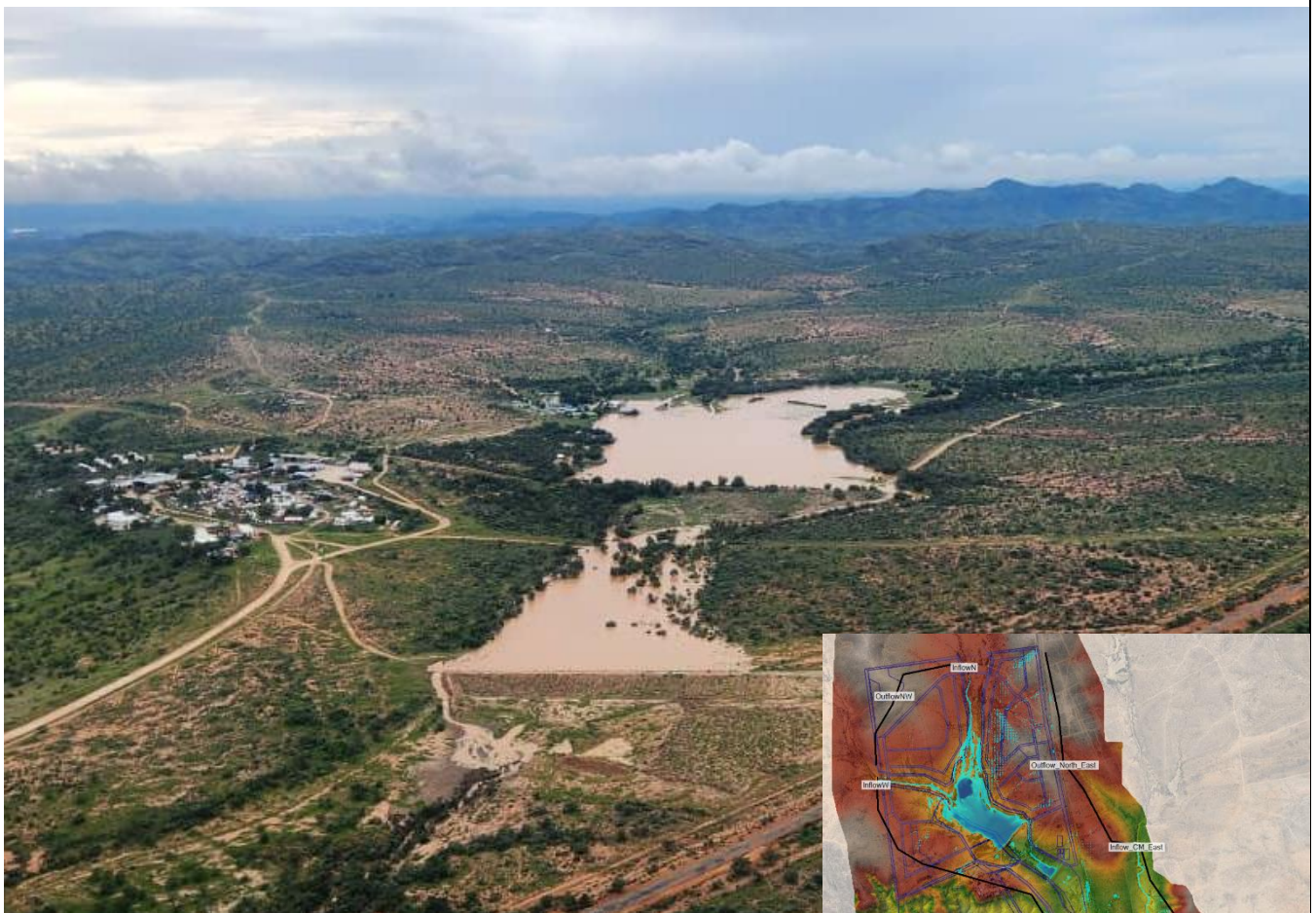




FLOOD EVALUATION GONDWANA LIFESTYLE & COUNTRY ESTATE WINDHOEK



FINAL REPORT

25 October 2025

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Date

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1 INTRODUCTION

Chris Muir Consulting Engineer was appointed by Windhoek Consulting Engineers to undertake a flood evaluation of the property on which the Gondwana Lifestyle and Country Estate will be developed. The site is located approximately 7 km east of Windhoek and it will be developed on the property of the existing Heja Lodge.

The location of the site is shown in **Figure 1-1**.

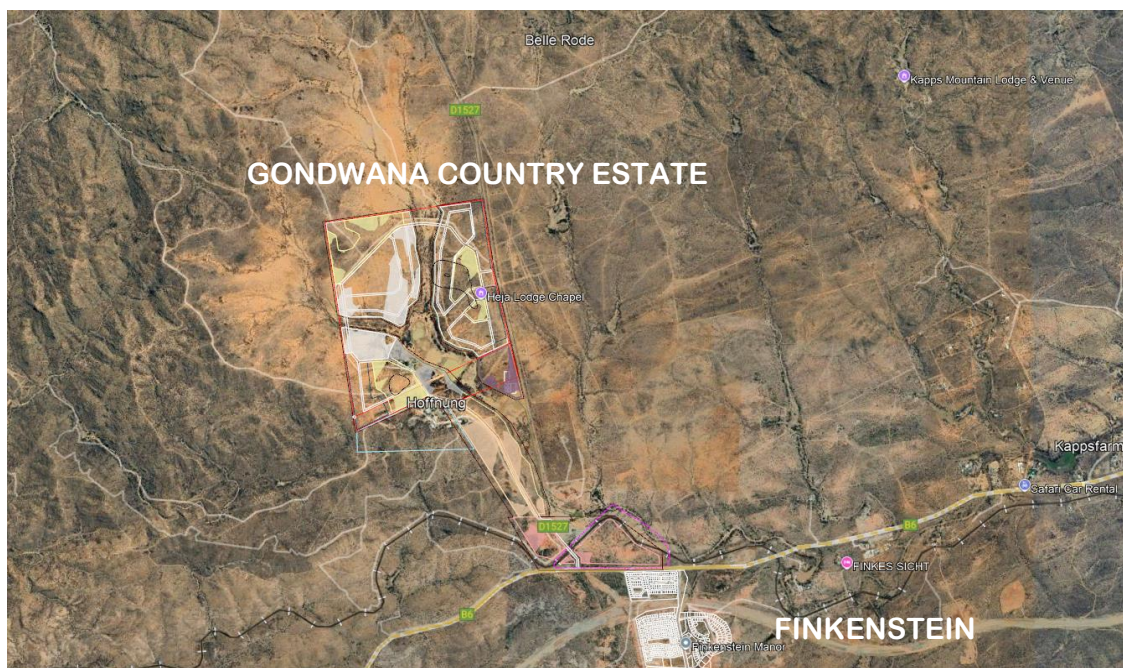


Figure 1-1: Location of the proposed Gondwana Lifestyle and Country Estate

A Master Plan of the proposed Estate is shown in **Figure 1-2**.

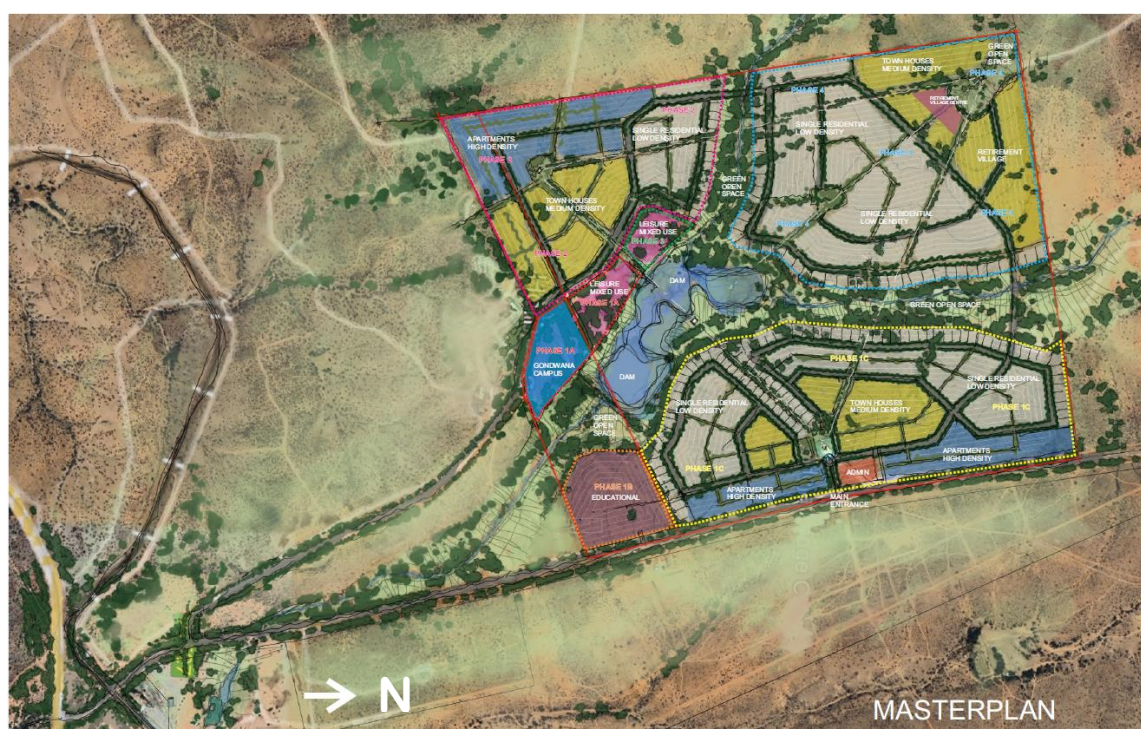


Figure 1-2: Master Plan of the proposed Estate

A preliminary zoning map of the development is shown in **Figure 1-3**.

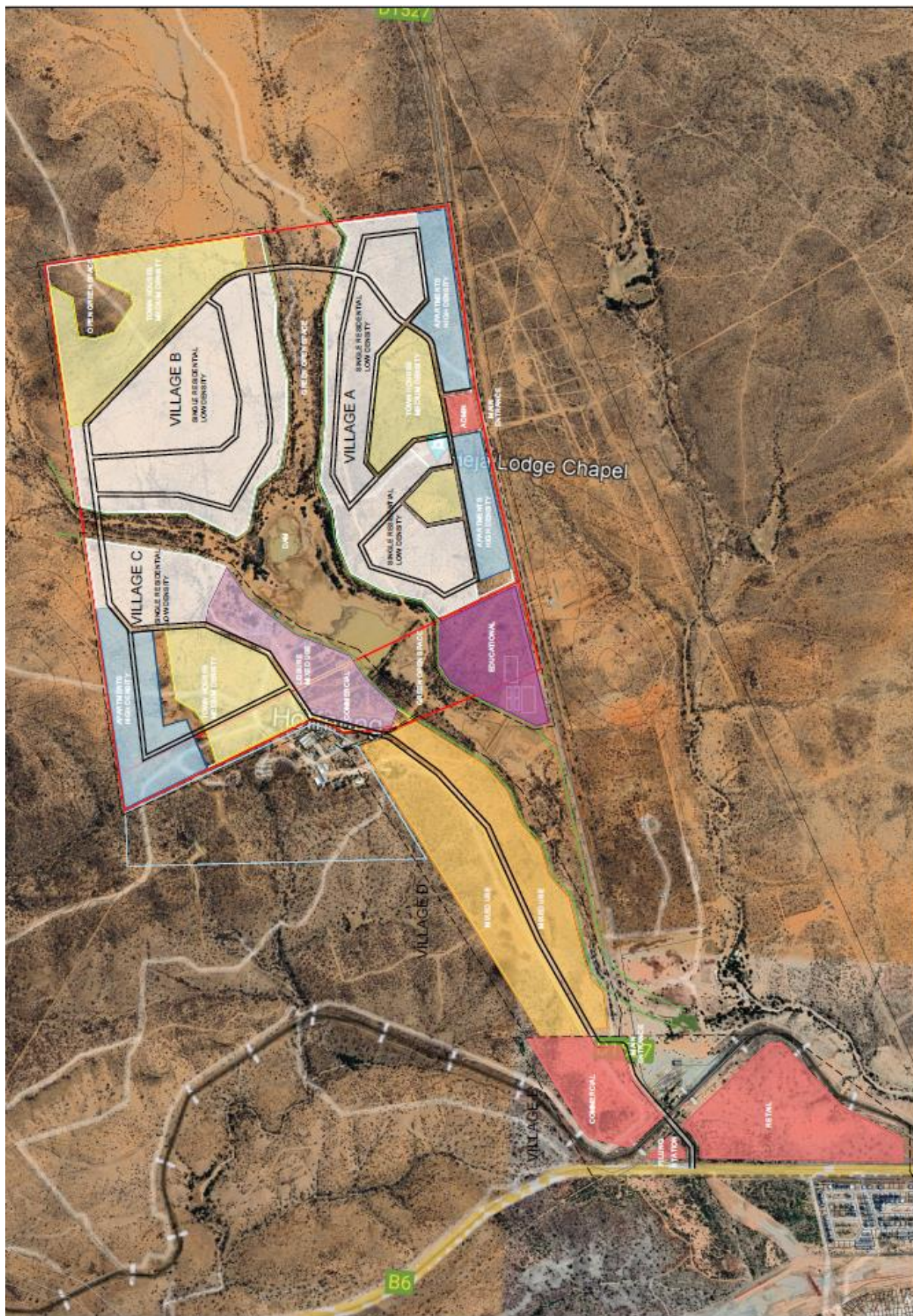


Figure 1-3: Preliminary Zoning of the Development

A Digital Terrain Model (DTM) of the Estate and the surrounding area is shown in **Figure 1-4**.

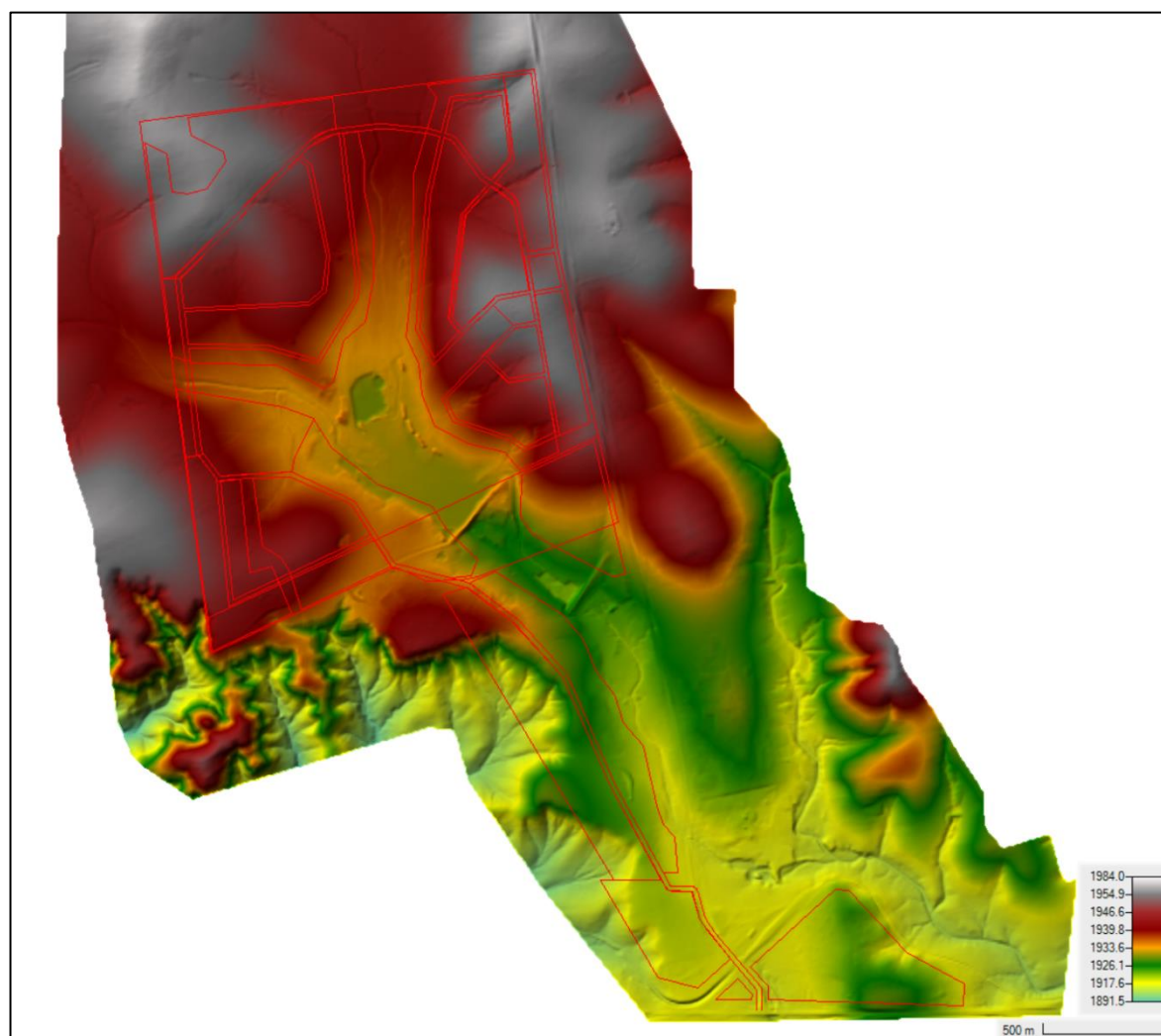


Figure 1-4: DTM of the development and surrounding area

2 PURPOSE OF THE STUDY

In terms of the Local Authorities Act 23 of 1992, no development is allowed within the 1 in 50-year flood zone of a river. The purpose of the study is thus to map the inundation areas of the rivers that flow through the proposed development. This information will assist in developing the layout of the proposed development.

The study has been divided into 3 phases:

Phase 1: a high-level modelling of the 1 in 50 and 1 in 100-year floodlines to enable the development of the initial layout of the Estate.

Phase 2: detailed modelling of the current development level to enable the detailed planning of the Estate layout, and of the roads and services.

Phase 3; the modelling of the Estate once all the roads with bridges and culverts have been designed (post-development). This will ensure that the development will meet all the requirements of the Local Authorities Act.

All three phases have been completed

3 SURVEY

An aerial survey was flown by the survey firm Strydom and Associates of Windhoek who produced a digital terrain model of the development area. The survey was carried out to the specifications provided by Windhoek Consulting Engineers, with a high resolution of 0.5 m by 0.5 m and acceptable level of detail to allow for accurate flood simulations.

An image of the DTM is shown in **Figure 3-1**.

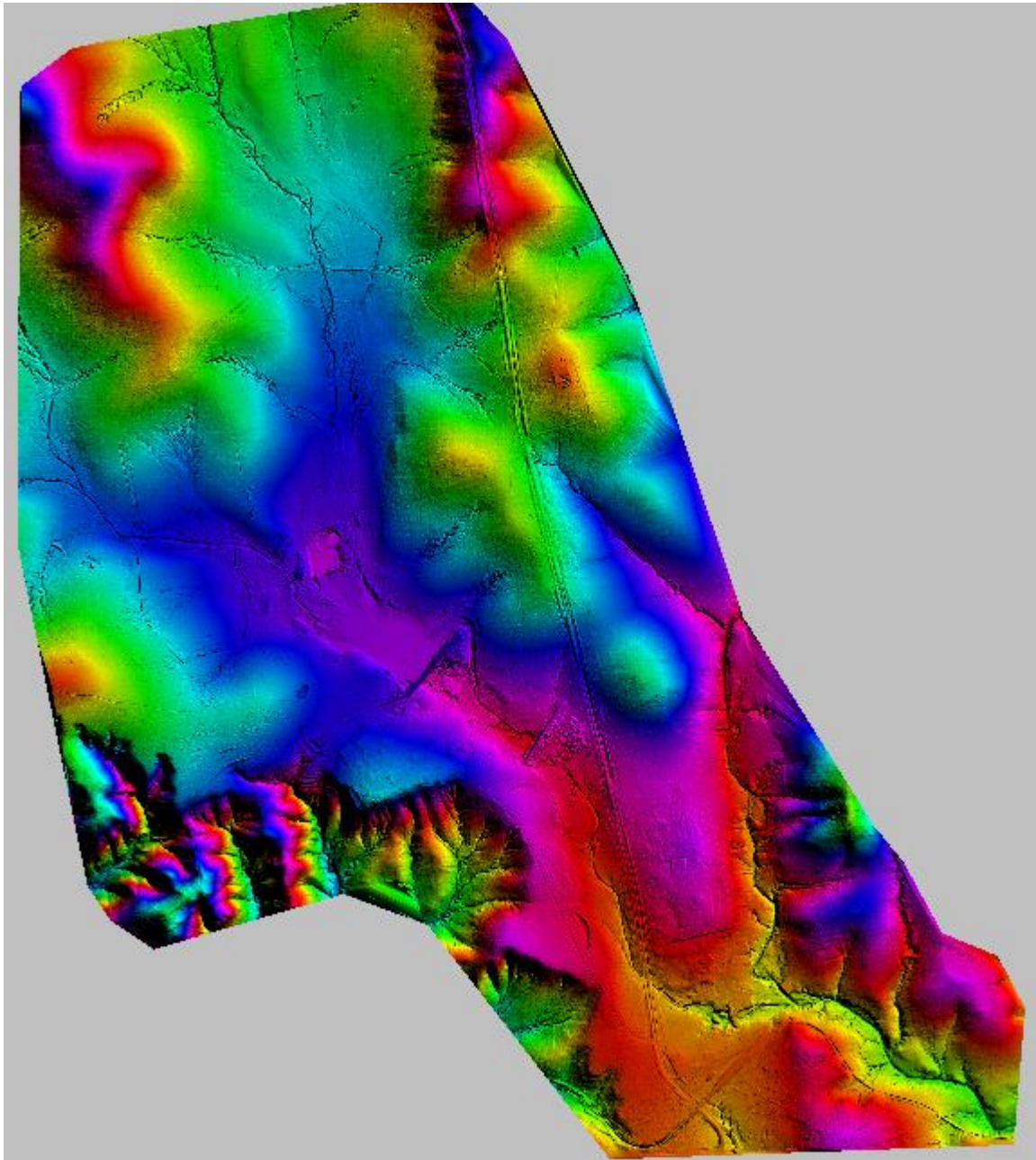


Figure 3-1: Digital Terrain Model of the Development Area

4 HYDROLOGY

The catchment areas that drain through the development border on the catchment area of the Klein Windhoek River. The hydrological characteristics of the adjacent catchments are similar and therefore the same rainfall records of the Windhoek Met Office were used in to derive the flood hydrographs and rainfall intensities of the Klein Windhoek River were used in this study.

Hydrological Modelling

The hydrological modelling techniques used in this study and described below have been developed and refined over the past 10 years for use in the Windhoek area. The first work was done in 2014 for the floodline assessment of the three main rivers flowing through Windhoek.

The model used in 2014 was calibrated using the gauged flows in the Arebbusch River at the Monravia gauging station.

Description of the Task

This task involved the determination of the hydrology of the catchments draining to the Gondwana development area for use in the determination of the 1 in 50- and 100-year flood lines.

The hydrological modelling used both Deterministic and Empirical modelling techniques which aid in the estimation of peak flow rates along natural watercourses and artificial structures within the study area. The typical model parameters included:

- a. Up to date Windhoek rainfall data from the Windhoek Meteorological Office.
- b. Catchment slope, size and shape. The catchments extended up to the origin of the rivers.
- c. Soil condition and Antecedent Moisture Conditions (AMC)
- d. Water course size and shape
- e. Storm rainfall. A probabilistic regression analysis was carried out on the historical rainfall to establish the correlation between rainfall depth and probability of occurrence. The rainfall information was then used as an input to the Hydrological models.

Methodology for the Hydrological Modelling

The methodology included the following:

- A site visit, to get a good understanding of the physical characteristics of the catchment;
- The deterministic methods (Rational, alternative Rational and SCS methods, where relevant) were used for the determination of the flood hydrology of the catchment;
- Existing hydrological information was sourced from the relevant institutions, including detailed flow records at the Monravia gauging station, and the Windhoek area rainfall records;
- Determine catchment characteristics using information collected during the site visit, the Namibian Soil Map, as well as the relevant literature for the deterministic methods;
- Analyse the available rainfall records and determine the relevant storm rainfall

records using weighting as required;

- Determine the flood peaks at the relevant sites for the catchment with probabilities of exceedance of 1% and 2% using the above-mentioned methods.

Model calibration:

The results of the models developed for the 2014 study were used to calibrate the Gondwana model using the Windhoek rainfall records and the recorded flow gauging at the Monravia gauging station on the Arebbusch River.

Catchment Areas

The catchment area that drains through the development is shown in **Figure 4-1**. The derived catchment area is illustrated with a hatched green area and the longest flow path with a blue line.

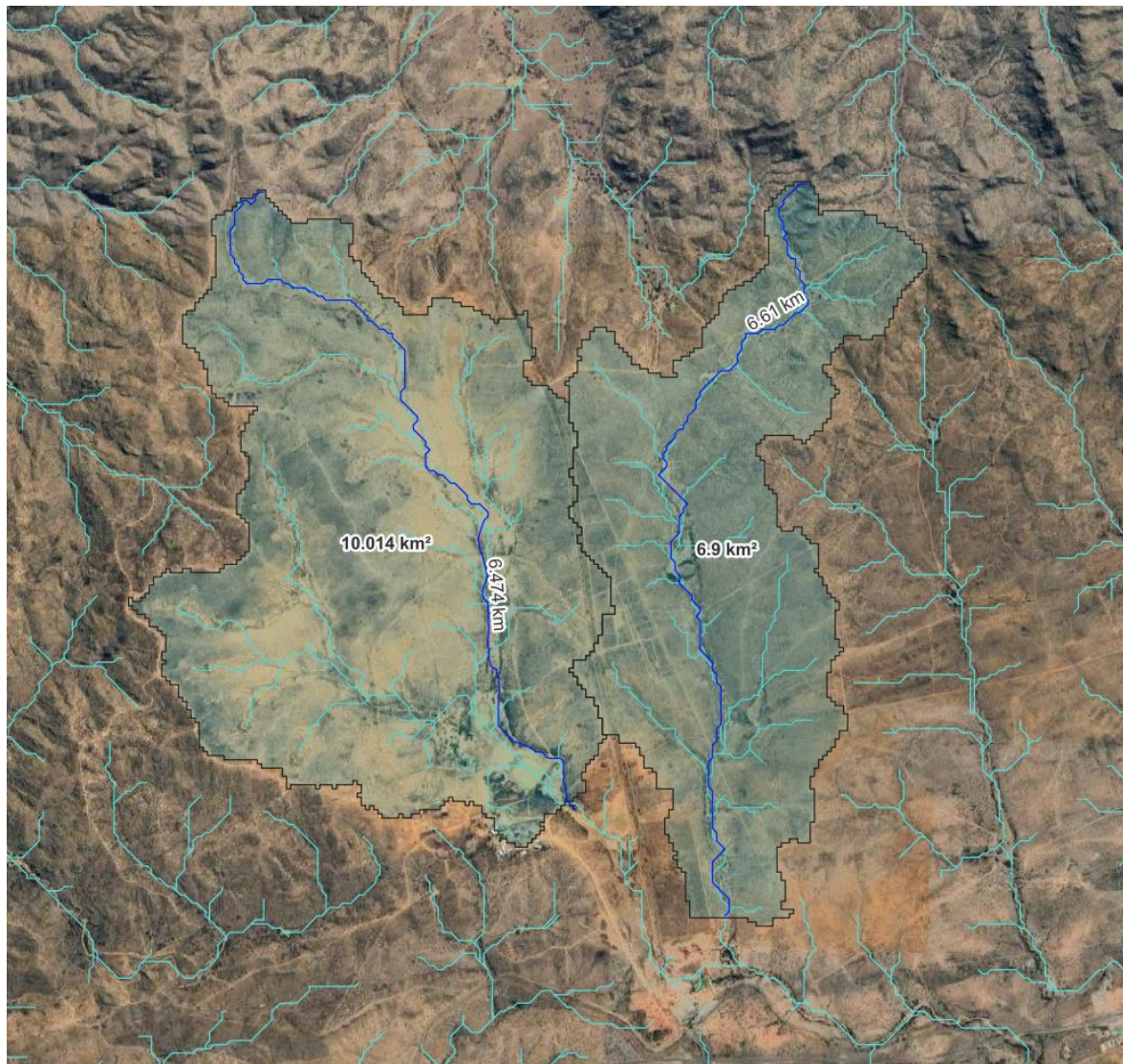


Figure 4-1: Catchment Areas

4.1 HYDROLOGICAL MODELLING RESULTS:

Catchment Statistics: (Refer Figure 4-1)

Catchment North

Area = 10.014 km²

Longest path = 6.48 km

Catchment East

Area = 6.9 km²

Longest path = 6.61 km

Rain on Grid

Area = 6.4 km²

4.2 DESIGN FLOOD MAGNITUDES

The calculated design flood peaks for the inflows and rain on grid are:

- 1 in 50 years:
 - North: 11.3 m³/s
 - West: 7.6 m³/s
 - East: 6.8 m³/s
 - Rain on grid: 7.1 mm/hr.
- 1 in 100 years:
 - North: 13.6 m³/s
 - West: 9.1 m³/s
 - East: 8.6 m³/s
 - Rain on grid: 9.2 mm/hr.

