Specialist Report: Flood risk assessment for the proposed site for the raw water storage dam

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1. Introduction

Mr. Mukendoyi A. Mutelo was appointed by Namib Consulting Services to carry out a flood risk and hydrological specialist impact assessment for the expansion of the Oshakati Water Purification Plant. This investigation is part of NamWater's Environmental Impact Assessment (EIA) for the proposed developments relating to the extension of the Oshakati Waterworks.

2. Background

Overall, the project aims to extend the water purification plant in order to attain a daily operational capacity of 90,000 m^3 /day. The new plant was envisaged to extract and utilize water from the existing Raw Water Storage Dam. It is a prerequisite the raw water storage dam should be able to provide guaranteed water supply safety of up two weeks when the canal is not operational. However, evaluation of the raw water storage dam revealed that the existing storage was inadequate and inefficient and has an effective storage capacity that can provide a water supply guarantee for one and half (1.5)days only. Therefore, to achieve the envisaged operational goal, a new raw water storage dam that augments the existing storage is proposed.

3. Rationale and Objectives

The proposed site for the location of the fore dam, forms part of a local oshana area that gets annually inundated by localized rainfall events and at the same time serves as an important wetland area within the local biophysical environment. The area also provides an important conduit and route for floods as it links the upper Cuvelai to the Etosha Pans via the Okatana network of oshanas. Therefore, the objectives of this assessment as required for the EIA Study are:

i. Establish the prevailing topographical flow regimes/drainage to the local oshana
ii. Assess the various flow regimes towards the oshana and resultant risks associated
iii. Ascertain the flood risk of reducing the oshana area extending through development modification

iv. Assess how the reduced area performs in effectively routing the basin-discharge driven episodic floods
v. Assess how the reduced area performs in effectively routing local rainfall-driven floods
vi. Look at measures for safeguarding the fore dam development from flood damage.

4. Location of the Project

The project area is within the town of Oshakati, the main administrative and economic center of the Oshana Region. The beneficiary area includes Ohangwena, Omusati, and Oshikoto Regions. The town and the region are situated within the Cuvelai Delta, which is characterized by shallow drainage channels called Oshanas with pockets of higher-lying land in between.

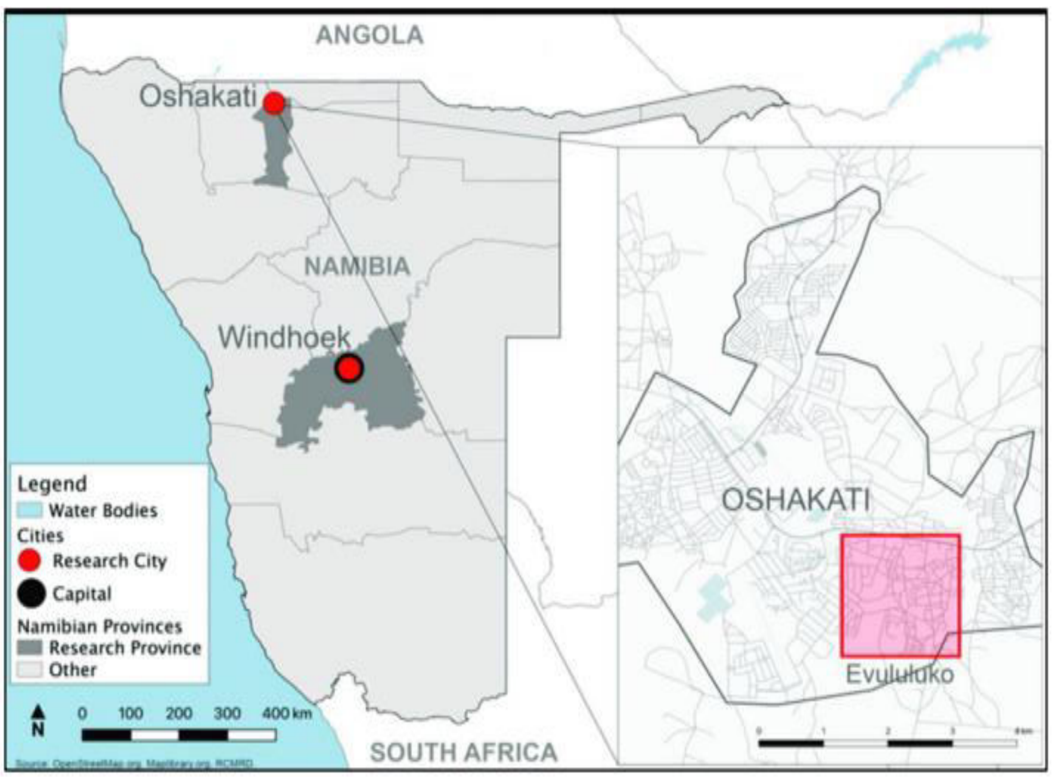

Figure 4-1 Location of the overall project

5. Raw Water Storage Dam Siting

5.1 Overview of the Site

The general site proposed for the development of the raw water storage dam, as seen in Figure 5-1, is part of a semi-wetland oshana, presently under multiple informal uses such as grazing area, human corridor, but importantly flood routing, and supporting semi-wetland type fauna and flora. At local flood regime level, the oshana is categorized as a secondary flooding area (OTC, 2012) and it serves to contain and hold large quantities of rainfall and Cuvelai discharge-based flood water.

Figure 5-1 Oshana hosting the proposed raw water storage dam site

5.2 Proposed Raw Water Storage Dam Designs

The planning and design phase of the proposed extension works designed three proposals for siting and positioning the raw water storage dam. The three alternative designs are presented in Figure 5-2 to 5-4.

5.2.1 Design Alternative 1

This alternative encompasses an area of 38.10 hectares of the local oshana, however extending into the adjacent Oshoopala informal settlement, northwards.

Figure 5-2 Design alternative 1 for raw water storage dam

Figure 5-2 shows the area coverage of proposed Alternative 1. This design blocks the feeding channel and also impounds most of the floodplain while taking up a section of the Oshoopala informal residential area. The proposal also results in the removal of about 729m of canal length in order to accommodate the required dam area.

5.2.2 Design Alternative 2

Alternative 2 is similar to Alternative 1 in area, however the design is shifted eastwards leaving the canal to deliver raw water to the existing fore dam. However, encroaching onto the settlement of Ehenye in the east and further still encroaching onto the Oshoopala informal settlement. Due these encroachments beyond the availed land and onto settlements (Figure 5-3), this alternative was deemed unfeasible and withdrawn from onset.

Figure 5-3 Design alternative 2 for raw water storage dam

A significant portion of the Okatana channel, which is the primary flood water carrying channel is engulfed by the raw water storage dam development and does not allow water to flow downstream stream without mitigation.

5.2.3 Design Alternative 3

Alternative 3 including the dam confining walls requires an area of approximately 22.86 hectares, accounting for about 25% of the total area of the connected floodplain as shown in Figure 5-4.

Figure 5-4 Design alternative 3 for raw water storage dam

The proposed area coverage is such that it allows the Okatana channel to maintain its natural flow characteristics and also ensures that the largest section of the oshana is available to provide ecological and flood routing services.

6. Environmental setting

6.1 Drainage and Climate

In general, north-central Namibia is part of the Owambo Basin, an ancient depression filled with sediments and surrounded by hills and gently undulating sand dunes. The region's prominent physiographic characteristics relates to wide low-lying areas with an apparent lack of terrain relief. The climate is semi-arid and characterised by rain that varies greatly in quantity and timing. Almost all the rain falls during the months of February to April. The annual rainfall in Oshakati can be as low as 300mm in drought years. However, normal rainfall seasons annually vary between 500 and 600mm.

6.2 Historic Flooding

The Oshakati Town and surrounding areas in the Oshana region, historically experiences episodic flooding of various magnitude. The years 2008 to 2011 forms an era in history where higher floods with extensive economic and social impacts occurred. These floods emanated from local rainfall and higher volumes of flow received from upper Cuvelai basin in Southern Angola. Figure 6-1 shows the flood impacts of 2009 in the Oshana.

Figure 6-1 Regional floods of 2009 (source: GRN, 2009)

While local rainfall frequently causes local flooding in the area, larger floods are driven by discharge coming from the highlands of the Cuvelai Basin in Angola. The occurrence, frequency and magnitude of these floods are both erratic and variable. Mendelson et al. (2000) and other authors report that medium or high flow occurs between four to ten years on average. There is no study that has been found to fully identify the frequency of occurrence of flooding events in the Cuvelai particularly in the context of climate change

6.3 Oshakati Town Council Flood Masterplan

The Oshakati Town Council (OTC) flood masterplan categorizes the oshana proposed to host the raw water storage dam as a secondary flooding area occupying a critical role in the overall flood management masterplan.

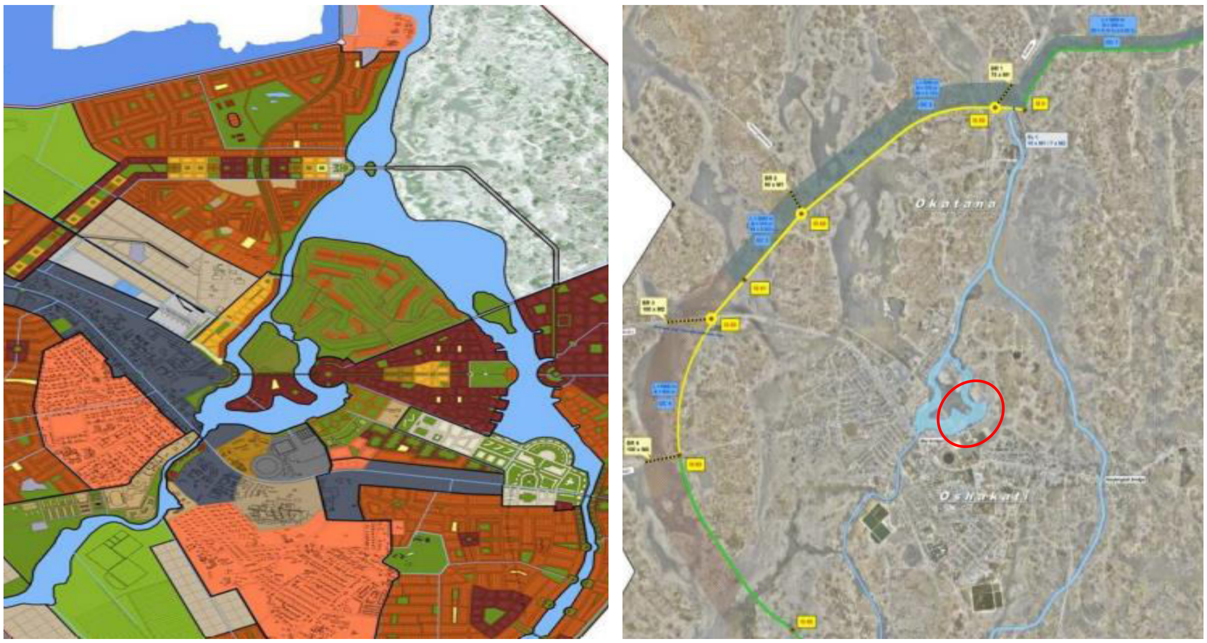

Figure 6-2 Oshakati Flood management and flow routes (source: OTC, 2010)

Figure 6-2 shows the envisaged flood management plan which is centered around widening and deepening of the primary feeding and using the oshana to route the flood water further south towards the Etosha Pan. Based on the flood management plan, a second channel is envisaged from the feeding Okatana channel in a southwestern direction to have a two prone channel flow system that prevents flooding of the residential areas. Presently, the development of a second channel has not been carried out. Therefore, all flows are carried through the naturally existing channel network which moves to the area of the proposed raw water storage dam, marked in red in Figure 6-2.

7. Legal Instruments

The key national legal and policy frameworks underpinning this study are:

i. The Constitution of the Republic of Namibia

ii. The 2009 Disaster Risk Reduction (DRR)
iii. Water Act of 1956
iv. Environmental Management Act of 2007
v. National Heritage Act 27 of 2004

In summary, these aim towards achieving sustainable development by preserving the ecological and biophysical functions of the receiving environment, preservation of heritage and cultural sites, as well as preventing disaster and risk of development.

8. Methodology and Approach

8.1 Flood Hazard Mapping

This study first undertook a historic flood risk assessment i.e., information on floods that have occurred in the past to understand the general flood risk characteristics. The second facet relates to undertaking predictive analysis of flood inundation and identify flood prone areas based on lumped flow modelling.

The ability of flood models to identify sudden changes in inundation extent and water level from digital elevation models, is a distinctive feature that influences flood hazard assessment. Hence, flood hazard assessment and inundation mapping were done using the HEC RAS 2D model by imposing lumped flow. This model is well adapted for hydraulic computing water and flood extent coverage in 2D. The process started in the flowing sequence;

i. hydro-processing the flow direction and connectivity using GIS tools.
ii. Subsequent flood inundation modelling using HEC-RAS 2D - The minimum cell size i.e., individual unit available to accumulate flood was set at pixel size of 3 x 3m.

The flooding inundation of the following lumped flow quantities were evaluated:

- 5m^3/s discharge via oshana network of Okatana
- 10m^3/s discharge via oshana network of Okatana
- 23 m^3/s discharge via oshana network of Okatana (1:50 year flood, Source: Oshakati Flood Masterplan)

- 50m³/s discharge via oshana network of Okatana (1:100 year flood, Source: Oshakati Flood Masterplan)

The magnitude of the 1:50 and the 1:100 year floods were found from literature especially the Oshakati flood Master Plan. Based on benchmarking processes and convenient sampling, the lower magnitude of floods included in this study were set at 5 and 10m³/s.

8.2 Hydro-Processing of Terrain Relief and Ground Relations

The Town of Oshakati and the entire Oshana region is characterized by flat terrain and gently undulating ground terrain. Figure 8-1 and 8-2 show the terrain elevation profile over the area covering the proposed fore dam site. Overall, it can be seen that the terrain elevation ranges between 1090 and 1110masl with the median found between 1099 and 1101. It is notable that sections within the surrounding residential areas have elevation below the oshana.

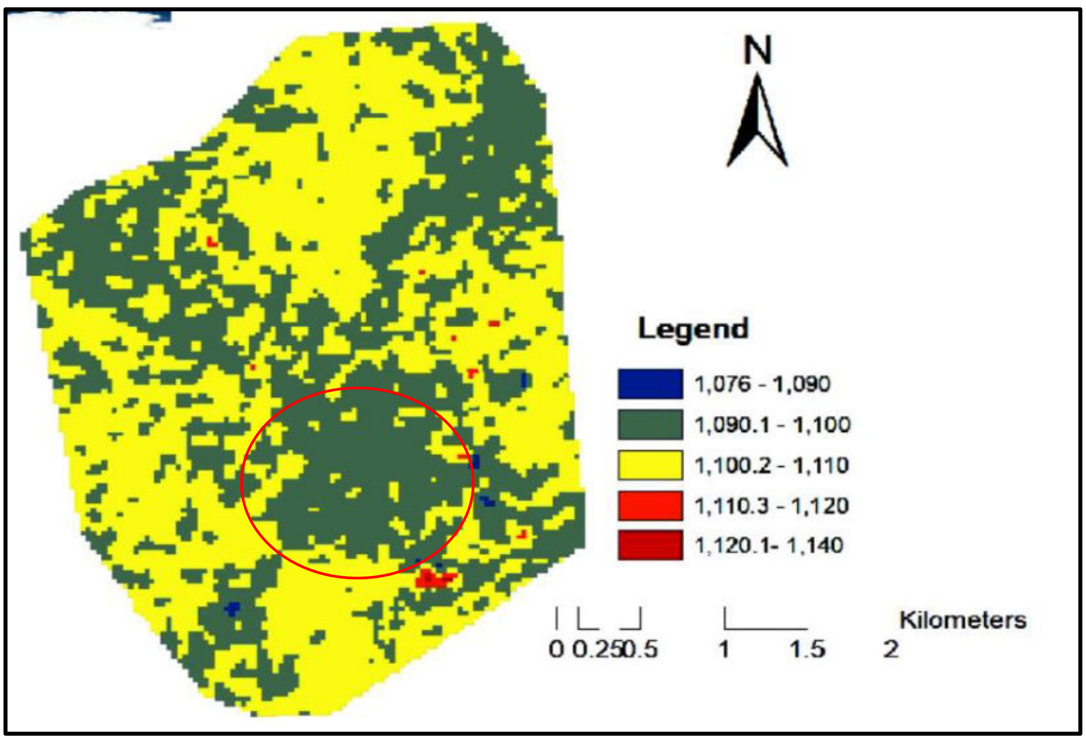

Figure 8-*1* Digital elevation model

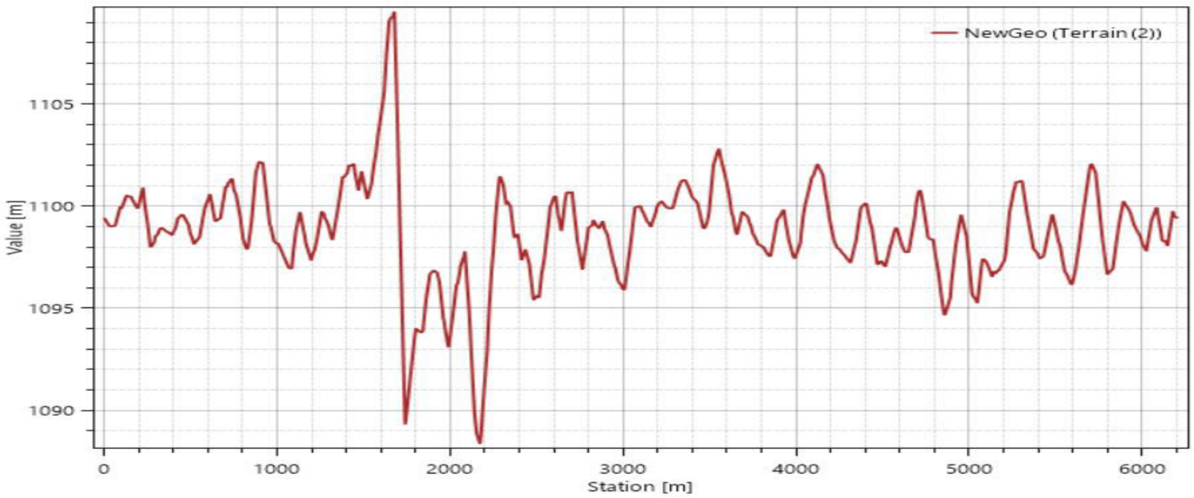

Figure 8-2 Elevation profile along a longitudinal slice of the terrain model of the oshana

Figure 8-2 above shows the elevation profile from a longitudinal slice of the digital elevation model taken across the east to western direction. It is seen that the middle section of the oshana is relatively high-lying as shown by a spike in the elevation profile.

