April 2016

Nelson Mandela Bay Municipality

Seaview Bulk Water Supply

Design Report Rev 4

NELSON MANDELA BAY MUNICIPALITY
SEAVIEW BULK WATER SUPPLY
DESIGN REPORT

BOSCH STEMELE Nº: 8003/011	**DATE:** April 2016	**REPORT STATUS:** DRAFT

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SYNOPSIS:
Seaview Bulk Water Supply – Design Report

FUNCTION:
Water Engineering

QUALITY VERIFICATION

This report has been prepared under the control of the Bosch Stemele Quality Management System which meets the requirements of ISO 9001:2008 as independently certified by international auditors.

Verification	Capacity	Name	Signature	Date
By Author	Project Manager	R Bode		
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CONTENTS

NELSON MANDELA BAY MUNICIPALITY

SEAVIEW BULK WATER SUPPLY

DESIGN REPORT

1. INTRODUCTION

Bosch Stemele was appointed by Nelson Mandela Bay Municipality to investigate and supply the Municipality with a Design Report on the Seaview Bulk Water Supply. Refer to drawing 8003/011/002 indicating the Seaview and Greenbushes supply areas.

The Seaview Supply Area is 15 km west of Port Elizabeth and south of the study area. The land is sloping down to the sea and incorporates Seaveiw, Beachveiw, Clarendon Marine, Kini Bay and Maitlands. The area is 2459 ha in extent and the elevation ranges from 270 mamsl down to sea level. This area is divided into 6 Zones due to the topography in the area. Refer to drawing 8003/011/003 indicating the supply zones.

The Greenbushes Supply Area situated north of the Seaview Supply Area is bounded by the Island State Forest in the south, This area incorporates Bridgemead, Chade Manor, Murray Park, Rowallan Park, Hunja Heath, Parsons Green, Masakhane, Greenbushes, Ericadene, Progress, Hunters Retreat, Kuyga, Denholm, Colleen Glen, Lavendula, Crockarts, Dustpan, Westlands, Butterfield and Altona. The area is 14488 ha in extent and the elevation ranges from 265 mamsl down to 180 mamsl. This area is divided into 3 Zones due to the elevation and extent of the terrain. Refer to drawing 8003/011/003 indicating the supply zones.

The existing potable water supply is supplied into the Seaview supply area from the Churchill and Elandsjagt WTW via a 675mm ø steel pipeline and 1075mm ø pre-stressed concrete Socomon pipeline. Connections from these pipelines to storage reservoirs provide the area with a water supply. Refer to drawing 8003/011/004.

A connection to the Seaview reservoir and pump station delivers the potable water into two rising mains, 610ø steel and 450ø C.I., which pump the water to the 24,95 Ml Greenbushes Reservoir 4,45 km north of the Seaview pump station. The Greenbushes Reservoir supplies under gravity to the Greenbushes supply area. Refer to drawing 8003/011/005.

The Design Report for the Seaview Bulk Water addresses the future provision of potable water to the Urban, Coastal, Peri-urban and Rural zones. A design horizon for 2010, 2020 and ultimate design has been considered.

The ultimate design would require the provision of bulk water infrastructure to 33677 erven within the Seaview and Greenbushes Supply Area, made up as follows;

- Urban zone – 24465 erven (73%)
- Coastal zone – 3551erven (10%)
- Peri-urban zone – 5661erven (17%)

The 2015 horizon would require the provision of bulk water infrastructure to 8020 erven within the supply area made up as follows;

- Urban zone – 6106 erven (76%)
- Coastal zone – 1024 erven (13%)
- Peri-urban zone – 890 erven (11%)

The 2025 horizon would require the provision of bulk water infrastructure to 12691 erven within the supply area made up as follows;

- Urban zone – 10440 erven (82%)
- Coastal zone – 1269 erven (10%)
- Peri-urban zone – 982 erven (8%)

The proposed bulk water infrastructure for the 2015 design horizon has been based on proposed developments currently at planning stage, while the design horizon for 2025 and the ultimate design has been assumed based on the current growth trends.

The proposed bulk water infrastructure required for the various design horizons with cost is detailed below;

2016

- 2.5Mℓ Clear water reservoir (Seaview Pump Station Complex)
- Pump station (Seaview Pump Station Complex)
- 315mmø Rising main (from Seaview Pump Station Complex and Upper Seaview)
- 2.5Mℓ Clear water reservoir (Upper Seaview Area - East)
- 350mm ø, 315mm ø, 250mm ø & 200mm ø Gravity mains (from Upper seaview to Supply Zones)
- Bulk gravity connections to Reticulation within the supply zones (315mm, 250mm, 200mm &160mm ø)
- 700mm ø gravity mains (Greenbushes Reservoir to Chelsea Reservoir)

The total cost for the above proposed bulk water infrastructure is R 75, 277, 000

2025

- 1.0Mℓ Clear water reservoir (Upper Seaview Area - East)
- Pump station (Greenbushes Reservoir Area)
- 90mmø rising main (Greenbushes Reservoir Area)
- 55kℓ Elevated reservoir (Greenbushes Reservoir Area)
- 7.0Mℓ clear water reservoir (Greenbushes Reservoir Area)
- 1.0Mℓ clear water reservoir (Lake Farm Road Reservoir)
- 350mm ø & 250mm ø gravity supply mains (Greenbushes Area)
- Bulk gravity connections to Reticulation within the supply zones (315mm, 250mm, 200mm &160mm ø)

The total cost for the above proposed bulk water infrastructure is R 63, 215, 000

Ultimate

- 0.35Mℓ Clear water reservoir (Upper Seaview Area - West)
- Augmentation of existing pump station (Seaview Pump Station Complex)
- 100mmø and 90mmø rising main (Upper Seaview Area - West)
- 1.0Mℓ Clear water reservoir (Upper Seaview Area - East)
- 7.0Mℓ Clear water reservoir (Greenbushes Reservoir Area)
- 1.0Mℓ Clear water reservoir (Lake Farm Road Reservoir)
- Bulk gravity connections to Reticulation within the supply zones (315mm, 250mm, 200mm &160mm ø)

The total cost for the above proposed bulk water infrastructure is R 124,660, 000

2. INTRODUCTION

2.1 BACKGROUND

The Nelson Mandela Bay Municipality (NMBM) is located within the Sarah Baartman District Municipality of the Eastern Cape. The project is located in the South Western corner of the NMBM area and is concentrated around the existing Seaview pump station and Greenbushes reservoir.