5 HYDRAULIC MODELLING

The flood was modelled using HEC-RAS Software Version 6.7 Beta, where a two-dimensional mesh is created on the imported DTM. This forms the basis of the model. The 2d-modelling produces the floodlines and inundation areas, as well as the water surface elevations and water velocity for the 1 in 50- and 1 in 100-year flood events.

Phase 1 modelled the present-day condition at a high level. These initial modelling results were submitted to the Client to guide the first “broad strokes” of the layout.

Phase 2 also modelled the current situation. Further details such as the footprints of the existing buildings, building heights, existing culverts and other infrastructure were imported, together with the latest survey data as DTM. Essential inputs included information on invert elevations, centrelines, and Manning’s roughness values (n).

Phase 3 assessed the impact that the final development will have on the floodlines. First the Phase 2 model of the present-day condition was determined, before the impact of the development was assessed. The comparison of the Phase 2 and Phase 3 models was then used to evaluate if the development has a negative impact on the flood levels and to estimate safe elevations for the proposed roads, including culverts, building platforms, final finished levels of buildings, and to

ensure that the requirements of the Loal Authorities Act are fully met. The model provides the soffit levels of the major culverts, from which the final vertical alignments of the roads can be designed.

5.1 THE HYDRAULIC MODEL

A 2D mesh was generated and optimised based on the DTM of the survey area, the mesh is shown in **Figure 5-1**. Also shown are the boundary condition lines where inflow hydrographs are introduced onto the mesh, as well as the outflow boundary lines.

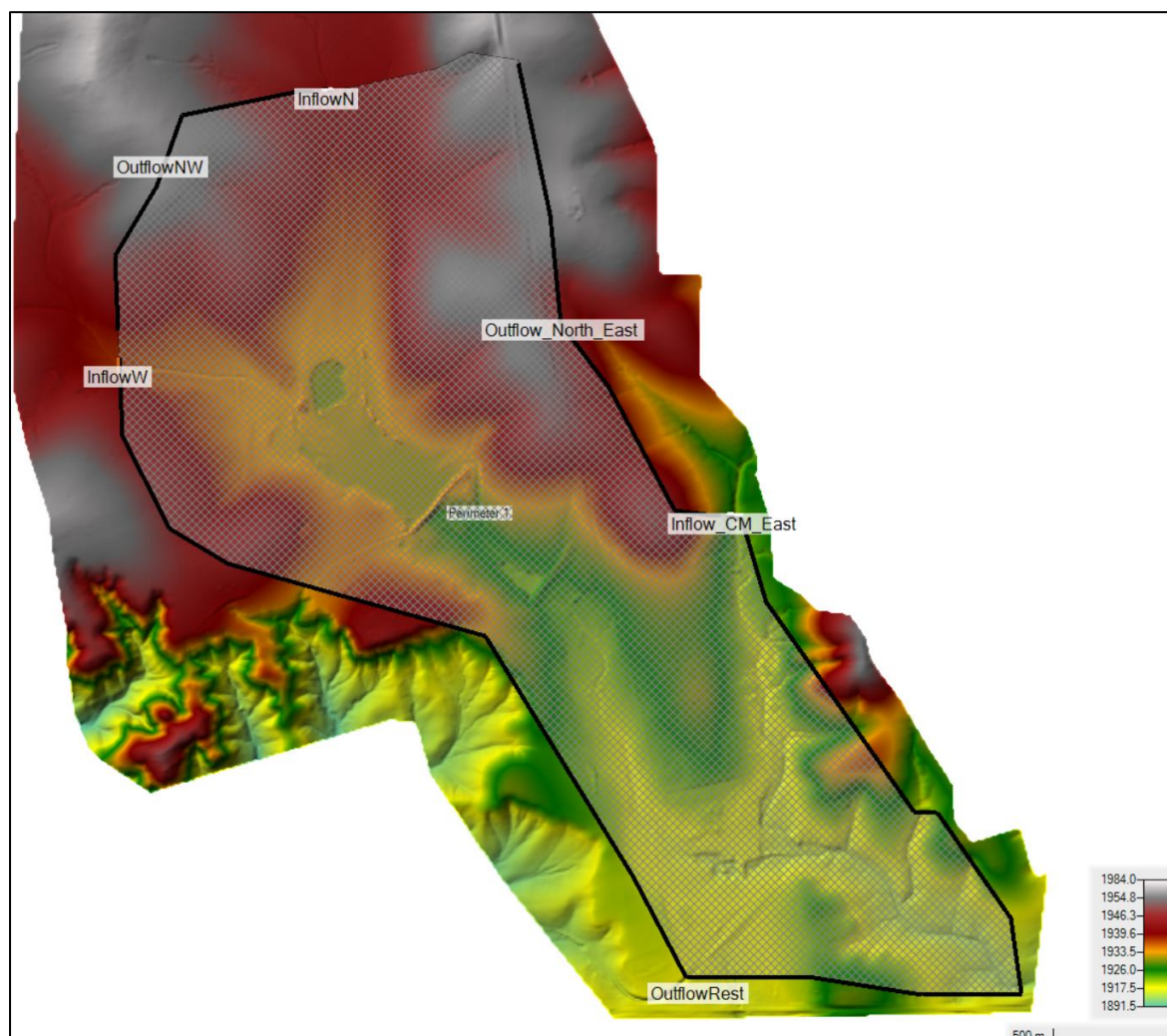


Figure 5-1: 2D Mesh and Boundary Condition lines

Inflow hydrographs were introduced at the downstream drainage points of the rivers where they flow into the study area. The rivers flow from the West, North and from the East. In addition, rain on grid was added to the whole 2D mesh area. This also caters for the flow downstream of the Main Dam which is made up of spills from the Main Dam, and drainage from the rain on grid that accumulates downstream of the dam.

The catchments and the rivers that feed into the project area are shown in **Figure 5-2**.

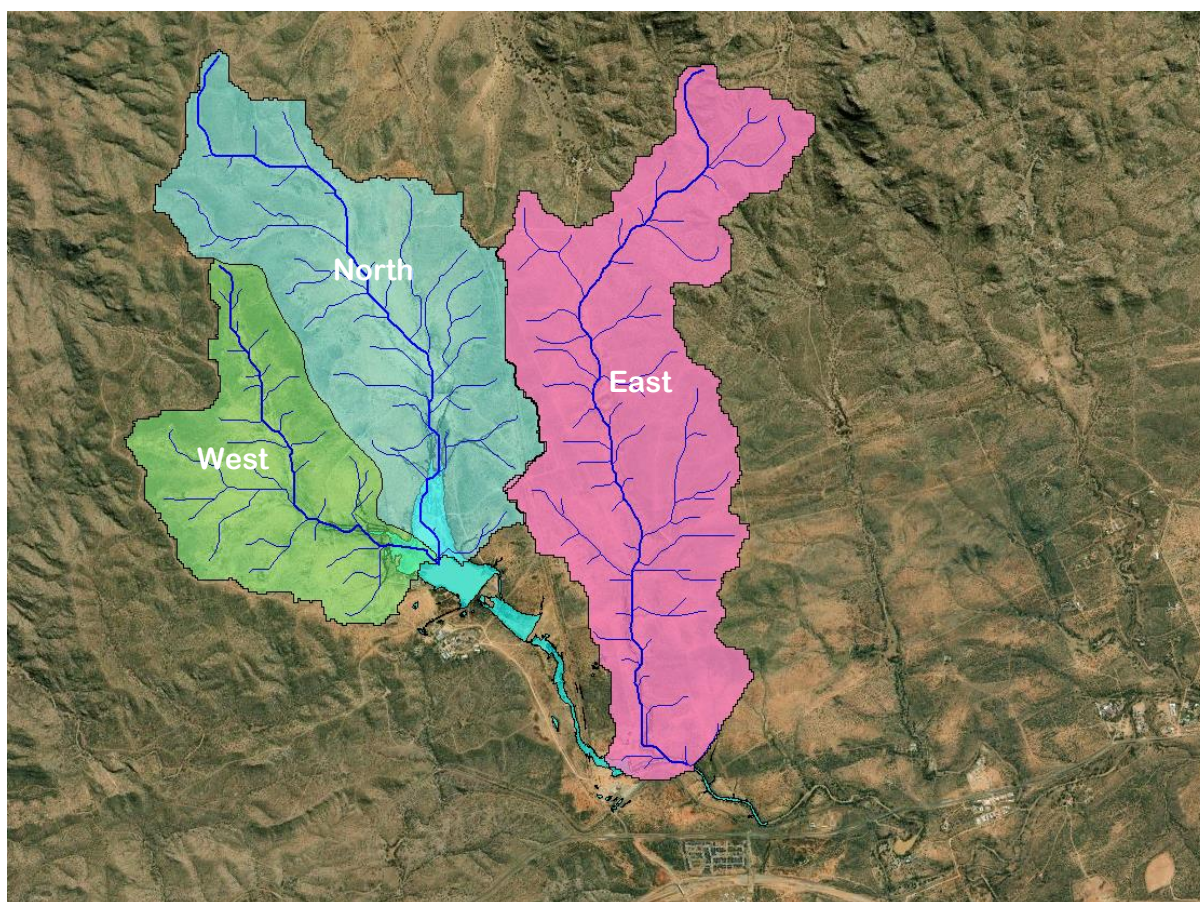


Figure 5-2: Rivers in the Project Area

The rivers “West”, and “North” flow through the proposed development. The river “East” was modelled to see whether there is any backwater in the Seeis River that may affect the flood levels in the project area.

“Rain on Grid” was superimposed over the full 2D mesh shown in **Figure 5-1**. The Rain on Grid is also used to generate the flow in the 2D mesh downstream of the Main Dam.

5.2 SCENARIOS MODELLED

The following scenarios were modelled to evaluate the impact of the proposed development on the floodlines:

- Model 1: A high level pre-development model to guide preliminary layouts. The results of this high level model were submitted to the Client. A report on the high level modelling results was not required.
- Model 2: A detailed pre-development model to properly assess the present state for the preparation of the final layouts.
- Model 3: The post-development model to assess the impact of the development on the pre-development flood levels, This model considered the higher run-off generated in the developed area due to higher runoff factors used for built up areas, and to confirm the hydraulic design of major culverts, to ensure that plots

are raised above the flood elevation, and to inform the design of stormwater systems.

5.3 MODEL 2: 2D MESH RESOLUTION AND ROUGHNESS

A uniform roughness value of $0.03 \text{ s/m}^{1/3}$ was applied to the whole 2D mesh for the Manning's n value used for the rain-on-grid. This is shown in **Figure 5-3**.

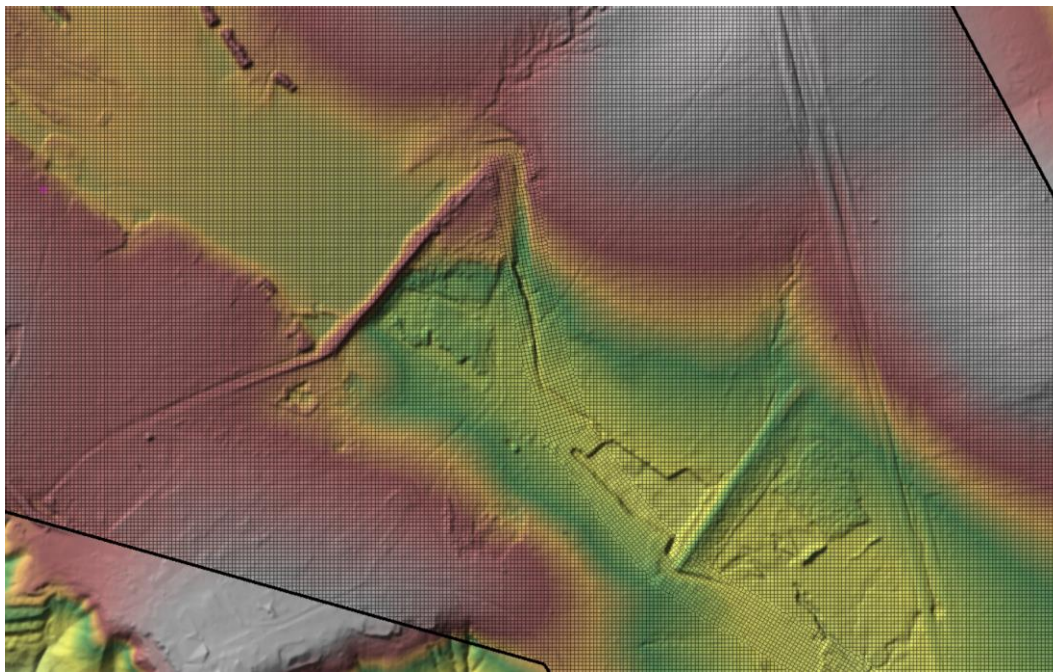


Figure 5-3: 2D Mesh pre-development with uniform Manning's n value.

6 MODELLING RESULTS

6.1 MODEL 2

The 1 in 50-year modelling results of the current situation (pre-development) are shown below.

6.2 PRE-DEVELOPMENT INUNDATION

The 1 in 50-year inundation area is shown in **Figure 6-1**.

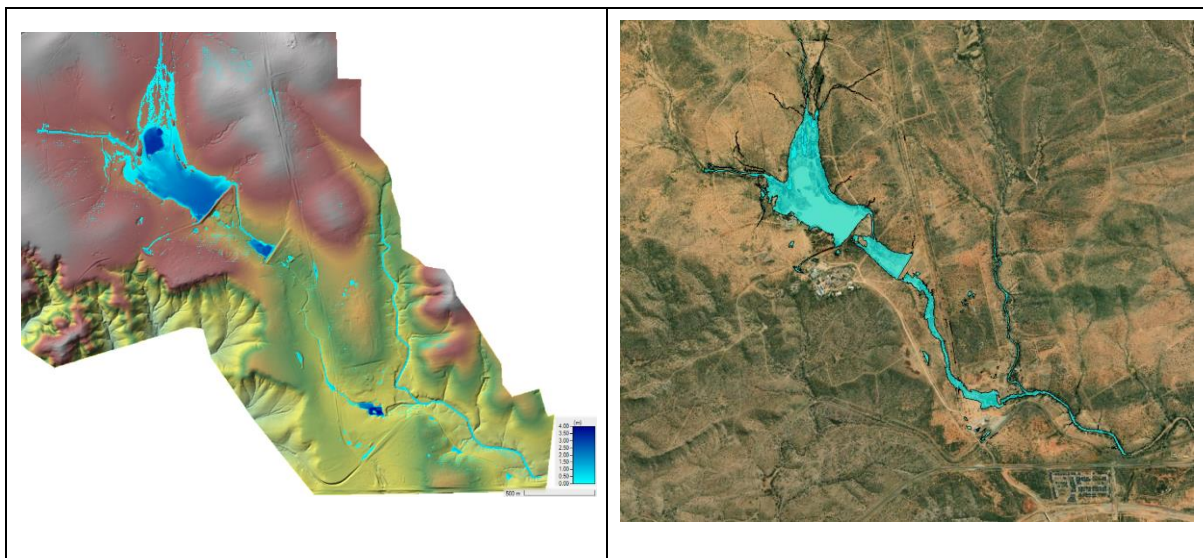


Figure 6-1: Water inundation area for the pre-development scenario 1 in 50-year.

The 1 in 50-year inundation area, superimposed on the proposed layout, is shown in **Figure 6-2**.

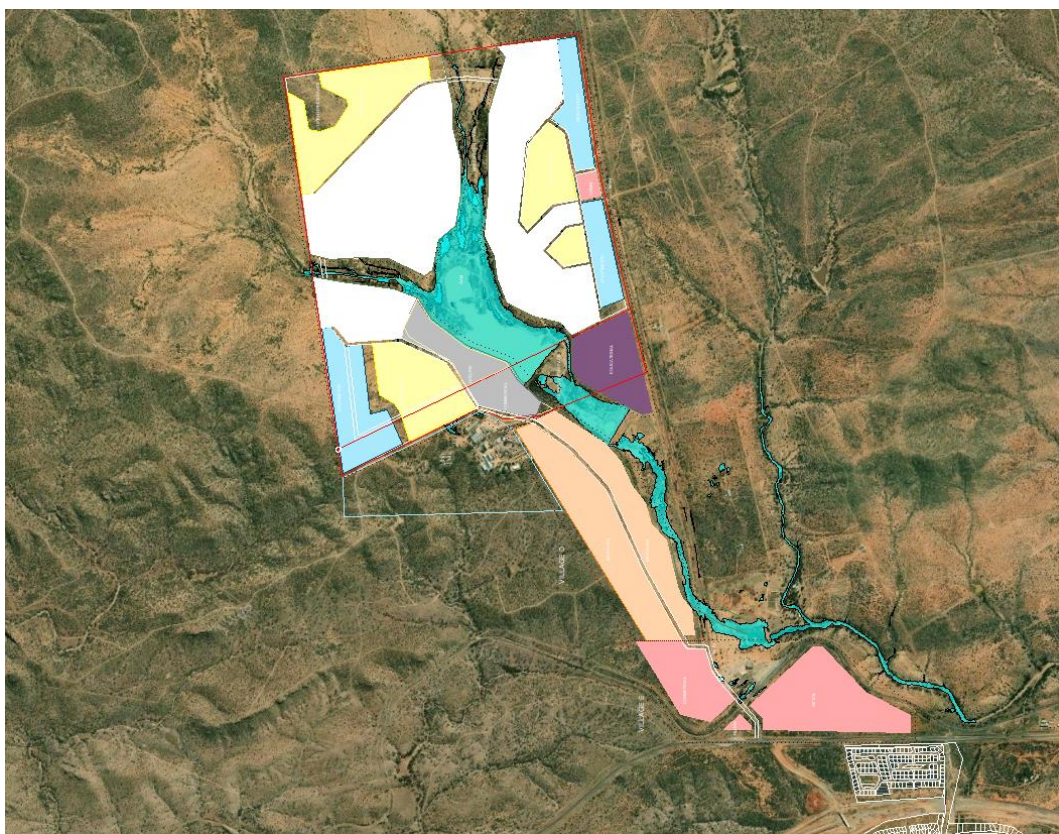


Figure 6-2: 1 in 50-year inundation area superimposed on the layout.

6.3 MODEL 3

Model 3 modelled the following impacts:

- i. The higher runoff factors of the larger built up area
- ii. The introduction of the major culverts into the model

- iii. Any negative impacts on the flood levels and floodlines caused by the higher runoff factors, with the possible encroachment into the planned erven.

6.3.1 The Post Development Floodlines

The pre- and post development floodlines are shown in **Figure 6-3**.

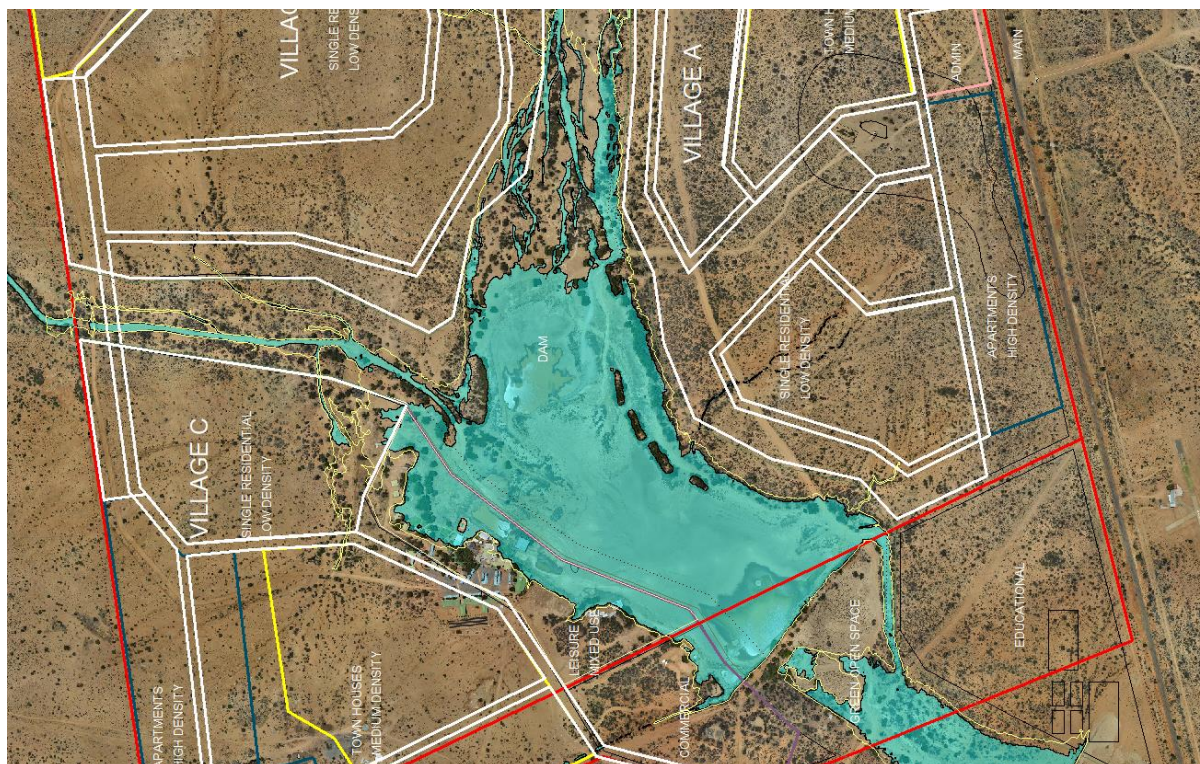


Figure 6-3: Comparison of pre- and post development floodlines

The yellow line shows the position of the pre-development 1 in 50 year floodline, and the hatched blue area is the post-development, 1 in 50 year inundation area. This indicates that the post development flood level is lower than the pre-development level. Naturally, it would be expected to be the other way around due to the higher runoff coefficients used for the rain on grid on the built up areas.

This phenomenon will be explained in the following paragraph which deals with the impact of the culverts on the flood levels.

6.3.2 Impact of the culverts

Three culvert groups were analysed. These culverts are all located on the ring road that runs around the development. The location of the three culvert groups is shown in **Figure 6-4**.

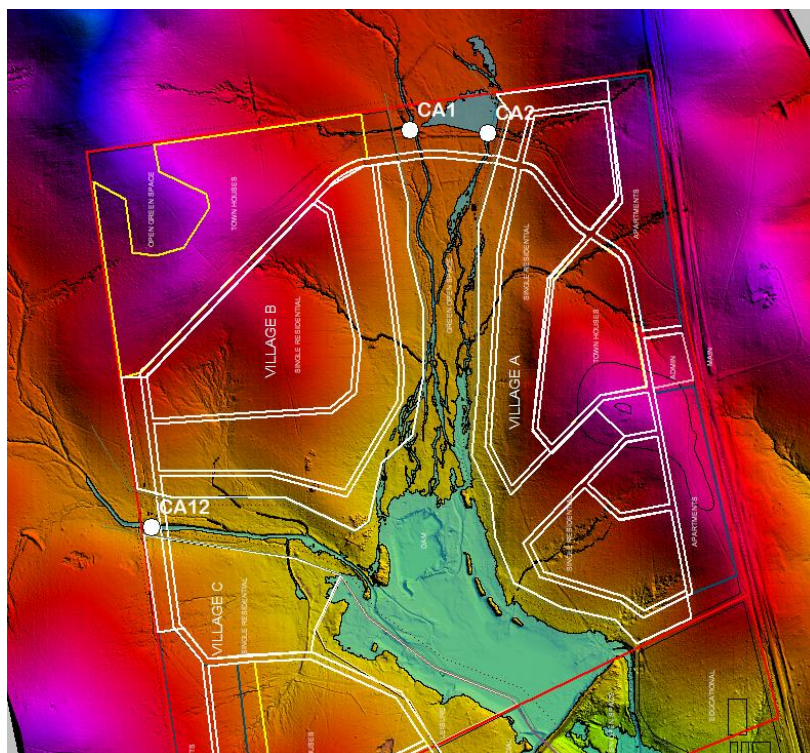


Figure 6-4: Location of the three culvert groups

Culverts CA1 and CA2

CA1 drains the major river of the northern catchment, while CA2 drains a smaller sub-catchment of the main northern catchment shown in **Figure 5-2**.

CA1 is located on a well defined river channel with well defined river banks. However, the river that drains through Culvert CA 2, while it is well defined in its upper reaches, lower down it flows into an area that can be described as a floodplain with an ill-defined river channel and very low river banks which allows the river to spread out over a large area. This is shown in **Figure 6-5**.

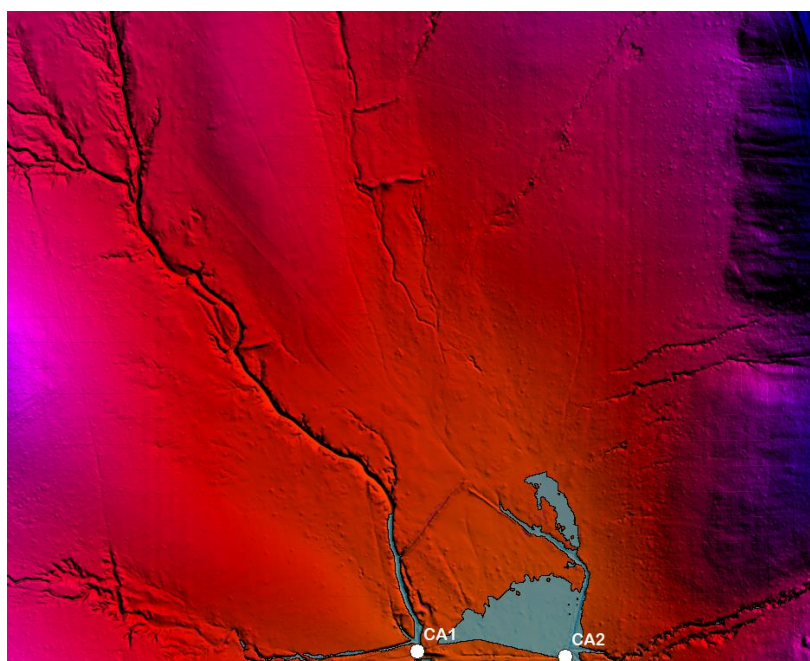


Figure 6-5: Rivers that drain through culverts CA1 and CA2.