9. Flood Risk and Inundation Extent Mapping

9.1 Flood Inundation Mapping depicting flows in an undeveloped oshana

9.1.1 5m^3/s Discharge Rate Flood Risk Assessment

Typically, the surface flow from Angola spreads via a network of oshanas. In respect to the area of interest to this study, the primary flood accumulation point is the Okatana network of oshanas. These oshanas subsequently transmit the flow through to the secondary floodplain located near NamWater Waterworks via broad shallow channel. The Okatana floodplains also have another major outlet via the Okandjengedi channel.

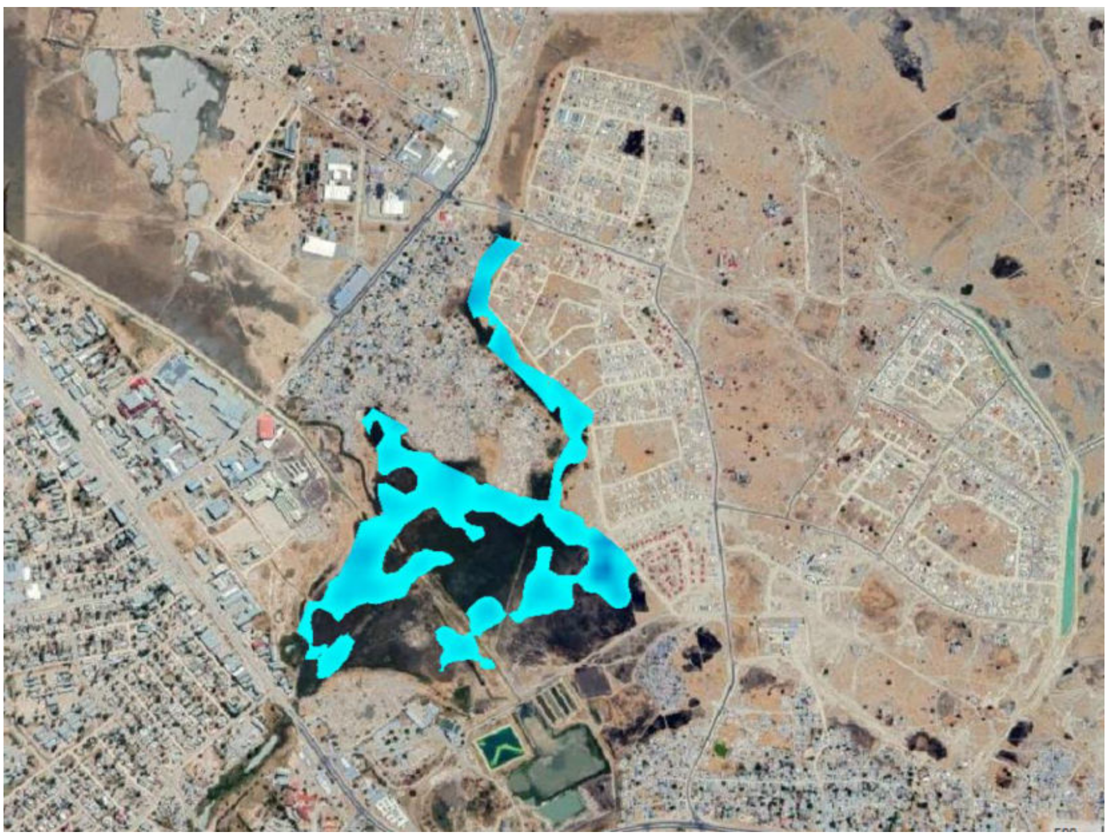

Figure 9-1 Flood inundation based on 5m^3/s

The inundation predicted for 5m^3/s discharge released from Okatana area can be seen from Figure 9-1. This magnitude of flood covers about 35% of the total oshana area where the raw water storage dam is proposed to be located. The flow within the oshana is typically shallow and associated with low velocities. The average inundation period is 3 to 5 days, after which the flow would have been transmitted further southwards.

9.1.2 10m^3/s Discharge Rate Flood Risk Assessment

Doubling of the discharge to 10m^3/s increases inundation and results in a flood extent coverage of 75% of the total area of the local flood plain. The velocities associated with this flood discharge, dissipates rapidly as in enters the oshana and generates an inundated area that varies greatly in depth.

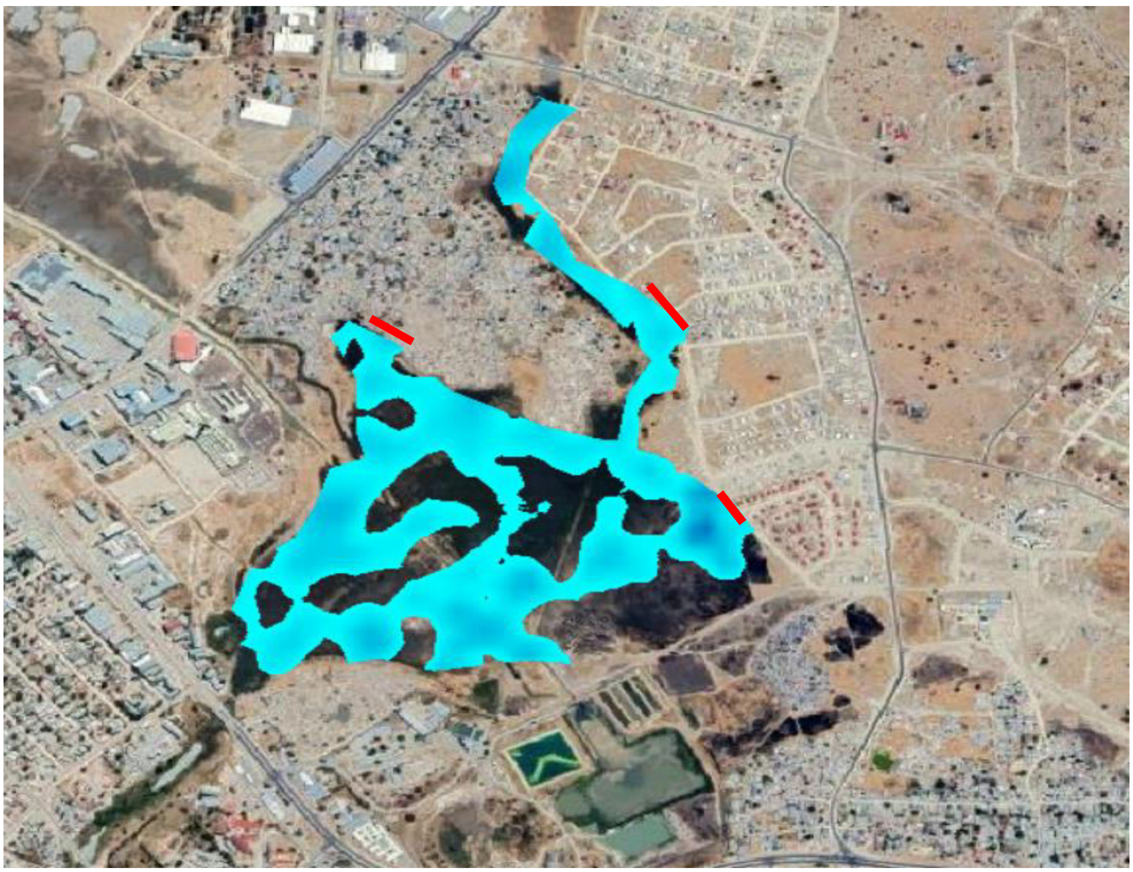

Figure 9-2 Flood inundation based on 10m^3/s

Figure 9-2 shows the inundation area extent in the oshana from a 10m^3/s discharge regime. The flow pattern in the oshana is such that it typically spreads in the easterly and westerly directions relative to the flow and fills the floodplain area from the sides. The average flow depth of the flood water covering the oshana from a 10m^3/s discharge is less than 0.5m, however sections of up 3m are observed especially occupying the proposed site for the raw water storage dam. This trend, indicates that the middle sections in the oshana undulates gently upwards, creating a local high-lying zone that pushes the water to the sides where the elevation is lower.

The area to the eastern section of the oshana directly lies on the proposed site for the fore dam development, indicating an associated flood risk. Also, at this level, the risk of flooding towards the section of the surrounding residential areas starts to be apparent. Sections identified as threated and within flood risk zone at this are level of flooding are marked in red in Figure 9-2.

9.1.3 High Flood Regimes (23m^3/s +)

The 1:50 and 1:100-year floods represent severe flooding, occupying 95 to 100% of the oshana and creates flood in large sections of the adjacent residential. The flood model was set to confine the flow in the oshana, however, at 1:50 and 1:100-year flooding regimes, it is seen that the flow marginally extended beyond the confined area and started to cause flooding to the areas adjacent to the flow channel and the oshana as shown in Figures 9-3 and 9-4.

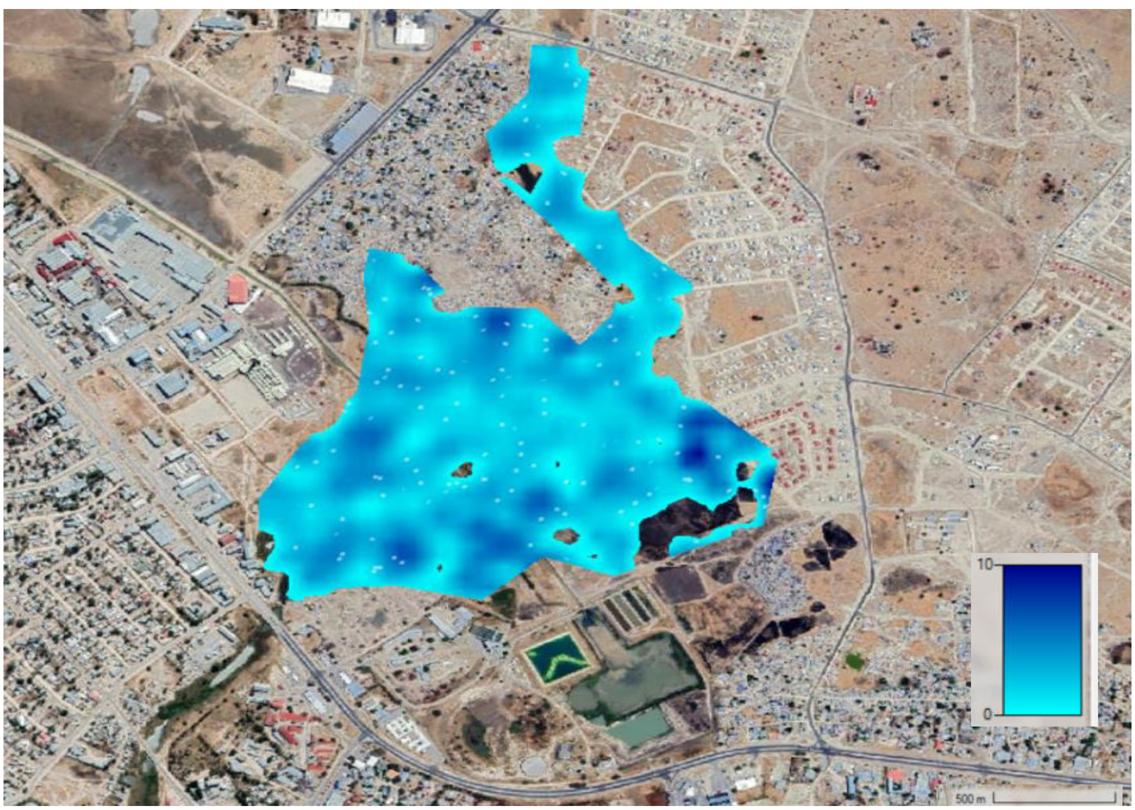

Figure 9-3 Flood inundation map based on 1:50 year flood

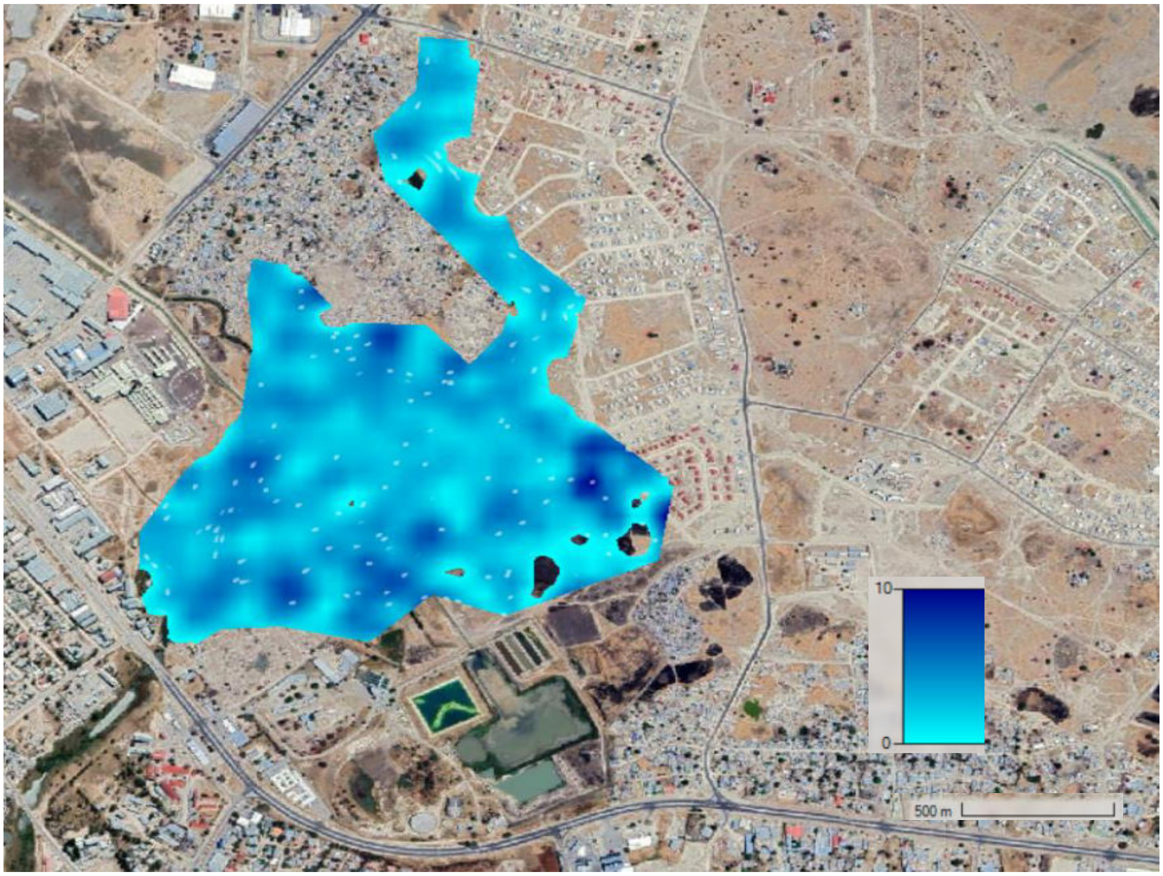

Figure 9-4 The 1:100-year flood inundation map

The inundation maps also show that the flow confined to the oshana for these flood regimes maintains wide depth profile where some sections are inundated at a depth of 0.5m and other sections up to a 7m depth. It is known that the natural characteristics of the oshana creates a situation where one the water exceeds a depth of one meter it is likely to spread beyond the oshana and cause flooding in the surrounding residential areas. These two flood regimes create flooding that occupies fills the entire oshana and extending outward to the residential areas. The flood risk and flow duration dissipate within 5 to 7 days, as the flow transmits further southward.

9.1.4 Flow Velocities in the oshana

Flow velocity profiles associated with the 1:50 and 1:100 year floods can be seen in Figure 9-5. It can be seen from the flow velocity maps that in the channel flow occurs at mostly 0.1 to 1m/s with few sections where velocities are greater than 1m/s. In both flood regimes, flow in the channel area effectively flows over a five-day period at velocities between 0.02 to about 1m/s.

However, it is observed when the flow enters the oshana, its velocity is greatly reduced as the flow begins to spread slowly west and east before wholly inundating the oshana.