Refer to the locality map, Drawing No. 8003/011/001, which shows the project area.

The Nelson Mandela Bay Municipality (NMBM) is deemed to be the Water Service Authority (WSA) and incorporates the management structure of the old Port Elizabeth Municipality, Uitenhage and Despatch.

The Seaview and Greenbushes supply zone is an area some 15 km west of Port Elizabeth. Refer to 8003/011/002.

Although mainly agricultural, there are some low density high income townships scattered throughout the zone with the main concentration along the coastline. In addition, some low income high density townships have been planned with a number of agricultural layouts comprising erven averaging about 3 ha in size scattered throughout the zone.

The areas being served by the Seaview Bulk Water Supply include:

- Seaview, Clarendon Marine and Kini Bay formal township, and
- The following proposed developments are at planning stage namely; Seaview low cost housing scheme, Blackrock Coastal Estate, Stu Davidson Development and Portion 8 Farm 28 Seaview.

The areas being served by the Greenbushes Bulk Water Supply include:

- Bridgemead, Chade Manor, Murray Park, Rowallan Park, Hunja Heath, Parsons Green, Masakhane, Greenbushes, Ericadene, Progress, Hunters Retreat, Kuyga, Denholm, Colleen Glen, Lavendula, Crockarts, Dustpan, Westlands, Butterfield and Altona.

Allowance for future expansion of these townships has been allowed for and will be clarified in the body of this report.

2.2 SOURCE OF INFORMATION

The sources of information used to compile this report are summarised below:

- Guidelines for Human Settlement Planning and Design
- Nelson Mandela Bay Municipality – Water Distribution
- Bulk Water Planning Report – Bosch Stemele (June 2005)
- Water Master Plan: June 2006 and January 2012
- NMBM Spatial Development Framework Plan
- Rural Management Plan
- NMBM – Infrastructure and Engineering Business Unit
- Various Consulting Engineering Companies
- Town Planners

2.3 TERMS OF REFERENCE

In a letter dated 28 September 2004, Nelson Mandela Bay Municipality appointed Bosch Stemele to investigate and supply the Municipality with a report on the Seaview Bulk Water Supply.

The brief included.

- To investigate capacity of existing water infrastructure within the zone,
- Determine the demand for the zone ,
- Determine the demand for the Seaview Nodal Development (liaise with Housing and Land Business Unit on the number of erven),
- Design the necessary water infrastructure i.e. water mains, pump stations and adequate water service reservoirs required for the supply zone,
- Prepare contract documentation and construction drawings,
- Tender enquiry and adjudication,
- Contract administration, and
- Liaise with Afri-Coast Engineers so that the demand projections can be included in the Metro's Master Plan

Approval has subsequently been given for Phase 1 which is detailed further in this report.

2.4 CLIENT REQUIREMENTS

The objectives of this could be defined as:

- Eliminate individual supplies off of existing rising mains and bulk supply mains,
- Improve supply zone delineation,
- Provide adequate storage for each supply zone, and
- Eliminate existing brick and steel water retaining structures,
- The pump station should operate unmanned and is to be linked to the existing telemetry system.

The following technical/Client specific standards have been identified:

- KSB centrifugal pumps are preferred,
- The rising main should be uPVC,
- All isolating valves are to be TTV or equivalent with gearbox,
- The new level control valve is to be Baker (match existing),
- Pipe coatings should be Rilsan,
- The new pump station should maintain the same aesthetic appeal as the existing,
- The pump station layout is to be based on the successful layout of the existing Chelsea station,

The original scope of Phase 1 (Seaview Supply Zone) and Phase 1 (Greenbushes Supply Zone) as defined in the Bosch Stemele Report titled “Bulk Water Planning Report” revised in June 2005. The various sub-zones are depicted on drawing 8003/011/003 for Seaview and Greenbushes. This area is divided into 6 Zones for Seaview and 3 Zones for Greenbushes due to the elevation and extent of the terrain.

2.4.1 Unresolved requirements/client specific issues to be defined

- Telemetry requirements,
- Operational regime of existing pump station,
- Exact tie in point for zone supplies.

2.4.2 Exclusions

- Any upgrade required to the bulk electrical supply,
- Application for way leaves and formalisation of servitudes.

2.5 DESIGN REPORT OBJECTIVES

This Design Report sets out the requirements of all parties for the Driftsands Collector Sewer Augmentation and defines the proposals which have been developed to meet these requirements. Any subjective issues or alternatives have been discussed with the Client and the basis of the decision has been set out.

The objective of the Design Report is to also define the scope requirements and content of the project for the Design Team. It confirms the scope, content of the project and Client requirements, by providing a record of the basis on which planning and subjective decisions were made.