Culvert CA1

For Culvert CA1, Windhoek Consulting Engineers (WCE), the project design team, proposed a culvert group comprising 3 barrels of dimensions 2 400mm x 1 200mm. This proposal was checked in the hydraulic model, and it proved to be adequate.

Culvert CA2

The design of culvert CA2 is complicated by the shallow flood plain on its upstream side.

Several iterations involving different culvert sizes and numbers of barrels were modelled. The optimum culvert arrangement, which provided the maximum water level reduction on the upstream side, was a culvert group with the following dimensions:

- 4 culverts x 2400 x 1200, required to ensure the maximum draw down of the water level on the upstream side.

Four more culverts were added into the model to test the sensitivity to increasing the number of culvert barrels. This resulted in no significant change in depth (-5 cm change).

The final layout has cut out this corner from the affected erf to ensure that all erven in the proposed layout fall outside the post-development 1 in 50 year floodline.

The affected area is shown in **Figure 6-6**.

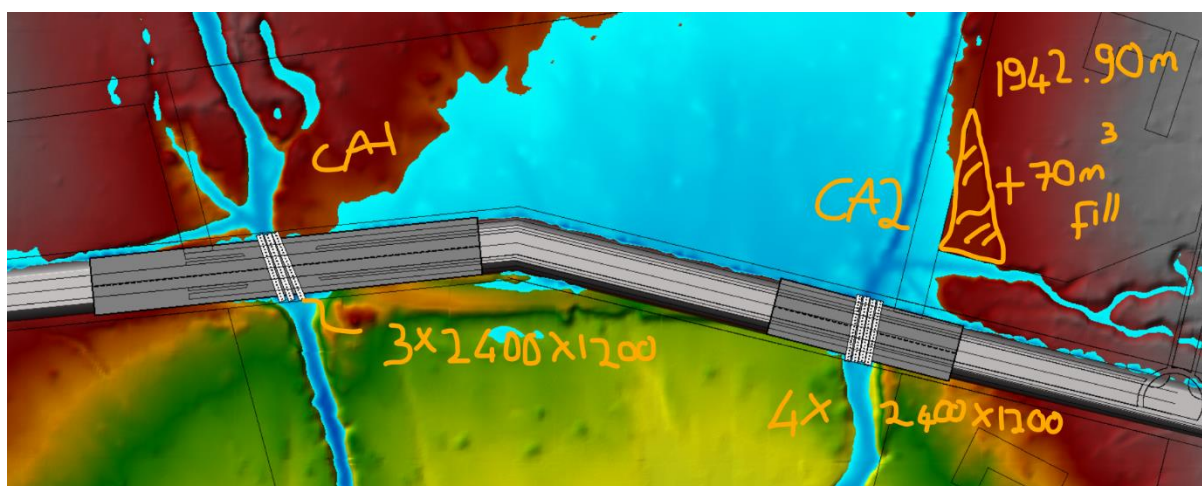


Figure 6-6: Culvert groups CA1 and CA2

Culvert CA12

Culvert CA12 drains the catchment on the western side of the development, shown in **Figure 5-2**. The location of the culvert is shown in **Figure 6-4**.

The road crossing over the river is currently a low level causeway which is effectively a concrete slab over the river. Through the years the river has deposited alluvium on the upstream side of the slab and has eroded a deep “hole” on the downstream side where the concrete slab has acted as a weir.

The long section of the river bed shown in **Figure 6-7** illustrates this.

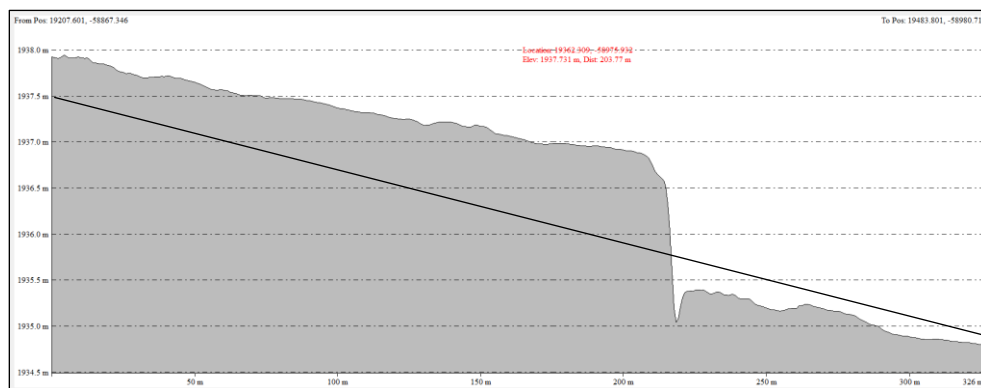


Figure 6-7: Long section of the riverbed at Culvert CA12 with proposed bed alignment

The required culvert size for CA12 is 3 culverts x 2400 x 1200 which will convey the flood with unpressurised/ free surface flow.

The culvert arrangement is shown in **Figure 6-8**.

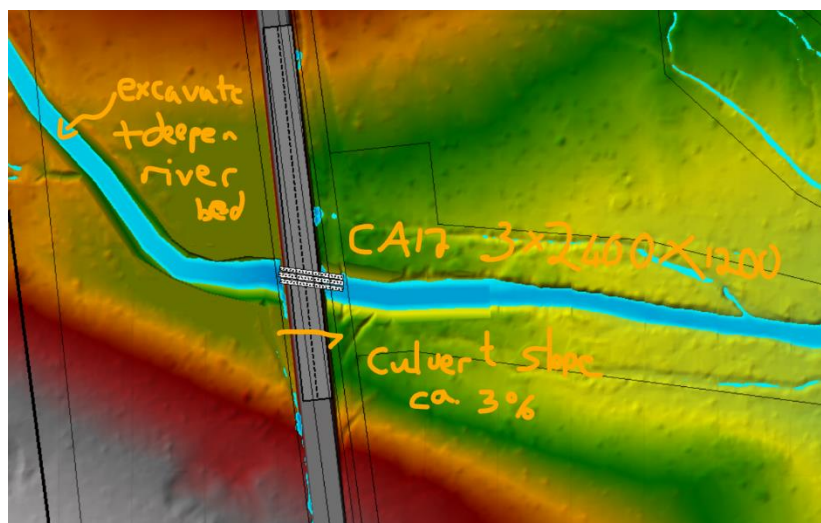


Figure 6-8: Culvert group CA12

The water surface profile through the culvert is shown in **Figure 6-9**.

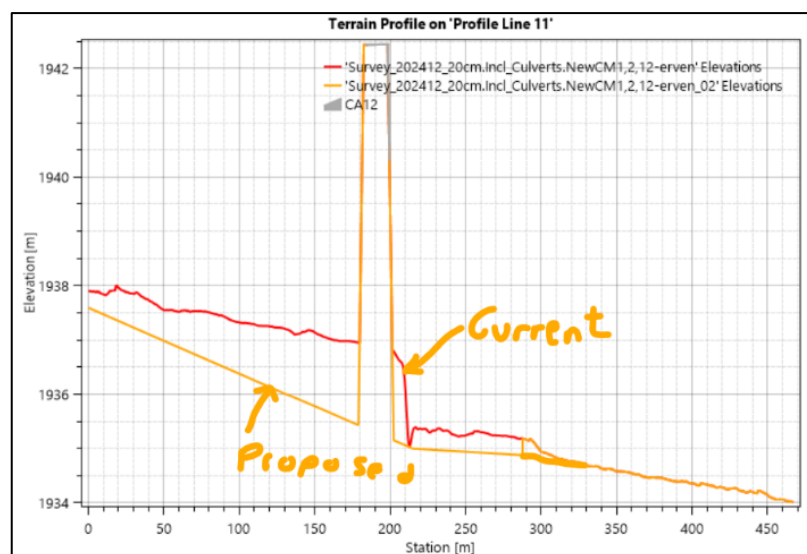


Figure 6-9: Water surface profile through Culvert group CA12

Additional work that is required is the following:

- align the upstream bed slope of the stream with the downstream slope to obtain a uniform grade.
- fill the sides of the river upstream of the culvert with approximately 65 m³ of fill material up to a level of 1937.85 mamsl, to obtain a deep enough cross-section.

7 IMPACT OF THE DAMS

The main impacts that the dams could have on the flood risk to the development are the capacity of the spillways and the freeboard of the non-overspill crests. Although the freeboards of both dams have been checked, it should be noted that this study is not a dam safety evaluation. Should the freeboards be adequate it should not be assumed that the dams are safe from all failure modes.

In **Figure 7-1** below, the water level in the Main dam is 1933.0 mamsl, and the minimum level of the non -overspill crest is 1934.75 mamsl. This provides a freeboard of 1.75 m.

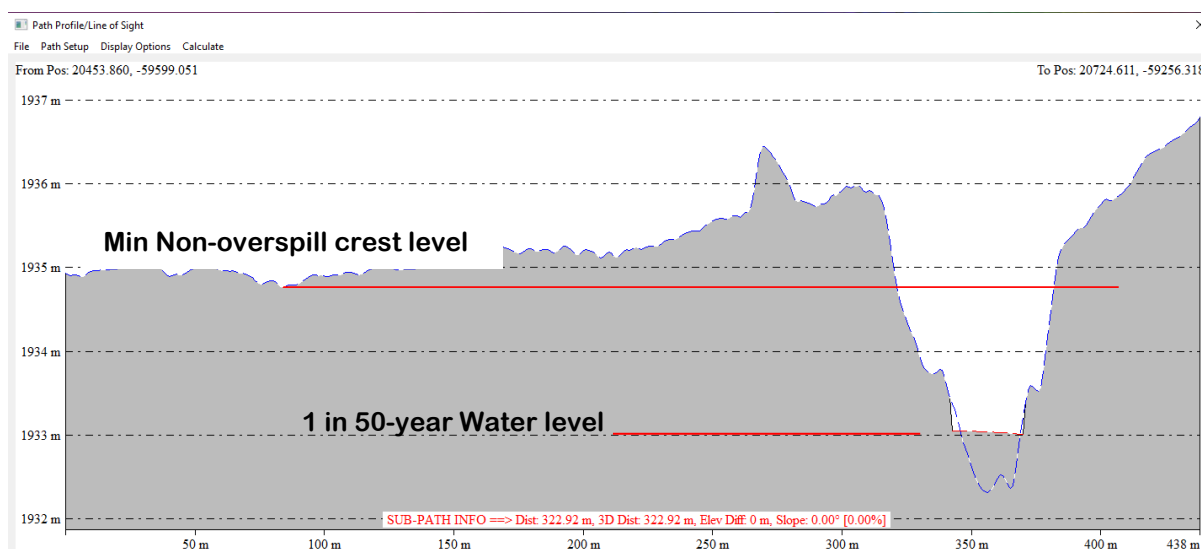


Figure 7-1: Freeboard for 1 in 50-year flood (Main Dam)

In **Figure 7-2** below, the water level in the Downstream Dam is 1927.25 mamsl, and the minimum level of the non-overspill crest is 1927.63 mamsl. This provides a freeboard of 0.38m.

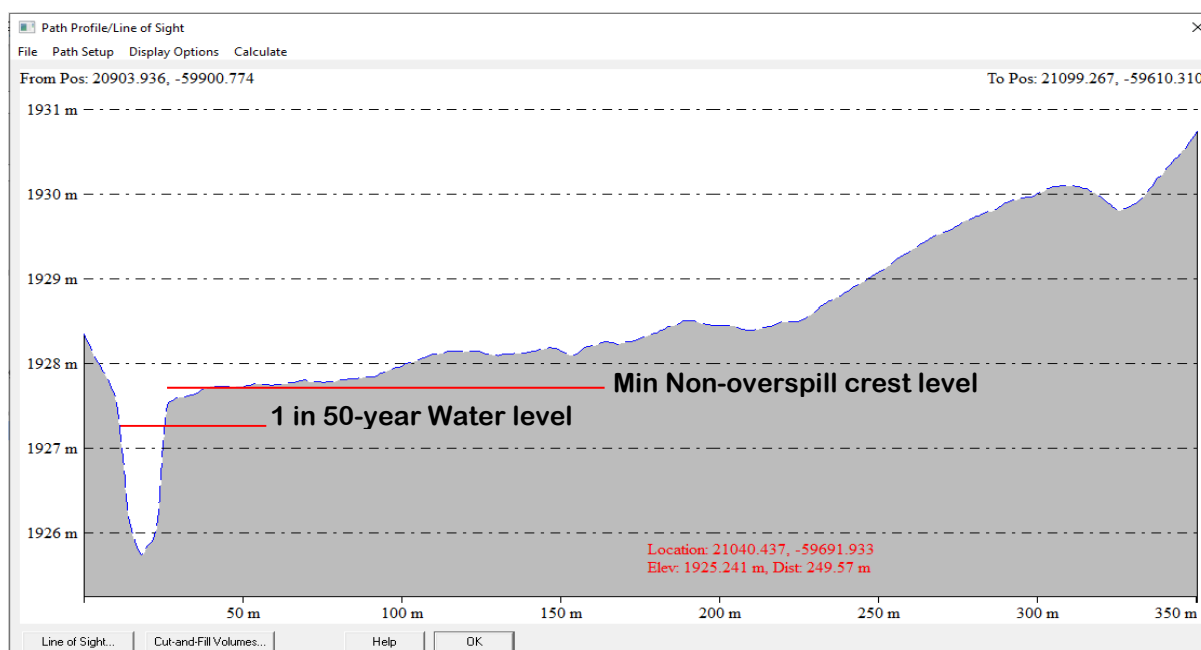


Figure 7-2: Freeboard for 1 in 50 year flood (Downstream dam)

The Storage elevation curves of the dams are shown in **Figure 7-3**.

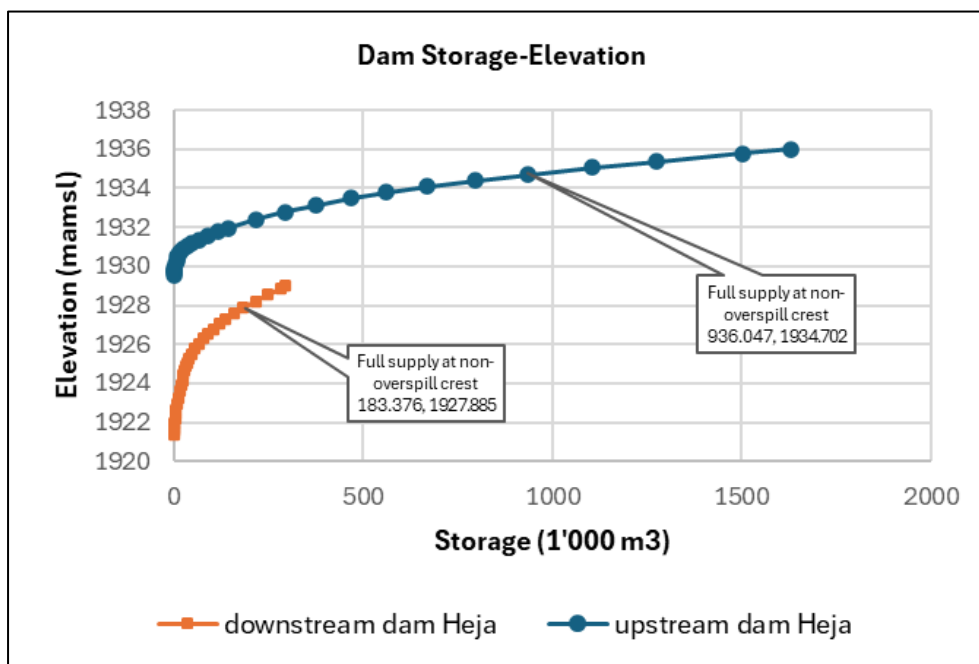


Figure 7-3: Storage-elevation curves for upstream and downstream dams

7.1 SPILLWAY DESIGN

The spillway must be designed to pass the 1 in 200 year flood, which has a magnitude of 36 m³/s, while maintaining the required freeboard to the lowest elevation along the dam wall crest. The freeboard should be calculated using the SANCOLD Freeboard Guideline Vol II, Final, March 2011.

The current hydraulic model should not be used to design the spillway, due to the attenuation in the dam. Standard hydraulic design methods should be used. However, the current spillway channel is small. It is possible that a proposed causeway for a road or a vented causeway can be designed to pass the flood with a lower water level in the dam than the water currently modelled for the 1 in 100 year flood.

8 FINAL FLOOD INUNDATION MAP FOR THE 1 IN 50 YEAR FLOOD

The final inundation map and floodline for the 1 in 50-year flood is shown in

Figure 8-1.

1. The light blue area is the inundation area of the 1 in 50 year flood – Post Development.
2. The yellow line is the 1 in 50 year floodline – Post Development.
3. The red line is the 1 in 100 year floodline – Post Development.

From the figure it is clear that the development is not impacted by either the 1 in 50 or the 1 in 100 year flood levels.

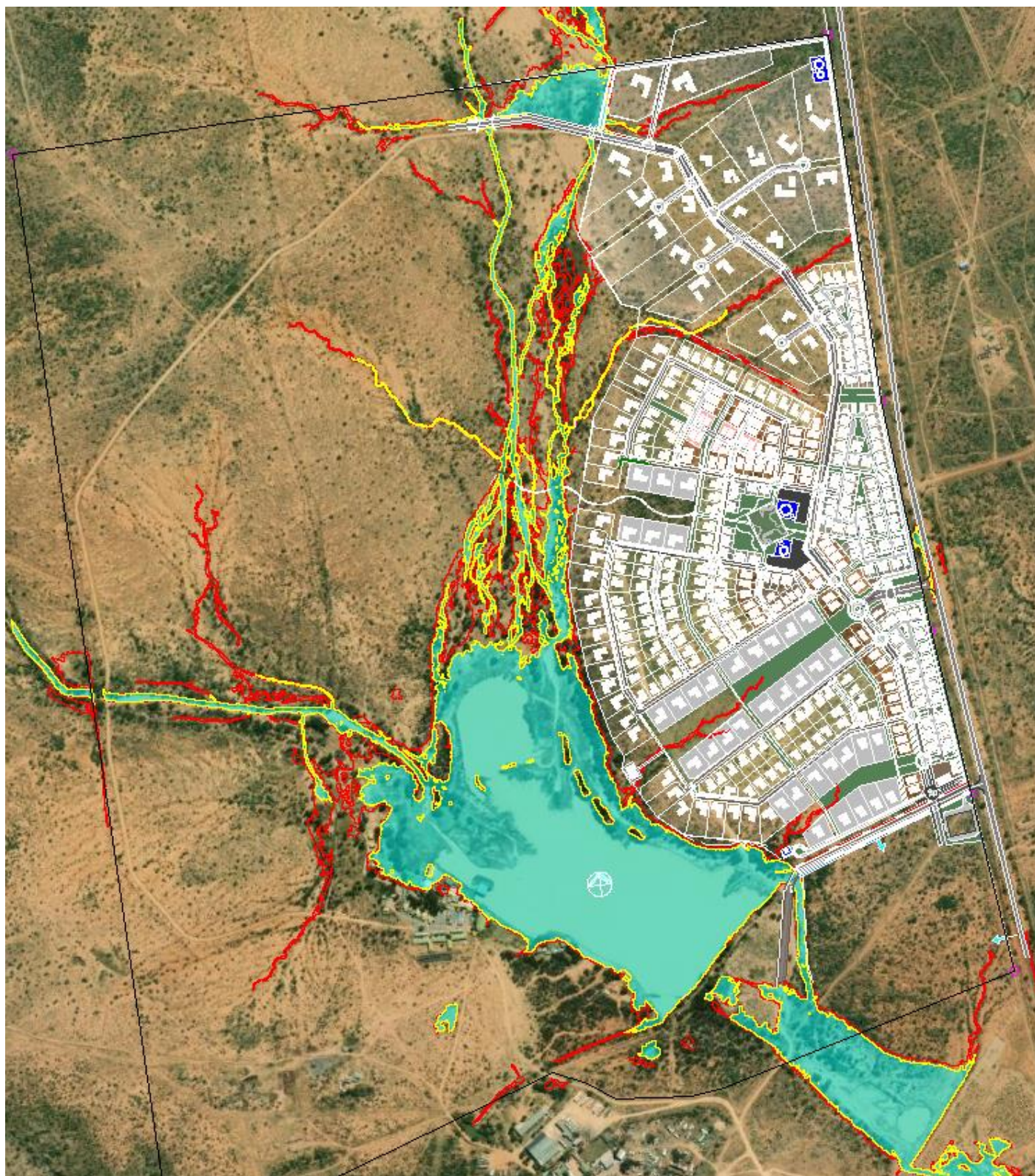


Figure 8-1: 1 in 50-Year Pre-and Post Development Scenarios

9 IMPACT OF THE FLOODS ON THE EXISTING DEVELOPMENTS

Several existing structures near the edge of the dam lie within the 1 in 50 year flood zone. The 50-year flood level is 1933.4. It is proposed that the affected structures be protected by a constructed berm, or platform, that has a minimum crest level of 1933.5.

The edge of the berm is shown in **Figure 9-1** with the magenta coloured line.

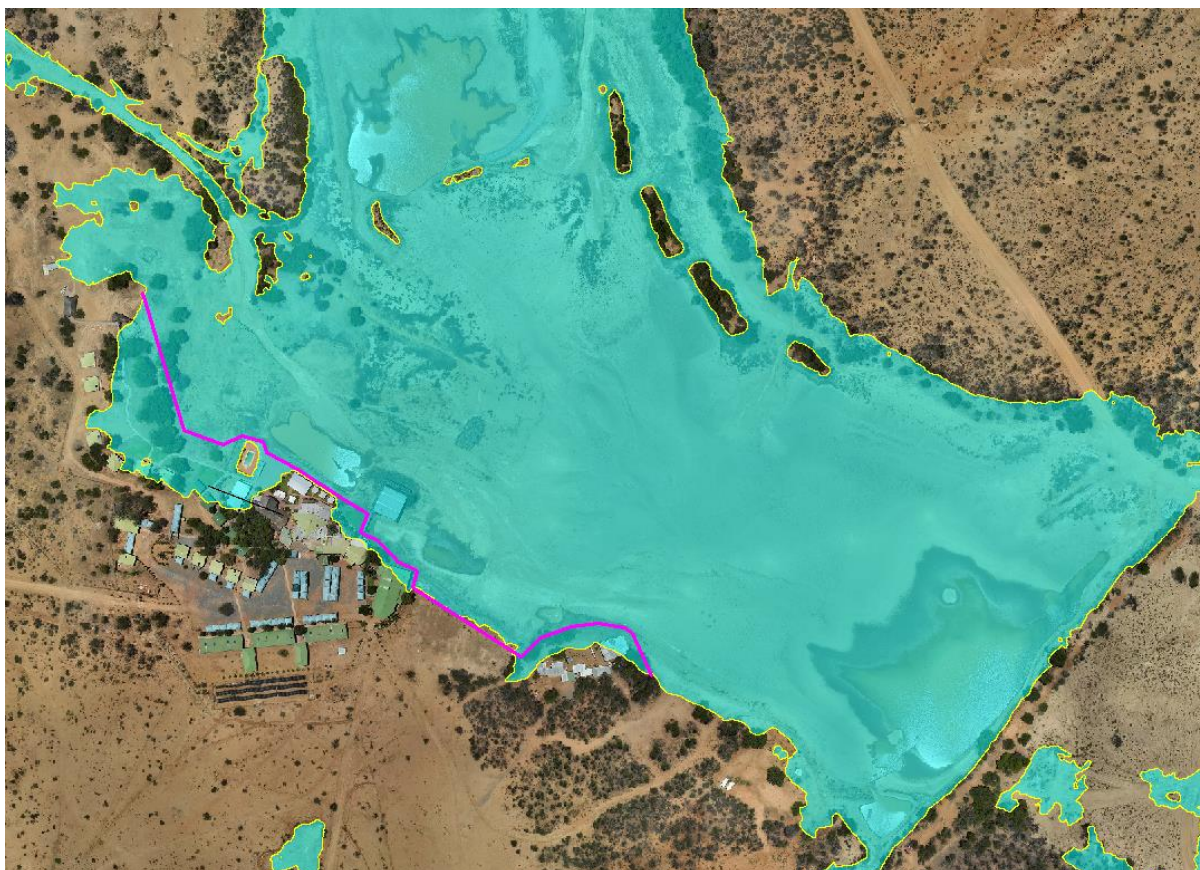


Figure 9-1: Flood protection berm.

There is an existing restaurant structure which is constructed at the end of a pier that juts into the dam. Should the pier or the walkway be below the flood level of 1933.4, it is suggested that the entrance to the pier be closed off and guarded by security personnel until the flood subsides.

10 CONCLUSIONS

The following conclusions can be drawn from the results of the flood study:

1. Parts of the existing development lie within the 1 in 50-year flood line. The 50-year flood level is 1933.4. It is proposed that the affected structures be protected by a constructed berm, or platform, that has a minimum crest level of 1933.5.
2. The 1 in 50 year flood level of the post development scenario is lower than that of the pre-development case. This is due to the retention provided by culvert groups CA1 and CA2, and the time it takes for the water to drain through the culverts. The final town layout was amended to accommodate any ponding that may occur in this area.
3. Culvert group CA12 can safely pass the design flood. However, a significant amount of alluvium has accumulated on the upstream side of the existing causeway. At the same time the weir effect of the concrete slab has created a hole in the river on the downstream side. Earthworks will be required to restore the gradient of the riverbed to its original condition.
4. The freeboard of the Main Dam appears to be adequate.
5. The freeboard of the downstream dam appears to be low, and should be checked.

11 RECOMMENDATIONS

The following is recommended:

1. That the hydraulic design of the culverts be approved for the structural design to continue.
2. That the City of Windhoek issues no objection to the development presented in this study and that the flood report be released for the detail design to continue.
3. That the spillway of the main dam be designed to pass the 1 in 200 year flood of $36 \text{ m}^3/\text{s}$.
4. That the freeboard be calculated using the SANCOLD Freeboard Guideline Vol II, Final, March 2011
5. The owner of the dam must register the dams in accordance with the Water Resources Management Act 11 of 2013.

Report compiled by:

A C Muir (PE 88100)

Chris Muir Consulting Engineer

Date: 25 October 2025

Annexure C

NamWater Situation Assessment on Gondwana Lifestyle Estate Bulk Water Supply

SITUATION ASSESSMENT ON GONDWANA LIFESTYLE ESTATE BULK WATER SUPPLY



Figure: Location of the planned Gondwana Lifestyle Estate Development at Heja Farm, opposite Finkenstein.

NamWater
Private Bag 13389
Windhoek
Namibia

Prepared by:
Infrastructure Planning

MAY 2025

Executive Summary

Gondwana Collections Namibia, through Windhoek Consulting Engineers, submitted a bulk water supply application to NamWater for the proposed Gondwana Lifestyle Estate at Heja Farm, Namibia. The development will be located within the City of Windhoek (CoW) municipal boundaries. The estate would ideally connect to the city's water distribution network; however, due to the absence of local distribution infrastructure, CoW has directed new industrial and commercial off-takers to source water directly from NamWater's bulk water supply infrastructure.