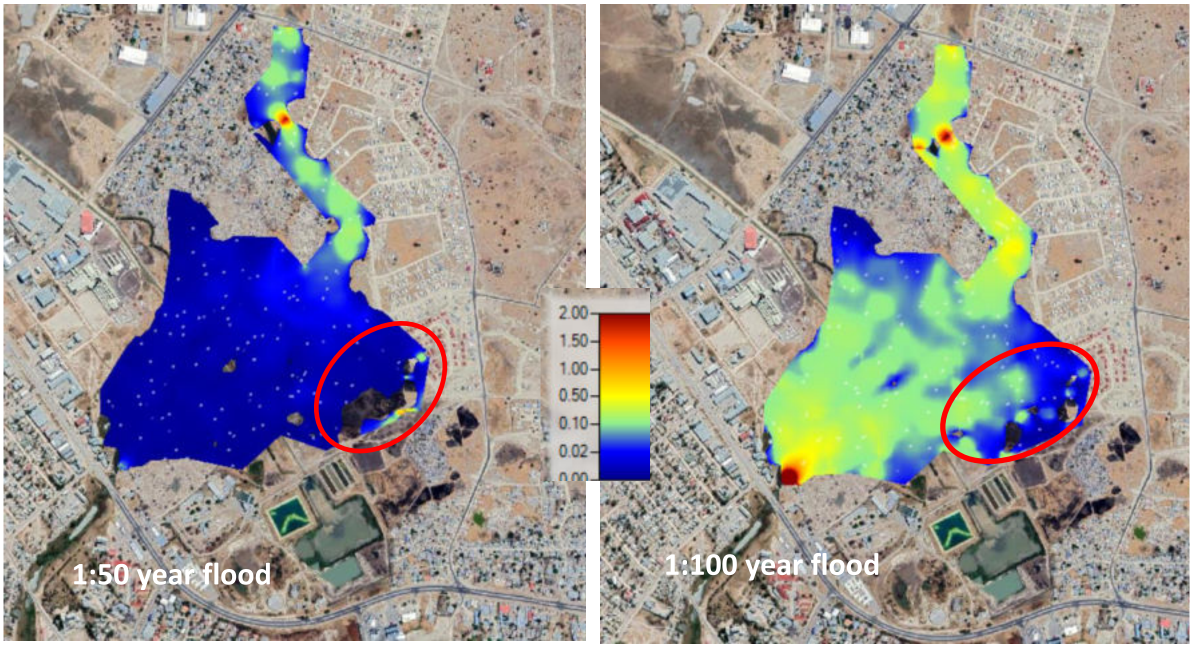

Figure 9-5 Flow velocities associated with 1:50 and 1:100-year floods

This observation is interpreted to show that the oshana provides a stilling effect to the flow and the water spreads at average flow of less 0.05m/s in the 1:50 flood while the 1:100 flood moves across the floodplain area at velocities between 0.02 and 0.5m/s. The section of the floodplain where the proposed fore dam site is located, appears to accumulate deeper water levels flowing at very low velocities.

9.1.5 Flooding Impact of Point Rainfall

The annual rainfall in Oshakati can be as low as 300mm in drought years. However, normal rainfall seasons annually vary between 500 and 600mm. Hence, local rainfall flood risk is linked to rainfall intensity and the duration of the risk ranges from a few hours to a day. The impact is much localized and dependent on the flow connectivity to adjacent receiving points.

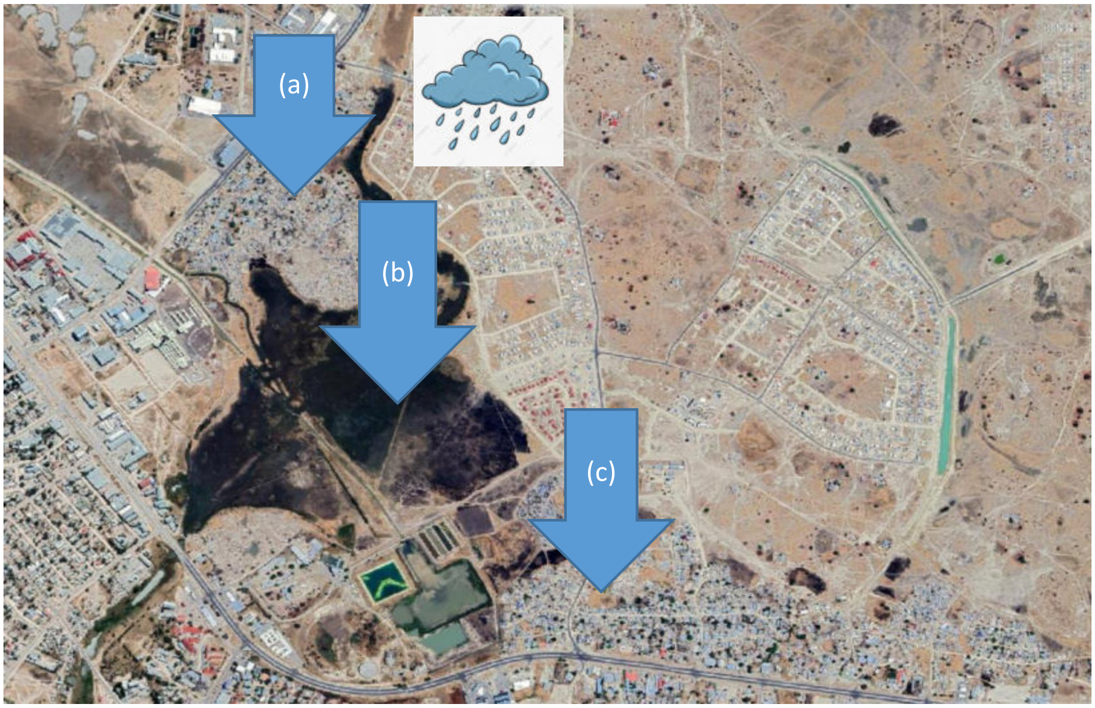

Figure 9-6 Rainfall flooding scenario presentation

A flood scenario assessment, of the floodplain area proposed to host the fore dam was performed and found that, the potential risks from rainfall are negligible and do not warrant any management response associated with the development of the fore dam. Point rainfall of 100mm intensity was made to fall over a local receiving area covering settlement areas marked points (a) and (c), and the adjacent oshana set as point (b) in Figure 9-6, with uniform distribution over five hours. By superimposing the terrain relief model presented in Figure 8-1, the flow pattern over the flooding cells showed a tendency of rainwater flowing from localized high-lying areas and accumulate at only adjacent low-lying cells with active flow connection.

From Figure 8-1 presenting the terrain elevation, it was observed that certain sections in the residential areas are situated on areas of lower elevation compared to neighbouring ervens. Hence, at an intensity of 100mm over five hours, the catchment response of the oshana is to generate stormwater of approximately 90 000m^3 in volume. The oshana is large and well adapted to contain this volume at an evenly distributed depth of 0.1m. On the other hand, when the same rainfall falls over a settlement area of five connected ervens of 300m^2 hosting housing unit of approximately 100 m^2 each. These erven will produce approximately 150m^3 total of stormwater. This stormwater subsequently follows a local path to the nearest flow-connected low-lying erven and elicit flooding for a duration of time. Consequent to the referred flow characteristics, is that the greater risk of stormwater based flooding is from direct precipitation. This is problematic in that the vast areas of the town do not have stormwater drainage systems except minimal, as such point rainfall is responsible for such flooding in locations where low-lying areas accumulate standing water while remaining unconnected to the stormwater accumulated in the Oshana's and the proposed fore dam area. The effect of such point rainfall does not have any linkage to impacts generated from the development of the proposed alternative designs.

9.2 Flood Risk Evaluation for Feasible Raw Water Storage Dam Design

The evaluation of the flooding risk of each alternative is based on an assumption of a discharge rate of 10m3/s. This discharge is considered more reasonable and within norm to occur annually than the discharge rate for 1:50 and 1:100 year pattern.

9.2.1 Alternative 1 – Flow and Flood Risk

Developing the raw water storage dam based on proposed alternative 1 modifies the natural state of flow and effectively imposes reservoir characteristics in the area behind the dam wall. Figure 9-7 shows the extent of flooding and the pattern of inundation in the oshana when a flood magnitude of 10m^3/s discharge is imposed on the oshana through Okatana channel. It can also be seen that only the western section of the oshana retains its natural functions of flood routing when the said development alternative is implemented with no mitigation measures imposed. The settlement west of the channel becomes greatly affected by severe flooding from a low flood discharge, requiring implementation of multiple measures of flood mitigation including the relocation of the residents and creation of the proposed western second channel as per Oshakati flood master plan.

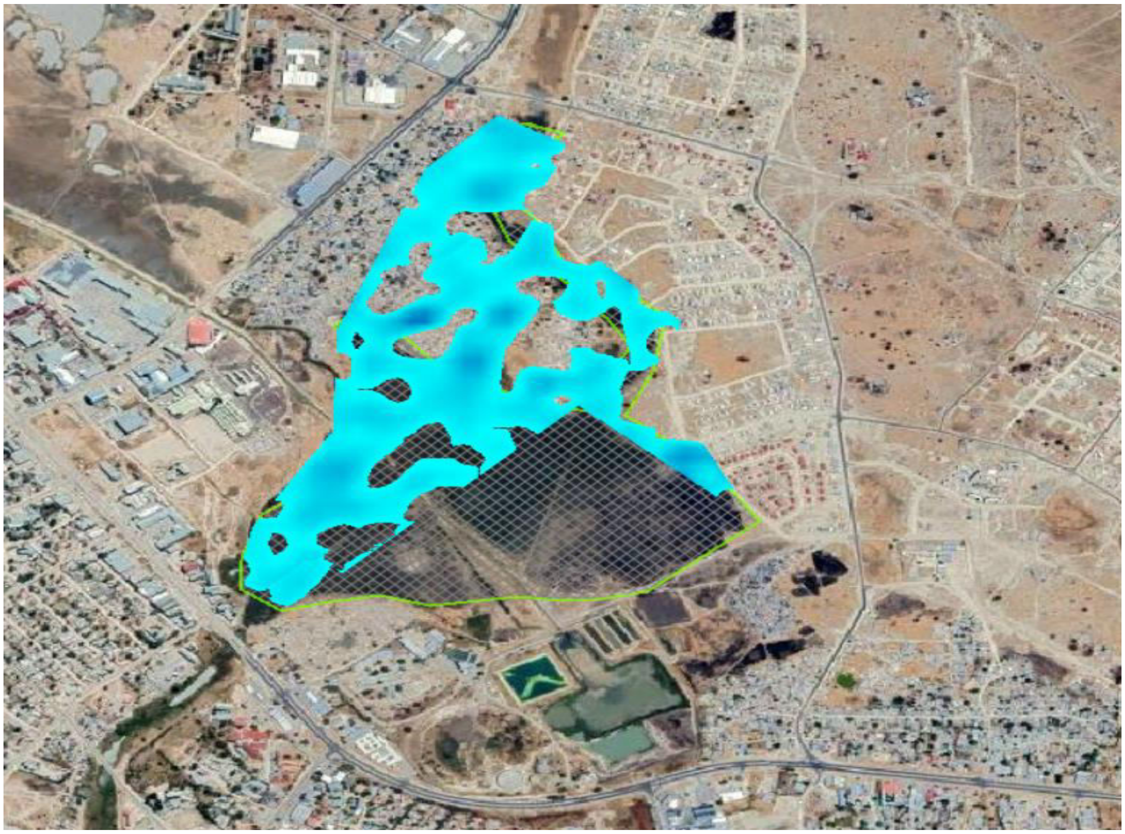

Figure 9-7 Flow pattern associated with unmitigated implementation of proposed alternative 1

The flood risk and impact relating to the implementation of proposed alternative 2 is similar to the observed flooding pattern of developing alternative 1. It is expected that alternative 2 will mimic and exacerbate the impacts associated with alternative given that they are similar in design area coverage and at the same time alternative 2 closes off a major portion of the flow channel.

9.2.2 Alternative 3 – Flow and Flood Risk

The flow pattern and flood inundation risk associated with developing the raw water storage dam based on proposed Alternative 3 is presented in Figure 9-8. This development scenarios allows the channel to flow into the oshana and the resulting flooding associated with a lumped flow of $10m^3/s$ via Okatana channel.

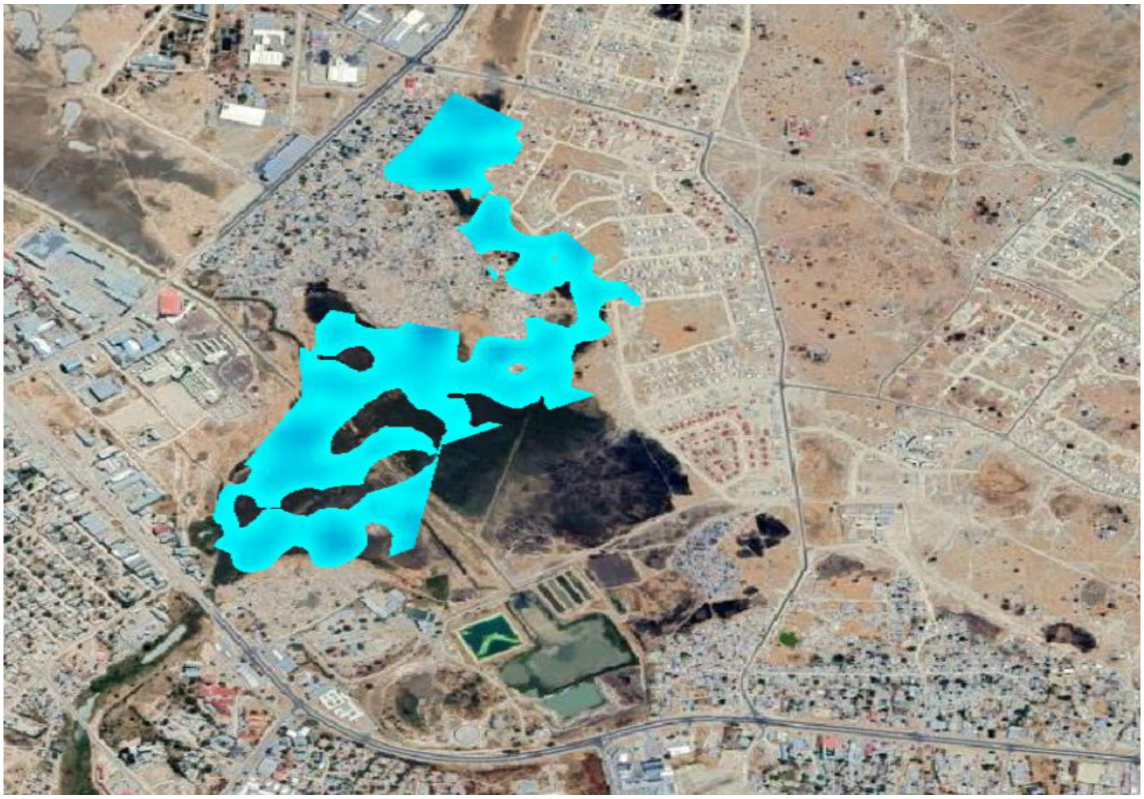

Figure 9-8 Flow pattern *associated with unmitigated implementation of* proposed alternative 3

The results show that the developed raw water storage dam constricts flow such that it causes flooding risk upstream and along the channel. Sections of the surrounding residential areas both to the east and west direction of the channel begin to get flooded. A large part of the oshana also retains its natural functions in terms of routing floods and supporting semi-wetland conditions..

10. Evaluation of Impacts

Section 6 of this report presented information demonstrating that the oshana over which the raw water storage dam will be built has been identified as an active flood route and is integral to the overall flood management masterplan of Oshakati Town Council. On the other hand, Section 8 presented the pattern of flow along the Okatana channel and how the oshana acts as a natural flood control entity by holding water and also dissipating the velocity of flow before transmitting the floodwater southwards via the downstream receiving channel at Oshakati skybridge. It is believed that for this specific environmental service and capacity to effectively reduce the speed of incoming floodwater, that it was identified and selected as a major flood route within Oshakati Town. The following impact analysis is made;

Table 10-1 Identified impacts matrix

Activity	Impact	Impact nature (+Ve, -Ve, /)	Extent	Duration	Intensity	Probability	Significance
Alternative design 1 & 2	Flooding of adjacent area	-Ve	2	4	3	4	15
	Disturbance to flood routing of the oshana	-Ve	1	3	3	4	11
	Relocation of settlement due to flood vulnerability	-Ve	2	4	3	4	13
Alternative Design 3	Flooding of adjacent area	-Ve	2	3	2	2	9
	Disturbance to flood routing of the oshana	-Ve	2	2	2	2	8
	Relocation of	-Ve	2	3	2	2	9

	settlement due to flood vulnerability						

The results of the impact analysis indicate that the alternative 1 is a high risk and requires a change of the entire project scope relating to the placement of the fore dam. However, alternative 3 presents a feasible alternative to consider for further development.

Bearing the location of the Oshakati water purification plant and its importance to the Oshana region and other benefiting regions of Ohangwena, Omusati and Oshikoto, there is limited areas available for hosting the raw water storage dam to secure raw water for the envisaged development in proximity. Hence, it is imperative that the raw water storage dam for the expanded Oshakati water purification plant be developed on a portion of this oshana based on alternative 3. Hence, the direct impact identified are as follows:

i. The proposed raw water storage dam in all alternatives, forces the relocation of a planned route for channeling flood downstream in a controlled manner. The flood route that will require to be shifted to different section of the oshana is shown in Figure 6-2.
ii. Design Alternative 1 and 2 for the raw water storage dam creates enormous flooding to the surrounding residential areas and the development may be associated with complex mitigation measures that could potentially have unwarranted financial implications. Therefore, these alternatives should not be recommended for development.
iii. The area of the oshana that remain in its natural state and available to provide floodplain services such as flood routing will be reduced in size
iv. The fore dam becomes an infrastructure of high socio-economic value that needs to be safe guarded from incoming future flood water especially the 1:50 and 1:100-year floods.
v. Triggers need for economic/financial investment into alternative flood control/mitigation mechanisms

Point rainfall from time to time creates local flooding but there are no impacts that could be identified and attributable to the proposed development. The settlement areas adjacent to the proposed development are affected by rainfall that they directly receive. The oshana traps massive quantities of rainfall water but discharges it safely downstream through the outlet channel by the Oshakati skybridge.