The following Design Report revisions have been issued, with the amendments as stated,

2.5.1 REVISION 1 – NOVEMBER 2007

This was the original Design Report that was submitted

2.5.2 REVISION 2 – NOVEMBER 2008

The following changes/additions were included in this revision:

- Gravity Main from Greenbushes' reservoir to Chelsea reservoir,
- Upper Seaview reservoir 160mamsl, and
- Gravity pipeline to Beachview.

2.5.3 REVISION 3 – MARCH 2009

The following changes were included in this revision:

- Upper Seaview reservoir increased in size, and
- Upsizing of gravity pipelines

2.5.4 THE REVISION 4 – THIS REPORT, APRIL 2016

The following changes were included in this revision:

- Requirements from the Water Master Plan,
- Seaview Pump Station complex amendments, and
- Gravity pipeline to Kini Bay.

2.6 STATUTORY AND THIRD PARTY REQUIREMENTS

2.6.1 Soil Resistivity Survey

A Soil Resistivity survey will be conducted once it has been agreed that a steel pipe is the preferred option. A basic assessment was completed in March 2010.

2.6.2 Wayleaves

The following wayleaves have been obtained:

Sanral – Approval and requirements for crossing the N2 received in Jan 2009
Telkom – Approval and existing services issued to SBA November 2008
Munilek – Existing services issued to SBA January 2009

Once the project is to be implemented notification will be forwarded to the above parties for approval.

2.6.3 Land Evaluations

The information relating to the servitudes required for the pipelines and reservoir were forwarded to Mr D Welgemoed of NMBM.

Majola & Boyd were appointed by NMBM to proceed with the land evaluations in September 2009 and the Land Evaluations were completed in March 2010.

At a meeting on the 08 July 2015, it was agreed that NMBM, Mr D Welgemoed should now proceed with acquiring registration for the servitudes and to liaise with landowners which run along the route of the water main and reservoir area.

2.6.4 Environmental Requirements

In terms of the National Environmental Management Act (NEMA Act No 107 of 1998) Environmental Impact Assessment (EIA) regulations promulgated in July 2006, the proposed work includes a listed activity in terms of GNR 386 therefore a Basic Assessment application as described in GNR 385 needs to be submitted to the Department of Economic Development and Environmental Affairs (DEDEA) for authorisation prior to the proposed works taking place.

SRK were appointed by NMBM to proceed with the Basic Assessment Process for the Seaview Bulk Water Supply Project and reports submitted to DEDEA for approval.

Environmental Management Plan (EMP) was completed on the 25 September 2009

DEDEA issued the Environmental Authorisation (RoD) for this project on the 5 August 2009 authorising the Seaview Bulk Water Supply Projects. This was extended to 30 July 2011 and has since lapsed.

DEDEA indicated that as the Environmental Authorisations has lapsed and cannot be extended the applicant, NMBM, will have to submit a new application for authorisation in terms of the 2014 EIA Regulations in the event that the applicant wishes to continue with the project. In this regard it would have to be determined which listed activities in the 2014 EIA Regulations will be triggered by the proposed project and the appropriate environmental assessment process followed as provided for in the 2014 EIA Regulations.

SRK has been appointed by NMBM in June 2015 to proceed with the re-submission in terms of the 2014 EIA Regulations for the Environmental Authorization.

2.7 SITE INFORMATION

A detailed geological investigation has been conducted to ascertain the envisaged ground conditions. Refer to Annexure "A" for the results of the geological investigation.

3. EXISTING INFRASTRUCTURE

3.1 RAW WATER SOURCE

3.1.1 Churchill / Elandsjagt Sub-system

The 1 in 50 year yield for Impofu Dam is 65 Mℓ/day and Churchill Dam 56.6 Mℓ/day (combined yield 121.6 Mℓ/day).

3.1.2 Kouga / Loerie Sub-system

In order to bring the overall use from the Kouga Dam in line with the yield of this supply source the 100 Mℓ/day allocation to NMBM from the Kouga Water Scheme was reduced by DWAF in 1992 to 62.2 Mℓ/day.

3.2 TREATMENT WORKS

3.2.1 Churchill / Elandsjagt Sub-system

The Churchill and Elandsjagt WTW's were designed for a hydraulic capacity of 100 and 105 Mℓ/day respectively.

3.2.2 Kouga / Loerie Sub-system

The Loerie WTW's was designed for a hydraulic capacity of 100 Mℓ/day.

3.3 BALANCING STORAGE

3.3.1 Churchill / Elandsjagt Sub-system

The two tunnels directly downstream of Churchill WTW offers 0.5 Mℓ balancing storage, whereas the final water balancing reservoir at Elandsjagt WTW has a capacity of 27 Mℓ.

3.4 TRANSFER CAPACITY

3.4.1 Churchill / Elandsjagt Sub-system

The balancing reservoir at Elandsjagt with TWL 146m mamsl, is some 12-15m higher than the hydraulic gradient of the dual Churchill pipelines at the confluence point of the two WTW pipelines. This results in outlet control from Elandsjagt reservoir which wastes available head.

The Churchill booster pump station transfers Churchill water into the Elandsjagt reservoir which results in an increase at the WTW supply end.

A maximum of 143 Mℓ/day passed through the Gamtoos Booster Pump Station at some point.

3.4.2 Kouga / Loerie Sub-system

The Loerie sub-system is designed for a transfer capacity 100 Mℓ/day.

3.5 BULK SUPPLY PIPELINES

(Refer to drawing 8003/011/004 & 005)

3.5.1 Churchill / Elandsjagt Sub-system

Water is transferred some 117km via a pair of potable water pipelines. The first pipeline consists of 760mm ø and 675mm ø steel piping with spigot and socket joints. The second pipeline consists of 1300mm ø, 1150 mm ø and 1075mm ø pre-stressed concrete Socomon pipelines which originate from the Churchill Water Treatment Works at Churchill Dam and the Elandsjagt Water Treatment Works at Impofu Dam and traverses east / west through the zone some 3 km and less from the coastline.