The envisaged development, planned in phases, will include residential, commercial, and leisure components, with a Phase 1 water demand of 240,000 m³/a and a full development demand of 940,000 m³/a anticipated by 2040. NamWater's Infrastructure Planning Division conducted a Situation Assessment Report to evaluate the impact on the Von Bach – Windhoek and Booster 2 – Otjihase schemes, assess water resource availability, analyse infrastructure sufficiency, and propose development options with cost estimates.

The Central Area of Namibia (CAN) Model, indicates that the current run-dry date of Von Bach dam falls slightly short of the required two years assuming no additional inflow, confirming the stress on existing water sources despite a strong rainy season. This underscores the urgent need for water source augmentations, such as the Okavango Link (35 Mm³/a).

Water supply infrastructure sufficiency analyses reveal that the Von Bach – Windhoek infrastructure (Ø1100 mm pipeline, water treatment plant, and pump stations) will reach capacity by FY2033, FY2036, and FY2039/40, respectively, with Gondwana's demand having minimal impact. The Booster 2 – Otjihase scheme is adequate until FY2042 without Gondwana but requires upgrades by FY2030, or by the time Gondwana's demands reach 200 000 m³/a, particularly the Von Francois Ost (VFO) pump station and the chlorination system at the Otjihase reservoirs.

In the short term, including Gondwana Lifestyle Estate's water demands up to **200 000 m³/a**, no upgrades to existing water supply infrastructure are required. However, in this case it is important for Gondwana to note that this comes with a supply reliability risk since it assumes (1) that the Booster 2 – Otjihase scheme is operated continuously and does not experience prolonged breakdowns, and (2) that sufficient water is available at the source, Von Bach dam, which in recent years reached dangerously low levels even without the additional water demands of Gondwana and is only likely to be augmented in 3-5 years, when the Okavango Link project is expected to be completed.

To mitigate the risks, NamWater strongly recommends that Gondwana investigate and develop emergency groundwater sources to ensure security of supply. Surrounding emergency groundwater sources, including Hoffnung and Kuruma Fault boreholes, Ondekaremba wellfield, and Otjihase Mine dewatering, offer sufficient potential capacity for an emergency back-up scheme but require further investigation. Thus, the proposed **Phase 1** (0 – 200 000 m³/a) comprises the Otjihase – Gondwana scheme:

- Construct a 750 m long above-ground steel pipeline from the Otjihase Reservoirs, parallel to the existing feeder pipeline to the booster pump station.

- Construct a new dedicated booster pump station to transfer potable water to Gondwana, 2 + 1 duty and standby configuration with a total capacity of 180 m³/h @ 140 mWH.
- Construct a new dedicated ±12 km long, Ø315 mm Class 16 uPVC pipeline to the Gondwana Lifestyle Estate.
- Construct Gondwana Terminal Reservoir/s.
- Proportional volume emergency groundwater backup scheme.

Phase 1 first-order capital development costs are estimated at **N\$ 51 million**.

In the medium-term, Gondwana's projected water demands will significantly strain the Booster 2 – Otjihase scheme and infrastructure upgrades will be required. Two further development phases were proposed. **Phase 2** (200 000 – 500 000 m³/a) comprises intermediate upgrading of the Booster 2 – Otjihase scheme:

- Upgrade VFO pump station to supply 220 m³/h (2 x operational pumps).
- Upgrade the chlorination system at Otjihase reservoirs
- Proportional incremental capacity increase of emergency groundwater scheme, if still required

Phase 2 capital development costs are estimated at **N\$ 13 million**.

Finally, to accommodate Gondwana's envisaged long-term water demands, the Booster 2 – Otjihase scheme will require major upgrades, augmentation or replacement. Three options were proposed for **Phase 3** (500 000 – 940 000 m³/a):

- **Phase 3 – Option 1:** Upgrade the existing Booster 2 – Otjihase pipeline's capacity with new base and booster pump stations, at a cost of **N\$ 57 million**
- **Phase 3 – Option 2:** Construct a dedicated 13.5 km Ø250 mm pipeline and pumping scheme parallel to the existing Booster 2 – Otjihase pipeline (180 m³/h), at a cost of **N\$ 107 million**
- **Phase 3 – Option 3:** Replace the existing Booster 2 – Otjihase pipeline with a larger Ø500mm pipeline and pumping scheme to accommodate other potential commercial / mining off-taker, at a full cost of **N\$ 204 million**, of which **N\$ 52 million** will be contributed by Gondwana under this water supply concept based on their proportional demand allocation. Note that this contribution may vary as Gondwana's requirements are refined and will need to be set at a later stage.

The above costs do not include development and connection of emergency groundwater sources, which require further investigation. Phase 3 – Option 3 would be the preferred long-term option as it makes provision for further growth east of Windhoek, which cannot be firmly quantified at this stage but is deemed likely based on communication with existing and prospective developers. NamWater and Gondwana should prioritize the phased developments with adequate lead times.

Since Heja farm falls within the CoW municipal boundaries, an official authorization letter should be obtained from the CoW for NamWater and Gondwana to proceed, indicating the planned operations and processes regarding the supply of water (i.e. the billing points, entity responsible for billing, storage reservoir locations etc.).

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1 Introduction

Gondwana Collections intends to develop the Gondwana Lifestyle Estate at Heja Farm, encompassing residential, commercial, and leisure facilities within the City of Windhoek (CoW) municipal boundaries. Ideally, the estate would connect to the city's water distribution network; however, due to the absence of local distribution infrastructure, CoW has directed new industrial and commercial off-takers, including Gondwana, to source water directly from NamWater's bulk water supply infrastructure. Consequently, Gondwana has engaged NamWater to explore supply options via the Von Bach Dam – Booster 2 – Otjihase – Airport / Finkenstein scheme, which currently serves the following customers:

- Booster 2 – Otjihase consolidated offtake
- Otjihase Mine and town
- Hosea Kutako International Airport
- Sungate development
- Bergvlug Research Farm
- Neudamm Agricultural College
- Naankuse Guest Farm
- Finkenstein Estate
- Herboth's Blick
- Several smaller customers

On 14 December 2024, Gondwana, through their consultant, Windhoek Consulting Engineers (WCE), submitted a Bulk Water Supply Application to NamWater for the proposed estate. An introductory meeting on 5 February 2025 at NamWater allowed WCE to present the project and its water requirements. In response, NamWater's Infrastructure Planning Division assessed existing water resources and infrastructure to meet the estate's projected demands.

The objectives of this report are to:

- Summarize the bulk water supply application submitted to NamWater.
- Evaluate current and future water supply and demand dynamics on the Von Bach – Booster 2 – Otjihase – Airport scheme, identifying resources and infrastructure needed to meet Gondwana's requirements.
- Propose a development plan with first-order cost estimates and provide recommendations for implementation.

2 Gondwana Lifestyle Village Project & Bulk Water Application

The development will occur eight phases consisting mostly of single and general residential erven, with some administrative, educational, commercial, leisure and retail land uses. A summary of the phases and corresponding water requirements is shown in **Table 1** and **Figure 1**. The Average Annual Daily Demand (AADD) figures were provided by WCE (including 15% distribution losses), and the Average Day in Peak Month (ADPM) water requirements were estimated by NamWater assuming a peak factor of 1.4, similar to that of Finkenstein Estate based on historical water sales data.

The development will have a substantial impact on the existing water resources and supply infrastructure. The annual water requirement of Phase 1 (1A, 1B and 1C, **Figure 2**) amounts to **±240 000 m³/a**. In comparison, this figure is roughly double the volume sold by NamWater to the largest offtaker on the Booster 2 – Otjihase – Airport / Finkenstein water supply scheme, namely Finkenstein Estate, i.e. 120 752 m³/a in FY2024. The water requirement of the full development is estimated at **±940 00 m³/a** – roughly double the total volume sold by NamWater to the existing water supply scheme, i.e. 456 938 m³/a in FY2024.

Table 1: Phasing and water requirements of Gondwana Lifestyle Estate.

Project Phase	Estimated Year of Development	Estimated Average Water Demand (AADD)		Estimated Peak Water Demand (ADPM, x1.4)	
		(m³/day)	(m³/a)	(m³/day)	(m³/h)
1A	2026/2027	268	97 784	375	19
1B	2029	157	57 159	219	11
1C	2031	247	90 009	345	17
Sub-Total		671	244 952	940	47
2A	2030	155	56 670	217	11
2B	2030-2037	570	207 915	797	40
3A	2035	422	154 176	591	30
3B	2040	458	167 338	642	32
Commercial	To be Determined	299	109 186	419	21
Total		2576	940 236	3 606	180

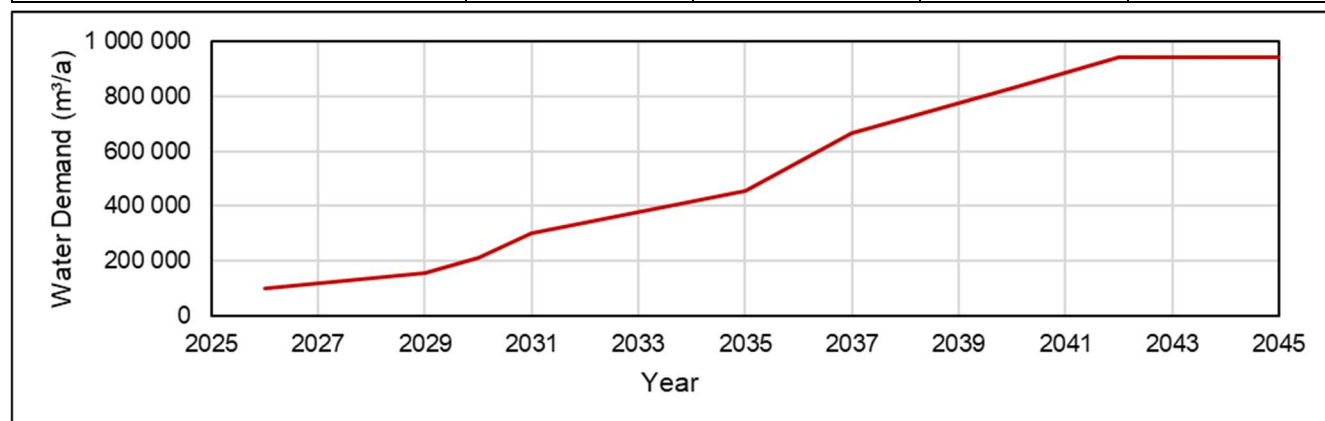


Figure 1: Gondwana Lifestyle Estate annual water demand projection.



Figure 2: Envisaged Gondwana Lifestyle Estate surrounding the Heja Farm dam.

3 Existing NamWater Bulk Water Supply Infrastructure

3.1 Overview & Approach

This section will mainly cover the scheme that is directly relevant to supplying Gondwana's envisaged development, i.e. the Von Bach – Windhoek scheme and the Booster 2 – Otjihase – Airport / Finkenstein scheme.

Although the Otjihase – Airport scheme's infrastructure will not be covered in detail, the impact of its current and future water demands on all upstream water supply infrastructure up to the Von Francois Ost Pump Station at Booster 2 and CAN water sources will be incorporated in the subsequent *Water Demand Assessment* and *Sufficiency Analysis* sections, as shown in **Table 2**.

Table 2: Booster 2 - Otjihase - Finkenstein scheme components and relevant customers.

Component	Description	Relevant Customers / Demand Centres
Von Bach – Booster 2		
Water Source	CAN Integrated Sources	<u>Von Bach – Windhoek Customers</u> Windhoek, Osona Military Base, Osona Village, NPI, Brakwater, Elisenheim, Monte Christo, Ongos, other online customers
Treatment Plant	Von Bach WTP	
Pump Stations	Base and Booster 1 & 2 Pump Stations	<u>All Booster 2 – Otjihase – Airport / Finkenstein Customers</u> (See below)
Pipeline	Von Bach - Windhoek	
Booster 2 - Otjihase		
Pump Station	Von Francois Ost	<u>Booster 2 Otjihase Customers</u> Otiase mine & town Various smaller Customers
Pipeline	Booster 2 - Otjihase	
Reservoirs	Otiase	<u>Airport Scheme Customers</u> Hosea Kutako Airport, Sungate, Neudamm Agriculture College, Herboth's Blick, Bergvug Research Farm, Various smaller customers
Pipeline	Otiase Reservoirs - Pump Stations	
		<u>Towards Finkenstein</u> Finkenstein Estate Gondwana Lifestyle Estate (potential)
Otiase - Finkenstein		
Pump station	Otiase - Finkenstein	<u>Finkenstein Pipeline</u> Finkenstein Estate
Pipeline	Otiase - Finkenstein	
		<u>Proposed New Dedicated Pipeline</u> Gondwana Lifestyle Estate (potential)

Von Bach – Windhoek Scheme Overview

Potable water is conveyed from three clear water wells at the Von Bach Water Treatment Plant (VBWTP) into the 30 000 m³ terminal reservoir in Windhoek via the Von Bach – Windhoek transfer scheme (see **Figure 3**). The scheme consists of the following main components:

1. Von Bach Dam, augmented by the CAN integrated system
2. Von Bach base pump station
3. Two Booster pump stations (Booster 1 and Booster 2)
4. Dual clear water transfer pipelines, laid in parallel, consisting of:
 - i) A Ø600mm nominal diameter spiral welded, bitumen coated and lined steel pipeline. This pipeline was decommissioned due to the bitumen lining coming loose and some of the valves having rusted in position (LCE/PHIM, 2021).
 - ii) A Ø1100mm nominal diameter pre-stressed concrete pipeline.
5. Windhoek Terminal Reservoir.

Booster 2 – Otjihase – Airport / Finkenstein Scheme Overview

NamWater also supplies treated surface water from Von Bach Dam to the Booster 2 – Otjihase – Airport / Finkenstein scheme as follows (see **Figure 4**):

1. At Booster 2, water is pumped from the Von Francois Ost pump station to two reservoirs at Otjihase mine.
2. An above-ground steel pipeline from the Otjihase reservoirs feed two booster pump sets at Otjihase that transfer water through two separate pipelines to Finkenstein and the Hosea Kutako Airport.
3. For the Otjihase – Airport component, a dedicated booster pump station transfers water to a collector reservoir located on top of the eastern water shed, from where it gravitates to Hosea Kutako Airport and en route customers.

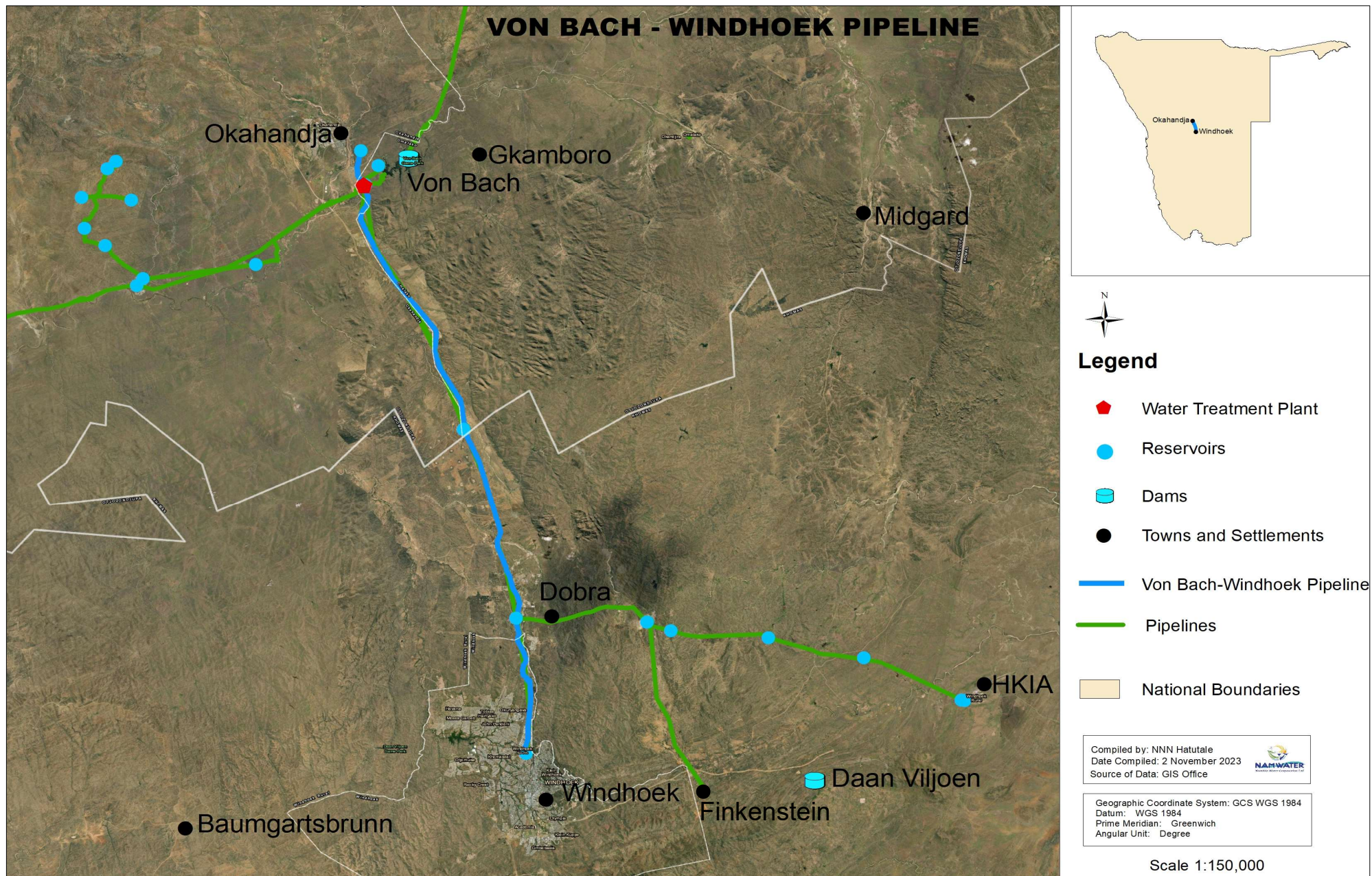


Figure 3: Locality of Von Bach - Windhoek water supply scheme and major components.

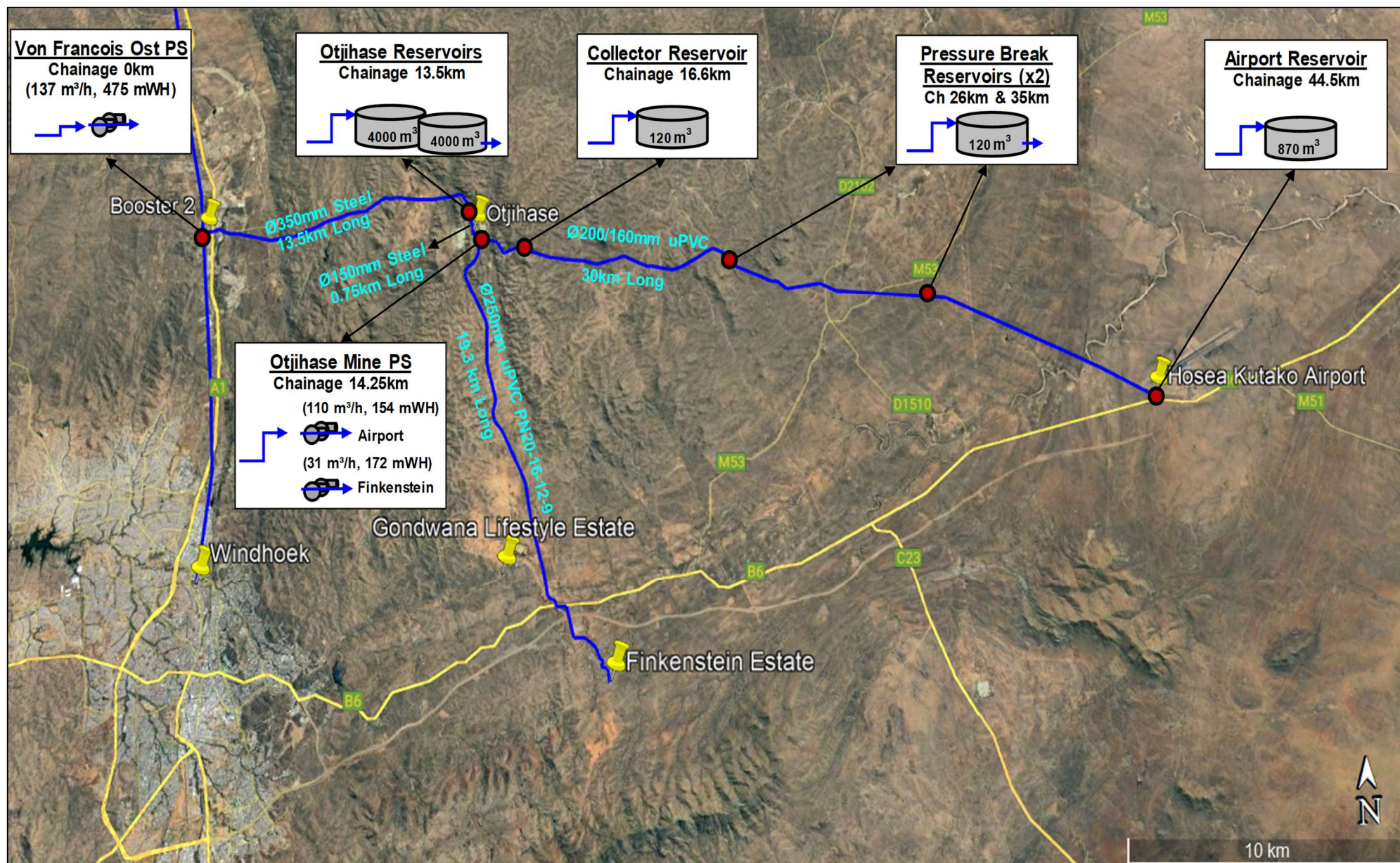


Figure 4: Schematic of Booster 2 - Otjihase - Airport / Finkenstein bulk water supply scheme.

3.2 Water Sources

3.2.1 Von Bach Dam & Central Area of Namib (CAN) Integrated System

Von Bach Dam is augmented by the Integrated Central Area of Namibia (CAN) water supply system, including Swakoppoort Dam, Omatako Dam, and non-surface water sources including several groundwater aquifers and the City of Windhoek's Water Reclamation Plant. A map of the CAN system is provided in **Figure 5**.

Water availability to the customers in Table 2 is impacted by dam inflows and operational conditions at the various supplementary water sources. Hence, water availability and run-dry dates are regularly re-evaluated by NamWater using the **Central Area of Namibia Model (CAN Model)**. The results of this analysis including the Gondwana Lifestyle Estate Development will be covered in the *Sufficiency Analysis* section.

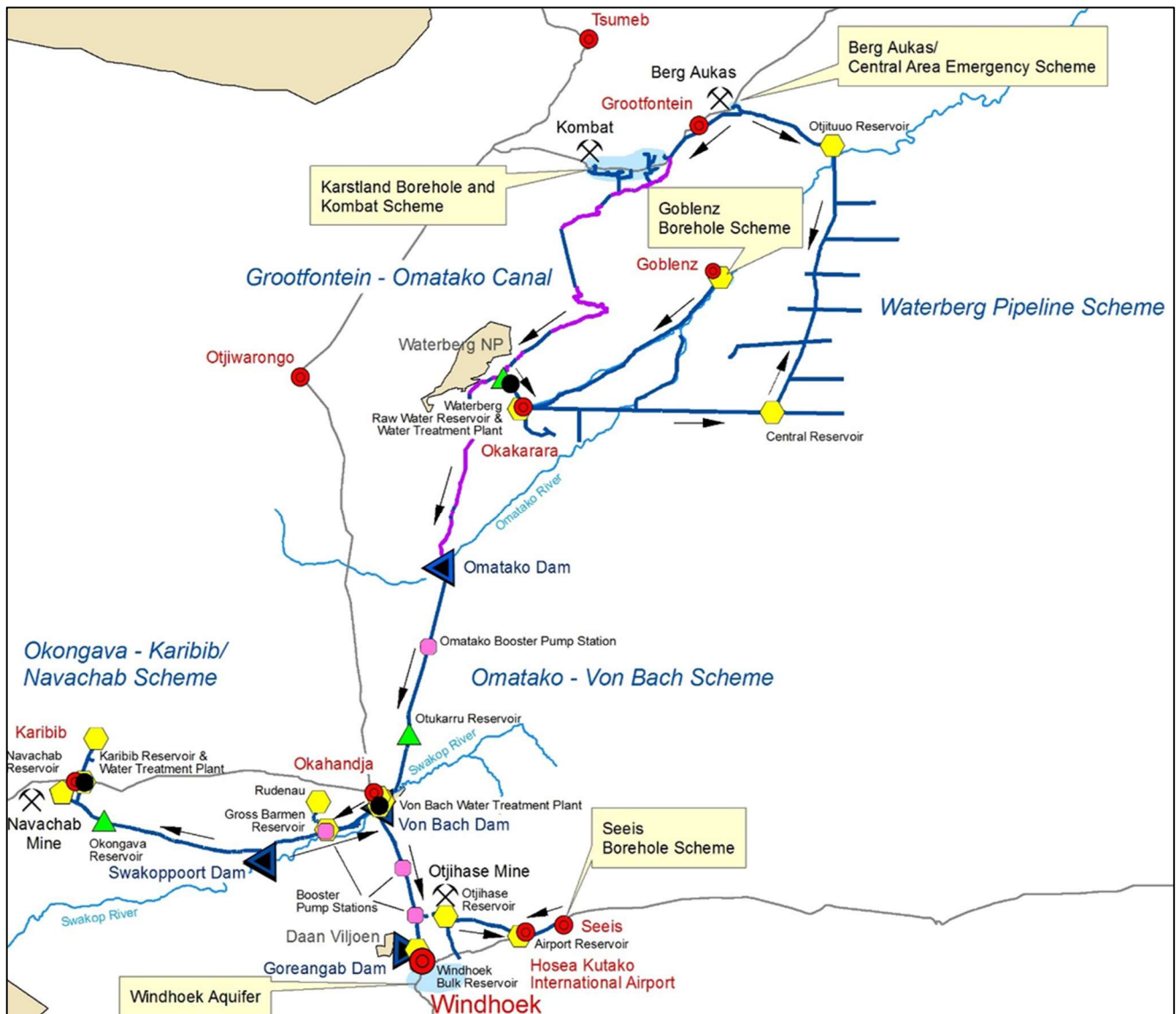


Figure 5: Integrated Central Area of Namibia (CAN) water supply system.

Planned Augmentation of CAN Water Sources

a. Okavango Link

Status: R&D work Ongoing

Most of the water sources within the CAN have already been developed and are nearing the limit of their supply potential. The long-term water security for the CAN has been an issue the Government of Namibia has been trying to address since the 1970s as evidenced by the feasibility studies that identified drawing water from the perennial Okavango River or abstracting desalinated water from the Central Coastal Area. The Eastern National Water Carrier (ENWC) canal that links Grootfontein and the integrated supply system feeding Windhoek was built in 1987 with the provision for water to be abstracted from the Okavango River as a lifeline for Windhoek.