11. Mitigation of Impacts

11.1 Mitigation for Reduced Oshana/Floodplain area

Figure 10-1 shows the location of the most suitable option for the proposed development site. This area covers about 22.86 hectares which is approximately 25% of the entire oshana which covers an area of just over 90 hectares. The northern part of the proposed dam is a high flood water concentration point.

Figure 11-1 Modified Design to Alternative 3

<u>Recommendations</u>

The following mitigation measures are recommended for minimizing the impact and increase the size of the oshana kept in natural state:

i. Without prejudicing the intended functions of the raw water storage dam, to change the dam to a rectangular shaped dam. This moves the dam wall away from major flood concentration points. The proposed alternative shape is outlined in yellow.

ii. Consider and explore the viability of increasing the depth to allow for reduced area extent of the dam while achieving the same amount of storage
iii. Introduce integrated raw water storage by reducing the size of the proposed storage dam capacity and extend the size of existing raw water storage dam so that their combined capacities can guarantee the required water supply safety when the canal is not in operation

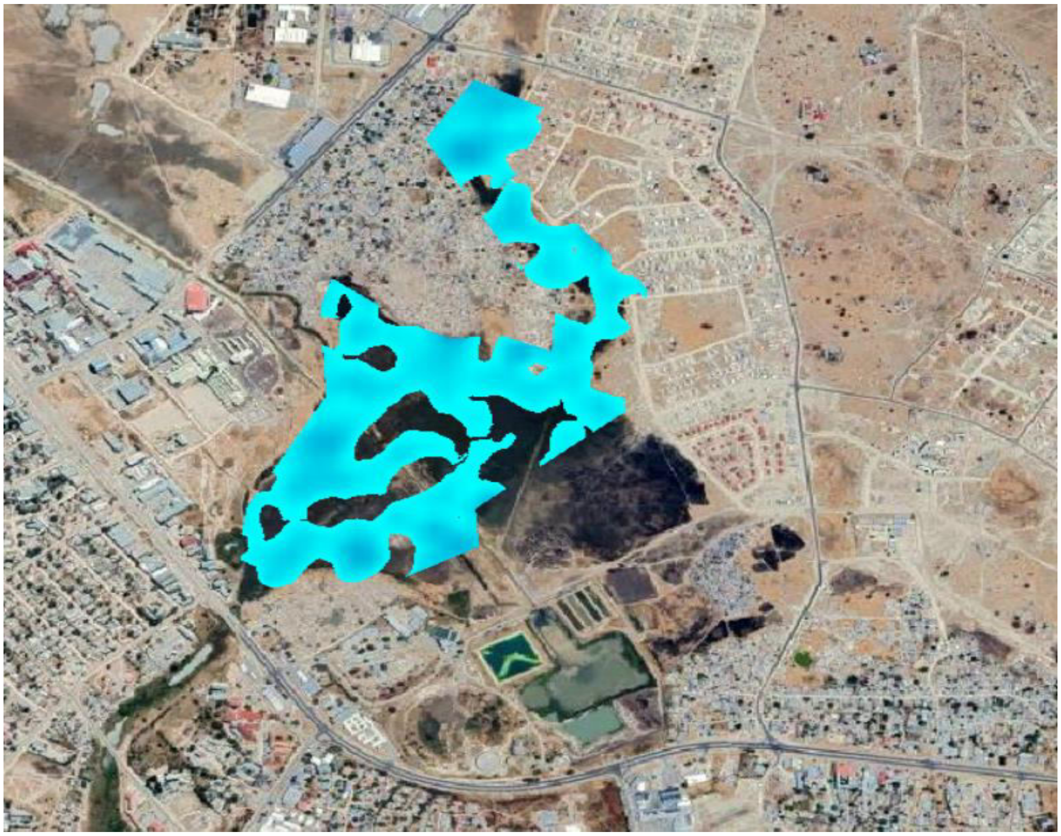

Figure 11-1 Flood pattern associated with the unmitigated implementation of the modified Alternative 3

The flood risk and area extent inundation based on the implementation of the proposed modified design to Alternative 3 is presented in Figure 11-2. It can be seen that this represents the most effective way to achieve the required raw water storage while preserving a large section of the oshana in natural state. Hence, this is the recommended intervention towards the development of the raw water.

11.2 Mitigation Against Reduced Flood Routing

The plan set out in the Oshakati Town Council Flood Masterplan indicate that the floodwater received from the Okatana channel will be transported across the oshana in control manner by depending on a channel going to the eastern direction of the oshana before the same channel turns to a southward direction. The described route will be occupied by the raw water storage dame and considering the location of the water purification plant and its regional importance, there is no other possible location except on this oshana, hence, mitigation measures need to be put in place to ensure that ensuing flood continue to transmit in a controlled manner.

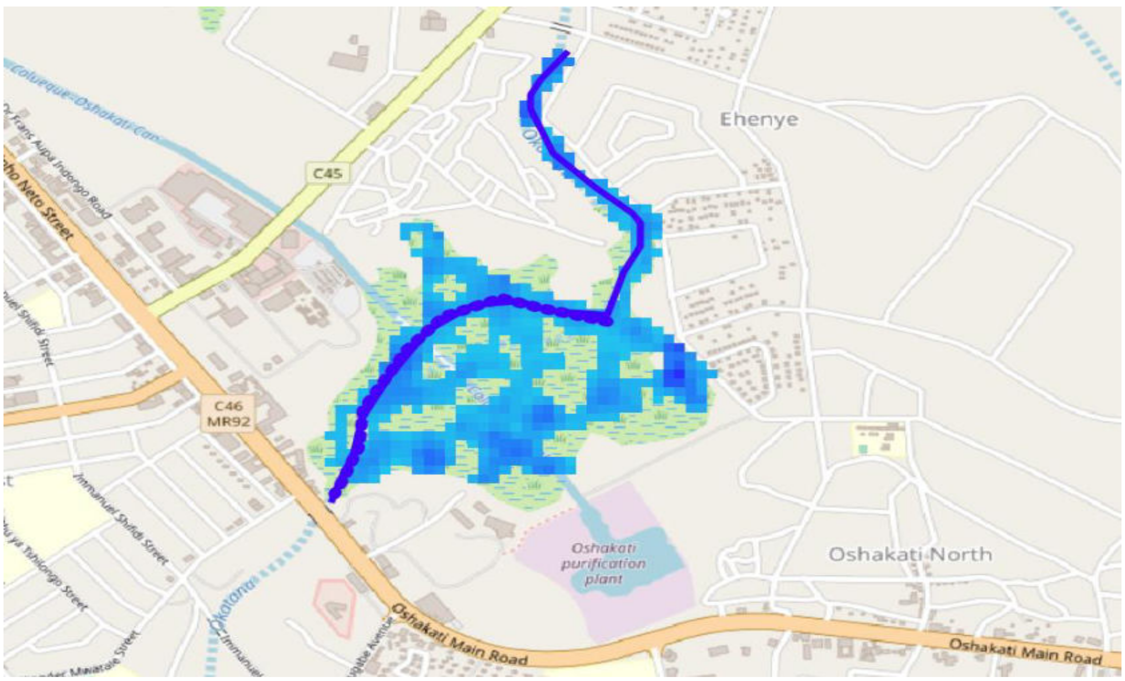

Figure 11-2 proposed channel modification

The following mitigation measures have been identified:

<u>Recommendation 1</u>

i. Implement the measures outlined in the Oshakati Flood Masterplan. The flood master plan recommends the deepening and widening of the Okatana channel (represented by the solid blue river centre line in Figure 10-2) and use the soil filling removed from the deepened center line of the river to raise the channel bank along the whole channel up to the beginning of the oshana.

ii. The flood masterplan also recommends that a modification be made to the skybridge to increase its capacity to allow water to flow past.

Narrative: The section of the river recommended for modification is presented by a blue solid in Figure 10-2. It is known that flooding has been occurring in the area before this development, hence flooding along this section of the river is not a direct effect of the development, however, it is integral to the successful mitigation of the flooding impacts of proposed development. The custodian of the flood masterplan is the Oshakati Town Council; hence dialogue is recommended between NamWater and Oshakati Town council to seek joint solutions in terms of improving the channel capacity to transmit flow effectively.

Recommendation 2

i. Create an excavated channel to contain and direct the discharge received in the oshana. A 30 to 40m wide channel and a depth of 2 to 2.5m is well capable of transmitting extreme floods at the flow velocities of 0.1 to 1.5m/s. This is a mitigation measure against direct impacts of the proposed raw water storage dam development; hence, the developer should remain ready to implement this measure while seeking to possibly collaborate with the custodian for the flood masterplan given that many measures in the referred masterplan have not been implemented.
ii. The center line for the proposed channel across the Oshana is presented as a blush dash line in Figure 10-2. This maintains some of the natural functions of the oshana by allowing the middle section to maintain typically oshana ecosystem functions. This is also critical because it allows a flood safety structure to be built on the middle in order to safeguard the proposed development dam from flood damage. The process to excavate and expand the proposed channel, will require surveying and step-wise procedures in respect of ensuring that it is done suitably.
iii. The client should look to establish dialogue with the Oshakati Town Council in order to explore possibilities for the Town Council to implement some of the measures in the Oshakati Flood Master Plan such as expanding the Oshakati Sky-bridge and the receiving

channel. This is vital since is will allow for the measures implemented during the development of the fore dam to be more effective and integrated within the broader context of the flood master plan. Without collaboration with Oshakati Town Council, then there is a risk that when larger magnitude floods occurs, the impacts at the sky-bridge and downstream of it, maybe coupled to the fore dam development while the main cause is a general lack of intervention and poor implementation of the measures set out in the Oshakati Town Council Flood Master Plan.

11.3 Safeguarding the Raw Water Storage Dam

The flooding risk posed after the development was identified given it will be located in an active flood zone, requiring measures to safeguard against flood damage.

Figure 11-3 Proposed dyke for protection of the dam against flooding

The flood zone is represented by the meshed structured superimposed on a google satellite image showing the oshana inundation zones. Hence, a dyke or embankment structure is proposed to safe guard the dam from flooding. The centre line for the proposed dyke structure is represented by the brown line in the figure above. This allows for the measures proposed above and those measures in the Oshakati masterplan to be implemented. The section of excavated channel across the oshana where excavation and channel modification is proposed is presented with a sold blue line in Figure 10-3. The design and material used for the dyke should create synergic resistance to flood damage in order to protect the dam from flood damage during very high floods.

11.4 Re-Evaluation of Impact Based on Mitigation

Table 11-1 Re-evaluated impacts matrix

Activity	Impact	Impact nature (+Ve, -Ve, /)	Extent	Previous significance	Duration	Intensity	Probability	Significance
Alternative Design 3	Flooding of adjacent area	-Ve	1	9	1	1	1	4
	Disturbance to flood routing of the oshana	-Ve	1	8	2	1	2	6
	Relocation of settlement due to flood vulnerability	-Ve	1	9	1	1	1	4

12. Summary of Recommendations

In summary of the findings of this study, the emphasis is placed on the following recommendation;

- Alternative site 3 is recommend notwithstanding the associated proposed mitigation measures.
- A channel should be excavated across the oshana going around to the western direction before orientating southward.
- The Okatana channel should be excavated, and banks elevated to ensure that the proposed development do not exacerbate flooding impacts for the respective flood discharge.
- A dyke of suitable design and building material should be constructed to safe guard the raw water storage dam from flooding.

13. References

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Assessment of the Raw Water Storage Dam Capacity And Hydraulic Condition Of The Oshakati-Ogongo Canal

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Abstract

The extension of the Oshakati Water Purification Plant overall, aims to extend the water purification plant in order to attain a daily operational capacity of 90,000 m3 /day. The new plant was envisaged to extract and utilize water from the existing Raw Water Storage Dam (RWSD). Hence, a prerequisite that the existing raw water storage dam should be able to provide guaranteed water supply safety of up two weeks when the canal is not operational. To verify the capacity of existing raw water storage dam in respect of providing the required water supply safety and the canal's ability to transport the required amount of water, an evaluation study was required.

As such, a bathymetric study was completed using a single beam depth sounder to obtain the water depth and bottom elevation profile, also, a calibrated 20mm sediment core trapping pipe was used to measure the sediment depth. The Hydraulic performance of the canal was performed using HEC-RAS model.

The results showed that the existing raw water storage dam has the potential capacity t0 provide guaranteed water supply safety for only one and half days at the envisaged production of 90,000m^3 per day. Hence, there is a need to develop an alternate raw water storage dam that can meet the water supply safety requirements independently or conjunctive to the existing dam. On the other hand, the canal water transportation capacity is greatly variable, with a maximum potential to transport about 1 to 1.5 m^3/s when the roughness condition is maintained in a better condition, mostly when Manning's roughness is at n=0.010. At a roughness value of around n=0.018, the canal seems to overflow, and adapted to transporting a lower discharge

1. Introduction

The Government of the Republic of Namibia, through Namibia Water Corporation (Nam Water), is implementing the "Oshakati Purification Plant Extension (C-NOSH116) Project [OPPEP]" as a part of the "Namibia Water Sector Support Program (NWSSP) with funding from the African Development Bank (AfDB). The Oshakati water purification plant extension project is a national priority investment to expand and improve water supply service in the project area, i.e., urban centres and rural areas of the Oshana, Ohangwena, and Oshikoto regions.

Overall, the project aims to extend the water purification plant in order to attain a daily operational output of 90,000 m^3 /day. The new plant is envisaged to extract and utilize water from the existing Raw Water Storage Dam (RWSD). Therefore, it is a prerequisite that the raw water storage dam can provide guaranteed water supply safety of up to two (2) weeks when the canal is not operational. An assessment to verify the capacity of the existing raw water storage dam in respect of providing the required water supply safety was required as part of the overall project planning and design.

2. Objectives and Scope of Work

The general purpose of this study is to undertake a bathymetric survey to ascertain the storage capacity of the existing fore dam and estimate the volume of accumulated sediment. The main aim of the assessment and evaluation of the study was to:

i. Ascertain adequacy of the fore dam capacity in respect of complying with the management objective to ensure that the dam can guarantee up to 14 days of water supply safety under no-canal operation
ii. Estimate the volume of accumulated sediment at the base of the dam
iii. Predict the hydraulic condition of the Ogongo-Oshakati Canal using 1D flow modeling

Limitations

The scope of this study was limited to performing a bathymetric study, which involved measuring the water depth profile in the fore dam. No topographic survey was conducted. Futher to this, canal study was purely based on model simulations, few field data points in terms of velocity, water depth and top width of water coverage were collected around Oshakati.

3. Methodology

3.1 Desk Planning

The following formed the field plan to collect data towards the stated objective;

a) ***Fore dam field data collection;***
   i. Description of the onsite raw water storage dam
   ii. Measurement of perimeter
   iii. Water Depth elevation
   iv. Dam depth profile

b) ***Field data collection for the canal study;***
   i. Extraction of canal geometry information from the design drawings
   ii. Setting up of channel geometry in the HEC-RAS model
   iii. Flow simulation (modeling) and Flow data collection

3.2 Raw Water Storage Dam

3.2.1 Description of the existing raw water storage dam

Generally, the dam is excavated and has earthfill wall structures that impound the reservoir. The fore dam has an inlet receiving water from the canal towards the northwestern side and five overflow pipes built on the dam wall to the eastern side. The dam can also be described as having a main dam section, semi connected to a small to a small dam section located to the south of the main dam. The onsite raw water storage dam is shown in Figure 3-1.

