE REGISTER AND MINUTES

APPENDIX I

COMMENTS AND RESPONSE REPORT

APPENDIX J

LAND APPLICATION APPROVAL FROM RUNDU TOWN COUNCIL