A 280 km long pipeline and pumping scheme is still required to complete the connection to the Okavango River, referred to as the Okavango Link (**Figure 6**). NamWater motivated the implementation of the Okavango Link Project to Government via a 2024 Cabinet submission. Cabinet subsequently approved funding for the implementation of the project to transfer a volume of 35 Mm³/a. NamWater is currently engaged in the procurement of a consultant to conduct the Environmental and Social Impact Assessment (ESIA) study and an engineering consultant was appointed to carry out the Front-End-Engineering-Design (FEED)/Design Development and Report, preliminary design and bid documentations for the effective implementation of the Okavango link project. Being in its early stages, the associated completion timeline is still unclear and currently estimated between 3-5 years.

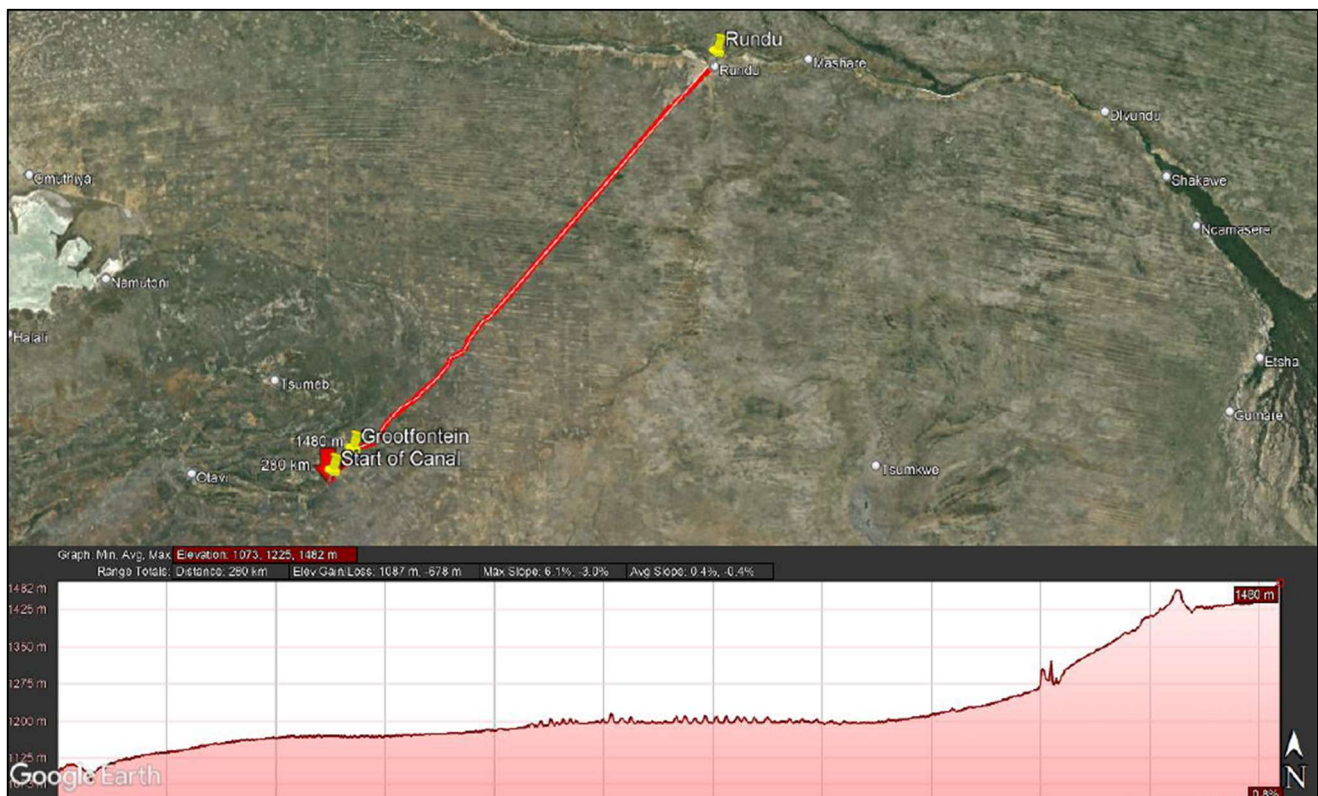


Figure 6: Okavango Link preliminary pipeline route and longitudinal profile (Google Earth).

Additionally, NamWater has initiated several short- to medium-term projects to augment supply to the Central Area of Namibia (CAN):

b. Abenab Emergency Groundwater Scheme

Status: On hold due to environmental concerns and re-allocation of budgets

The Abenab option entails an emergency groundwater scheme north of Grootfontein. The pumping - scheme via a new pipeline of an estimated length of ± 39 km will discharge the water onto the existing ENWC system through which it will be conveyed to the rest of the CAN. The scheme could transfer a maximum of $13.4 \text{ Mm}^3/\text{a}$ in three consecutive years followed by a 12-year recharge period, or $2.4 \text{ Mm}^3/\text{a}$ continuously.

c. Gammams Advanced Water Reclamation Plant (GAWRP), known as 'DPR2'

Status: R&D work Ongoing

The City of Windhoek (CoW) is planning a second Direct Potable Reclamation Facility (DPR2) to address water supply shortages and produce an additional $3.6 \text{ Mm}^3/\text{a}$ by 2030. Recent developments confirm that the Government of Namibia will fund upgrades to the GAWRP and the DPR2 facility through a KFW loan, with CoW appointed as the implementing agent. Upon completion, both the DPR2 facility and the upgraded GAWRP will be transferred to NamWater.

d. Other Short-Term Projects

Short-term projects being undertaken by NamWater are listed below:

- Von Bach bypass pipeline, additional volume $1.33 \text{ Mm}^3/\text{a}$, completion by 2026/27.
- Kombat capacity increase, additional volume $2.5 \text{ Mm}^3/\text{a}$, completion by 2026/27.
- Goblenz Waterberg Water Supply, additional volume $2 \text{ Mm}^3/\text{a}$, completion by 2027/28.
- Berg Aukas Additional Boreholes, additional volume $1.5 \text{ Mm}^3/\text{a}$, completion by 2026/27.
- Windhoek Boreholes Exploration – still to be investigated
- Water Demand Management (Reduced Consumption / Water Savings)

Notwithstanding the planned augmentation of CAN water sources, which entail uncertainty and unclear lead-times, it is important to recall that Namibia experienced a very severe drought before the strong 2024/25 rainy season, leading to water savings initiatives and deferred bulk water applications. No additional major water source developments have been completed in the interim to reduce the risk of a repeated drought situation in the CAN, which could disrupt water supply security to Gondwana Estate and the wider CAN system.

Therefore, the development of a dedicated or semi-dedicated groundwater scheme at the Hoffnung boreholes / Otjihase area is deemed crucial to ensure reliability of water supply to Gondwana Estate. These potential groundwater sources are discussed in the following sub-section.

3.2.2 Farm Hoffnung / Otjihase Potential Groundwater

This section covers four potential groundwater sources, namely (i) drilled but uninstalled existing boreholes in the Hoffnung and Kuruma Faults, (ii) decommissioned boreholes of the Ondekaremba wellfield, (iii) Otjihase mine water from the Hoffnung Fault that was intercepted by mining activities, and (iv) potential target areas (see **Figure 7**). While it is envisaged that the Gondwana Estate will be supplied with surface water from the Von Bach dam, these potential groundwater sources should be investigated and developed as emergency sources to ensure supply reliability during drought periods.

Existing Hoffnung and Kuruma Fault boreholes

Currently, there are five (5) existing boreholes located within the Otjihase – Heja Farm area that were drilled between 1996 and 1997 by the Department of Water Affairs, namely WW36161, WW36164, WW36160, WW36163 and WW36162. None of the boreholes are currently installed, and a connecting pipeline was constructed for WW36161.

WW36161, WW36164, and WW36160 were drilled into the Hoffnung Fault south of Otjihase Mine, while WW36163 and WW36162 were drilled into the Kuruma Fault west of the mine. The geohydrological environment can be described as a schist matrix with major faulting as main water strike targets. In 2016, SLR Environmental Consulting (Namibia) (Pty) Ltd was appointed by the Portion Three Trust (PTT) to conduct a geohydrological investigation with the aim of connecting WW36161, WW36164, and WW36160 to supply Finkenstein Estate during emergency drought periods only. The three boreholes were rehabilitated and WW36161 was pump tested. Although a Ø100 mm connecting pipeline was constructed from WW36161 to the Otjihase-Finkenstein pipeline, its power supply and pump installation was not completed. This borehole was previously intended to serve as a back-up source for Finkenstein Estate and other consumers on the scheme during extreme drought periods only and the abstraction permit had a 2-year validity period that expired in 2019 (MAWLR Abstraction Permit, see **Annexure 1**).

The recommended abstraction strategy is shown in **Table 3**, and indicates a combined sustainable yield of **288 000 m³/a**. The additional two Kuruma Fault boreholes have not been pump tested, however, it is estimated that they could yield **28 800 m³/a** based on blow yield results. This amounts to a total available yield of **316 800 m³/a** from the five existing boreholes between Otjihase and Heja Farm.

Table 3: Recommended abstraction strategies of boreholes WW36161, WW36164 and WW36160.

Borehole Number	Water Quality	PID (m)	Recommended abstraction strategy				
			m ³ /h	h/day	m ³ /day	m ³ /month	m ³ /annum
WW36161	A	102	25	20	500	15 000	180 000
WW36164	A	102	10	20	200	6 000	72 000
WW36160	Not Tested	102	5	20	100	3 000	36 000
Total			40		800	24 000	288 000

Ondekaremba Wellfield

There are four (4) boreholes (WW8982, WW7643, WW7358 and WW21504) at Ondekaremba that were decommissioned around 2001 and can be recommissioned pending borehole camera inspections. The boreholes can deliver approximately 48 000 m³/a.

Otjihase Mine Potential Groundwater (Dewatering) – Hoffnung Fault

In 2003, NamWater Infrastructure Planning conducted a reconnaissance study: utilization possibilities of groundwater at the Otjihase Mine. The study revealed that the Hoffnung Fault was intercepted by mining operations about 500 m below ground surface. The mine management at that time considered taking water from the fault in a controlled way to supply a part of the mine's water requirement with the possibility of surplus water being available for NamWater to supply other customers.

According to the study, a preliminary estimate of **1.4 Mm³/a** sustainable yield can be expected, of which about 0.3 Mm³/a was already used that time, 0,5 Mm³/a was required by the mine for their own potable water demand and **0.6 Mm³/a** was indicated to be available to NamWater.

There are risks and challenges associated with this option. Firstly, it will require negotiations and agreements with the current owners of the Otjihase Mine, Consolidated Copper, to develop water supply infrastructure, which may include the following (NamWater INF Planning, 2003):

- Construction of collector and balancing reservoirs underground and at the mine surface that offer protection to the water against contamination.
- Installation of underground base and booster pump stations, and associated power supplies and control systems.
- Construction of pipelines in the mine.
- Pipework connections at the reservoirs to allow for incoming water from the mine in addition to incoming water from Booster 2.

Secondly, although this Report considers groundwater as an emergency backup source in case of a drought, it should be noted that the groundwater from Otjihase mine may entail water quality challenges. According to samples collected in 2002, the water quality was classified as Group B and considered marginally suitable for human consumption. However, a sulphate concentration of 490 mg/l was reported, which does not conform to the new Acceptable Standard requirement for human consumption of < 300 mg/l stipulated in the Water Resources Management Act 11 of 2013 Regulations. Similarly, total hardness of 580 mg/l was reported, which does not conform to the Acceptable Standard requirement of < 400 mg/l.

An investigation that was carried out by the Geohydrology Division of the Department of Water Affairs (DWA, 1989) also indicated that the possibility of pollution of the Hoffnung fault water by leachates from the Otjihase mine tailings dam should be considered as a potential threat to the utilisation of the water for human consumption.

Potential Target Areas

There is potential for further investigation in the fractured zones, targeting the Hoffnung Fault north and south of the existing three boreholes, the Kuruma Fault and north-south trending faults to the west and

The Otjihase – Airport pump station consists of two 75 kW WEG 3~phase induction motors and KSB pumps that deliver **110 m³/h @ 154 mWH** in a 1 + 1 duty and standby configuration.



Figure 11: Otjihase - Airport and Finkenstein pumps.

3.5 Reservoirs and Disinfection

At Booster 2, the VFO pump station transfers water to Otjihase from directly from the Von Bach – Windhoek pipeline. Clear water storage at Otjihase consists of 2 x 4 000 m³ reinforced concrete reservoirs (**Figure 12**).

Disinfection at Otjihase is done with an old venturi chlorination system – flow is throttled with a partially closed valve to create an adequate pressure differential of (typically 30-40 mWH) to allow for suction of chlorine into the system. This disinfection system will need to be upgraded to accommodate an additional operational pump at VFO pump station due to:

- Operating pressures: To transfer larger water volumes, higher pumping heads will be required at VFO pump station. A proper chlorination system at Otjihase with a separate dosing pump will allow for pumping at acceptable pressures according to the pump curves of the VFO Sulzer pumps and reduce the risk of pipeline leakages and breaks from higher pressures.
- Operating flexibility: The position of the abovementioned throttling valve is adjusted manually based on the dosing requirement. Since no NamWater personnel is stationed permanently at Otjihase, this will make it difficult to switch between one or two operational pumps when required.

Thus, the chlorination system will need to be replaced with a proper dosing system, for which power also needs to be relayed from the Otjihase pump station.



Figure 12: Otjihase 4 000 m³ reinforced concrete reservoirs.

A summary of the relevant water supply infrastructure and their capacities are provided in **Table 4**.

Table 4: Summary of scheme components and capacities.

Scheme Component	Description / Comments	Capacity
VON BACH - BOOSTER 2		
Von Bach Water Treatment Plant	Design capacity	6500 m ³ /h
Base and Booster Pump Stations	Capacity of current 3 + 1 configuration	5400 m ³ /h
Von Bach – Windhoek Pipeline	Ø1100mm prestressed concrete	5400 m ³ /h
BOOSTER 2 - OTJIHASE RESERVOIR		
VFO Pump Station - Current	1 x Sulzer multi-stage pump Capacity based on current operation	137 m ³ /h @ ±475 mWH
VFO Pump Station - Potential	2 x Sulzer multi-stage pumps With two pumps in operation	220 m ³ /h
Booster 2- Otjihase Pipeline	13.5 km long, Ø350mm Steel	260 m ³ /h
Otjihase Reservoirs	2 x 4 000m ³ RC Reservoirs	8 000 m ³
Otjihase Reservoirs - Booster Pipeline	0.75 km long, Ø150mm Steel, Above Ground, V = 2 m/s	130 m ³ /h
OTJIHASE BOOSTER - FINKENSTEIN		
Finkenstein Pump Station (observed capacity)	2 x CR32 Grundfos vertical multistage pumps (1 + 1 duty and standby)	31 m ³ /h @ 172 mWH
Finkenstein Pipeline (design capacity)		32 m ³ /h

3.6 Power Supply

3.6.1 Booster 2 Pump Stations

Power is supplied to the Booster 2 pump stations from the substation located immediately to the south of NamWater's premises. The substation consists of two transformers; one is dedicated to the NamWater pump stations, the other for other users in the area.

NamWater's current contractual Notified Maximum Demand (NMD) with NamPower is 1913 kVA, of which NamWater utilized an average of 1558 kVA to supply ±1300 m³/h during December 2024 to February 2025. NamWater intends to increase the contractual NMD to enable larger transfer capacities from Booster 2 to Windhoek, which will entail additional fixed capacity charges and a security deposit to NamPower. Hence, if an intermediate upgrade of the Von Francois Ost pump station to two operational pumps (220 m³/h capacity) is required to supply the Gondwana Lifestyle Estate, similar capacity charges and security deposit will be attributable to Gondwana.

If a third operational pump is to be added to the VFO pump station to supply the full development of the Gondwana Lifestyle Estate, it is foreseen that the 5 MW substation would need to be replaced with a larger substation. While the substation is being replaced, temporary power supply will also need to be established to service the users in the Brakwater area. The cost of such an upgrade could be in the order of N\$ 15-20 million, however requires further investigation.

3.6.2 Otjihase Pump Station

The installed transformer capacity at the Otjihase pump station is 315 kVA (WCE, 2009). The Otjihase – Airport and Otjihase – Finkenstein pump stations require 60 kVA at their maximum pumping capacity, which also leaves substantial surplus capacity from the 315 kVA transformer, which is deemed sufficient to accommodate an additional pump station to supply Gondwana (± 100 kVA).

4 Water Demand Assessment

4.1 Von Bach – Windhoek Customers

The water demands of the Von Bach – Windhoek customers supplied from surface water were adopted from the Central Coastal Desalination Feasibility Study (ILF, 2021). The FY2025 annual water demand was estimated at 20.86 Mm³/a, with a peak month factor of 1.27 based on monthly historical volumes. The future demand projection includes further growth of other major envisaged developments such as Ongos, Monte Christo, Elisenheim, and Brakwater.

4.2 Gondwana Lifestyle Estate

As discussed in Section 2, the Gondwana Lifestyle Estate will be phased gradually, starting in 2026/27. The maximum annual water requirement of the full development as stated in the Bulk Water Application will be ±940 000 m³/a. The corresponding peak hourly demand is estimated at **180 m³/h** based on an assumed peak month factor of 1.4, i.e. similar to the observed peak factor of Finkenstein Estate.

4.3 Booster 2 – Otjihase – Airport Customers

The water demands and growth rates of the Booster 2 – Otjihase – Airport customers were estimated based on a combination of historical water sales data and the 2021 Desalination Feasibility Study (ILF, 2021). The total water sales volume in FY2024 was 0.46 Mm³ (**Figure 13**). The projected FY2050 water demand excluding Gondwana Estate is 0.95 Mm³/a. This also includes provisions for potential customers that are currently supplied from private boreholes, such as Sonnleiten Village.

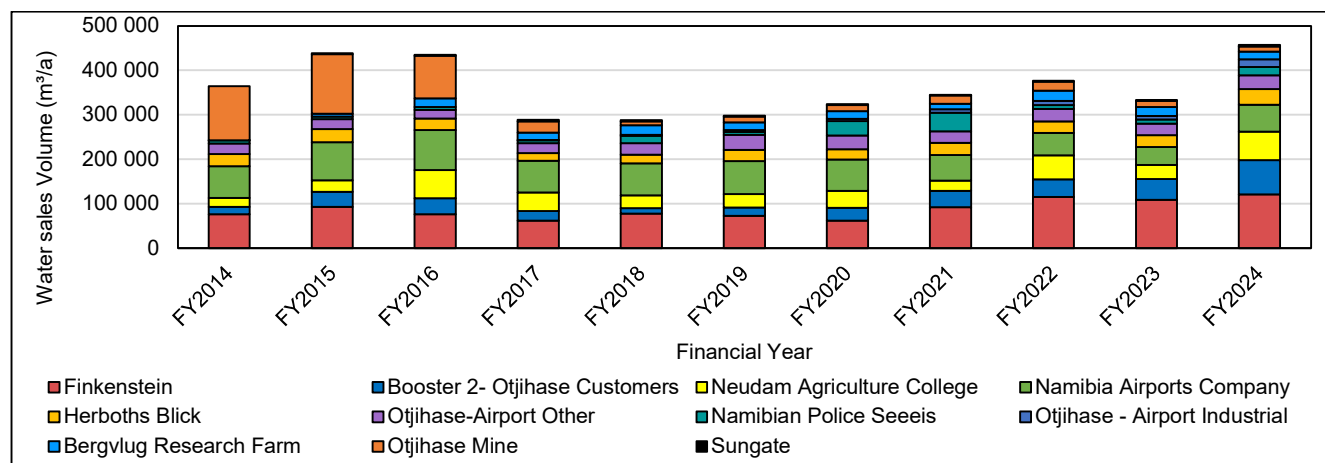


Figure 13: Annual historical water sales volumes of the Booster 2 – Otjihase – Airport scheme.

The Sungate development's water demand was initially projected at 1,373,878 m³/a by 2023 (WCE, 2009), but only 3,459 m³ was recorded in FY2024 due to limited progress. For this assessment, Sungate's demand is assumed not to exceed 20,000 m³/a within the planning horizon.

The Otjihase Mine, owned by Consolidated Copper and currently under care and maintenance, plans to resume operations according to workers at the mine. However, as Consolidated Copper did not respond to NamWater's requests for additional information, a maximum water demand of 300,000 m³/a was adopted based on ILF (2021) projections. A summary of the water demand projections is provided in **Table 5** and illustrated in **Figure 14**.

Table 5: Projected annual water demands of the Von Bach – Windhoek and Booster 2 – Otjijase schemes (Mm³/a).

Date	A: Okahandja		Sub-Total A	B: Von Bach - Windhoek					Sub-Total B	C: Booster 2 - Otjijase			D: Otjijase - Airport							E: Otjijase - Finkensteen			Sub-Total C - E	Total VB -Mm Demand
	Okahandja	Resorts		Osona Village	Von Bach - Windhoek (online)	Brakwater and Elisenheim	Ongos and Monte Christo	Windhoek Terminal Res		B2 - Otjijase (online)	Otjijase mine & town	Sub-Total C	Hosea Kutako Airport	Sungate	Neudamm Agriculture College	Bergvliet Research Farm	Herbotts Blick	Various Smaller Customers	Sub-Total D	Finkensteen Estate	Gondwana Lifestyle Estate	Sub-Total E		
2025	2.09	0.14	2.23	0.05	0.72	0.71	0.39	18.99	20.86	0.05	0.01	0.07	0.07	0.004	0.05	0.02	0.04	0.08	0.25	0.13	0	0.13	0.45	23.54
2026	2.15	0.14	2.29	0.07	0.75	0.85	0.61	19.25	21.52	0.06	0.01	0.07	0.07	0.004	0.05	0.02	0.04	0.08	0.26	0.13	0.10	0.23	0.55	24.37
2027	2.22	0.14	2.36	0.11	0.78	1.04	0.91	19.51	22.35	0.06	0.02	0.07	0.07	0.004	0.05	0.02	0.04	0.08	0.26	0.13	0.10	0.23	0.56	25.27
2028	2.28	0.14	2.43	0.16	0.81	1.29	1.33	19.78	23.37	0.06	0.02	0.08	0.07	0.005	0.05	0.02	0.04	0.08	0.27	0.13	0.10	0.23	0.57	26.36
2029	2.35	0.14	2.49	0.22	0.84	1.62	1.86	20.05	24.60	0.06	0.02	0.08	0.07	0.005	0.05	0.02	0.04	0.08	0.27	0.13	0.15	0.29	0.64	27.73
2030	2.42	0.14	2.57	0.30	0.88	2.04	2.52	20.32	26.05	0.06	0.02	0.08	0.07	0.005	0.05	0.02	0.04	0.08	0.27	0.14	0.21	0.35	0.71	29.32
2031	2.50	0.14	2.64	0.39	0.91	2.53	3.29	20.51	27.63	0.06	0.03	0.09	0.07	0.006	0.05	0.02	0.04	0.09	0.28	0.14	0.30	0.44	0.81	31.08
2032	2.57	0.14	2.71	0.50	0.95	3.08	4.17	20.70	29.40	0.06	0.03	0.09	0.07	0.006	0.05	0.02	0.04	0.09	0.28	0.14	0.30	0.44	0.82	32.93
2033	2.65	0.15	2.79	0.61	0.98	3.69	5.11	20.89	31.30	0.06	0.04	0.10	0.07	0.006	0.05	0.02	0.04	0.09	0.29	0.14	0.30	0.44	0.83	34.92
2034	2.73	0.15	2.87	0.73	1.02	4.33	6.09	21.09	33.26	0.06	0.04	0.11	0.07	0.007	0.05	0.02	0.04	0.09	0.29	0.15	0.30	0.45	0.84	36.98
2035	2.78	0.15	2.93	0.85	1.03	4.96	7.06	21.28	35.19	0.07	0.05	0.11	0.07	0.007	0.06	0.02	0.04	0.09	0.30	0.15	0.46	0.60	1.01	39.13
2036	2.84	0.15	2.98	0.97	1.04	5.57	7.98	21.28	36.84	0.07	0.05	0.12	0.08	0.008	0.06	0.02	0.04	0.09	0.30	0.15	0.46	0.61	1.03	40.85
2037	2.89	0.15	3.04	1.08	1.05	6.13	8.80	21.28	38.35	0.07	0.06	0.13	0.08	0.008	0.06	0.02	0.05	0.10	0.31	0.15	0.66	0.82	1.25	42.64
2038	2.95	0.15	3.10	1.17	1.07	6.62	9.52	21.28	39.65	0.07	0.07	0.14	0.08	0.009	0.06	0.02	0.05	0.10	0.31	0.15	0.66	0.82	1.26	44.02
2039	3.01	0.15	3.16	1.25	1.08	7.03	10.10	21.28	40.74	0.07	0.07	0.15	0.08	0.010	0.06	0.02	0.05	0.10	0.32	0.16	0.66	0.82	1.28	45.18
2040	3.07	0.15	3.22	1.31	1.09	7.36	10.56	21.28	41.60	0.07	0.08	0.16	0.08	0.010	0.06	0.02	0.05	0.10	0.32	0.16	0.83	0.99	1.47	46.29
2041	3.13	0.15	3.28	1.36	1.10	7.62	10.90	21.28	42.26	0.07	0.10	0.17	0.08	0.011	0.06	0.02	0.05	0.10	0.33	0.16	0.83	0.99	1.49	47.03
2042	3.19	0.15	3.35	1.39	1.11	7.81	11.13	21.28	42.72	0.08	0.11	0.18	0.08	0.012	0.06	0.02	0.05	0.11	0.33	0.16	0.94	1.10	1.62	47.69
2043	3.26	0.15	3.41	1.42	1.12	7.94	11.27	21.28	43.04	0.08	0.12	0.20	0.08	0.013	0.06	0.02	0.05	0.11	0.34	0.17	0.94	1.11	1.64	48.09
2044	3.32	0.15	3.48	1.44	1.13	8.03	11.35	21.28	43.23	0.08	0.14	0.22	0.08	0.013	0.06	0.02	0.05	0.11	0.34	0.17	0.94	1.11	1.67	48.38
2045	3.39	0.15	3.55	1.45	1.14	8.09	11.37	21.28	43.34	0.08	0.16	0.24	0.08	0.014	0.06	0.02	0.05	0.11	0.35	0.17	0.94	1.11	1.70	48.58
2046	3.46	0.16	3.61	1.45	1.15	8.13	11.37	21.28	43.39	0.08	0.18	0.26	0.08	0.015	0.06	0.02	0.05	0.12	0.36	0.17	0.94	1.11	1.73	48.73
2047	3.53	0.16	3.68	1.46	1.17	8.15	11.34	21.28	43.40	0.08	0.20	0.29	0.08	0.016	0.06	0.02	0.06	0.12	0.36	0.18	0.94	1.12	1.76	48.85
2048	3.60	0.16	3.76	1.46	1.18	8.16	11.30	21.28	43.38	0.09	0.23	0.31	0.08	0.018	0.06	0.03	0.06	0.12	0.37	0.18	0.94	1.12	1.80	48.94
2049	3.67	0.16	3.83	1.46	1.19	8.17	11.24	21.28	43.35	0.09	0.26	0.35	0.09	0.019	0.06	0.03	0.06	0.12	0.37	0.18	0.94	1.12	1.84	49.02
2050	3.74	0.16	3.90	1.46	1.20	8.18	11.19	21.28	43.32	0.09	0.30	0.39	0.09	0.020	0.06	0.03	0.06	0.13	0.38	0.18	0.94	1.12	1.89	49.11

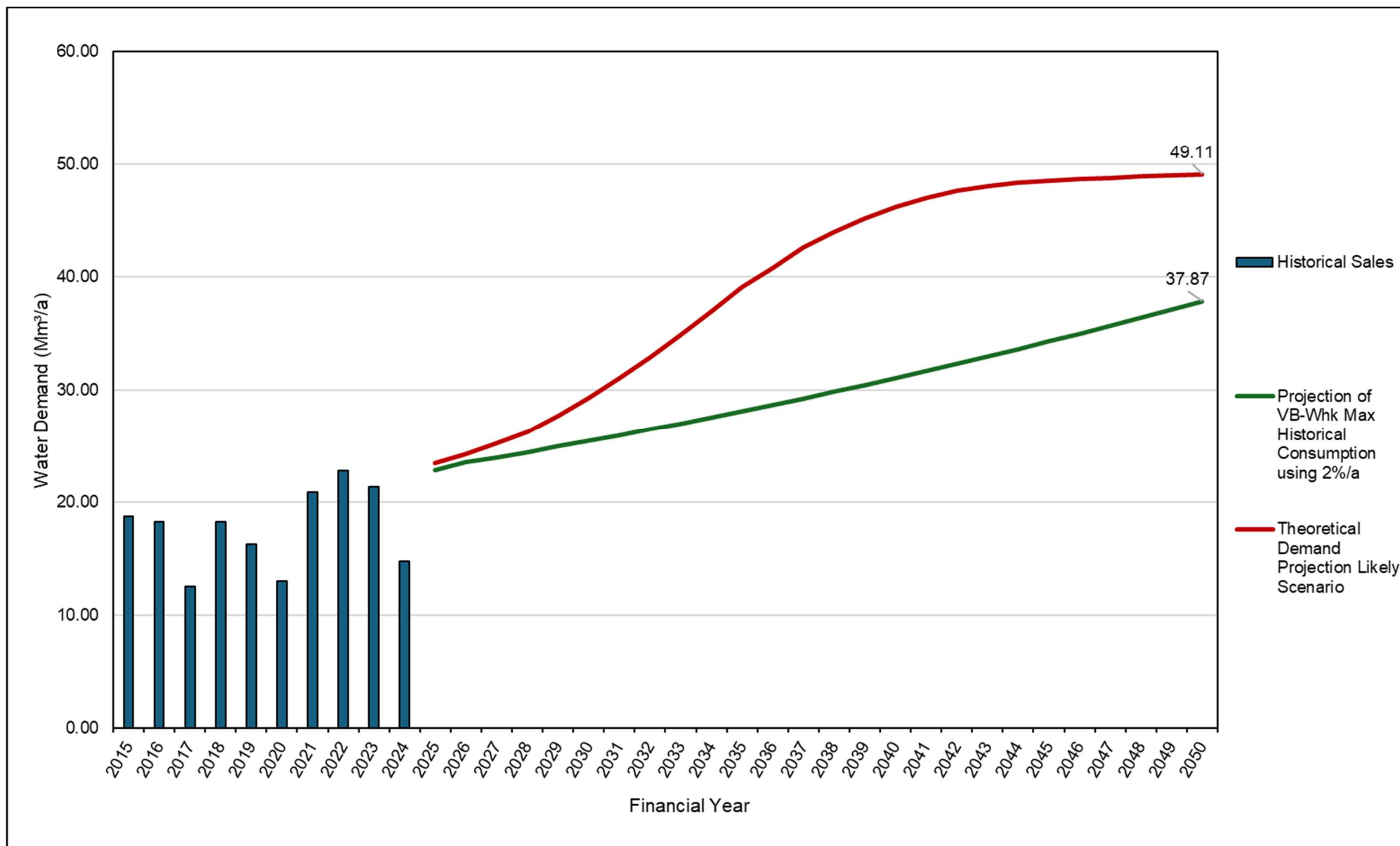


Figure 14: Projected annual water demands of the Von Bach – Windhoek and Booster 2 – Otjijase schemes compared for reference to the maximum historical consumption, excluding water supplied from CoW boreholes and reclamation, projected with 2%/annum (Mm³/a).