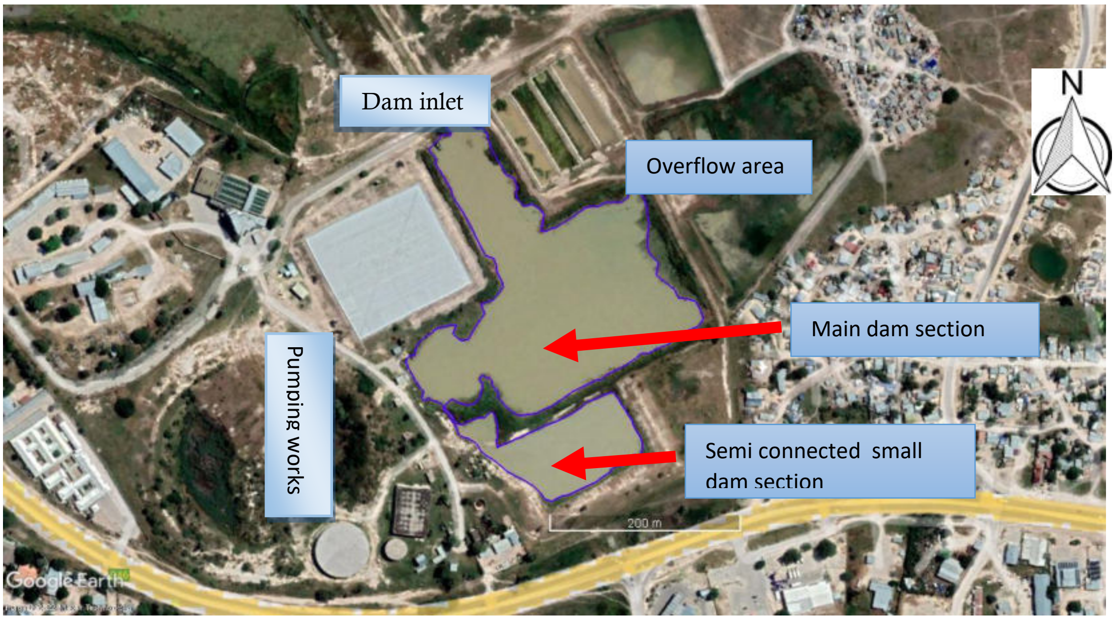

Figure 3-1 Onsite raw water storage dam

3.2.2 Determining the Dam Perimeter

In this study, the wetted perimeter was obtained by digitizing the water coverage extent on Google image of June 6, 2022 using Google Earth Pro. The horizontal distance from one side of the dam to the other in the digitized area was validated based on field points collected using the single beam depth/distance finder. Furthermore, it was only feasible to measure the waterline inward of the reach of the reeds, given that the beam from the recording instrument is sent back in a similar manner, whether deflecting on reeds or land surface. Subsequent to this, GIS tools were used to measure the length of the wetted perimeter which was taken as the digitized boundary outline. The maximum wetted/storage area was digitized from the Google Satellite Image of 31 June 2019 when the canal was filled to maximum and adjusted based on the aerial photographs taken onsite using a drone to compensate for growing vegetation in the dam.

3.2.3 Determing the Water Depth Profile

i. Survey Instrument

A survey of the fore dam was carried out between the 6th and 9th of June 2022. A single beam depth sounder was used to measure water depth and bottom elevation profile at various data points. This method was selected because of its effectiveness with which the ecosounder identifies under water sediment dune undulations, making the dam's floor surface. Typically, the depth echosounder determines water depths by measuring the time interval required for ultrasonic waves to travel from a known point (transducer face) to a reflecting surface (reservoir bottom) and return. Where has similar intruments used?

ii. Depth profile survey Plan

The transects for measuring water depth in the Fore dam were set at 3-5 metres apart. Additionally, the use of a motorized boat in the dam was not deemed feasible and, thus resorted to a manually driven canoe as the mode of water transport to reach all the target waypoints for sampling.

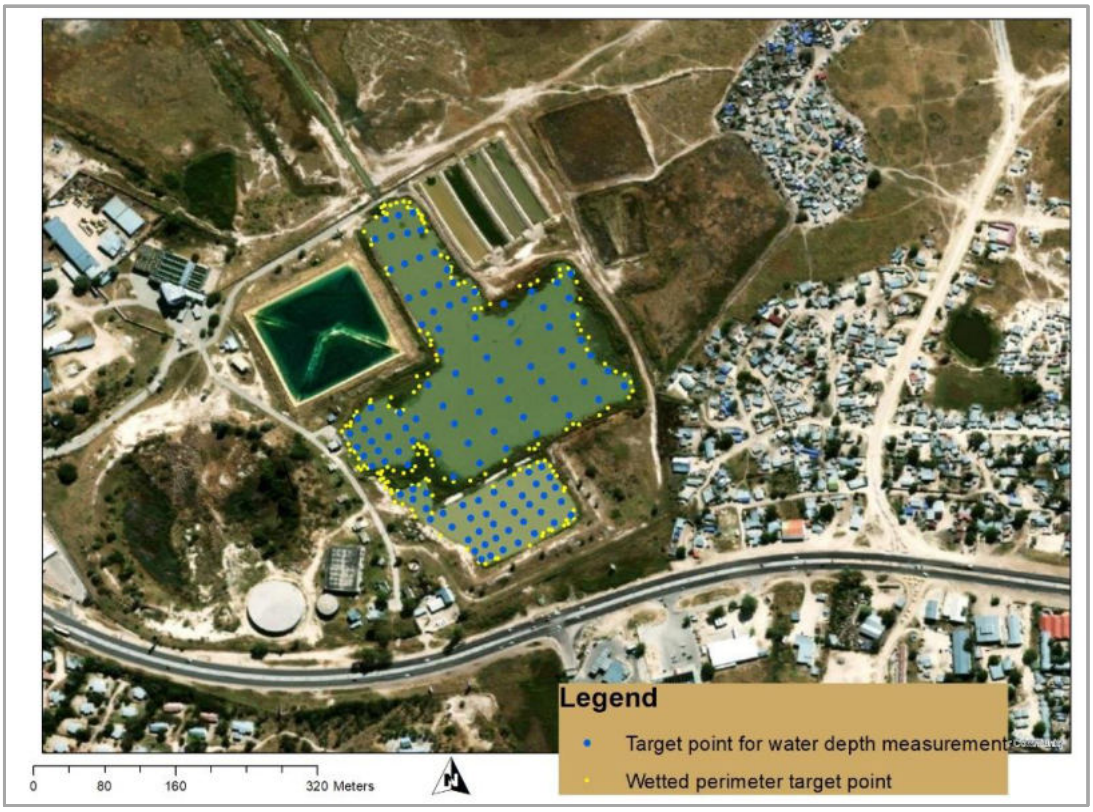

Figure 3-2 Target points for data collection

The target points used in the collection data for the bathymetric survey are presented in Figure 3-3, superimposed on a July 7, 2022 Google Satelite imagery.

3.2.4 Sediment Depth Profiling

The sediment depth profile was measured using a five-meter long calibrated sediment core trapping pipe, measuring 20mm in diameter. The sediment pipe was forced through the sediment column at the bottom of the dam by using a rubber gravity hammer and human-body weight until the pipe could not further penetrate the hard compacted bottom surface, after which a sediment core was extracted. The height of the extracted sediment core was read from the calibrated pipe, and the trapped sediment core was then dislodged back into the dam. The sediment trapping pipe was calibrated at 100mm length intervals.

Figure 3-3 Longitudinal length profile for sediment reporting

The longitudinal line through which the sediment and depth profile were taken, going from left to right (Figure 3-3).

Figure 3-4 Aerial photo showing growing vegetation

The vegetation growing on sand/silt banks can be seen in the photograph taken at the site (Figure 3-4). The vegetation roots stabilize the silt islands and cause them to trap more sediment resulting in consistent expansion of the silt bank towards the inland of the dam, hence decreasing the water storage capacity.

3.2.5 Bathymetric Data Processing

The water depth elevations were computed as the absolute/actual depth measured from the depth echosounder, taking the floor of the dam as zero depth elevation. The resultant data were processed by using ArcGIS (version 10.8.1), which contains hydrographic software for data viewing and editing, data processing, generation of interpolated data, and creation of map products. These GIS tools were utilized to generate water depth contours from which the average dam depth, actual storage, and maximum storage capacity were calculated. The area of the resulting shapefiles was calculated using the ArcMap Field Calculator. This includes:

(i) The actual wetted area at the time of sampling
(ii) The maximum wetted area (dam capacity)

Once the actual wetted area and the maximum storage areas were determined, the volume in the dam was calculated based on the following:

$$Volume(m^3) = Surface\ Area\ x\ Average\ Depth$$

The average depth was calculated on a weighted basis, taking into account the proportion of the contributing area as determined based on the depth contours.

3.3 Methods for hydraulic assessment of the Ogongo-Oshakati

The first step was digitize the canal reach to find its length and how it meanders along the terrain between Ogongo-Oshakati, and identify the locations of the inverted siphons.

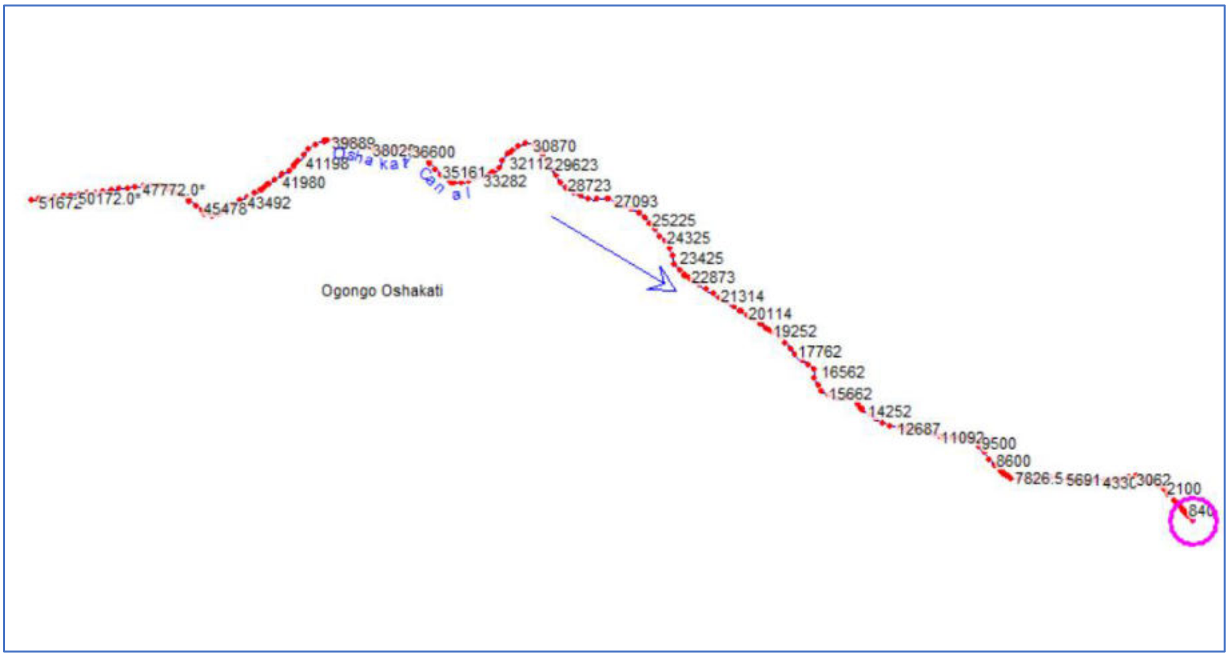

Figure 3-5 Canal chainage and geometry profile

The channel is drawn from upstream to downstream in HEC-RAS as a way of defing the direction of flow. Hence, the chainage is such that the furthest upstream point is assigned the value of the channel length and the furthest downstream point is assigned 0m as that is the end of the channel. The in-between cross-sections were located about 300m from the upstream cross-section on the open canal section while on the inverted siphons, two or more cross-sections were defined depending on the length of inverted siphon structure.

The canal section with defined canal cross-sections is seen in Figure 3-5. As extracted from the channel the design drawings, the overall canal is about 51,672m in channel length from the inlet at Ogongo to the outlet at the Oshakati Water Purification Plant. The channel bed solpe as obtained from the design drawings, ranged between 0.0029 and 0.1333%.

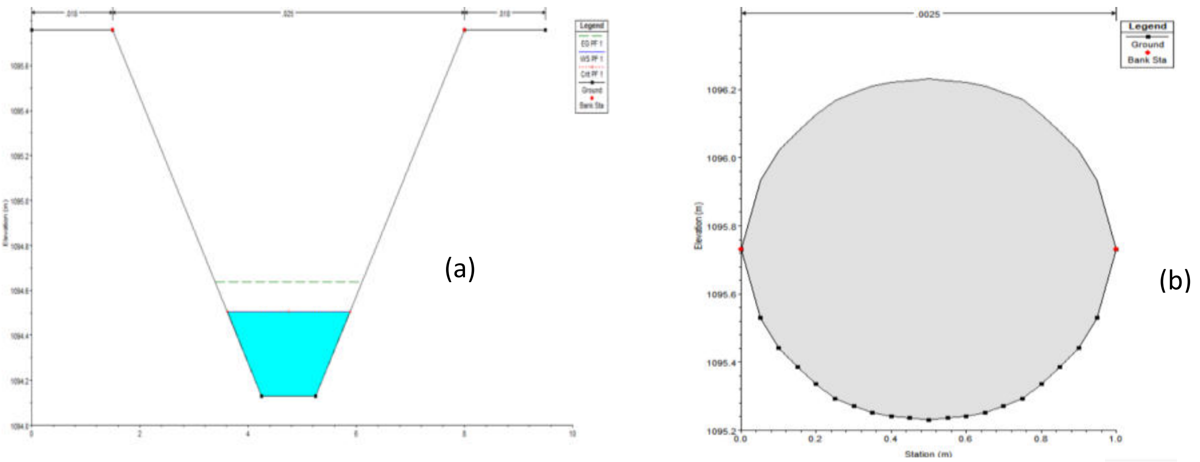

Figure 3-6 Typical open canal cross-section (a) and lidded cross-section (inverted siphon)(b)

Generally, the canal consists of open canal and inverted siphons which were presented as cross-sections with lids in the channel geometry as shown in Figure 3-6 (b). The open canal section is trapezoidal in shape (Figure 3-6(a)) with the channel walls sloping at 1:1.5, the bottom of the channel has an effective bottom width of 1m, and a top width of 5.6m, and a water depth of 1.43m.

3.3.1 Model principle for predictiong velocity and water surface profiles

The presented channel information was used in defingging the channel geometry in HEC RAS 6.2 in preparation for model simulation. The HEC RAS model solves the energy equation and evaluates the Manning's friction equation for the absolute roughness (ks) as part of a stepwise process for simulation of water surface profile at each cross-section. The Manning's equation takes the following form when expressed in terms of discharge:

$$Q = \frac{1}{n} A R^{2/3} S^{1/2}$$

Where: Q is discharge, n is Manning's roughness coefficient, A is the flow area , R is hydraulic radius and S is the friction slope. This equation can be re-written into its constinutent items based on the continuity equation. Hence, the steady gradually varied flow water surface profiles (depth) are well predicted by a steady, one-dimensional energy equations.

The HEC-RAS model solves the following 1D energy equation while prediction the water surface profiles.

$$Z_2 + Y_2 + \frac{a_2 V_2^2}{2g} = Z_1 + Y_1 + \frac{a_1 V_1^2}{2g} + h_e$$

Where a_1, a_2 are velocity weighting coefficients, Z_1,Z_2 are invert elevation of the channel between two cross-sections, Y_1,Y_2 are water depth at cross-sections, V_1,V_2 are average velocities, g is gravitational acceleration and h_e is energy head loss.

3.3.2 Running the HEC-RAS Model

The model simulates flow and evaluates water surface profiles (depth) and velocity distribution at the defined channel cross-sections resulting from specified flow conditions. In this study, the discharge introduced iteratively in the canal was kept between 0.5 and $2m^3/s$ while the Manning's n-values evaluated were varied from n= 0.005 to 0.030. The maximum discharge was taken as the largest discharge carried by the canal that produce water surface profiles that allow for 100mm freeboard at all cross-sections, and the associated Manning's roughness coefficient (n-value) was taken as representing the acceptable channel roughness in the canal. This process was repeated iteratively for the specified range.

The complementary data collection for validating the model was only done at the cnal section within the vicinity of Oshakati. The depth ecosounder was used to measure depth, a twine line was used to measure the topwidth of the surface water coverage in the canal and a velocity plank instrument was used for recording velocities. Further to this, manual methods were used to find average velocity and area. Subsequently the actual discharge was found in the canal based on the following:

$$Q = VA$$

Where Q is discharge, V is average velocity and A is area of water coverage in the canal.

4. Results

4.1 Characteristics of the Raw Water Storage Dam

The actual wetted area and associated water depth are presented in Figure 4-1, showing the extent of the wetted area and the water depth profiles at the time of sampling.

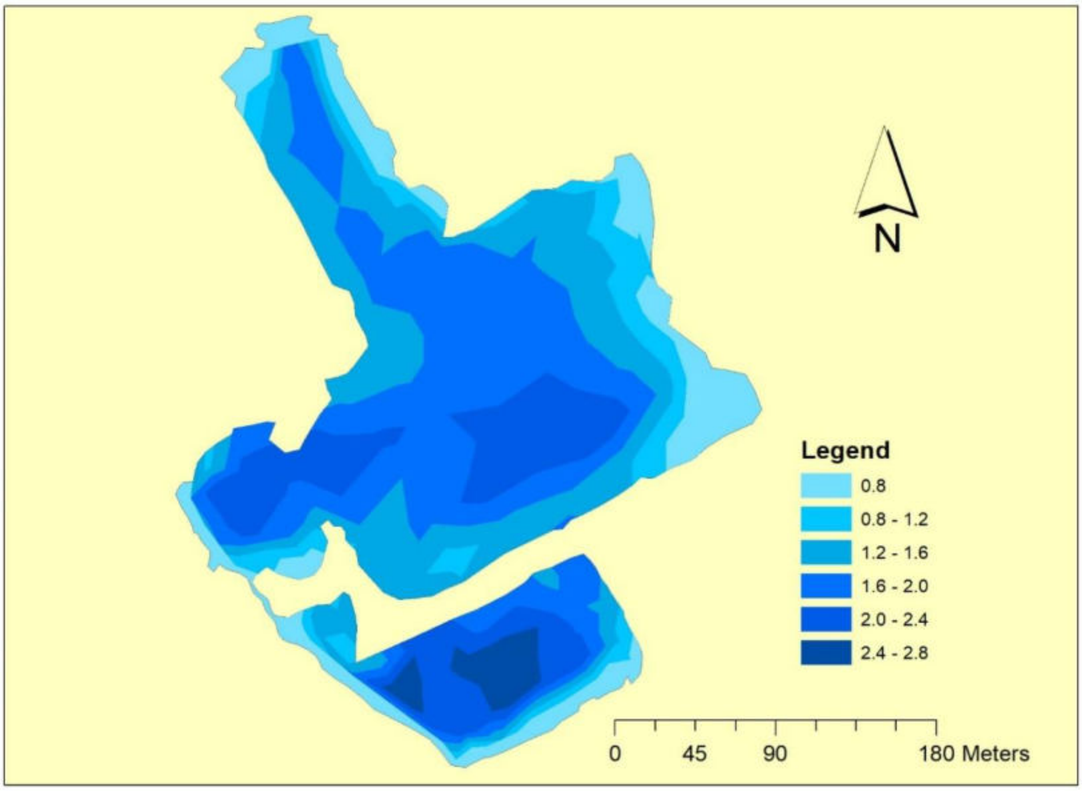

Figure 4-1 Surface water depth contours

The water area coverage at the time of sampling was found to be approximately 63,015m^2. The raw water storage dam was found to have a greatly varied depth profile, but generally it was more deeper in the middle and shallower on the sides. The deepest sections lie between 2.4 and 2.8 meters while most of the dam area is covered by water at the depth 1.6 and 2.4m. There was no water quality measured in this study, however, the water was observed to be murky and containing large quantities of suspended sediment. The larger middle section of the dam was observed to have a decreasing depth and size especially towards the western edge where the pump works are located. It was difficult to identify the natural pattern of sediment build-up as the desludging vehicle from time to time mobilizes sediment into the water column which settles and deposit in a random but unknown pattern. However, the average wighted water depth was found to be approximately 2.15m. This was taken to be the actual water depth and further applied in detrming the volume of water in the fore dam.