The water is drawn from a pair of potable water pipelines, 675mm ø and 1075mm ø below the Seaview pump station.

3.5.2 Kouga / Loerie Sub-system

Water is pumped 4.9 km from the Loerie Treatment Works to the Summit Reservoir via a 1065mm ø pipe. From the Summit reservoir a 5km gravity supply pipeline 750mm ø and 1050mm ø transfers potable water to the Churchill pipeline. A 1136mm ø gravity main transfers potable water 34.7km from the Summit Reservoir to Chelsea Reservoir.

3.6 SOURCE

The water is drawn from a pair of potable water pipelines, (675ø and 1075ø), which originate from the Churchill Water Treatment Works at Churchill Dam and the Elandsjagt Water Treatment Works at Impofu Dam and traverse east / west through the zone some 3 km and less from the coastline.

3.7 COASTAL STRIP

The water is supplied into the coastal strip as follows:

- For Beachview via a short 100mmø pipeline to the 750kℓ Beachview Reservoir,
- For Kini Bay via a short 75mmø pipeline to the 700kℓ Kini Bay Reservoir,
- For Clarendon Marine via a connection to the 3 No Brick Lower Seaview Reservoirs 750kℓ off the gravity main supplying the Seaview pump station, and
- For Seaview via a connection to the 120kℓ Upper Seaview steel Reservoir off the existing Seaview rising mains pumping to Greenbushes/ Chelsea.

3.8 SEAVIEW PUMP STATION AND GREENBUSHES RESERVOIR

3.8.1 Seaview Pump Station

The Seaview pump station is the major pump station for the inland areas. Two connecting pipelines from the Churchill supply mains, 610ø steel and 450ø C.I., discharge into a 1 200 kl balancing reservoir which serves as a sump for the pumps.

The pump station consists of four large (460kW) and four small (205 kW) pump sets delivering into two rising mains cross-connected immediately outside the pump station. The rising mains, 610ø steel and 450ø C.I., deliver potable water to the 24,95 Ml Greenbushes Reservoir 4,45 km north of the Seaview pump station. A bypass link, which is normally closed, has been installed at the Greenbushes Reservoir and is utilised to deliver directly to Chelsea Reservoir bypassing the Greenbushes Reservoir. In pumping water through into the Greenbushes / Chelsea pipelines higher flow rates are achieved during periods of high demand.

3.8.2 Performance of the Pumps at Seaview Pump Station

There are eight pumps in this pumpstation all pumping to Greenbushes Reservoir via a common rising main consisting of two pipelines, a 610ø cement lined steel and a 450ø C.I line. Four pumps are Harland units and the other four are Salsa Weir units, smaller in size. The operator selects appropriate combinations of pumps to deliver the required flow.

Due to the age of the pumps it was considered necessary to test the delivery of the units and combinations of units and thus to check the water consumption of the area served. This has been done and is being reported on separately.

This investigation uses the data collected to comment on the state of the pumps. The pressure gauges gave erratic readings and unfortunately are not accurate enough for wholly reliable results. Note that the pressure gauges are connected to the respective pump delivery pipes and that the positive suction pressure of about three metres should slightly more than compensate for friction and minor losses between the sump and the pressure gauge points. It is considered that these factors can be ignored.

Salsa Weir Pumps: The Salweir pumps are numbered 1 to 4. We do not have the original specification or performance curve. The tests on the pumps gave the following:

Pump No 1: Pressure	1840kPa	187.9m Flow	64.3 l/s
Pump No 2: Pressure	1850kPa	189.0m Flow	70.9 l/s
Pump No 3: Pressure	1950kPa	199.2m Flow	70.9 l/s
Pump No 4: Pressure	1900kPa	194.1m Flow	68.7 l/s

Pump No 1 is obviously in a worse condition than the other three. The pressure gauges show different pressures for the same flow indicating inaccurate instruments.

Harland Pumps: The Harland pumps are numbered 5 to 8. The original performance curve, converted to metric units, called for a flow of 155.3 l/s to a head of 208.8m or 2044 kPa. The tests on the pumps gave the following:

Pump No 5: Pressure 1820kPa 185.9m Flow 156.1 l/s
Pump No 6: Out of commission
Pump No 7: Out of commission
Pump No 8: Pressure 1420kPa 145.0m Flow 170.0 l/s

Pump No 5 gives the specified flow but at a pressure 11% below specification, if the pressure gauge is correct. Comparison with the other gauges indicates that it is under-reading. The Pump No 8 pressure gauge is obviously very wrong but if the pressure of the other gauges is accepted, it plots on the characteristic curve. Our conclusion is that Pump No 5 has deteriorated but Pump No 8 is still pumping according to the original specification. Pumps 6 and 7 could not be tested being out of commission.

Pipelines: The static head between the Seaview sump and the Greenbushes reservoir is 183m. The greatest flow achieved was with pumps Nºs 3, 4, 5 & 8 – 434.5 l/s – but no pressure gauge reading was recorded. With pumps Nºs 2, 3, 4 & 5 the flow amounted to 359 l/s and the highest reading of the four pressure gauges was 2000kPa or 204.3m head.

When the other two Harland pumps become available there should be no problem in pumping the maximum required to Greenbushes Reservoir, 315 l/s, plus the required emergency flow to Chelsea Reservoir, 174 l/s, a total of 489 l/s.

Regarding pipe loss calculations it seems that our original loss calculation, 13m at 470 l/s, is of the right order but without better pressure gauge readings we cannot be more precise.