5 Sufficiency Analysis

The sufficiency analysis of NamWater's infrastructure to meet the requirements of the Gondwana Lifestyle Estate was divided into two main scheme components, namely the relevant Von Bach - Windhoek scheme infrastructure and the Booster 2 – Otjihase scheme, for the following two water demand projection scenarios:

Scenario 1: Base likely water demand projection, excluding Gondwana Lifestyle Estate.

Scenario 2: Likely water demand projection, including Gondwana Lifestyle Estate.

Estimated surplus or deficit capacities are analysed for short-, medium- and long-term time frames, including FY2025, FY2030, FY2035, FY2042 and FY2050. The sufficiency of the pump stations and pipelines were estimated using peak (ADPM) water demands, while that of the reservoirs was based on the standard 48 hours of Average Annual Daily Demand (AADD) storage requirement of NamWater.

Note on the potential utilization of existing Otjihase – Finkenstein pipeline and pumping scheme:

The design capacity of this scheme is 32 m³/h and is reserved for Finkenstein. Over the past five years, monthly water sales to Finkenstein exceeded 15 000 m³/month on several occasions, which corresponds to ±25-26 m³/h and suggests a surplus of 6 m³/h during these high peak months. However, Finkenstein have plan drawings to develop an additional ±100 erven that may require roughly 6 m³/h if assuming a household demand of 750 litres/house/day, adding 15% distribution losses and applying a peak factor of 1.4. Therefore, this infrastructure does not have sufficient spare capacity to reliably supply both the Gondwana Lifestyle Estate and Finkenstein, except potentially for temporary construction water requirements. Borehole WW36161 with its recommended yield of 25 m³/h could also be installed and to meet construction water requirements.

5.1 Von Bach - Windhoek Component

5.1.1 CAN Water Sources

NamWater utilizes the Central Area of Namibia (CAN) Model, operational for nearly two decades, to evaluate water demand and supply dynamics in the CAN. The model supports short-term forecasting, enabling NamWater to prepare two- to three-year water supply projections. It assesses available water resources, including Omatako, Swakoppoort, and Von Bach dam levels, against demand to calculate run-dry dates, aiming to secure supply across two rainy seasons (two years). As noted in Section 3.2.1, existing water sources are under severe stress, complicating acceptable run-dry dates and necessitating projects like the Okavango Link.

For this Situation Assessment Report, the CAN Model was used to evaluate short-term water availability and the impact of the phased Gondwana Lifestyle Estate development on the current run-dry date. NamWater's Hydrology Division analyzed three scenarios:

- Scenario 1: Base case, excluding Gondwana Lifestyle Estate's water demands.
- Scenario 2: Including Phase 1 water demands of Gondwana Lifestyle Estate.
- Scenario 3: Including full development water demands of Gondwana Lifestyle Estate.

Table 6 shows projected Von Bach dam run-dry dates: 20 April 2027 (Scenario 1), 10 April 2027 (Scenario 2), and 23 March 2027 (Scenario 3). Scenario 1 indicates existing sources fall slightly short of a two-year supply without Gondwana's demands, assuming no further dam inflows. Scenario 2 shows Phase 1 advancing the run-dry date by 10 days, while Scenario 3, reflecting full development, advances it by about one month. Scenario 3 is less realistic, as Gondwana's development is phased and targeted for completion by 2040, but it illustrates the potential impact of full build-out.

These results underscore the urgent need to fast-track additional water sources for the CAN, regardless of Gondwana's development. While sufficient water exists for Gondwana to proceed, they must collaborate with NamWater to develop emergency groundwater sources to ensure supply security during droughts, complementing medium- to long-term projects with longer lead times.

Table 6: CAN Modelling Results (NamWater Hydrology Division).

SCENARIO	DAM WL DATE	SOURCES (Mm ³ /a)					RUN DRY DATES	
		Northern Sources	COW BH	WINGOC	SW to VB	OM to VB	VB DS	SW DS
S1 MAR 2.5 (2Yrs) Nav 3.1	28-Apr-25	BA 2.0, KB 3.81 & Karst 1 BH 0.9	0.5	5.84	10	22.5	20-Apr-27	10-Sep-27
S2 MAR 2.5 (2Yr) Nav 3.1 (2026), Add. Dem 0.252	28-Apr-25	BA 2.0, KB 3.81 & Karst 1 BH 0.9	0.5	5.84	10	22.5	10-Apr-27	10-Sep-27
S3 MAR 2.5 (2Yr) Nav 3.1 (2026), Add. Dem 0.968	28-Apr-25	BA 2.0, KB 3.81 & Karst 1 BH 0.9	0.5	5.84	10	22.5	23-Mar-27	10-Sep-27

5.1.2 Von Bach – Windhoek Water Supply Infrastructure

The sufficiency analysis for the Von Bach – Windhoek water supply infrastructure, presented in **Table 7**, evaluates capacity against projected water demands under two scenarios, with results summarized below.

Scenario 1 (Excluding Gondwana Lifestyle Estate):

- The Ø1100 mm pipeline reaches capacity by FY2033.
- Von Bach Water Treatment Plant capacity is exceeded by FY2036.
- Base and booster pump stations become inadequate by FY2040.

Scenario 2 (Including Gondwana Lifestyle Estate):

- The Ø1100 mm pipeline reaches capacity by FY2033.
- Von Bach Water Treatment Plant capacity is exceeded by FY2036.
- Base and booster pump stations become inadequate by FY2039.

The analysis indicates that the pipeline, water treatment plant, and pump stations will exceed maximum capacities by FY2033, FY2036, and FY2039/40, respectively. The Gondwana Lifestyle Estate's water demand has minimal impact on these timelines. In 2016, Lund Consulting Engineers (LCE) recommended replacing the existing pipeline with a Ø1400 mm steel pipeline, but the project was deferred. NamWater should prioritize detailed planning, budgeting, and construction of these upgrades, beyond the scope of this report, to address the projected shortfalls.

5.2 Booster 2 – Otjihase Component

The sufficiency analysis for the Booster 2 – Otjihase water supply infrastructure, presented in **Table 8**, evaluates capacity against projected water demands under two scenarios, with results summarized below.

Scenario 1 (Excluding Gondwana Lifestyle Estate):

- All components remain adequate for existing customer demands until FY2042.
- From FY2042, the VFO pump station requires upgrading from one to two operational pumps to ensure supply security.
- The 750 m above-ground steel Otjihase Reservoirs – Booster pipeline may reach its capacity limit by FY2050, based on an assumed maximum velocity of 2 m/s.

Scenario 2 (Including Gondwana Lifestyle Estate):

- The VFO pump station and Otjihase Reservoirs – Booster pipeline require augmentation by FY2030 due to capacity constraints from phased Gondwana demands.
- By FY2042, all components, including the upgraded VFO pump station, will be inadequate and require further upgrades, augmentation, or replacement.

The analysis highlights that while the infrastructure supports existing demands until FY2042, the inclusion of Gondwana's phased demands accelerates capacity constraints, necessitating upgrades to the VFO pump station and pipeline by FY2030 and comprehensive developments/upgrades by FY2042.

Table 7: Von Bach – Windhoek Water Supply Infrastructure Sufficiency Analysis.

VON BACH - BOOSTER 2 COMPONENT SUFFICIENCY													
Scenario 1 (Base): Excluding Gondwana Lifestyle Estate													
Scheme Component	Type	Unit	Capacity	FY2025		FY2030		FY2035		FY2042		FY2050	
				Required	Surplus/ Deficit	Required	Surplus/ Deficit	Required	Surplus/ Deficit	Required	Surplus/ Deficit	Required	Surplus/ Deficit
Von Bach Water Treatment Plant - Design Capacity	Treatment Plant	m³/h	6 500	3 707	2 793	4 618	1 882	6 219	281	7 551	-1 051	7 702	-1 202
Base and Booster Pump Stations	Pumps	m³/h	7 200	3 707	3 493	4 618	2 582	6 219	981	7 551	-351	7 702	-502
The Von Bach – Windhoek Pipeline	Pipeline	m³/h	5 400	3 707	1 693	4 618	782	6 219	-819	7 551	-2 151	7 702	-2 302
Scenario 2: Including Gondwana Lifestyle Estate													
Von Bach Water Treatment Plant - Design Capacity	Treatment Plant	m³/h	6 500	3 707	2 793	4 655	1 845	6 299	201	7 715	-1 215	7 866	-5 072
Base and Booster Pump Stations	Pumps	m³/h	7 200	3 707	3 493	4 655	2 545	6 299	901	7 715	-515	7 866	-4 372
The Von Bach – Windhoek Pipeline	Pipeline	m³/h	5 400	3 707	1 693	4 655	745	6 299	-899	7 715	-2 315	7 866	-6 172

Table 8: Booster 2 - Otjihase Water Supply Infrastructure Sufficiency Analysis.

BOOSTER 2 - OTJIHASE COMPONENT SUFFICIENCY													
Scenario 1 (Base Scenario): Excluding Gondwana Lifestyle Estate													
Scheme Component	Type	Unit	Capacity	FY2025		FY2030		FY2035		FY2042		FY2050	
				Required	Surplus/ Deficit	Required	Surplus/ Deficit	Required	Surplus/ Deficit	Required	Surplus/ Deficit	Required	Surplus/ Deficit
VFO PS: 1 x operational pump	Pumps	m³/h	137	86	51	95	42	106	31	130	7	183	-46
Booster 2- Otjihase Pipeline	Pipeline	m³/h	260	86	174	95	165	106	154	130	130	183	77
Otjihase 2 x 4000 m³ Reservoirs + 1000 m³ @ B2	Reservoirs	m³	9 000	2 945	6 055	3 254	5 746	3 650	5 350	4 472	4 528	6 273	2 727
Otjihase Reservoirs - Booster Pipeline, V = 2 m/s	Pipeline	m³/h	130	83	47	90	40	98	32	110	20	125	5
Scenario 2: Including Gondwana Lifestyle Estate													
VFO PS: 1 x operational pump	Pumps	m³/h	137	86	51	135	2	194	-57	311	-174	363	-312
VFO PS: 2 x operational pumps	Pumps	m³/h	220	86	134	135	85	194	26	311	-91	363	-229
Booster 2- Otjihase Pipeline	Pipeline	m³/h	260	86	174	135	125	194	66	311	-51	363	-189
Otjihase 2 x 4000 m³ Reservoirs + 1000 m³ @ B2	Reservoirs	m³	9 000	2 945	6 055	4 645	4 355	6 647	2 353	10 654	-1 654	12 455	-6 400
Otjihase Reservoirs - Booster Pipeline, V = 2 m/s	Pipeline	m³/h	130	83	47	131	-1	185	-55	290	-160	306	-259

6 Development Proposal

The Development Proposal was carried out based on the sufficiency analysis of water demand Scenario 2, including the Gondwana Lifestyle Estate's phased water requirements. The current capacity of the Booster 2 – Otjihase scheme is sufficient to supply all projected water demands up to FY2030. Thereafter, upgrades and new infrastructure will be required to meet the projected water demands. The envisaged water supply infrastructure upgrades / developments are subdivided into **three phases** and **tied to water demands** since WCE indicated that Gondwana's water requirements and timelines are not final and will evolve going forward:

Phase 1: Short-term, to accommodate water demands between 0 – 200 000 m³/a.

Phase 2: Medium-term, to accommodate water demands between 200 000 – 500 000 m³/a.

Phase 3: Long-term, to accommodate water demands between 500 000 – 940 000 m³/a.

Phase 1 includes the proposed new dedicated pipelines and a pump station from the Otjihase reservoirs to the Gondwana Lifestyle Estate, sized to cater for the full development, and onsite storage.

Phase 2 includes the intermediate upgrade of the VFO pump station to supply 220 m³/h (two pumps in operation) and chlorination system upgrade at Otjihase reservoirs.

For **Phase 3**, three options are proposed to upgrade or augment the capacity of the Booster 2 – Otjihase component to supply the long-term water demands. **Option 1** considers upgrading the capacity of the existing pipeline with a booster pump station, **Option 2** considers a separate dedicated pipeline and pump stations for the Gondwana Estate, and **Option 3** considers complete replacement of the Booster 2 – Otjihase pipeline and pumping scheme to accommodate additional future consumers that have not submitted formal bulk water applications but are likely to do so in future. Kindly note that these high-level options were not optimized with consideration of different materials.

6.1 Phase 1 (0 – 200 000 m³/a): Otjihase-Gondwana Scheme

Dedicated water supply infrastructure will need to be developed between the Otjihase reservoirs and Gondwana Lifestyle Estate. In summary, the following concept is proposed for Phase 1:

1. Construct a 750 m long above ground steel pipeline parallel to the existing feeder pipeline between to the booster pump station.
2. Construct a new dedicated booster pump station to transfer potable water to Gondwana, 2 + 1 duty and standby configuration with a total capacity of 180 m³/h @ 140 mWH.
3. Construct a new dedicated ±12 km long, Ø315 mm Class 16 (ID 277 mm) uPVC pipeline to the Gondwana Lifestyle Estate, and
4. Construct onsite clear water storage reservoir at Gondwana Lifestyle Estate with a capacity of ±6 000 m³ to provide 48 hours of storage (includes assumed 20% provision for dead storage), including instrumentation, telemetry and controls, and meters. This may consist of a single centralized reservoir or a phased, decentralized system, provided that a total effective storage of at least 48 hours of the Average Annual Daily Demand (AADD) is always maintained.
5. Develop and connect emergency groundwater sources.

The hydraulic modelling results verifying the technical viability of Phase 1 is shown in **Figure 15**.

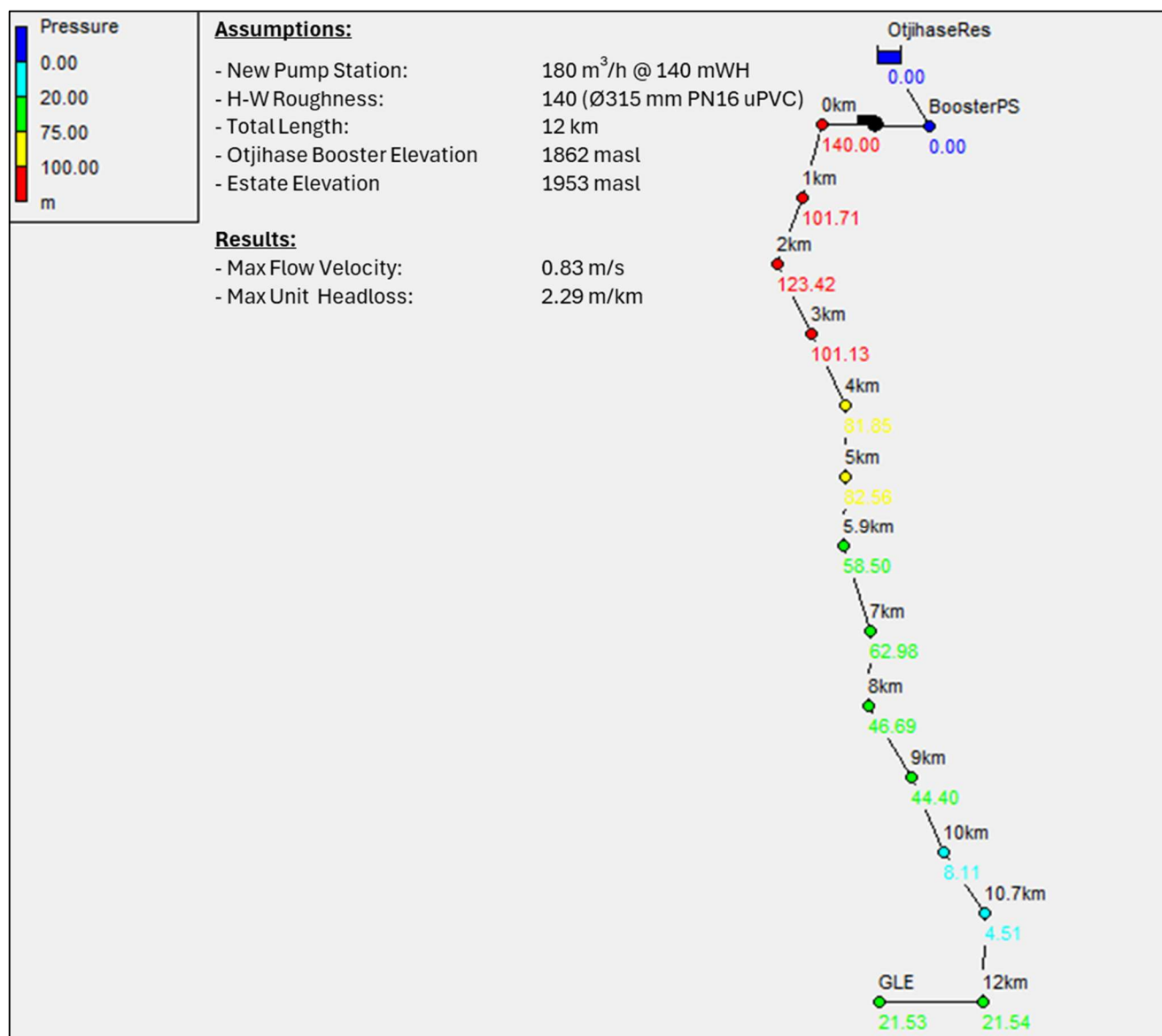


Figure 15: Hydraulic modelling results of proposed Otjihase – Gondwana scheme.

6.2 Phase 2 (200 000 – 500 000 m³/a): VFO PS Intermediate Upgrade

The Von Francois Ost pump station contains two Sulzer multistage pumps with space for a third. Only one pump is currently in operation. The intermediate upgrade to two operational pumps will increase the capacity of the Booster 2 – Otjihase scheme to 220 m³/h and will be sufficient until FY2035 based on the projected water demands, or when Gondwana's water demand reaches about 500 000 m³/a:

1. Upgrade VFO pump station to supply 220 m³/h (2 x operational pumps).
2. Upgrade chlorination system at Otjihase reservoirs.
3. Proportional increase of emergency groundwater scheme capacity, if required.

The hydraulic modelling results verifying the technical viability of Phase 2 is shown in **Figure 16**.

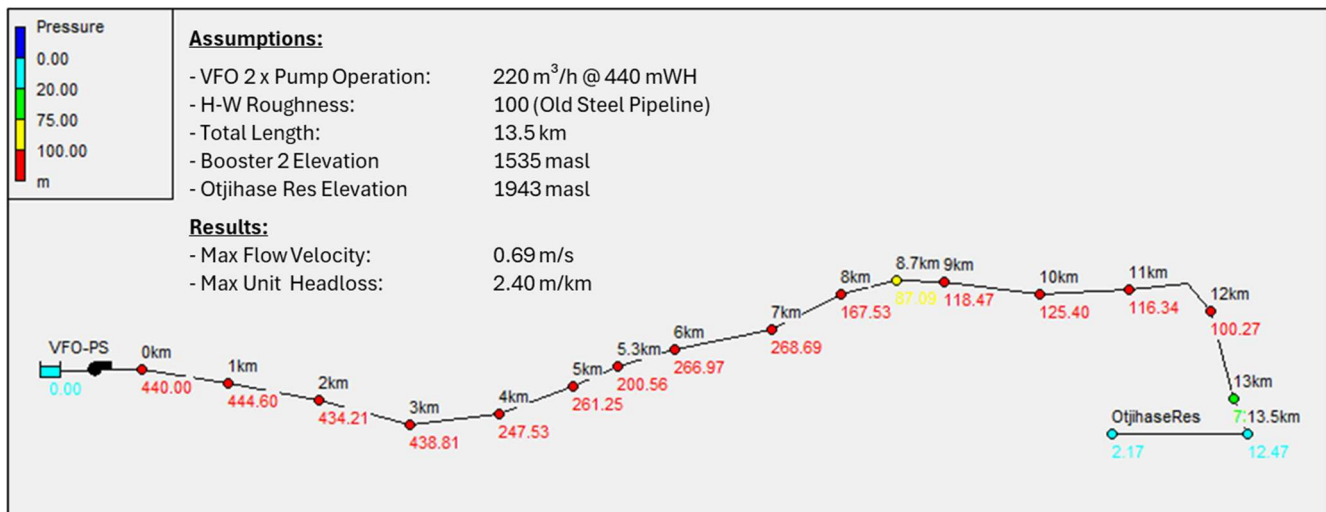


Figure 16: Hydraulic modelling results of Booster 2 - Otjihase 220 m³/h upgrade.

6.3 Phase 3 (500 000 – 940 000 m³/a): Booster 2 – Otjihase Upgrade/Replacement

6.3.1 Phase 3 – Option 1: Increase Capacity of Existing Booster 2 – Otjihase Scheme with New Base and Booster Pump Stations

As mentioned in Section 3.3.2, the design capacity of the Booster 2 – Otjihase component of 260 m³/h was adopted in this report and is governed by the assumed maximum allowable pumping head of 460 mWH through the existing old steel pipeline. However, a higher capacity of 360 m³/h will be achievable if a booster pump station is added along the pipeline. The use of two pump stations will also allow for substantially lower pumping heads, i.e. 270 mWH at each pump station in the proposed option, which may extend the remaining useful life of the pipeline.

There are risks associated with utilizing the existing steel pipeline. Firstly, the pipeline was constructed to supply the Otjihase mine. The owners of the mine, Consolidated Copper, have not responded to NamWater's requests for information on their plans to resume mining operations and the associated water requirements. Should the demand of Otjihase mine throughout the planning horizon increase beyond the assumed 300 000 m³/a adopted from the Desalination Feasibility Study (ILF, 2021), this option will not be sufficient. Secondly, it is not clear whether the pipeline (±50 years old) will remain in good working condition throughout the planning horizon.

The following development concept is proposed for Phase 3 – Option 1:

1. 1 x base pump station at Booster 2 and 1 x booster pump station at chainage 6.5 km.
2. Upgrade substation at Booster 2 and relay power to the proposed booster station.
3. Civil modifications to VFO pump station building and a new pump station building at chainage 6.5 km.
4. A 1 000 m³ reinforced concrete pump balancing reservoir at chainage 6.5 km.

The hydraulic modelling results verifying the technical viability of upgrading the existing Booster 2 – Otjihase scheme to deliver 360 m³/h is shown in **Figure 17** and a schematic of Option 1 is shown in **Figure 18**.

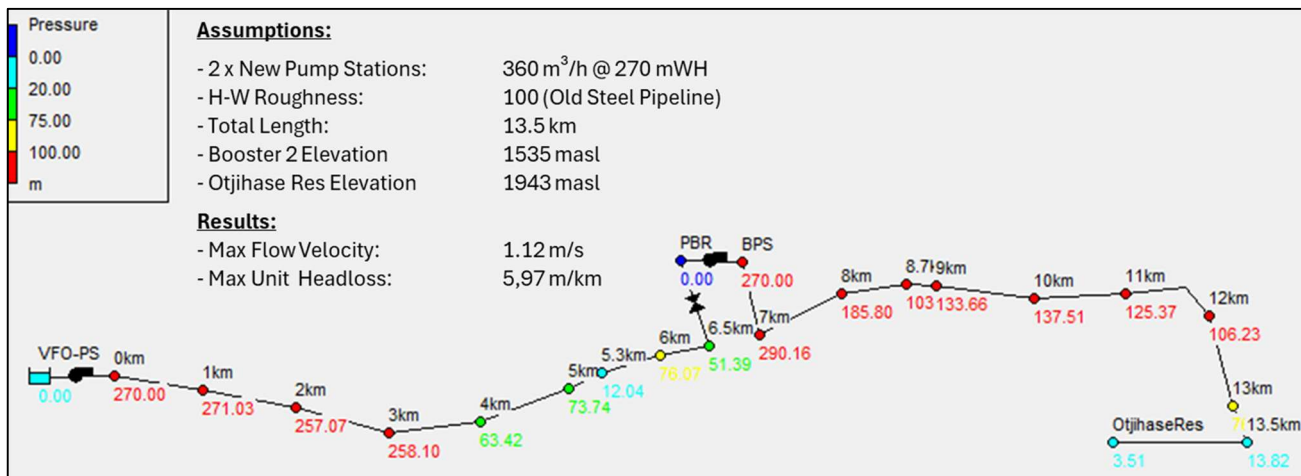


Figure 17: Hydraulic modelling results of Booster 2 - Otjihase 360 m³/h upgrade.