4.2 Sediment depth profile

The sediment deposited in the raw water storage dam is presented in Figure 4.2, showing the height contours of the sediment.

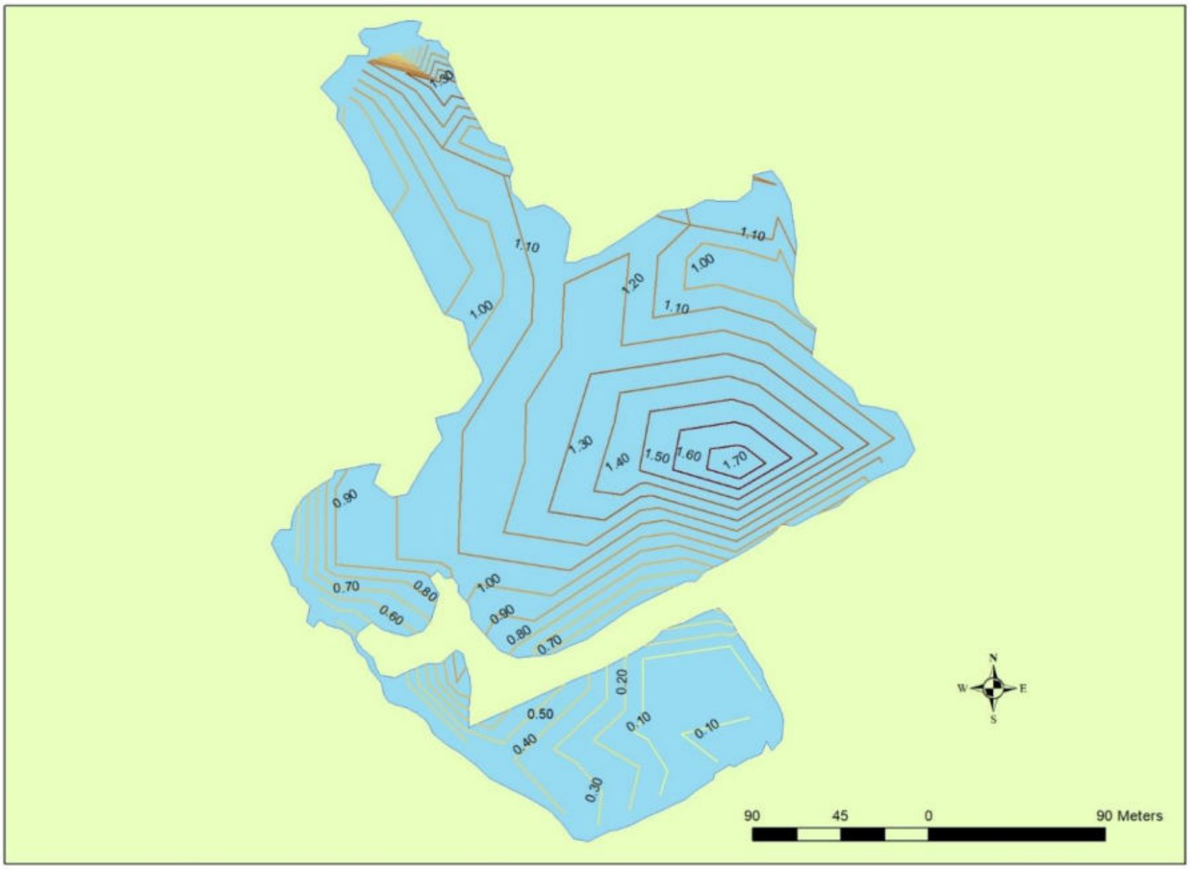

Figure 4-2 Sediment height contours

The sediment depth is widely varied, and it was found that the main dam section has the largest sediment deposit with depth found to rand between 0.50 and 1.70m. The height contours show that the middle sections of the main dam generally present a sediment height profile greater than 1m all the time, and the periphery of the dam especially towards the pump works, the depth ranges between 0.60 and 0.90m. On the other hand, the semi-connected section was found to have the least sediment deposits, with height conctours showing the sediment level as ranging between 0.1 and 0.8m in height. Overall, the weighted average sediment height was found to be 0.784m.

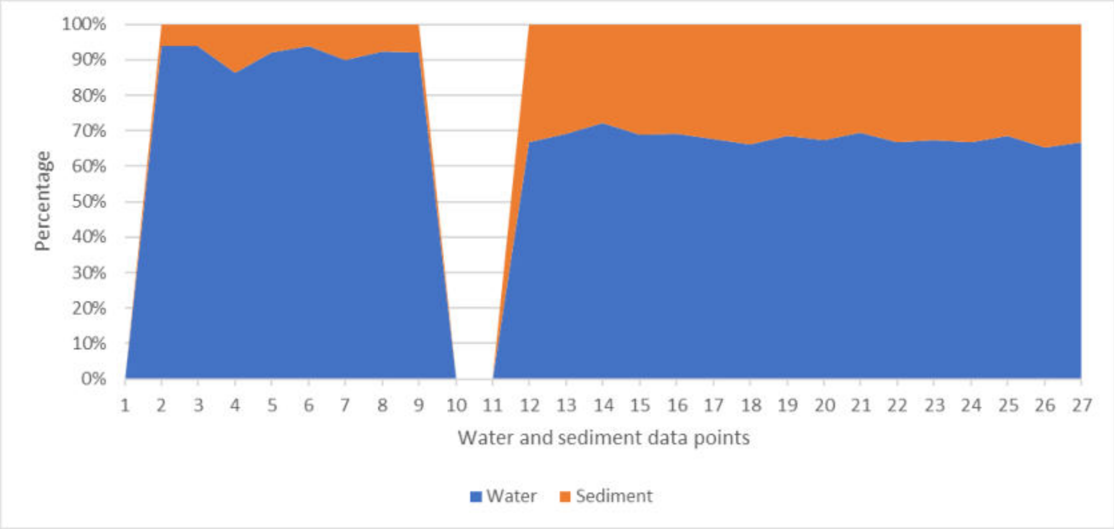

Figure 4-3 Water and sediment profile in the semiconnected and main sections of the dam

Figure 4-3 shows the percentage contribution of water and sediment to the total depth elevation against the dam walls. In the main section of the fore dam, sediment depth contributes an average of about 30 to 35% of the total sediment-water depth profile from the bottom of the reservoir while in the semi-connected small dam section, the sediment content covers only to an average of 10% of the total depth. (whats with the break in data on the graph?)

Considering the average height of sediment in the fore dam to 0.784m and factoring the total area of the dam reported in section 4.1, the total sediment volume was found to be approximately 51000m^3. About 92% of the total sediment volume is locked up in the main dam section and less than 10% of the sediment volume is contained in the semi-detached section of the fore dam.

Figure 4-4 Aerial photograph showing different levels of freeboard in the main section and the side-section

The impact of sediment deposit on dam filling from can be seen in Figure 4-4. The difference in freeboard available in the main section and the semi-connected side section of the dam shows how sediment build-up influences the elevation of the water surface elevation respect to the dam wall and dam water storage capacity.

The sediment build-up in the main section of the raw water storage dam further create potential risks in respect of clogging, blockage and damage to the pumping infrastructure, while the low sediment levels in the semi-attached section provides vital design lessons. The operational cost in terms of back wash and risk of damage will be reduced if the pumping works were located on the semi-detached section of the dam that have very low sediment deposit. Hence, future designs should consider reducing the incoming sediment load by designing and developing a weir structure that keeps large quantities of the inherent sediment load from getting through to the pumping works.

4.3 Raw Water Storage Capacity

The computed dimensions of the dam were as follows:

- Dam wall crest 5-8m high along the embankment perimeter.
- Wetted perimeter 1.39km
- Maximum area including embanked area is 88, 298m^2
- Maximum capacity of wetted area is 75,603m^2
- Wetted area during the time of the survey (actual) was 63,015m^2

The wall at the dam inlet is the least raised at 5m elevation. This is followed by the wall on the eastern side with about five outlet pipes to the overflow area. These values were found to be located at approximately 7.2m height from the bottom of the dam. After subtracting the sediment depth from the surface water elevation, the average depth at the time surveying was 2.15m. The water in the dam the at the time of survey was found to 135,482.25m^3, which is an amount equivalent to one day guaranteed water supply for the envisaged expanded water purification plant, with a large proportion of this water locked in sediment.

The dam in its present state, has a maximum effective depth of approximately 3.5m, when filled to its maximum capacity. This provides that the maximum storage capacity for the dam is 264,610.5m^3. This maximum volume of water stored is only sufficient for supplying a future safety guarantee of one and half days given that about 30 to 40% of that volume is inaccessible as it is locked in sediments while about 3% will be lost to evaporation.

5. Water transfer capacity of the canal

5.1 Graphic Representation of the Water Surface Elevation Profile in the Open Canal and Lidded Cross-Section

Figures 5-1 to 5-3 shows the model-predicted water surface profile in the canal under various hydraulic roughness conditions. The inverted siphon section seems to maintain efficient transportation of water even under highly degraded roughness condition. At Manning's roughness coefficient n=0.025, the siphon components appear to have the capacity to carry water of 1-1.5m^3/s. The open canal section behavour on the other hand, shows high sensitivity to variation and degradation in channel hydraulic roughness, Figure 6-1 shows that at Manning's n=0.018 the canal is overtopped when discharge of 1m^3/s is carried in the canal.

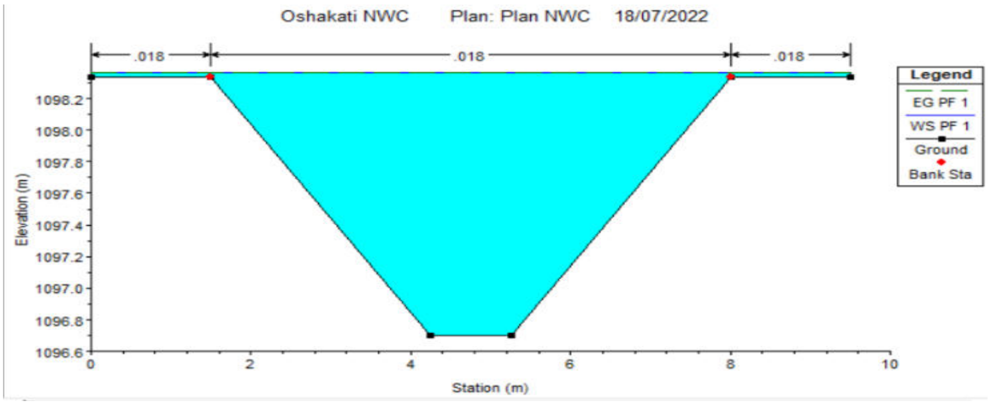

Figure 5-1 Water surface profile at chainage 39223m

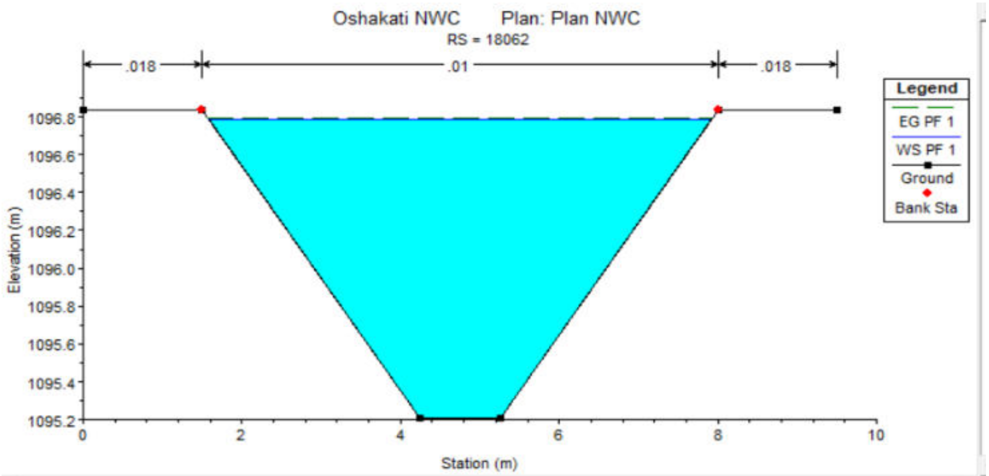

Figure 5-2 Water surface profile at chainage 18062m

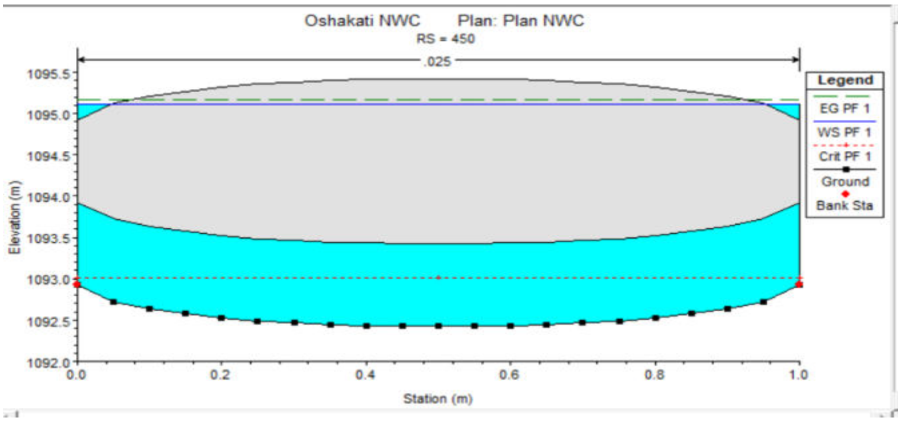

Figure 5-3 Water surface profile in the inverted siphon at chainage 450m

Figure 5-2 shows that when the canal roughness is kept at the Manning's n-value typical for prefabricated concrete channels which is n=0.010 (Chang, 2010), then the canal starts to accommodate discharge in the order of magnitude of 1-1.5m^3/s with a freeboard of 150mm, which is adequate to safeguard the canal from overflowing. The field data collected around Oshakati seems to show some agreement with the model results, however, these were few and not sufficient for validating the model results with 95% confidence. Therefore, these results are purely based on modelling only.

Figure 5-4 Damage along the canal near Oshakati

The hydraulic performance assessment shows that the canal has the potential to carry between 95,000 and 130,000 m^3/day at discharge rates of 1.1 to 1.5 m^3/s. Generally, the model predicts that the canal will be able to safely transport discharge of 1m^3/s or larger. However, whenever the roughness conditions in the canal diminishes such that the Manning's roughness coefficient becomes significantly larger than n=0.010, the canal begins to fail to transmit the said flow magnitude in an efficient manner i.e. without overtopping any cross-sections along the entire length of the canal. For the canal to meet the water supply targets of the new water purification plant, it should operate at the minimum of 1.1 m^3/s.

The greatest risk for the canal to fail to transmit the required discharge is closely linked to the age of the concrete lining of the canal, the finishing rendered when the concrete works were made, sediment build-up and the local climatic conditions especially the impact of hot temperatures on the degradation concrete finishings.

The model results presented in this study were not validated with field data, owing to the short field excursion which did not allow field data collection and the scope of the study which was focused on undertaking a modelling-based assessment. However, the results present very relevant information for the Client and meets the objectives of the project. This is supported by random field observations which shows multiple structural damages to the can indicating a need for rehabilitation works and the age of the canal. Figure 5-4, shows the type structural damage that exist along the canal which requires some rehabilitation works in order to be in a sound state of operation and condition to transport water to near maximum capacity. Hence, it is important that the ongoing works to upgrade the water purification plant should include targeted rehabilitation of the canal including measures to minimize sedimentation. The rate of sedimentation while unquantified, but reconnaissance visit along the canal revealed the present of large deposits of sediment in the canal, which reduces the water carrying capacity.

6. Conclusion

The existing raw water storage dam has the potential capacity to provide guaranteed water supply safety of only one and half days for the envisaged level of 90,000m^3 per day. This is not adequate the satisfy the planned management target for water supply security buffer of up to 14 days. Hence the need to develop alternate ways of securing water supply to the envisaged development over the canal redundancy period, provided at 14 days. This can be achieved by constructing a new raw water storage to a full capacity that meet water supply safety guarantee required or alternatively develop an additional raw water storage dam that will be operated conjunctive to the existing dam.