3.8.3 Greenbushes Reservoir

The Greenbushes Reservoir supplies under gravity a large part of the Greenbushes supply area on both sides of the N2 as far inland as the Greenbushes rural area and the Kuyga and Masakhane high density low income townships.

3.9 SUPPLY TO CHELSEA RESERVOIR

The Chelsea Reservoir is supplied with water from two sources, namely:

- The Loerie Water Treatment Works via the Summit pipeline, and
- 525ø embedded steel and 375ø AC pipelines from Greenbushes Reservoir.

3.9.1 Greenbushes Reservoir to Chelsea Reservoir Pipeline

The 525ø embedded steel cylinder pipeline from Greenbushes is a dedicated standby supply to Chelsea whereas the 375ø AC pipeline provides for a 450ø steel tee off to Chelsea Reservoir (normally isolated). The 375ø AC pipeline continues through to Cape Road where after it turns and heads east to the Linton Treatment Works. The pipeline is not continuous all the way through the Linton Works and is divided by a zone valve in the Bridgemead area.

3.9.2 Summit Reservoir to Chelsea Reservoir Pipeline

The Summit Reservoir to Chelsea Reservoir pipeline is a 1136ø prestressed concrete pipeline supplying water from the Loerie system into the Chelsea Reservoir. This system was not considered further in the investigation.

3.10 CHELSEA / MOTHERWELL PIPELINES

The 90 Ml Chelsea Reservoir supplies into two 750ø steel lines changing into a 750ø steel and a 900ø line running north-easterly toward Booysens Park, outside the study area. This system does not serve the Seaview zone and hence falls outside the scope of this investigation.

A component of the brief was, however, to make provision in the Seaview / Greenbushes pumped scheme for a 50 Ml/d emergency supply to serve as backup for the Loerie supply via Summit. This was subsequently changed to 45 Ml/d and the Bulk Planning Report was issued on this basis. Subsequently the emergency supply to Chelsea Reservoir was further reduced to 15 Ml/d. This has necessitated re-planning and this revised report is based on this flow.

The capacity of the Chelsea Reservoir and pipelines were not considered further.

3.11 INTERIM CONVEYANCE OF 45Mℓ/D EMERGENCY FLOW

The proposed cross connection of the Churchill pipelines to the Summit line, which will reduce the emergency flow requirement at Seaview from 45Ml/d to 15Ml/d, is currently being commissioned.

4. DESIGN CRITERIA

4.1 WATER SUPPLY

4.1.1 Adopted Design philosophy

The Design Criteria for water demands have been based on the data provided by the Nelson Mandela Bay Municipality – Water Distribution.

These guidelines have been used as a basis for sizing the theoretical capacity for the various elements under consideration.

4.1.2 Abbreviations and Losses

ADD	= Annual Daily Demand	≈ (Population x ℓ/capita/day)
GADD	= Gross Annual Daily Demand	≈ (ADD x losses)
SPDD	= Summer Peak Daily Demand	≈ (ADD x SPF)
ADD	= Annual Daily Demand	≈ ℓ/capita/day
GADD	= Gross Annual Daily Demand	≈ Lf x Ld x ADD
SDD_{pl}	= Summer Daily Demand (pipe lines)	≈ SPF x GADD
SDD_{plu}	= Summer Daily Demand (borehole pumps)	≈ SPF x GADD
SDD_{ww}	= Summer Daily Demand (water works)	≈ SPF x GADD
SPF	= Summer Peak Factor	≈ 1,2 – 1,5
RPF	= Reticulation Peak Factor	≈ 2,0
Lf_r	= Conveyance / Reticulation Losses (15%)	≈ 1,15
Lf_w	= Water Treatment Plant Use (10%)	≈ 1,1
Ld	= Down time (10%)	≈ 1,1
Lo	= Allowance for other uses (10%)	≈ 1,1

4.1.3 Design Parameters

Bulk Water Supply

Maximum design pressure	-	250m head
Minimum design pressure	-	30m
Maximum pipe velocity	-	2,0 m/s
Minimum storage requirement	-	48 hours of average day
Fire flow	-	No allowance is made

Distribution (Urban)

Minimum storage requirement	-	48 hours of average day

Downstream of Storage:

Peak factor supply mains PF_{sm}	-	3,5 (medium and high income zones > 1500 erven)
Peak factor for PHB (PF_{phb})	-	2,5

Fire flow for PHB	-	only on ring main
Maximum design pressure	-	90m head
Minimum design pressure	-	30m head
Maximum pipe velocity	-	1,5 m/s
Minimum pipe velocity	-	0,6 m/s

Upstream of Storage:

Average day peak week (ADPW)	-	1,6 x ADD (high income areas)
Ave. day peak week for PHB ($ADPW_{phb}$)	-	1,4 x ADD (middle-lower income)
Maximum pipe velocity (gravity mains)	-	1,5 m/s
Maximum pipe velocity (rising mains)	-	1,2 m/s
Minimum pipe velocity	-	0,6 m/s
Fire flow	-	No fire flow allowance

Distribution (Rural / Peri-Urban)

ADD_{pu} high income areas	-	1000 ℓ/Ha/day
ADD_{pu} medium / low income areas	-	500 ℓ/Ha/day
Peak factor (Pf)	-	2,0
Minimum sub-divided area	-	1,8 Ha
Maximum design pressure	-	90m head
Minimum design pressure	-	30m head
Fire flow-	-	Nil - (hydrants installed on occasion for operational purposes)
Maximum pipe velocity	-	1,8 m/s
Minimum pipe velocity	-	0,6 m/s
Minimum storage	-	48 hours of average day

4.1.4 Pump Station

The pump station is to be designed using the following formula:

Rate of flow (l/s) = ADD / (24 x 3,6) x 1,4 or 1,6 x Lo x Lfr x Ld

4.1.5 Pumping Mains

The pumping main is to be designed using the following formula:

Rate of flow (l/s) = ADD / (24 x 3,6) x 1,4 or 1,6 x Lo x Lfr x Ld

4.1.6 Gravity Bulk Supply Pipelines

The gravity main is to be designed using the following formula:

Rate of flow (l/s) = ADD / (24 x 3,6) x Lo x PF_{retic} x Lfr

4.1.7 Service Reservoirs

The reservoirs are to be designed using the following criteria:

Capacity (kℓ) = 48hrs x ADD for pumped schemes

= 24hrs x ADD for gravity schemes

4.1.8 Power Requirements for Pump

Motors > 25kW: Add 10%

Motors < 25kW: Add 25%

4.1.9 Pump Standby Capacity

100% standby capacity for single pumps

33% minimum standby acceptable for larger pump sets

4.2 SUPPLY ZONES

The Seaview and Greenbushes Supply Area have been divided into 9 distinct supply zones depicted on drawing 8003/011/003.

5. TOWN PLANNING CONSIDERATIONS

5.1 PRESENT SITUATION

The study area as defined on drawing 8003/011/002 covers an area of approximately 16 947ha of which 2714ha falls within the Seaview supply area and 14233ha falls within the Greenbushes supply area.

To-date the development within the study area has been sporadic with limited formal town planning prepared for the region. The lack of a sustainable bulk water supply for the region has also hampered further development prospects.

The present developmental trend for the study area has been to concentrate low density high income housing within a 1 km band along the coastal zone with the medium and low income high density housing developments being positioned in the north eastern quadrant of the study area. The balance of the study area is either protected areas, fallow land or is being used for agriculture.

5.1.1 Urban Zone

The Urban Zone are areas with an increased density of human-created structures in comparison to the areas surrounding it. Urban areas are demarcated by the urban edge. The urban edge is defined on drawing 8003/011/006.

5.1.2 Peri-Urban Zone (P1 and P2)

Under this classification, reference is made to localities suitable for future development. This implies that the areas are located in close proximity to urban areas of opportunity. Refer to drawing 8003/011/007.

5.1.3 Rural Zone (R1 and R2)

The area forming the Rural Zone is located on the periphery of the Metropolitan Area. Refer to drawing 8003/011/007.

5.1.4 Coastal Zone

These are areas with their own unique character with low density residential development. Refer to drawing 8003/011/007.

5.1.5 Critical Biodiversity Zone (C1 and C2)

These areas are characterised by highly sensitive ecological areas and are a valuable non-renewable resource in the metropolitan area. It does not only include isolated sensitive areas, such as then coastline or red data sites, but also the ridge systems, waterway systems and ecologically sensitive areas. Refer to layout 8003/01/007.

5.2 LAND-USE

Table – 1 Reflects the current land-use areas within the supply areas.

SUPPLY AREA	AREA (ha)	Urban Zone (ha)	Peri-Urban Zone - P1 (ha)	Peri-Urban Zone - P2 (ha)	Coastal Villages Zone (ha)	Critical Biodiversity Zone (ha)
Seaview	2459	20	0	589	693	1156
Greenbushes	14488	2321	5365	1449	0	5243
	16947	2341	5365	2038	693	6399

5.3 RATE OF DEVELOPMENT

5.3.1 Introduction

The rural areas in and around the Nelson Mandela Bay Municipality are pressurised by urban sprawl, receding rural landscapes, the disruption of ecological systems, ad hoc applications for subdivision and rezoning, the inclusion of urban activities into the rural environment, the pressure to provide adequate engineering infrastructure to the developing area and the absence of a land use management policy or guideline to manage the rural land development.

In 2006, the NMBM initiated a Rural Development Policy to guide and manage development specifically in the rural area of the Metro. The Rural Development Policy forms an important part of the overall review of the NMBM urban edge.

5.3.2 Objective

The Rural Development Policy aims to guide rural development towards the most appropriate places within the Metro area and to maximise the optimal use of existing infrastructure and re-development to be considered preferable to most green field development. These areas will contribute significantly to the reconstruction of the city by permitting growth in areas located well in terms of the environment, employment opportunities and the infrastructure.

5.3.3 Development Trends

In the absence of a formal town planning scheme and to facilitate the forecasting it is assumed that as indicated in the Rural Development Policy the densification for these zones would consist of the following:

Urban

Taking into consideration the existing trends, 10 dwelling units per hectare is assumed.

Peri-Urban (P1)

2 dwelling units per 1.8 hectare. This equates to 0.9 du/ha.

Peri-Urban (P2)

2 dwelling units per 5 hectare. This equates to 0.4 du/ha.

Coastal

5 dwelling units per hectare.

Rural (R1)

2 dwelling units per 10 hectare. This equates to 0.2 du/ha.

Rural (R2)

2 dwelling units per 20 hectare. This equates to 0.1 du/ha.

Critical Biodiversity (C1 and C2)

0 dwelling units per hectare.

6. POPULATION

6.1 EXISTING DEVELOPMENTS

6.1.1 Seaview Area

Currently the existing developments within the Seaview Supply Area are limited to the coast line. All the areas consist of low density high income developments. Refer to layout 8003/011/006 & 007 which reflects the developments within the urban edge.

Table – 2 Reflects the existing townships within the Seaview Supply Area.