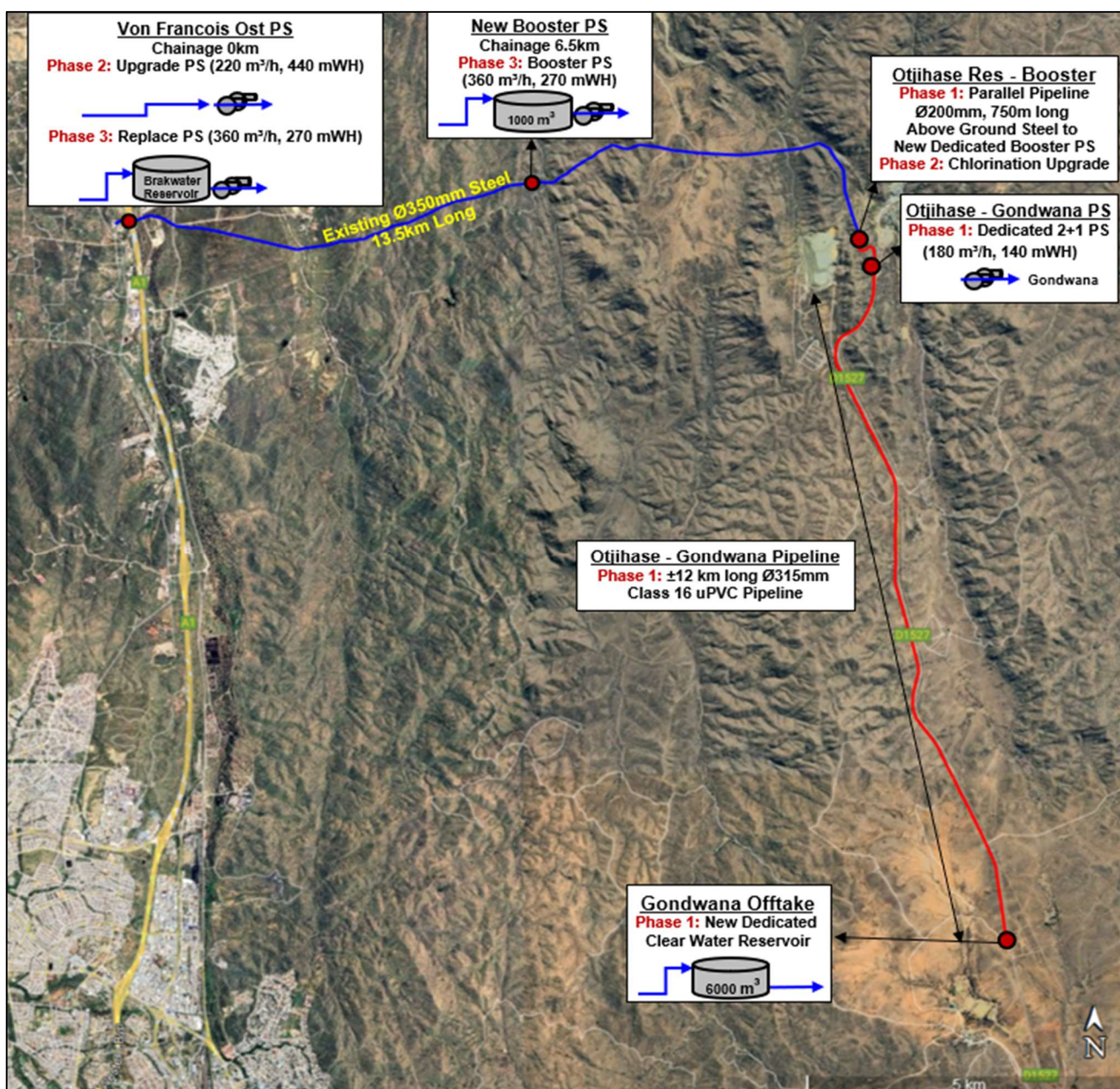


Figure 18: Schematic of the complete proposed development, including Phase 3 – Option 1.

6.3.2 Phase 3 – Option 2: New Dedicated Booster 2 – Otjihase Pipeline and Pumping Scheme to Supply Gondwana Lifestyle Estate

To avoid the risks associated with utilizing the existing Booster 2 – Otjihase steel pipeline, it is proposed for Option 2 that a new dedicated pipeline and pumping scheme be developed to supply the Gondwana Lifestyle Estate's estimated peak water demand of 180 m³/h. The following development concept is proposed for Phase 3 – Option 2:

1. 1 x base pump station at Booster 2 and 1 x booster pump station at chainage 6.5 km, each with a 2 + 1 duty and standby configuration with a total capacity of 180 m³/h @ 270 mWH. The base pump station can draw water from the new 8 000 m³ Brakwater reservoir that is planned for completion by 2027/28.
2. Upgrade substation at Booster 2 and relay power to the proposed booster station.
3. 2 x pump station buildings.
4. A 1 000 m³ reinforced concrete pump balancing reservoir at chainage 6.5 km.
5. A new dedicated ±13.5 km long, Ø250 mm Class 40 DCI pipeline running parallel to the existing steel pipeline.

The hydraulic modelling results verifying the technical viability of the proposed dedicated Booster 2 – Otjihase scheme to deliver 180 m³/h is shown in **Figure 19** and a schematic of Option 2 is shown in **Figure 20**.

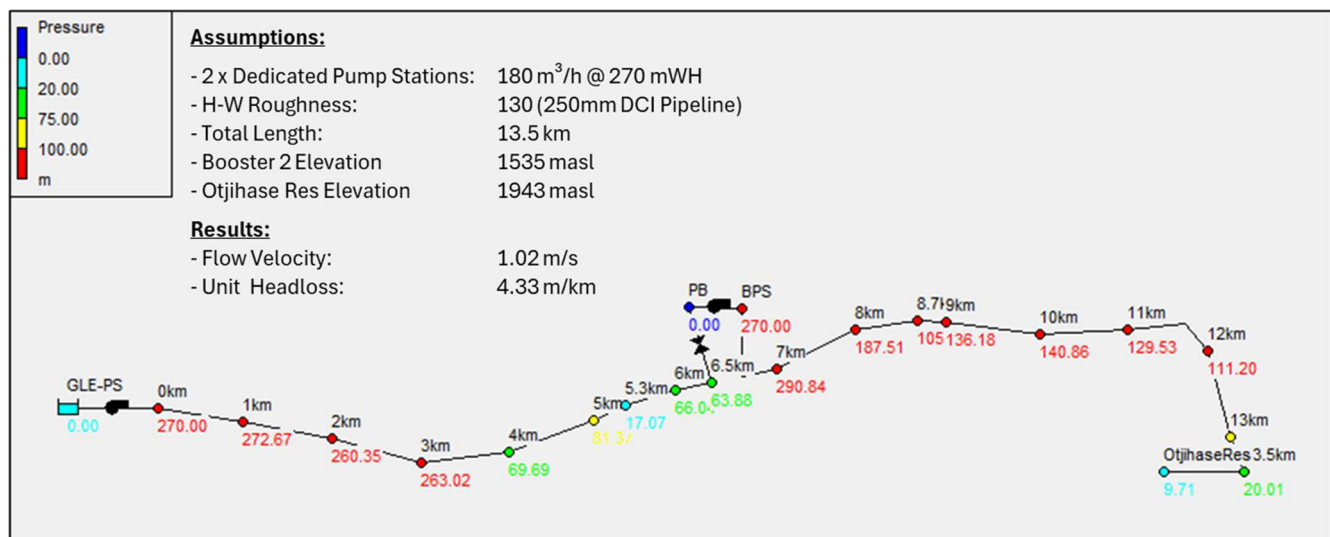


Figure 19: Hydraulic modelling results of proposed dedicated Booster 2 – Otjihase pipeline.

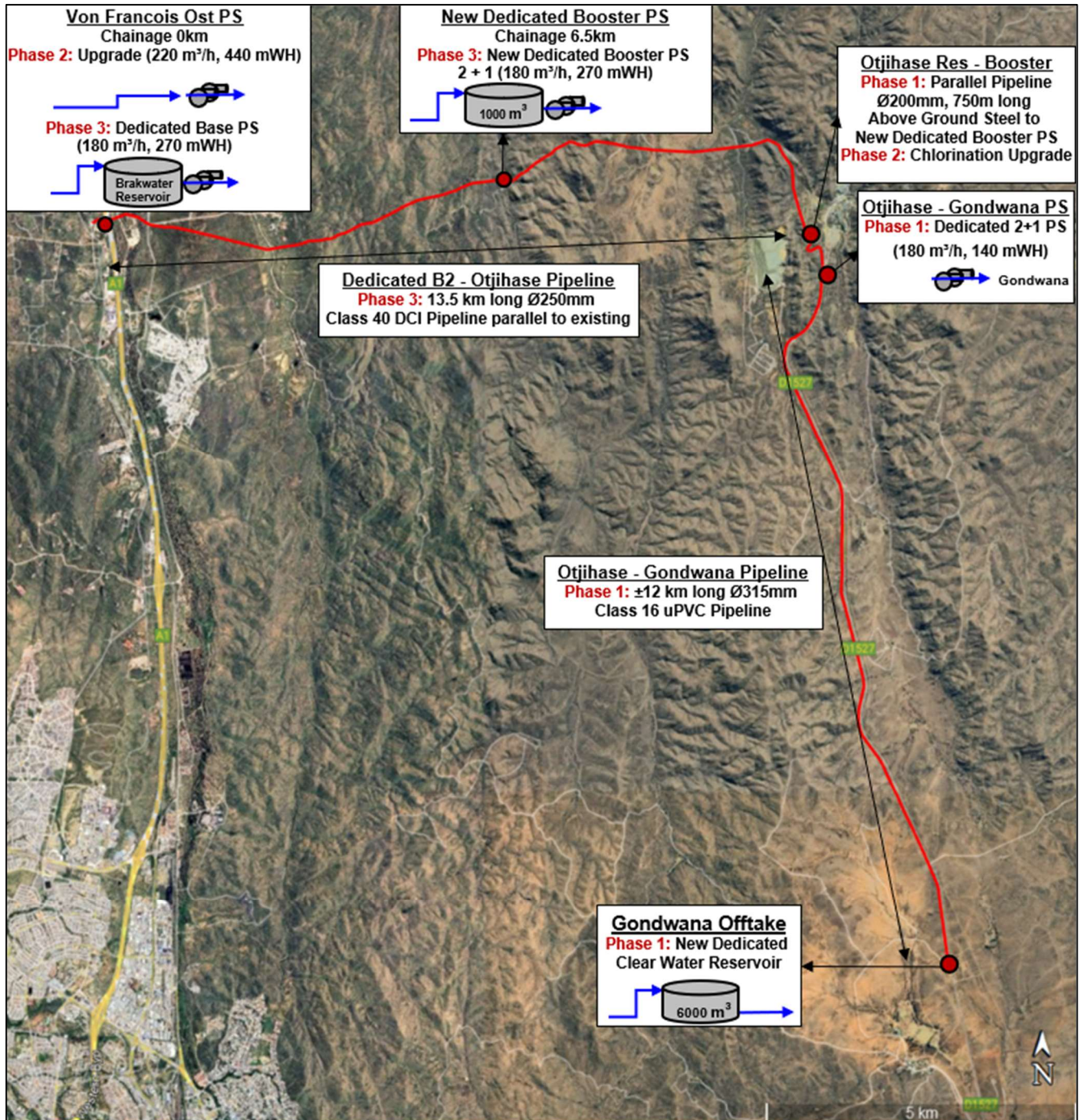


Figure 20: Schematic of the complete proposed development, including Phase 3 – Option 2.

6.3.3 Phase 3 – Option 3: New Shared Booster 2 – Otjihase Pipeline and Pumping Scheme to Supply All Potential Demands

NamWater has received multiple water supply requests in recent years for large volumes east of Windhoek, many of which await formalization through bulk water applications. On 6 June 2025, developers of Herboth's Blick met with NamWater to discuss expansion plans, starting with 30 additional plots over the next five years, followed by significant growth over the next 20 years. Additionally, Otjihase Mine may resume and upscale operations, while several developers, including Jindal, Lodestone, Anda, and Avanzar, have expressed interest in establishing copper mines in the area. Anda and Avanzar approached NamWater in May 2025 to discuss their plans.

If the Okavango Link is completed, sufficient water supply will be available. However, constructing a dedicated Booster 2 – Otjihase pipeline for the Gondwana Estate (Option 2) risks necessitating additional pipelines within the planning horizon to accommodate other potential off-takers. This could increase development costs, operational and maintenance expenses, implementation complexity, and environmental impact. Alternatively, Option 3 proposes replacing the existing Booster 2 – Otjihase pipeline and pumping system. For this report, a $\varnothing \pm 500$ mm pipeline, capable of delivering 700 m³/h or 5 Mm³/a, is assumed, with sizing to be confirmed through a separate feasibility study:

1. 1 x base pump station at Booster 2 and 1 x booster pump station at chainage 6.5 km, each with a total capacity of 700 m³/h @ 250 mWH.
2. Upgrade substation at Booster 2 and relay power to the proposed booster station.
3. 2 x pump station buildings.
4. A 1 000 m³ reinforced concrete pump balancing reservoir at chainage 6.5 km.
5. A new shared ± 13.5 km long, $\varnothing 500$ mm Class 30 DCI pipeline to replace the existing $\varnothing 350$ mm pipeline.

The hydraulic modelling results verifying the technical viability of the proposed shared Booster 2 – Otjihase scheme is shown in **Figure 21** and a schematic of Option 3 is shown in **Figure 22**.

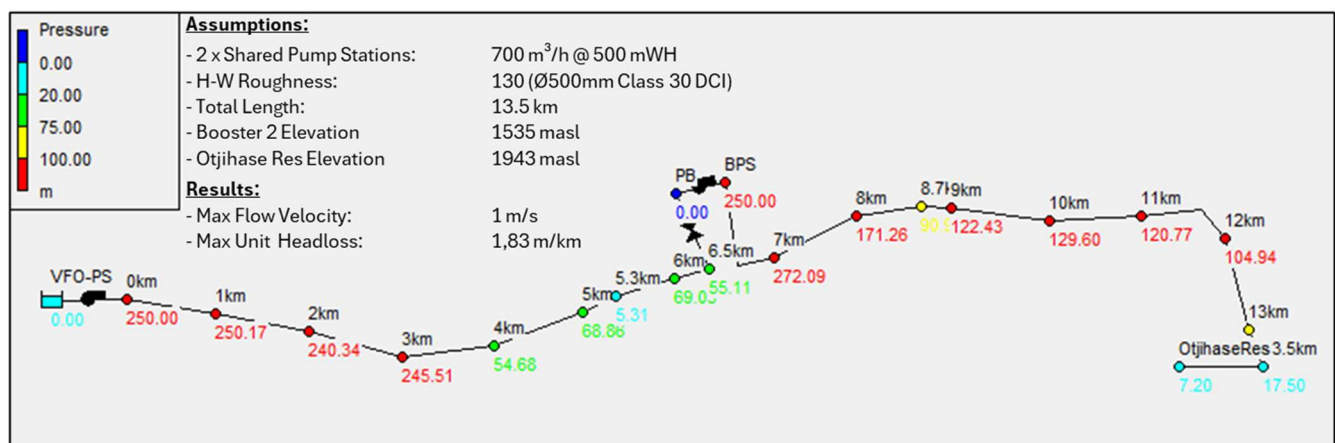


Figure 21: Hydraulic modelling results of proposed shared Booster 2 – Otjihase pipeline.

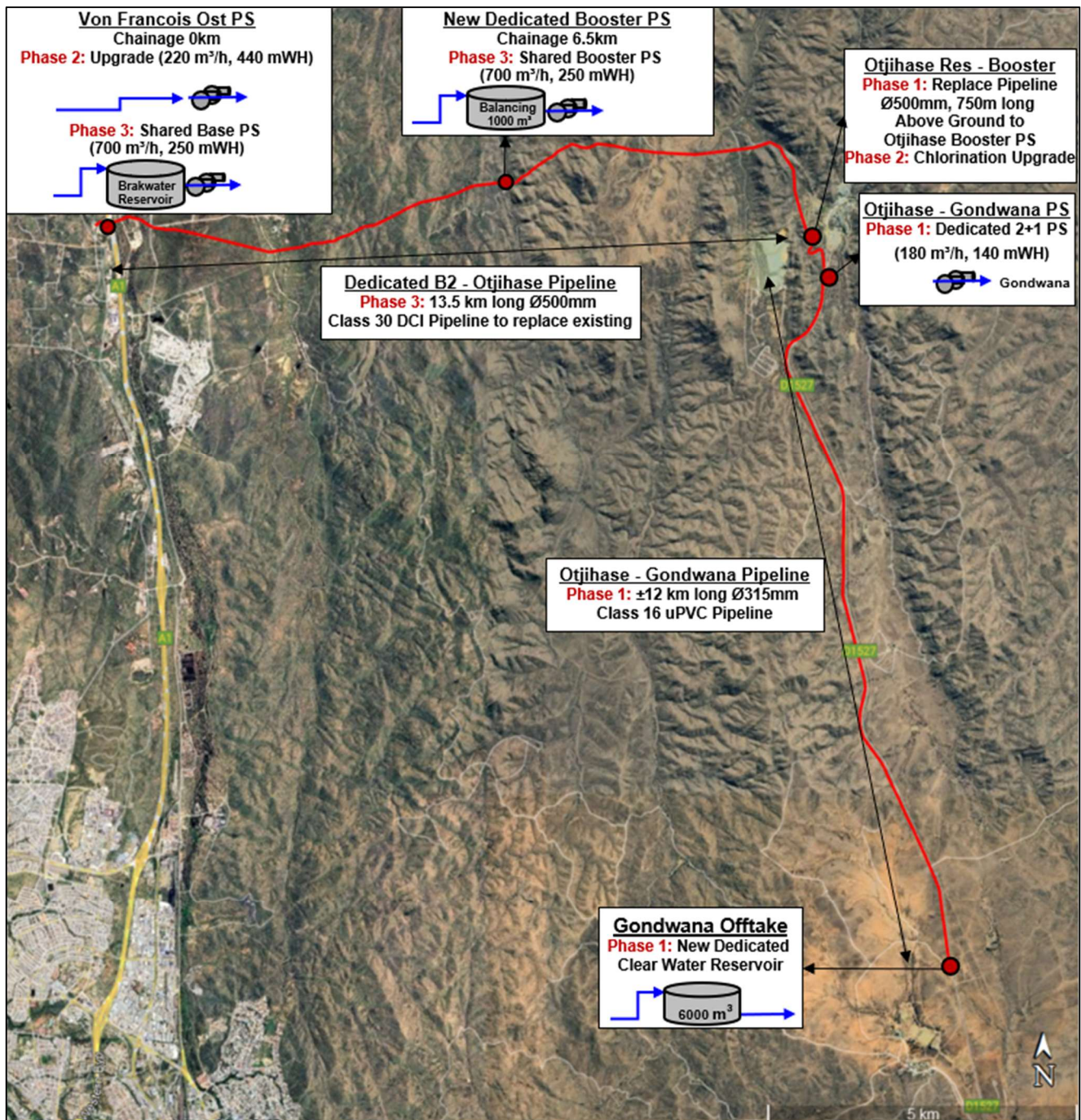


Figure 22: Schematic of the complete proposed development, including Phase 3 – Option 3.

7 Cost Estimates

This section outlines the first-order capital development costs and indicative incremental running costs for supplying water to the Gondwana Lifestyle Estate.

As presented in **Tables 9 to 13**, the first-order capital development costs are estimated at N\$ 51 million for Phase 1, N\$ 13 million for Phase 2 and Phase 3 costs of N\$ 57 million (Option 1), N\$ 107 million (Option 2) or N\$ 204 million (total for Phase 3 – Option 3, with N\$ 52 million attributable to Gondwana). These costs do not include development and connection of emergency groundwater sources, which require further investigation.

The Indicative incremental unit costs associated with Phase 1 and 2, and Phase 3 – Options 1, 2, and 3 were estimated at N\$ 5.62/m³, N\$ 6.05/m³, N\$ 6.25/m³ and N\$ 5.24/m³, respectively. These estimates represent the O&M costs of the proposed water transfer schemes, variable energy costs, maintenance, water quality (chlorination and monitoring), and the standard 15% O&M surcharge by NamWater. Note that the fixed power capacity charges and security deposit associated with power upgrades at Booster 2 require further investigation and were not included. The current cost of water at Otjihase is N\$ 18.13/m³. The final cost for supply to Gondwana for the respective phases will be determined by NamWater Finance.

Per NamWater's standard policy for commercial customers, capital costs for water supply infrastructure will not be embedded in the final water tariff due to the financial risks associated with commercial entities / large development projects. The customer is responsible for funding all capital costs, developing the required infrastructure in collaboration with NamWater, and adhering to NamWater's standards.

Upon completion, the infrastructure (excluding onsite facilities at the development) will be transferred to NamWater for operation and maintenance, with the customer being charged a lower tariff that excludes capital redemption costs. Once water supply infrastructure has been developed to supply the agreed water volume, customers are typically not required to fund upgrades for the lifetime of the infrastructure. In the event that future upgrades or infrastructure replacement is required due to age, customers are approached individually with a motivation for such an intervention.

Table 9: Capital development cost estimates for Phase 1.

Description	Unit	Quantity	Rate N\$	2025 Amount N\$
PHASE 1 (Gondwana Water Demand: 0 - 200 000 m³/a)				
Description: Otjihase - Gondwana Dedicated Scheme				
Pipeline				21 645 000
Otjihase reservoirs - booster parallel pipeline, Ø200mm Above Ground GMS - Supply, lay, joint and strap on pedestals	km	0.75	2 460 000	1 845 000
Otjihase Gondwana pipeline, Ø315mm Class 16 uPVC pipeline - Supply, joint, lay, bed	km	12	1 650 000	19 800 000
Civil Works				12 500 000
6,000 m³ RC Concrete Ground Level Reservoir at Gondwana Estate	no.	1	12 500 000	12 500 000
M&E Works				4 780 000
@ Gondwana Reservoir:				
Instrumentation, controls, meters, telemetry, chlorination facilities	no.	1	1 750 000	1 750 000
@ Gondwana Pump Station:				
Pump & motor set (2+1, capacity 2 x 90 = 180 m³/h @ 130 mWH)	no.	3	140 000	420 000
MCC & Electrical	no.	1	750 000	750 000
Flow meters, control panel & other mechanical	no.	1	860 000	860 000
PLC, SCADA and telemetry & control instrumentation	no.	1	1 000 000	1 000 000
Preliminary & General, 15%, Contingencies, 10%, Professional fees, 5%				11 677 500
TOTAL				50 602 500

Table 10: Capital development cost estimates for Phase 2.

PHASE 2 (Gondwana Water Demand: 200 000 - 500 000 m³/a)				
Description: Booster 2 - Otjihase, Upgrade to 220 m³/h Pumping Capacity + Otjihase Chlorination Upgrade				
M&E Works				9 720 900
@ Von Francois Ost Pump Station:				
Upgrade pump station to deliver 220 m³/h (2 + 1 duty and standby) - see Annexure 2				
Mechanical: Pump, motor, valves & pipework	Sum	1	4 601 400	4 601 400
Electrical & Instrumentation	Sum	1	4 269 500	4 269 500
@ Otjihase Reservoirs Chlorination:				
Relay 11kV powerline to reservoirs	km	0.75	200 000	150 000
Chlorination system	no.	1	450 000	450 000
Telemetry outstation	no.	1	150 000	150 000
Transformer	no.	1	100 000	100 000
Preliminary & General, 15%, Contingencies, 10%, Professional fees, 5%				2 916 270
TOTAL				12 637 170

Table 11: Capital development cost estimates for Phase 3 - Option 1.

Description	Unit	Quantity	Rate N\$	2025 Amount N\$
PHASE 3 (Gondwana Water Demand: 500 000 - 940 000 m³/a) - OPTION 1				
Description: Booster 2 - Otjijase Scheme: New Base Pump Station & 1 x Booster Station (each 360 m³/h, 250 mWH)				
Civil Works				7 700 000
1,000 m³ RC Ground Level Reservoir at Ch ±6.5km	no.	1	5 200 000	5 200 000
Existing pump station building civil modifications and and new building for booster PS	no.	1	2 500 000	2 500 000
M&E Works				36 125 000
New shared base and booster pump stations:				
Pump & motor sets (3+1, capacity 3 x 120 = 360 m³/h @ 270 mWH)	no.	2	3 000 000	6 000 000
MCC & Electrical	no.	2	1 875 000	3 750 000
Flow meters, control panel & other mechanical	no.	2	2 250 000	4 500 000
PLC, SCADA and telemetry & control instrumentation	no.	2	2 625 000	5 250 000
Bulk power line	km	6.5	250 000	1 625 000
Replace sub-station at Booster 2	no.	1	15 000 000	15 000 000
Preliminary & General, 15%, Contingencies, 10%, Professional fees, 5%				13 147 500
TOTAL				56 972 500

Table 12: Capital development cost estimates for Phase 3 - Option 2.

PHASE 3 (Gondwana Water Demand: 500 000 - 940 000 m³/a) - OPTION 2				
Description: Booster 2 - Otjijase Pipeline: New Dedicated Ø250mm Gondwana Pipeline				
Pipeline				46 170 000
New VFO-Otjijase pipeline, Ø250mm DCI Class 40 - Supply, lay, joint and bed	km	13.5	3 420 000	46 170 000
Civil Works				7 200 000
1,000 m³ RC Ground Level Reservoir at Ch ±6.5km	no.	1	5 200 000	5 200 000
Pump station buildings	no.	2	1 000 000	2 000 000
M&E Works				28 625 000
New dedicated base and booster pump stations:				
Pump & motor sets (2+1, capacity 2 x 90 = 180 m³/h @ 270 mWH)	no.	2	1 500 000	3 000 000
MCC & Electrical	no.	2	1 250 000	2 500 000
Flow meters, control panel & other mechanical	no.	2	1 500 000	3 000 000
PLC, SCADA and telemetry & control instrumentation	no.	2	1 750 000	3 500 000
Bulk power line	km	6.5	250 000	1 625 000
Replace sub-station at Booster 2	no.	1	15 000 000	15 000 000
Preliminary & General, 15%, Contingencies, 10%, Professional fees, 5%				24 598 500
TOTAL				106 593 500

Table 13: Capital development cost estimates for Phase 3 – Option 3.