In respect of the canal water transportation capacity, it is predicted from the model flow simulations, that the canal water transportation capacity is greatly variable, with a maximum potential to transport about 1 to 1.5 m^3/s when the roughness is maintained in a better condition, mostly when Manning's roughness is at n=0.010 in the open canal cross-sections. Hence, the process to extend the water purification plant should integrate other necessary works on maintenance works in respect of improving the hydraulic condition of the canal. Without major maintenance works, the canal presentely appears to fail to deliver the required water supply.

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Annexure B

NAMWATER
Namibia Water Corporation Ltd

Grievance Redress Mechanism

The Planning and Design, and Construction of the Oshakati Water Purification Plant Extension Project

June 2022

Project Information

Project Title	*The Oshakati Water Purification Plant Extension Project*
Document Title	Grievance Redress Mechanism
Date	May 2022
Client	The Namibia Water Corporation Pty Ltd.
Environmental Consultants	Namib Consulting Services CC
Engineering Consultants	Shah Technical Consultants Private Limited, India *IN JOINT VENTURE WITH* Water Resources Consultants (Pty) Ltd., Botswana *IN ASSOCIATION WITH* Zambezi Consulting Engineers, Namibia
Project Number	RFP No: P NA E00 005
Report Version	Version 1.3 (15 June 2022)
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Acronyms

AfDB	African Development Bank
IRM	Independent Review Mechanism
BID	Background Information Document
EAP	Environmental Assessment Practitioner
ESIA	Environmental and Social Impact Assessment
ESMF	Environmental and Social Management Framework
GRM	Grievance Redress Mechanism
GRT	Grievance Redress Committee
IESIA	Integrated Environmental and Social Impact Assessment
I & APs	Interested and Affected Parties
OS	Operational Safeguard
PEC	Project Environmental Coordinator

1. Background

This document outlines the grievance and redressal mechanism (GRM) for the proposed Oshakati Water Purification Plant Extension Project (OWPPEP). It describes and provide a systematic approach for addressing various grievances from project-impacted stakeholder groups and individuals. It sets a procedure through which affected parties can express their views and opinions about the project, and how the project is to respond and judiciously meet their expectations satisfactorily. The project recognizes that active involvement of all stakeholders whether affected or merely interested is critical to the implementation and sustainability over the long term.

2. What is a Grievance and Grievance Mechanism?

2.1 Definition

A grievance is a concern or complaint raised by an individual or a group within communities affected by activities related to the operations of an organization. Such impacts could be from activities on implementation of a particular project by public or private entity. A grievance is raised because of the uncomfortable and unacceptable state perceived will occur or actual by an Individual or group or a community, result of an introduced event to a particular area.

2.2 Grievance mechanism

A grievance mechanism is described as a project instrument that aims to give stakeholders or interested and affected parties (I & APs) the right to report all project-related inadequacies, the right to denounce any kind of human rights violation or detrimental event of the project and to request redress or cessation of the detrimental event (ECOWAS, 2021). The instrument when implemented allows resolving grievances of affected individuals or communities at earliest localized level or within project's immediate domain, preventing escalation to unmanageable levels. This will resultantly benefit the aggrieved parties and the proposed project implementors.

3. Guiding Framework

3.1 Namibian Policy and Legislative framework

Several national instruments prescribe the rights of I & APs to a project, ensuring that where a party is affected or considers a serious threat to human rights or the environment, such can instigate remedying of any such injustices. Instruments below outline instances where remedial actions will be initiated.

3.1.1 The Constitution of Namibia

The Constitution of the Republic of Namibia as law above laws, prescribes the basic human rights. The fundamental basic human rights enshrined are in Article 6 (the right to life), Article 8 (Respect for human dignity), Article 9 (Slavery and forced labour), Article 10 (Equality and freedom from discrimination), Article 15 (Children's rights), Articles 18 (Administrative justice). Further to above rights, is Article 95 in its subsection (a, b, i, l) that recognizes rights regarding matters of gender, health, labour and environment. These enshrined fundamentals rights where perceived violated, or actual violation empowers the aggrieved party to seek redressal.

3.1.2 The Environmental Management Act

The Environmental Management Act (Act No. 7 of 2007) seek to ensure sustainable development through controlling activities with potential impacts on the environment and associated social and economic systems. The Act explicitly lays out the importance of the public consultation process as key step in the project development process, where a given project may significantly affect the quality of the environment and social systems. The consultations process provides opportunities for potentially affected parties to raise concerns at earliest in the project development process and for continuous engagement to ensure areas of concerns are adequately addressed.

3.1.3 The Labor Act

The Labour Act (No. 11 of 2007) aims at entrenching fundamental labour rights and their protection. Moreover, the Act aims to ensure the health, safety, and welfare of employees, whilst protecting them from unfair labour practices. The Act sets out practices deemed violation of the fundamental rights of employees and where these are deemed to occur, enables the aggrieved party to seek redress through provisions of the Act.

3.1.4 The National Disability Policy

The national disability policy points to equal opportunities for persons with disabilities to have a productive and gainful employment in the labour market. Moreover, addresses that person living with disability should be safeguarded from abuse and violence. Such provides that where there is discrimination purported towards persons with disability, such causes need for remedy.

3.1.5 The National Land Policy

The policy hinges its principles on the fundamental human rights enshrined in the constitution and aims to overcome inequalities in the land delivery system to enable access by the poor and disadvantaged of a society. The policy further recognizes the fate of informal settlement in urban areas and a multisectoral approach to making land available to those displaced in the process of formalization of urban land. Where access to land is denied for the poor and marginalized persons of the society, this is considered a violation of the fundamental rights enshrined by the constitution and thus necessitates remedial course through legislative provisions.

3.1.6 National Policy On HIV/AIDS (2007)

The policy aims to provide a supportive environment for the implementation of programmes aimed at reducing the infections, improving care and treatment and mitigation of impacts inadeptly supporting vision 2030. Objectives 4, 6 7 and 8 are important to the project in that they drive towards fair opportunities, treatment and access to services that facilitate mitigation for those infected or affected by HIV/AIDS.

3.1.7 The National Gender Policy (2010)

The policy aims to achieve gender equality and the empowerment of women in the socio-economic, cultural, and political development of Namibia. The Policy aims towards actualizing the basic human rights enshrined in the Constitution, to eradicate discriminatory practices and allow participation of all genders in the socioeconomic development of the society.

3.2 The African Development Bank's Environmental and Social Management Framework

The AfDB updated it environmental policy, outlining its principles into the Integrated Safeguards System (ISS). The ISS is conveyed into Operational Safeguards (Oss), intended to promote sustainable outcomes from the bank's funded projects, providing protection to the environment and people from potentially adverse impacts. The ISS aims for the following;

a) Avoid adverse impacts of projects on the environment and affected people, while maximizing potential development benefits to the extent possible
b) Minimize, mitigate, and/ or compensate for adverse impacts on the environment and affected people when avoidance is not possible; and
c) Help borrowers/clients to strengthen their safeguard systems and develop the capacity to manage environmental and social risks.

The Bank adopted five OS's are there to achieve goals and optimal functioning of the ISS. These OS's are;

1. ***The Operational Safeguard 1 (OS1) for environmental and social assessments****:* governs the process of determining a project's environmental and social category and the resulting environmental and social assessment requirements.
2. *T**he Operational Safeguard 2 (OS2) for Involuntary Resettlement****:* consolidates the policy commitments and requirements set out in the Bank's policy on involuntary resettlement and requirements thereof, where there are implications of resettlement to the implementation of a proposed project.
3. ***The Operational Safeguard 3 (OS3) on Biodiversity and Ecosystem Services:*** aiming to conserve biological diversity and promote the sustainable use of natural resources, including commitments on integrated water resources management.
4. ***The Operational Safeguard 4 (OS4): Pollution Prevention and Control, Greenhouse Gases, Hazardous Materials and Resource Efficiency:*** covers the range of key impacts of pollution, waste, and hazardous materials for which there are agreed international conventions.
5. ***The Operational Safeguard 5 (OS5): Labor Conditions, Health, and Safety:*** sets requirements for concerning workers' conditions, rights and protection from abuse or exploitation.

The OSs ensure that borrowers meet the requirements set by the Bank and that financed projects safeguard individuals or communities from adverse impacts.

The Environmental and Social Management Framework (ESMF) for the Namibia Water Sector Support Programme (NWSSP) outlined that projects under this programme are of Category 2 and thus require an appropriate level of environmental and social assessment. Such shall be undertaken aligning with the Integrated Environmental and Social Impact Assessment (IESIA) Guidance Material on consultation, participation and broad community support encompassing the following key components;

(i) Identification of relevant stakeholders, especially potentially affected communities
(ii) Disclosure of adequate project information and environmental and social information to ensure that participants are fully informed
(iii) Conducting of information disclosure in a timely manner in the context of key project preparation steps, in an appropriate language, and in an accessible place.

(iv) Establishes a credible, independent, and empowered grievance and redress mechanism (GRM) to receive, facilitate and follow up on the resolution of affected people's grievances and concerns about the environmental and social performance of the project.

(v) The GRM shall always accessible to the stakeholders during the project cycle, and all responses to grievances recorded and included in project supervision formats and reports.

3.3 International Practices in GRM

Internationally, the participation of individuals, communities and organizations in project development process is entrenched in requirements for financing. Several international instruments require affected persons or groups to access information about the projects and have an opportunity to express and influence the planning and design process of projects through its lifecycle phases. The environmental and social management frameworks of lender institution's aim towards enhancing the environmental and social performance and sustainability of financed projects. Examples of these instruments with similar requirements are;

- The World Bank's Environmental and Social Framework
- Asian Infrastructure Investment Bank's Environmental and Social Framework

A GRM is a requirement in these frameworks to outline how to facilitate receiving and resolution of the concerns and complaints of persons or groups that deem impacted negatively by the project's activities.

4. GRM Guiding Principles

The grievance redress process in this document is founded on principles in the requirements and specifications of national legislation and the objectives of the ISS. Moreover, these consider standard and best practice steps to public consultation and information disclosure. The core principles to this GRM are;

a) ***Transparency*** - The grievance resolution process should be transparent in addressing issues raised to attain satisfaction or acceptable grounds of compromise with the complainants.

b) ***Accessibility*** – making information available and ensuring that all interested and affected parties in group or individual should have access to the grievance redress mechanism. Making available information on the project allows stakeholders to get to know and understand both the environmental and social risks and impacts associated with the project, as well as opportunities provided by the project and enhance chances for them to express concerns.

c) Equality and neutrality – The grievance resolution process should engrain social equity and equality and thus allowing the stakeholders to freely express their views.

d) ***Accountability*** – the project implementing agencies shall remain accountable to ensure that matters raised are addressed during the applicable project lifecycle phases.

e) ***Written records*** - All grievances registers and feedback provided should be recorded in accorded forms and maintain a file.

f) ***Timely resolution*** - grievances should be handled within a reasonable time.

g) ***Confidentiality*** – ensuring that information by persons raising the grievances is kept confidential in the process and consent is sought where such is to be made available to other parties involved.

5. Approach to Stakeholder Engagement and Information Disclosure

This document adopts a voluntary disclosure approach of project information to the relevant various stakeholders during the prescribed steps in the public consultation process. The prescribed steps for information disclosure in the steps of the ESIA are outlined below;

Scoping Phase		**ESIA Phase**
Steps to public consultation and participation: o Stakeholder identification and mapping o Establish register for I &APs o Public notifications to register as I &APs o Circulation of BID and making information available to I &APs. o Public notification and holding of consultation meetings o Focused meetings with key stakeholders. o Distribution of draft reports to I &APs for comments after review by NamWater and prior to submission to Client and MEFT. o Translation of information to local language to facilitate comprehensive understanding of the proposed project activities	→	Steps to public consultation and participation: o Submit the DESIA and ESMP to client and stakeholders for comments. o Public feedback session o Targeted feedback to concerned/affected stakeholders. o Record of issues to be included as annexures of reports.

Figure 1 Public participation and Information disclosure in ESIA process

Information disclosure to this project will take the following platforms:

- **Public notification and dissemination** of the project background information document (BID) to the stakeholders about the project.
- **Public meetings** – hold public meetings where project information is shared with the stakeholders and provided with the opportunity to voice views.
- **Key stakeholder meetings** – engage key project stakeholders to provide information and can voice their views towards the potential environmental and or social impacts.

- **Notice boards and posters**, on which the most up-to-date information on the Project developments, and the possible inconveniences to the local population, will be displayed.
- **Project / site office** - provide means and opportunity to submit comments / complaints, as well as access to the project documentation at the project site.
- **Placing of information** signs concerning the existing risks associated with the project implementation.
- **Radio notifications** in the local language.
- **Draft Project reports** sharing with the stakeholders

6. Grievance Redresses Mechanism

This section of the document outlines the process towards seeking redressal of grievances at different scales. The developed process is cognizant as per AfDB requirements that the process shall be culturally appropriate and accessible, therefore establishes appropriateness to different types of grievances.

6.1 Objectives

The aim of the Grievance Redress Mechanism (GRM) is to ensure that all grievances concerning the planned activities of the Oshakati Water Purification Plant Extension Project will be received, examined, and that appropriate corrective measures are taken to address them at earliest local level or within the project domain. Hence, the document outlines the procedure for receiving, consideration and resolution of grievances that may arise in the pre-construction and construction phases of the proposed project and associated recording system.

This mechanism is to ensure that stakeholders impacted by activities of the project are accorded the opportunity to freely express their comments, concerns on specific issues of interest and that such are received, considered, and addressed satisfactory in the applicable project lifecycle phases to facilitate timely and appropriate resolution.

6.2 Grievance Redress Process

The GRP outlined in Figure 2 below provides the steps towards resolution of grievances raised in the applicable phases of the project lifecycle for the OPPEP.

Grievance Redress Flow Process Chart

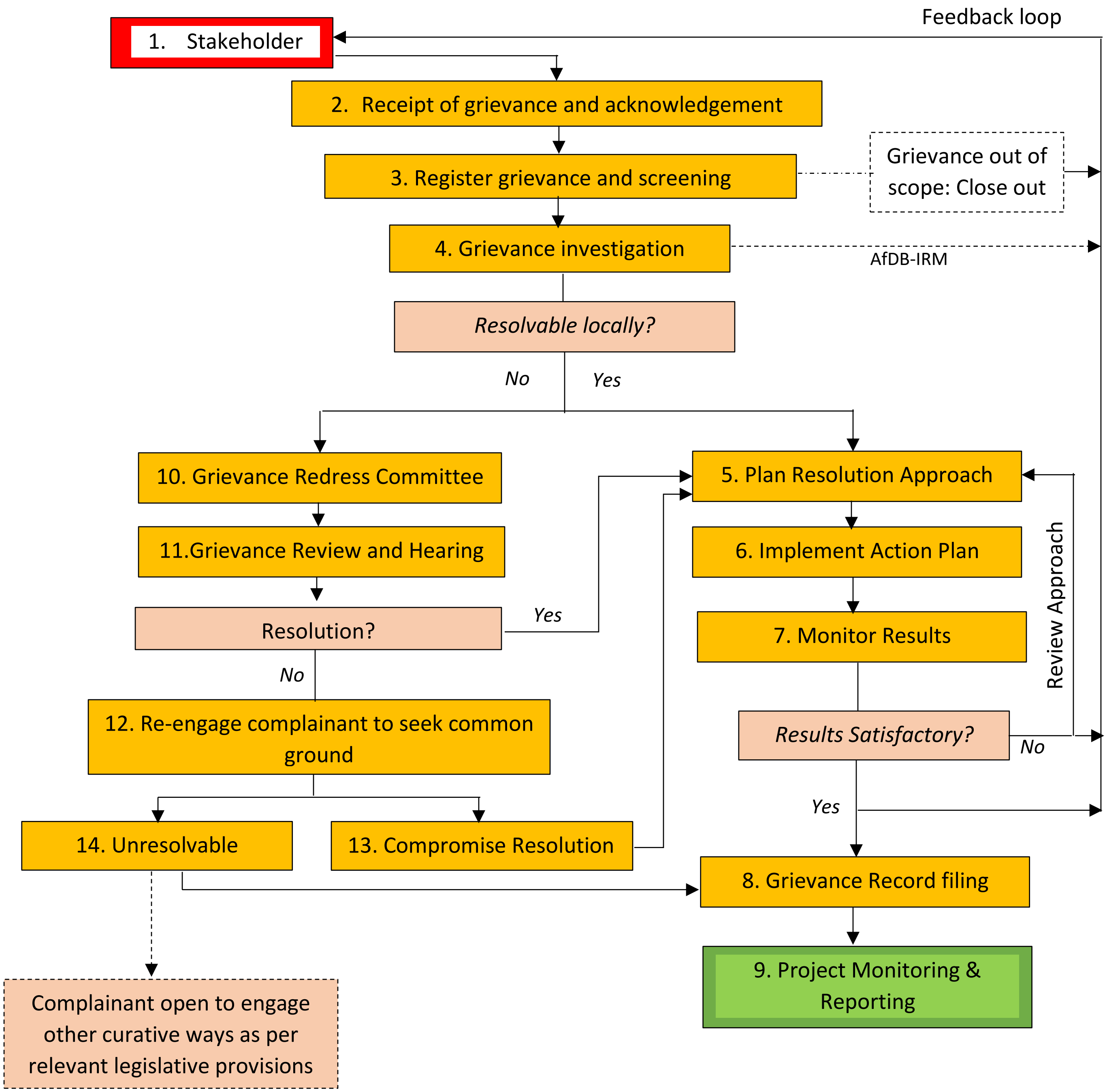

Figure 2 Process flow chart for grievance redressal

6.3 The Redress Process

The process flow towards grievance resolution through the steps outlined in Figure 2 is described as follows:

Step 1: Stakeholder grievance submission

Raising a grievance by the concerned party may take the form of the following:

- Response to public notification and call for comments on the project
- Concerns raised in public consultation meetings
- Concerns raised in key stakeholder's consultation meetings
- Response to posters and radio announcements
- Response to project reports shared with the public.
- Depositing in project site suggestion/comments box or office

Step 2: Receipt and acknowledgement

All grievance raised through above referred platforms are recorded in line with requirements of the EIA Process, however, those with particular emphasis placed by complainant will require follow up and facilitation to provide written submissions. Once received, the Environmental Assessment Practitioner (EAP) in the pre-construction phase and subsequent Safety and Environment Officer (SHEO) in the construction phase will facilitate and prepare an acknowledgement of receipt to issue the complainant within two (2) working days but not exceeding 7 days.