SUPPLY AREA	COMMUNITY	AREA (ha)	Nº OF ERVEN	RESIDENTIAL DENSITY (erven/ha)
Urban Zone	Housing Development	19.8	550.0	27.8
Seaview Coastal Zone	Beachview	54.7	253.0	4.6
	Seaview	74.2	494.0	6.7
	Clarendon Marine	29.6	133.0	4.5
	Kini Bay	19.4	95.0	4.9
		197.7	1525.0	

6.1.2 Greenbushes Area

Currently the existing developments within the Greenbushes Supply Area are limited to the Cape Road area. All these areas consist of high and medium density developments. Refer to layout 8003/011/006 & 007 which reflects the developments within the urban edge.

Table – 3 Reflects the existing townships within the Greenbushes Supply Area.

SUPPLY ZONE	COMMUNITY	AREA (ha)	Nº OF ERVEN	RESIDENTIAL DENSITY (erven/ha)
Urban Zone	Bridgemead	92.0	591.0	6.42
	Chade Manor	44.6	705.0	15.81
	Lavendula	2.6	50.0	19.23
	Rowallan Park	100.0	702.0	7.02
	Hunja Heath	3.4	56.0	16.47
	Parsons Green	20.1	142.0	7.06
	Masakhane	110.7	1739.0	15.71
	Greenbushes	308.5	101.0	0.33
	Ericadene	118.4	38.0	0.32
Peri-urban Zone (P1)	Denholm	33.0	17.0	0.52
	Colleen Glen	270.0	115.0	0.43
	Murray Park	88.0	17.0	0.19
	Crockarts Hope	133.2	50.0	0.38
	Dustpan	189.0	31.0	0.16
	Westlands	80.2	19.0	0.24
	Butterfield	86.4	18.0	0.21
	TOTAL	1680.10	4391.00	

6.2 FUTURE DEVELOPMENTS

6.2.1 Seaview Supply Area

The rate of development within the Seaview area is dictated at which the rate of development of individual townships occurs within the urban edge. There are large areas within the Seaview Supply Area which will remain rural for many years beyond the planning horizon. Refer to drawing 8003/011/007.

At the same time a bulk water supply system is expensive to expand and it will be unwise to underestimate the requirements or to design and build installations that will be difficult and expensive to augment.

The anticipated rate of development is therefore a critical factor in determining the design capacity of the primary bulk water supply system. We have been unable to obtain data from the Municipality relating to the expected growth rates or population estimates for the Seaview Supply Area.

To determine the primary water requirements to be supplied by the main bulk water supply system we have analysed the known existing developments in the area.

It is clear from these statistics and from the cadastral maps that not much development has taken place to date. However, the western suburbs of Port Elizabeth are growing apace and it can be anticipated that the growth will continue in a westerly direction on the available land in the Seaview Supply Area.

Table – 4 Reflects the existing and future developments within the Seaview Supply Area.

SUPPLY ZONE	COMMUNITY	AREA (ha)	Nº OF ERVEN	DENSITY (erven/ha)
Existing Seaview Area				
Coastal Zone	Beachview	54.7	253	4.63
	Seaview	74.2	494	6.66
	Clarendon Marine	29.6	133	4.49
	Kini Bay	19.4	95	4.91
Future Seaview Area				
Urban Zone	Housing Development	19.8	800	40.40
Peri-Urban Zone (P2)	Port Elizabeth Farms	366.3	145	0.40
	Uitenhage Farms	156.6	62	0.40
	Beachview West	66.4	27	0.40
Coastal Zone	Seaview	87.0	435	5.00
	Kini Bay	13.1	66	5.00
	Seaview West	150.1	750	5.00
	Port Elizabeth Farms	265.0	1325	5.00
Rural Zone (R1 & R2)		0.0		
Critical Biodiversity Zone (C1 & C2)	Seaview Game Park	30.3		
	Chinchilla Farm	23.2		
	Hillside	170.1		
	Verdun	37.2		
	Stone Kraal	161.7		
	Goedemoedsfontein East	93.6		
	Port Elizabeth Farms	188.5		
	Uitenhage Farms	451.7		
		2458.5	4584	

6.2.2 Greenbushes Supply Area

The anticipated rate of development is therefore a critical factor in determining the design capacity of the primary bulk water supply system. We have been unable to obtain data from the Municipality relating to the expected growth rates or population estimates for the Greenbushes area. Refer to drawing 8003/011/007.

To determine the primary water requirements to be supplied by the main bulk water supply system we have analysed the known existing developments in the area under the following headings.

High density low income townships mainly located inland in the vicinity of the main arterial transport routes.

Medium density medium income townships located inland

Rural and peri-urban areas resulting from the subdivision of farms into erven greater than 1,0ha. There is already a big area developed to these criteria and we would not anticipate many further developments.

Because the growth in water demand will not be from the intrinsic growth of the existing population but from the transfer of population from Port Elizabeth we are planning the primary bulk water supply into the area on a growth rate of 10% for the Urban Zone. The Peri-urban and Rural Zone will not expand at the same rate as the Urban Zone. For these, a growth rate of 2% p.a. has been used.

Table – 5 Reflects the existing and future developments within the Greenbushes Supply Area.