PHASE 3 (Gondwana Water Demand: 500 000 - 940 000 m³/a) - OPTION 3				
Description: Booster 2 - Otjijase Scheme: New Shared Ø500mm DCI Pipeline				
Pipeline				89 775 000
New VFO-Otjijase pipeline, Ø500mm DCI Class 30 - Supply, lay, joint and bed	km	13.5	6 650 000	89 775 000
Civil Works				15 800 000
1,000 m³ RC Ground Level Reservoir at Ch ±6.5km	no.	2	5 900 000	11 800 000
Pump station buildings	no.	2	2 000 000	4 000 000
M&E Works				50 981 000
New shared base and booster pump stations:				
Pump & motor sets (700 m³/h @ 250 mWH)	no.	2	5 928 000	11 856 000
MCC & Electrical	no.	2	3 125 000	6 250 000
Flow meters, control panel & other mechanical	no.	2	3 750 000	7 500 000
PLC, SCADA and telemetry & control instrumentation	no.	2	4 375 000	8 750 000
Bulk power line	km	6.5	250 000	1 625 000
Replace sub-station at Booster 2	no.	1	15 000 000	15 000 000
Preliminary & General, 15%, Contingencies, 10%, Professional fees, 5%				46 966 800
Full cost of shared pipeline scheme				203 522 800
TOTAL (Gondwana Cost based on Demand/Capacity Allocation, 26%)				52 334 434

8 Conclusions

1. **Water Demand Impact of Gondwana Lifestyle Estate:** The Gondwana Lifestyle Estate's phased development will significantly increase water demand on the Von Bach – Windhoek and Booster 2 – Otjihase schemes. Phase 1 (240,000 m³/a) doubles the water demand of the largest existing customer, Finkenstein Estate (120,752 m³/a in FY2024), while the full development (940,000 m³/a) nearly doubles the total FY2024 demand of the Booster 2 – Otjihase scheme (456,938 m³/a).

2. **Water Source Constraints:** The Central Area of Namibia (CAN) Model indicates that existing water sources, including Von Bach, Swakoppoort, and Omatako dams, are under severe stress, with projected Von Bach Dam run-dry dates of 20 April 2027 (base case), 10 April 2027 (including Gondwana Phase 1), and 23 March 2027 (full Gondwana development). These dates fall short of NamWater's two-year supply security target, highlighting the urgent need to fast-track augmentation projects like the Okavango Link.

3. **Infrastructure Capacity Limitations:** The sufficiency analysis reveals that the Von Bach – Windhoek infrastructure (Ø1100 mm pipeline, water treatment plant, and pump stations) will reach capacity by FY2033, FY2036, and FY2039/40, respectively, with Gondwana's demand having minimal impact on these timelines. The Booster 2 – Otjihase scheme is adequate until FY2042 without Gondwana but requires upgrades by FY2030 with Gondwana's phased demands, particularly for the Von Francois Ost (VFO) pump station and Otjihase Reservoirs – Booster pipeline.

For the proposed intermediate upgrading of the VFO pump station to two operational pumps (220 m³/h), NamWater may need to increase its contractual Notified Maximum Demand (NMD) with NamPower, which will entail additional fixed capacity charges and a security deposit to NamPower that will be attributable to Gondwana. For the proposed long-term upgrade (Phase 3), it is foreseen that the 5 MW substation would need to be replaced with a larger substation. While the substation is being replaced, temporary power supply will also need to be established to service the users in the Brakwater area. The cost of such an upgrade could be in the order of N\$ 15-20 million, however requires further investigation.

4. **Proposed Development Options:** To meet Gondwana's water requirements, Phase 1 (0 – 200 000 m³/a) includes constructing a dedicated 12 km Ø315 mm uPVC pipeline, a booster pump station, and a 6,000 m³ onsite reservoir at Gondwana. Phased and decentralized reservoir options can be considered provided that at least 48 hours of the AADD effective storage is always provided on site and developed with adequate lead times to prevent insufficient capacity (see **Annexure 3**).

Phase 2 (200 000 – 500 000 m³/a) includes upgrading the VFO pump station to 220 m³/h and upgrading the chlorination system at Otjihase reservoirs.

For Phase 3 (500 000 – 940 000 m³/a), three options are proposed – Option 1: Upgrade the existing Booster 2 – Otjihase pipeline with additional pump stations (360 m³/h capacity), Option 2: construct a new dedicated 13.5 km Ø250 mm DCI pipeline and pump stations, and Option 3: replace the existing Booster 2 – Otjihase pipeline with a larger pipeline. Options 2 and 3 mitigate the risks associated with the ageing existing pipeline and potential Otjihase Mine demand increases, and Option 3 makes provision for additional large off-takers to be accommodated on this scheme.

5. **Cost Implications:** N\$ 51 million for Phase 1, N\$ 13 million for Phase 2 and Phase 3 costs of N\$ 57 million (Option 1), N\$ 107 million (Option 2) or N\$ 204 million (total for Phase 3 – Option 3, with Gondwana's proportional contribution estimated at N\$ 52 million based on their envisaged full supply volume). Per NamWater's policy, Gondwana must fund capital development costs, with infrastructure (excluding onsite facilities) transferred to NamWater for operation and maintenance.
6. **Emergency Groundwater Needs:** Given the risk of drought and limited progress on major water source augmentations, developing emergency groundwater sources (e.g., Hoffnung and Kuruma Fault boreholes, Ondekaremba wellfield, Otjihase Mine dewatering) is critical for Gondwana's supply security. These sources, with a combined potential yield of approximately 1.76 Mm³/a, require further investigation and investment to ensure compliance with water quality standards and sustainable abstraction. Hence, the costs were not included in the above estimates.

9 Recommendations

It is recommended that:

1. This Situation Assessment Report be submitted to Gondwana Collections and their appointed Engineering Consultant, Windhoek Consulting Engineers, for their consideration and acceptance.

[Gondwana / WCE]

2. This Situation Assessment Report provide a basis for further water supply dialogue and meeting schedules and commitments between NamWater and Gondwana. NamWater should appoint a Project Manager to facilitate further meetings and communications on this Project.

[NW Programme Management / Gondwana/WCE]

3. Since the proposed estate development falls within the CoW municipal boundaries, an official authorization letter should be obtained from the CoW for NamWater to proceed. The letter should highlight the planned operations and processes regarding the supply of water (i.e. the billing points, entity responsible for billing, storage reservoir locations etc.).

[Gondwana/WCE / CoW]

4. NamWater and Gondwana should prioritize the proposed water supply infrastructure developments with adequate lead times and as required by Gondwana's water demands. For the long-term Phase 3, Option 3 is recommended despite a higher overall capital development cost to accommodate the increasing developments east of Windhoek.

[Gondwana / NamWater]

5. Gondwana should invest in emergency groundwater development based on potential sources identified by NamWater in this Report to mitigate drought risks.

[Gondwana / NW Geohydrology]

6. NamWater should expedite CAN water source augmentations such as the Okavango Link Project and consider detailed planning, budgeting, and construction of Von Bach – Windhoek scheme upgrades to address projected shortfalls with adequate lead-times.

[NamWater]

7. The details and cost implications of power supply upgrades at Booster 2 to support increased capacities must be investigated further.

[Gondwana / NW M&E]

10 References

1. ILF Consulting Engineers. (2021). Feasibility Study for Desalination Plant and Water Carriage System to secure Water Supply to Central Coast, Windhoek and en-route Users, Chapter: Water Resources and Water Demand Projections (O992-ILF-OD-0012/REV. 4).
2. LCE-PHIM JV. (2021). Development Proposal for the Von Bach – Windhoek Brakwater Reservoir.
3. LCE-SCE JV (2021). Medium-term Water Supply Alternatives for the CAN.
4. NamWater Geohydrology Division. (2022). Desk Study Report on Investigation of Potential Targets for Groundwater Supply to the Gondwana Lifestyle Estate.
5. NamWater Infrastructure Planning Division. (2003). Reconnaissance Study: Utilisation Possibilities of Groundwater at the Otjihase Mine.
6. Windhoek Consulting Engineers. (2009). Feasibility Study for a Bulk Water Supply Scheme to Sungate.

Compiled by NamWater Infrastructure Planning, May 2025

11 Annexures

Annexure 1: Farm Hoffnung Borehole WW36161 Previous Abstraction Permit



REPUBLIC OF NAMIBIA

MINISTRY OF AGRICULTURE, WATER AND FORESTRY

Telephone: (061) 2087111

Fax: (061) 2087183

Enquiries: J N Mouton

Reference: PK 66

Department of Water Affairs

Private Bag 13193

Windhoek

9000

PERMIT NUMBER: 11 249

DATE: 09 MARCH 2017

PERMIT ISSUED IN TERMS OF REGULATIONS 5 AND 9 OF GOVERNMENT NOTICE R1278 OF 23 JULY 1971 AS PROMULGATED UNDER SECTION 30(2) OF THE WATER ACT, 1956 (ACT 54 OF 1956), AS AMENDED

NAME OF PERMIT HOLDER	:	Namibia Water Corporation Ltd
ADDRESS	:	Private Bag 13389, Windhoek
REGISTERED PROPERTIES	:	Farm Hoffnung No 66
DISTRICT	:	Windhoek
CONTROL AREA	:	Windhoek – Gobabis Subterranean Water Control Area
VALIDITY PERIOD	:	Two (2) years
BOREHOLE TO BE USED	:	Serial number WW 36161
PURPOSE FOR WHICH WATER MAY BE USED	:	Water Supply Purposes
ABSTRACTION PER YEAR	:	182 500 m ³ maximum

This permit authorizes the holder (or his successors in title) to further abstract and use water for the purpose as stated above, from the existing borehole identified as WW 36161, on the farm planning map, attached as Annexure A, subject to the following conditions:

2.

1. The validity period shall be from 09 March 2017 to 08 March 2019. Notwithstanding the validity period of the permit for two years, this permit may be withdrawn or reduced at any time, should the groundwater level reach or approach a critical predetermined level.
2. An application for the extension of the validity period shall be in the possession of the Permanent Secretary at least 6 (six) months before the expiry date of the permit.
3. The permit is incident to the property and if the present owner sells the property, the permit shall be handed over to the new owner.
4. All water abstracted shall pass through a water meter and the permit holder shall bear all costs for the supply, installation and maintenance of this meter. The Permanent Secretary shall be informed beforehand if a water meter is to be installed so that an inspection, if necessary, can be conducted. Installation of the meter shall be to the satisfaction of the Permanent Secretary.
5. The permit holder shall record at the end of each month the readings on the water meters and enter such monthly readings on the prescribed Abstraction Return Form, which shall be submitted quarterly on or before the 10th day of the following quarter. Official quarters are understood to end on the last day of March, June, September and December of each year. Completed Abstraction Return Forms must be sent to the Control Officer: Abstraction Control, Private Bag 13193, Windhoek. If no water was abstracted during the quarter, a nil return must nevertheless be submitted. If the permit holder fails to send in returns regularly, this could lead to the withdrawal of the permit.
6. The permit holder shall record the water level of the pumped source once in three months at a time before the pump are switched on in order to obtain the rest water level and enter it on the above-mentioned return form.
7. Where a borehole is situated in a riverbed no embankments shall be constructed around the borehole in the riverbed which could result in the river damming up or its normal flow being impeded.
8. All installations, reservoirs, pipes, taps troughs and reticulation systems shall be leak proof to prevent any spillage of water. The permit holder shall take the necessary precautions to use the water on his property to the best advantage.
9. The Permanent Secretary or his authorized representative in consultation with the Minister shall have the right to:
 - (a) withdraw, amend or replace any condition of this permit or withdraw this permit in its entirety, after reasonable notice to the permit holder.
 - (b) inspect the source and installations at all reasonable times to determine whether the permit conditions are adhered to.

3.

10. The Permanent Secretary shall not accept liability for damage or loss suffered by the permit holder should the relevant source wane or run dry or the period of validity of the permit not be extended or renewed.
11. Should the permit holder not comply with any of the permit conditions:
- (a) the Permanent Secretary may seal the borehole until the conditions are complied with;
 - (b) the permit holder may be held liable for any costs which the Permanent Secretary may incur as a result thereof, and
 - (c) the permit holder shall be guilty of an offence and shall, on conviction, be liable to the penalties prescribed in Section 170 of the Water Act, 1956 (Act 54 of 1956).



P. W. Misika
PERMANENT SECRETARY

Annexure 2: Cost Estimate of Von Francois Ost Pump Station Intermediate Upgrade (NamWater M&E Department, 2025)

OTJIHASE BOOSTER PUMP STATION 220 m³/h Intermediate Upgrade

MECHANICAL			
Item	Unit Costs	QTY	Total Costs
Motor (315 kW)	765 000	1	765 000
Pump (130m ³ /h @ 490mWH)	2 470 000	1	2 470 000
300NB PN10 Wafer Butterfly Valves	30 000	1	30 000
150NB PN64 N0n-Retun Vklve	180 000	1	180 000
200NB PN64 Wedge Gate Valve	220 000	1	220 000
250NB PN64 Wedge Gate Valve	410 000	1	410 000
50NB PN64 Ball Valve	15 400	1	15 400
50NB PN64 Air Valve	11 000	1	11 000
Pipework PN64	500 000	1	500 000
Sub-Total			4 601 400
ELECTRICAL & INSTRUMENTATION			
Switchboard (Total MCC to be replaced)	1 000 000	1	1 000 000
315 kW Softstarters	375 000	3	1 125 000
By-pass Contactors	75 000	3	225 000
MPU's	250 000	3	750 000
Battery Protection	6 500	1	6 500
Converter	9 000	1	9 000
Battery Charger	6 500	1	6 500
Earthing	60 000	1	60 000
PLC Components	150 000	1	150 000
MB Gateway	9 000	2	18 000
HDMI Touch Screen	20 000	1	20 000
No-Flow Senso	8 000	1	8 000
Serial Protection	1 000	2	2 000
Electrical Cablling	350 000	1	350 000
Assesories	75 000	1	75 000
Casual Labour (Digging of Trenches)	2 000	10	20 000
Air-Conditioning	85 000	2	170 000
Energy Meter	16 000	1	16 000
TMT's	4 500	23	103 500
Cool Room In Building	120 000	1	120 000
Reservoir Level Sensor	20 000	1	20 000
Pressure Transducer (0-600mWh)	15 000	1	15 000
Sub-Total			4 269 500
10% Contingencies			887 090
TOTAL AMOUNT (M&E)			9 757 990

Annexure 3: Gondwana/WCE Clarifications & NamWater Responses

1. In the report, the development proposals are all tied to financial years, which were based on water demands and anticipated years of implementation of the various phases of the development (Reference Figure 1, page 2). However, the original water demands provided to NamWater, were calculated on early revisions of the planned township layout, which have since been refined and will continue to be refined as the project development continues. Currently, we expect the final water demands to be approximately **20% lower** than the original demands.

Considering this, we would like to request whether the development proposals can instead be tied to water demand figures. For example, instead of tying the Phase 1 upgrade works to FY 2030, it can be stated that when the development's water demand reaches 200,000 m³/a, the Phase 1 works must be completed. Please advise if this is possible?

NamWater Answer: Yes, the proposed development phasing can be tied to the corresponding water demands and allowing adequate lead times for implementation. However, critical capital investment costs should not be deferred to the convenience of the developer, who may not be available in later years to honour the obligation.

WCE/Gondwana Response – We confirm that the Developer will ensure that the required capital investments are made in time, so the required infrastructure is in place by the time the demand reaches the different thresholds. Not sure whether this will be written into the water supply agreement with the Developer? Kindly update the report then to tie development proposals to water demand figures. Thank you.

2. On page 2, reference is made to the volume of water sold to Finkenstein in FY2024. Is it possible to also include the Finkenstein total demand originally applied for with NamWater, to provide context to this statement?

NamWater Answer: Yes, the water supply scheme dedicated to supplying Finkenstein was sized for their projected peak water demand anticipated at that time over the planning horizon, i.e. 32 m³/h. The 2018 Water Supply Agreement volume is 13 487 m³/month.

WCE/Gondwana Response – Noted.

3. On page 11, it is noted that borehole WW36161 was previously earmarked to serve as an emergency groundwater supply for the Finkenstein Estate, but that the abstraction permit expired in 2019. We have the following questions regarding this:
 - a. Concerning the permit that expired, does this imply that the borehole is available to Gondwana to develop further with NamWater as a dedicated emergency supply to the Gondwana Lifestyle Estate?

NamWater Answer: The borehole is available to develop further, however (i) a valid abstraction permit is required, and (ii) the borehole would not be dedicated to supply Gondwana, but instead to augment the integrated scheme and relieve pressure from the Von Bach – Windhoek scheme during drought emergencies.

- b. Was the intention to connect the new borehole pump line directly into the existing pump line from the Finkenstein booster PS?

NamWater Answer: This pipeline is already connected to the existing Finkenstein pipeline, although the borehole is not installed.

WCE/Gondwana Response – This is noted. A solution that will be explored further during the design stages will be a joint capital development by Gondwana and Finkenstein to develop a say 3-borehole scheme and tie into both supply lines. In this way both customers have more security and the capital costs are shared. Technically possible, but will have to reach agreement between Finkenstein, Gondwana and NamWater.

c. Do you have more information on the pipeline already constructed – size, material, route.

NamWater Answer: During the NamWater and WCE site meeting, this pipeline appeared to be a ±Ø100mm HDPE pipeline that runs from WW36161 through the road culvert and towards the Finkenstein pipeline. Drawings might not be available.

NamWater BU Central might be able to provide additional information as this project was facilitated through the Business Unit. Please contact Mr. Stefanus Mukuya should he have any additional information.

WCE/Gondwana Response – Noted. We will contact Stefanus for more information on the pipeline. Perhaps some drawings.

d. Does Namwater have any suggestions or recommendations with respect to what percentage of AADD groundwater emergency supply should be developed/considered for?

NamWater Answer: NamWater does not have existing standards in this regard. Depending on confirmed available volumes, ideally 70-80% of AADD could be targeted as backup to improve water security in prolonged drought periods to meet basic water needs after water savings initiatives.

WCE/Gondwana Response – Noted thank you.

e. If Gondwana carries the capital cost to develop groundwater sources, is our understanding correct that these sources be dedicated to the Gondwana Development, and tied directly to the Gondwana supply infrastructure?

NamWater Answer: The groundwater sources can only be partially dedicated to Gondwana (allocated proportionally to demand and depending on the total available volume) and will serve to relieve pressure from the Von Bach – Windhoek scheme during emergencies. Accordingly, these backup sources should tie into the scheme where it is the most technically and financially feasible.

WCE/Gondwana Response – Noted.

NW: Background: In previous communication from NamWater to the Finkenstein Homeowners Association, it was clarified that, should there be no water in Von Bach, the Hoffnung boreholes will assist to supply all stakeholders in the area with the connection only to be paid for pro rata by all, and therefore no exclusive rights to anyone for use of these boreholes. In a clarification from NamWater to Finkenstein Homeowners Association on 14 March 2018, it was indicated that all beneficiaries of this back-up system may be approached to finance this development according to their water allocation.

WCE/Gondwana Response – Noted. It will definitely be worth speaking to Finkenstein then to establish joint contribution to the development of this borehole scheme as emergency backup to both estates, given their historical involvement on these boreholes specifically.

NW: Thus, NamWater expects Gondwana to equally develop additional boreholes for this drought hedging cause.

4. The report (page 18) mentions that when the VFO PS is upgraded to two operational pumps, additional NamPower fixed capacity charges and a security deposit will be required. Do we have an indication of what these charges may be and how will the charges be attributed to Gondwana? Will these charges be built into the unit rates for bulk water supplied, or are their upfront capital payments expected from Gondwana. This is important to understand for the financial modelling of the development.

NamWater Answer: Refer to NamWater M&E Engineering Team, Mr. Jaco Oosthuizen and Mr. Jan La Grange, and NamWater Finance, Mr. Naftal lindombo for the draft financial models discussion.

WCE/Gondwana Response – Noted. WCE will make contact with Jaco and Jan.

5. During the presentation, a question was raised on whether NamWater would consider groundwater as the primary bulk water source for the initial, short-term phases of the development, as opposed to only an emergency, back-up source. For example, would NamWater be open to an option where groundwater is the primary (and only) bulk water source for say the first 100 000 – 150 000 m³/a, and for demand beyond this, the supply infrastructure from Otjiase Reservoirs must be in place?

NamWater Answer: Given the previous and recent water stresses in the CAN, groundwater should be reserved and developed as an emergency source during drought.

WCE/Gondwana Response – Noted that groundwater cannot be the primary and only source.

NW: The background: A letter from the MAWLR (then MAWF) to NamWater stated that the three Hoffnung boreholes were drilled during the drought of 1996 for the purpose of abstraction to augment water supply to Windhoek. The Department of Water Affairs issued a water abstraction permit for borehole WW36161 situated on Farm Hoffnung to NamWater for the period 9 March 2017 to 8 March 2019 for a volume of 182 000 m³/a only with the purpose to improve water security to Finkenstein Development during water stress periods, i.e. when it can be reasonably argued that the 3-dam system should be relieved of the Finkenstein demand. Equally, CoW boreholes are used as a supplementary and emergency source.

WCE/Gondwana Response – Noted thank you.

6. Regarding the Phase 1 Development Proposal, we would like to clarify whether the intention is for NamWater to also take over the terminal reservoir/s at the Gondwana Estate? The report notes the size of this reservoir as 6000 m³, but the reservoir will most probably be phased with a smaller reservoir for Phase 1 and storage increased for later phases. Additionally, the developer is investigating an alternative water solution to one big, centralised reservoir, ie several smaller reservoirs distributed throughout the development. Your comments welcome.

NamWater Answer: NamWater usually does not prefer to take over ownership, operation and maintenance of a developer's infrastructure downstream of the bulk sales water meter that will be used

for billing. Hence, if the water meter will be upstream of the central reservoir, the reservoir management and maintenance will remain with the developer.

WCE/Gondwana Response – Noted thank you. These details will be worked through with NamWater during design stages.

NW: The phased and decentralized reservoir options can be considered provided that at least 48 hours of the AADD effective storage is always provided on site and developed with adequate lead times to prevent insufficient capacity.

WCE/Gondwana Response – Noted thank you.

NW: However, NamWater Civil, M&E and BU Central should review the designs and endorse the protocol accordingly.

WCE/Gondwana Response – Noted that final solution to bulk water on site to be reviewed and approved by NamWater Civil, M&E and BU.

7. It is our understanding that the upgrade of VFO PS to two operational pumps (220 m³/hr), including the upgrade of the Otjihase Reservoirs chlorination system, is only required by FY2030 (when the demand of Gondwana Estate has reached approximately 200 000 m³/a). We also understand that the demand required up to this time, can be supplied with the current 1 operational pump at VFO PS, but pumping for longer hours per day – given it currently pumps for only about 12 hours per day whereas the Von Bach Windhoek pumps pump for 20 on average. Is this understanding correct?

NamWater Answer: The understanding is correct; however it is important to remember that the above referred operating hours are based on recent average trends. As mentioned for other interventions, the upgrade needs to be completed before the safe operating limits are reached to ensure uninterrupted water supply. The upgraded capacity would also allow for quicker recovery of reservoir levels in the event of any prolonged interruption.

WCE/Gondwana Response – This is noted and recommended to then work in a safety buffer for water supply security, say, bring the upgrade of the VFO PS and Otjihase Chlorination System by the time the developments demand has reached 150 000 m³/a as opposed to the current estimated absolute max of 200 000 m³/a.

8. If the above is correct, can we propose that we split the Phase 1 Development Proposal into two sub-phases, say Phase 1-1 and 1-2:

Phase 1-1 (Required Immediately, except if groundwater as short-term primary source is an option – refer to paragraph 5 above):

- Construct a 750 m long above-ground steel pipeline from the Otjihase Reservoirs, parallel to the existing feeder pipeline to the booster pump station.
- Construct a new dedicated booster pump station to transfer potable water to Gondwana, 2 + 1 duty and standby configuration with a total capacity of 180 m³/h @ 140 mWH.
- Construct a new dedicated ±12 km long, Ø315 mm Class 16 (ID 277 mm) uPVC pipeline to the Gondwana Lifestyle Estate, and
- Construct Gondwana Terminal Reservoir/s.

Phase 1-2 (Required FY2030, or when demand reaches 200 000 m³/a):

- Upgrade VFO pump station to supply 220 m³/h (2 x operational pumps).
- Upgrade chlorination system at Otjihase reservoirs.

NamWater Answer: Yes, as long as the response on No. 7 above is accepted.

WCE/Gondwana Response – Accepted yes.

9. We agree that Phase 2 – Option 3 is the best, sustainable solution, and it seems that it will also be the lowest capital cost contribution attributable to Gondwana. However, we would like to request clarity on the following:
- As mentioned earlier, we expect the final demand for the Estate to be about 20% lower than the original provided demand figures. Will the capital contribution by Gondwana for this option be adjusted accordingly based on the final demand?

NamWater Answer: Yes, the capital contribution will be adjusted accordingly based on the volume confirmed in formal agreements prior to the development where the financial models are clearly stated.

WCE/Gondwana Response – Noted thank you.

- For this option we would like to gain clarity on the payment mechanism for the capital attributable to Gondwana – will an upfront capital payment be expected (as in partially paying for the construction works during implementation of the project), or will the capital attributable to Gondwana be recovered in the selling unit rates?

NamWater Answer: As mentioned in the Report, per NamWater's standard policy for commercial customers, capital costs for water supply infrastructure will not be embedded in the final water tariff due to the financial risks associated with commercial entities/ large development projects. Upon completion, the infrastructure (excluding onsite facilities at the development) will be transferred to NamWater for operation and maintenance, with the customer being charged a lower tariff that excludes capital redemption costs.

WCE/Gondwana Response – Noted thank you.

10. With respect to the incremental unit costs estimations provided on page 35, we would like to understand how this works exactly, is this the rates at which water will be sold to Gondwana, or are they the additional cost, ie to be added to the current cited cost at Otjihase of N\$18.13/m³. Please provide a sample estimate of what the unit cost of water at Gondwana could be when Phase 1 is implemented and when Phase 2 – Option 3 is implemented.

NamWater Answer: The unit costs in the Report are incremental. The final cost for supply to Gondwana for the respective phases will be determined by NW Finance. Kindly refer to Mr. Naftal lindombo for sample tariffs.

WCE/Gondwana Response – Noted. WCE will request Naftal for sample tariffs.

11. Page 39 mentions the infrastructure (excluding onsite facilities) will be transferred to NamWater for operation and maintenance. Are the terminal reservoir/s at the estate regarded as onsite facilities or is the intention for NamWater to also take over their operation and maintenance?

NamWater Answer: Refer to no. 6.

WCE/Gondwana Response – Noted thank you.

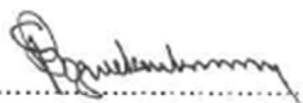
12. We would also like to understand the billing arrangements. Will NamWater directly bill Gondwana Lifestyle Estate by metering the new/proposed Gondwana booster pump installation at Otjihase Mine (if so, then Gondwana can bill their individual residents/users from erf meters?) Will this be a monthly billing from actual meter readings or prepaid water billing?

NamWater Answer: Billing will be done at the bulk sales water meter and based on actual meter readings. NamWater Civil, M&E and BU Central should review the proposed metering location and designs and endorse the protocol accordingly. Thereafter, NamWater Finance will come up with the tariff model.

WCE/Gondwana Response – Noted thank you. Once design stages are entered into, we will engage NamWater on metering protocol early on for their input.

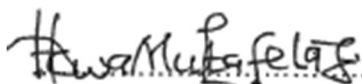
12 Approval

This Situation Assessment Report is submitted to Gondwana Collections as a deliverable in response to the Bulk Water Application.



Manager: Infrastructure Planning

Date: 18/09/2025



Head: Planning & Water Resources Management

Date: 18/09/2025



Chief: Scientific Services

Date: 19/08/2025