Step 3: Registering and screening

Grievances received are registered in an established grievance register for a record. This step further triggers need to screen the significance of the grievance. Relevance is established premised on the established scope of the project activities in the applicable phases. If any grievance is not applicable to the scope of the project at respective phase, the grievance shall be filed however considered out of context for further processing. The complainant is to be informed of the reasons for decision through a feedback loop, in written form.

Step 4: Grievance investigation

Subsequent steps in the process are aligned to the African Development Bank's independent review mechanism (AfDB-IRM). This step entails full disclosure of the requirements of the IRM to the concerned party thus validating the raised concern to affirm willingness to undertake the process. Grievances within the scope are investigated to comprehensively establish associated facts for validity. Investigation shall include engaging the complainant to provide detail description and associated evidence. If necessary, this step will include site visits to areas of concern. A report is compiled by the EAP or SHEO with potential alternative resolutions applicable and the most appropriate and preferable solution outlined.

Step 5: Plan Resolution Approach

The appropriate and preferred resolution at a local scale is outlined in detail to provide a plan of action for subsequent implementation in resolving the raised grievance. The details shall include required tasks, financial implications, timeframes and associated roles and responsibilities. This plan is to be agreed upon by the project site management staff.

Step 6: Action Plan Implementation

A compressively described and agreed upon resolution plan is applied towards resolution of the raised concern.

Step 7: Monitoring of Results

Monitoring of the action plan is imperative to collect data on the performance towards desired resolution. This will provide basis for review if the plan of action is addressing the raised grievance. It is necessary that where established that results are not satisfactory, a review of the action plan and pursue alternate approach or review the plan for re-application is triggered. Complementary to monitoring is providing feedback to the stakeholder on what is being done towards resolution of the raised grievance. Satisfactory results from implementation plan of action will provide critical information towards addressing the raised grievance, and such is communicated through the feedback loop to the concerned party (i.e., stakeholder).

Step 8: Grievance record filing

It is required that continuous filing be developed of all registered grievances to provide a record in the various project phases, and whether such were resolvable or otherwise provide information if subsequent steps were caried out to resolution of the grievance.

Step 9: Project Monitoring and Reporting

The information contained in the grievance record file will comprise part of the overall project monitoring and reporting protocols to the client and the financier.

Step 10: Grievance Redress Committee

In the initial investigation of the grievance to seek resolution (step 3), it is likely that some grievance may be unresolvable at a localized scale, here referred as project operational domain. This necessitates composition of a Grievance Redress Committee (GRC). The local GRC shall comprise key project staff including:

a) the convener (i.e., EAP or SHEO),
b) Site Manager,
c) the Engineering Consultants (ECs) and,
d) the implementing agency representative (NamWater).

These shall preside over the matter applying the above-described steps (1 to 7) towards resolution. Moreover, in relation to public concerns, beyond scope of project domain, where it necessitates the involvement of local or competent authorities, the GRC shall comprise the following officials, complementary to the local GRC established above.

e) the main client and financier representative (MAWLR/AfDB),
f) representative of the Oshana Regional Council,
g) representative of the traditional authority (where necessary) and
h) representative of the relevant Government Ministry or institutions to the matter at hand.

Step 11: Review and hearing

The GRC will review all collected information about the case from prior steps to understand and contextualize the matter brought to the committee. If considered necessary, the GRC will seek to gather further information on the matter and hold a hearing or site visits. The GRC may further request the concerned party to submit additional information as evidence to state clear of the raised matter. In consideration of the case, the GRC will aim towards resolution of the matter at earliest an at localized scale (i.e., regional level). Such process will involve consideration of the social and cultural context and thus may require consideration of the existing protocols to resolution of disputes provided in national instruments such policies and legislation and further customary practices where necessary. The GRC will outline alternatives to resolution of the matter and the most practical and preferable solution. The most appropriate and agreeable resolution will be processed through steps 5 to 9 of this procedure.

Step 12: Re-engagement of concerned party

Prior steps aim to ensure an appropriate resolution process to the matte raised, it is therefore that if the resolution by the GRC in prior steps unsatisfactory to the complainant, subsequent step involves will seek to r-engage the stakeholder to establish if there are common grounds reachable relating to the matter (i.e., settlement) in line with existing framework for resolution of such matters. Positive outcomes of a settlement resolution from re-engagement shall re-align to the processes outlined in step 6 to 9 of this resolution process.

Step 14: Unresolvable

It may occur that despite the thorough process involving all steps presented above, the concerned party may not be satisfied with the resolution process. Therefore, if all attempts to resolution thorough the engaged process are unsatisfactory, the final step of the process shall open and free the concerned party to seek other curative means as may deem necessary through national legislation or other international instruments deemed fit to attain satisfactory resolution.

7. Role and responsibilities

The following roles are essential to the successful operation of this established GRP:

7.1 EAP/SHEO

The Environmental Assessment Consultant (EAP) will hold the role of the convener and overall coordinator of the resolution process in the preconstruction phase. However, this role will transfer to the SHEO in the construction phase. Their roles shall include;

- Ensuring that the grievance redress process is activated and applied at applicable phases of the project.
- Facilitate constant feedback to the concerned party at all stages required of the process.
- Ensure that the GRM is always accessible to all stakeholders to the project in applicable phases of the project.
- Keep records and provide information as required of all grievances raised at various applicable phases of the proposed project and resolutions or state of the resolution process.
- Facilitate convening of the GRC as may be required.

7.2 Grievance Redress Committee

The GRC will take to operate to ensure that;

- Comprehensive information is composed pertaining a particular submitted grievance
- That the applicable context to resolution of the matter is considered in the process of seeking resolution such as applicable customary processes or policies or laws.
- The applicant is informed of the resolutions considered and the recommended appropriate to resolution of the matter at hand.
- All possible alternatives to resolution of the mater are explored at local level in a transparent manner.

The following shall roles comprise the GRC as established in prior sections:

7.2.1 The Engineering Consultant

Their role of the Engineering Consultant shall be to ensure that all grievances are addressed as swift as possible at local level to minimize impacts to the project.

7.2.2 Client Representative

The representative of NamWater shall participate in the grievance resolution process to serve the interests of the client.

7.2.3 MAWF/AFDB Representative

The role of the representative will be to serve the interests of the main client and financier in handling escalated grievances. The representative will serve to ensure transparency in the process of grievance handling and resolution in line with the legislative and requirements of the financier.

7.2.4 The Site Manager

The role of the Site Manager aligns to the appointed supervisor of the contractor for all work onsite. The holder of the position shall;

- Ensure that all grievances onsite are resolved to satisfaction at earliest and local level (i.e., project site domain)
- Update and bring to attention of the EC any grievance or conflicts onsite that may impact project progress.
- Facilitate all necessary measures to ensure implementation of the plan of action towards resolution of the matter at hand.

7.2.5 The Regional Authorities

The regional authorities shall include the representative of the regional council, the traditional authority and that of competent Ministry. Representative authorities shall serve to ensure transparency of the process that is escalated to a regional level, ensuring that applicable policies and legislation or applicable customary requirements if deemed necessary are addressed and met in the resolution process.

8. GRM Applicability

This GRM is earliest established in the pre-construction phase and applies to the planning and design process, and construction phases of the Oshakati Water Purification Plant Extension Project. In the operational and decommission phase of the commissioned infrastructure, the existing mechanisms of the implementing agency will consolidate where necessary aspects of this GRM and update to continually align with the guiding framework and further address principles set out in this document.

9. Submission of Grievances

9.1 Grievance submission and record

The submission of grievance shall comprise three formats;

i. Grievances or complaints raised from public engagement platforms such as public and key stakeholder meetings will be captured through minutes and form part of the grievances for consideration, resolution, and feedback to the stakeholder. However, these shall be handled through the standard Public Participation process that guide the conduct of EIA at national level. Peculiar matters that require submission of written complaints will be followed up if where captured.

ii. Submission of the written grievances directly by concerned interested or affected party to project representatives. Those submitted in this manner shall trigger application of the GRP.

iii. Oral grievances raised during the project implementation duration. Oral grievance shall further be handled as in (i), to written submission where necessary.

Except for originally written submitted grievances, all other grievance recorded or captured through oral means in public or key stakeholder meetings and indicating significance beyond resolution at local scale will require to be registered in written form aligning with the AfDB IRM and or the African Commission on Human and Peoples' Rights Complaint Procedure.

All the above referred grievance shall be considered valid and where required the application of the GRP will be applied appropriately. However, to maintain a consistent register of grievances, the attached grievance record sheet shall be completed either by the stakeholder or completed on their behalf where appropriate.

9.2 Details for Submission

Grievances can be submitted at the site office at the provided project suggestion box (construction phase), submission to the regional head of the project implementing agency (NamWater), Engineering Consultants project manager, Site manager (construction phase). All grievances deposited or registered at all referred offices or places shall be channeled to the SHEO for processing as per provided GRP.

A grievance registration form is included as Annexure I to this document. All completed forms are to be forwarded to the following below in the preconstruction phase. Submission in the construction phase will outlined and updated onsite and through necessary information platforms.

Mr. Siyamana Mulele
Project Environmental Coordinator
Email: namibconsulting@gmail.com
Mobile: + 264 85 697 9470
Alternate: +264 81 408 3679

Annexure I: Grievance/Compliant/Incident Submission Form

<table>
<tr><td colspan="6">Grievance/Compliant/Incident Submission Form
for
for the Preconstruction, Construction of the Oshakati Water Purification Plant Extensions Works</td></tr>
<tr><td>Name*:</td><td colspan="2"></td><td>Telephone*</td><td colspan="2"></td></tr>
<tr><td>Organization/Institution Represented</td><td colspan="2"></td><td>Email</td><td colspan="2"></td></tr>
<tr><td>Preferred language of feedback*</td><td colspan="2"></td><td>Residential or Business address</td><td colspan="2"></td></tr>
<tr><td>Title of Concern*</td><td colspan="5"></td></tr>
<tr><td>Brief Descriptions of the Comment/ Suggestion/ Advice/ Complaint/incident*</td><td colspan="5"></td></tr>
<tr><td rowspan="2">Do you have supportive evidence to the matter in hand?</td><td rowspan="2">YES</td><td rowspan="2">NO</td><td rowspan="2">If no, are you willing to assist obtain evidence on your concern?</td><td colspan="2">Yes</td></tr>
<tr><td colspan="2">No</td></tr>
<tr><td colspan="3">Date of observation of incident</td><td colspan="3"></td></tr>
</table>

*Required information

<table>
<tr><td>Signature</td><td></td><td>Date</td><td></td></tr>
</table>

OSHAKATI TOWN COUNCIL

Tel: +264 65 229500
Fax: +264 65 220435

906 Sam Nujoma Road
Private Bag 5530
OSHAKATI

OFFICE OF THE CHIEF EXECUTIVE OFFICER

Enquiries: Mrs. T. Muma
Our Ref: **746 Osh** Ext 2 & **105 Osh–North**

25 November 2021

The Chief Executive Officer
NAMWATER
Private Bag 13389
Windhoek

ATT: Mr. O. Shaningwa

Dear Mr. Nehemia

SUBJECT: UTILIZATION OF A PORTION OF LAND ALLOCATED TO NAMWATER FOR THE EXTENSION OF OSHAKATI WATER PURIFICATION PLANT

1. Your presentation to Council on 24th November 2021 regarding the above subject matter has reference.

2. Kindly be informed that the Council has granted permission to Namibia Water Corporation Ltd to utilise the portion of land allocated in terms of **Council Resolution No. CM158/10/2017** while statutory procedures and land transfer are being completed.

3. The portion of land to be utilised for this project should not incorporate the land that has already been planned by Council as reiterated during your presentation. When the statutory procedures are completed, the purchase price will then be determined upon the exact size of the land portion.

4. Appended hereto find the zoning map indicating the planned area which shall be excluded from the allocated portion of land.

5. The Council is trusting that the information provided will assist you to move forward with the implementation of this strategic project.

Yours sincerely

Timoteus M. Namwandi
CHIEF EXECUTIVE OFFICER

OSHAKATI TOWN COUNCIL
OFFICE OF THE CHIEF EXECUTIVE OFFICER
25 NOV 2021
P/BAG 5530, OSHAKATI
TEL: 065 229 500 FAX: 065 220 435

All correspondences should be addressed to the Office of the Chief Executive Officer

Your Ref: Power Supply Details to OPE

Our Ref: NamWater

Enquiries: KNI Mbangula

Date: 08 August 2022

The Senior Engineer
Zambezi Consulting Engineers cc
P. O. Box 91556,
Windhoek

Dear Mr. Abel Mashoko

RE: OSHAKATI PURIFICATION PLANT EXTENSION: ELECTRICAL POWER REQUIREMENT FOR A PROPOSED NEW 50MLD WATER PURIFICATION PLANT TO AUGMENT THE EXISTING 40MLD WATER PURIFICATION PLANT

Your letter dated 31st May 2022 and our site visit of 15 July 2022, on site, refer.

Based on the estimated maximum demand of 800kVA that the new 50MLD water purification plant will require, Oshakati Premier Electric would like to confirm that adequate additional supply can be provided for the proposed 50MLD water purification plant. Please note that the exact setup of material on site can only be confirmed after receipt of a formal application for power supply and finalization of a formal quotation.

With regard to the cost estimate for power supply to the new water purification plant, the application form for power supply was forwarded to your office. The client or their representative is required to complete the form together with the power supply agreement and send it back to OPE. OPE will then proceed to prepare a formal quotation for the client.

Should you require further clarification, please contact Mr. Kamati Mbangula, on telephone no. 065 220 229 (office), 081 1488 205 (mobile) or email kmbangula@ope.com.na.

We hope you will find the above in order.

Yours Sincerely

NELSON T SHEYA
CHIEF EXECUTIVE OFFICER

Mr Phillip Ndjendja (Chairperson), Ms Francina Bock, Mr Orestus Shilunga, Cllr. Katrina Shimbulu, Mr Simeon Antindi, Dr Regina M. Shikongo, Mr Pieter Greyling
Co. Reg. No. 2000/046

HEAD OFFICE
P.O. Box 91556,
Klein Windhoek
Main House,
Erf 3245, No. 62
Jenner St.
Windhoek West

KATIMA MULILO BRANCH
P.O. Box 1172, Ngweze
Erf 1654, Unit 02
Mavuluma Ext 2,
Old NHE, Kwena St.
Katima Mulilo, Namibia

ZAMBEZI
CONSULTING ENGINEERS

"Sustainable Engineering That Protects & Enhances the Environment"

Ref.: P2109-03-Power Supply Details to OPE

Date:31st May, 2022

To: Chief Executive Officer
Oshakati Premier Electric
Erf 3175, Oshakati East
Oshakati, NAMIBIA

Dear Sirs,

RE: OSHAKATI PURIFICATION PLANT EXTENSION: ELECTRICAL POWER REQUIREMENT FOR A PROPOSED NEW 50MLD WATER PURIFICATION PLANT TO AUGMENT THE EXISTING 40MLD WATER PURIFICATION PLANT

NamWater has awarded the Engineering Consultancy Services for New 50MLD water purification plant to Shah Technical Consultants Pvt Ltd. India in association with Water Resources Consultants Pvt Ltd. Botswana, Zambezi Consulting Engineers CC, Namibia.

The existing 40MLD water purification plant receives power supply through 11KV overhead line. Maximum demand for existing 40MLD plant is 937KVA (approx.)

The new 50MLD water purification plant shall be constructed near 40MLD plant and the estimated power requirement for new 50MLD is around 700 to 800KVA. Site plant (tentative) is enclosed for reference.

We do hereby request your esteemed organisation to confirm availability of power supply and estimated cost for providing power supply to new 50MLD proposed water purification plant. Planning and design of new 50MLD plant is in the preliminary stage.

We hope you find our details to be in order & of interest and we will happy to furnish further details / clarifications on hearing from you.

Yours Sincerely

Signature (of Consultant's authorized representative)

Full Name: Mr. Abel Mashoko
Title of Signatory: Senior Engineer
Name of Consultant: Zambezi Consulting Engineers CC
Address: 62 Jenner Street, Windhoek West, Windhoek, Namibia
Phone : +264-61-400-523, Fax : +264-88-632-302
E-Mail : zambezice@gmail.com/info@zambezice.com.na

Annexure F: Alternative Designs to the new RWSD

(Alternative 3)

(Alternative 3)