SUPPLY ZONE	COMMUNITY	AREA (ha)	Nº OF ERVEN	RESIDENTIAL DENSITY (erven/ha)
Existing Greenbushes Area Urban Zone	Bridgemead	81.6	312.0	3.82
	Chade Manor	44.6	631.0	14.15
	Lavendula	2.7	50.0	18.52
	Rowallan Park	89.2	687.0	7.70
	Hunja Heath	3.4	55.0	16.18
	Parsons Green	20.3	146.0	7.19
	Masakhane	110.7	1468.0	13.26
	Hunters Retreat	42.2	422	10.0
Future Greenbushes Area Urban Zone	Parsons Vlei	241.7	2417	10.0
	The Poplars	2.7	27	10.0
	Greenbushes	299.7	2997	10.0
	Ericadene	118.4	1184	10.0
	The Siding	50.5	505	10.0
	Klip Rand	15.5	155	10.0
	Goedemoeds Fontein	2.7	27	10.0
	Kentish Plains	81.1	811	10.0
	Progress	90.7	907	10.0
	Parkholme	60.1	601	10.0
	Progress North	19.8	198	10.0
	Swinburne	51.6	516	10.0
	Kuyga	194.9	1949	10.0
	Werrington	2.2	22	10.0
	Wedgewwod	91.7	917	10.0
	Port Elizabeth Farms	602.5	6025	10.0
	Uitenhage Farms	0.0	0	0.0
	The Valleys	50.7	46	0.9
Future Greenbushes Area Peri-Urban Zone (P1)	Waterkloof	23.9	22	0.9
	Hopewell	165.1	149	0.9
	Fairview Racecourse	217.7	196	0.9
	The Appex	134.5	121	0.9
	Clinic	3.8	3	0.9
	Surrey Hills	26.0	23	0.9
	Crockarts Hope	129.1	116	0.9
	Dustpan	161.7	146	0.9
	Westlands	59.2	53	0.9
	Altona	13.5	12	0.9
	Murray Park	81.8	74	0.9
	Tembani	91.5	82	0.9
	Frankfort	130.4	117	0.9
	Ferreira	212.8	192	0.9
	Colleen Glen	251.2	226	0.9
	Goedemoedsfontein	20.0	18	0.9
	Denholme	60.3	54	0.9
	Windomayne	186.4	168	0.9
	The Flats	191.4	172	0.9
	Kragga Kamma	123.9	112	0.9
	The Island	14.7	13	0.9
	Griffindel	13.8	12	0.9
	Trig Farm	30.3	27	0.9
	Lake Farm	34.3	31	0.9
	Lakeside	8.6	8	0.9
	Malvern	24.9	22	0.9
	Oshry	21.1	19	0.9
	Goedemoedsfontein East	50.8	46	0.9
	Port Elizabeth Farms	2150.2	1935	0.9
	Uitenhage Farms	681.5	613	0.9

SUPPLY ZONE	COMMUNITY	AREA (ha)	Nº OF ERVEN	RESIDENTIAL DENSITY (erven/ha)
Future Greenbushes Area Peri-Urban Zone (P2)	Waterkloof	20.4	8	0.4
	The Valleys	241.3	97	0.4
	Parsons Vlei	50.1	20	0.4
	Stade River	62.2	25	0.4
	Goedemoedsfontein East	36.0	14	0.4
	The Camp	32.7	13	0.4
	The Gums	5.8	2	0.4
	Hillside	128.8	52	0.4
	Stone Kraal	146.9	59	0.4
	Griffindel	78.8	32	0.4
	Kragga Kamma	34.5	14	0.4
	Port Elizabeth Farms	283.0	113	0.4
	Uitenhage Farms	328.3	131	0.4
Future Greenbushes Area Coastal Zone		0.0		
Future Greenbushes Area Rural Zone (R1 & R2)		0.0		
Future Greenbushes Area Critical Biodiversity Zone (C1 & C2)	Bridgemead	10.4	0	0.0
	Rowallan Park	10.8	0	0.0
	Hunters Retreat	50.0	0	0.0
	Parsons Vlei	1327.6	0	0.0
	The Valleys	1010.0	0	0.0
	Hopewell	732.5	0	0.0
	Kuyga	92.4	0	0.0
	Greenbushes	8.7	0	0.0
	Waterkloof	75.2	0	0.0
	Poplar Grove	34.8	0	0.0
	Swinburne	34.6	0	0.0
	Parkholme	8.5	0	0.0
	Progress North	21.1	0	0.0
	Werrington	55.3	0	0.0
	Wedgewwod	42.4	0	0.0
	Dustpan	4.6	0	0.0
	Westlands	27.1	0	0.0
	Clinic	9.6	0	0.0
	Altona	6.7	0	0.0
	Crockarts Hope	5.8	0	0.0
	Frankfort	8.2	0	0.0
	Ferreira	89.4	0	0.0
	Stades River	34.7	0	0.0
	Goedemoedsfontein	21.4	0	0.0
	Goedemoedsfontein East	47.8	0	0.0
	Hillside	2.1	0	0.0
	Griffindel	27.1	0	0.0
	Oshry	19.9	0	0.0
	Kragga Kamma	35.2	0	0.0
	Reservoirs	10.2	0	0.0
	Island State Forest	496.6	0	0.0
	Port Elizabeth Farms	455.7	0	0.0
	Uitenhage Farms	427.0	0	0.0
		14377.8	28437	

7. WATER CONSUMPTION

7.1 ANTICIPATED THEORETICAL WATER CONSUMPTION – SEAVIEW SUPPLY AREAS

The following anticipated water demands pertaining to the use of water in the Seaview Supply Area is as follows; (Refer to layout 8003/011/003, 004 and 005)

7.1.1 Existing and Ultimate Seaview Supply Area

Table – 6 Reflects the demands of the existing and ultimate developments.

SUPPLY ZONE	Nº OF ERVEN	ADD/ plot	ADD No of erven x ADD/plot}/1000		GADD ADD x Lfr x L_o		ADPW GADD x 3.5	
			kl/day	l/s	kl/day	l/s	kl/day	l/s
EXISTING SEAVIEW SUPPLY AREA								
Urban Zone								
Housing Development	550	300	165.00	1.910	208.73	2.42	521.81	6.04
Coastal Zone								
Seaview	494	1100	543.40	6.289	687.40	7.96	2405.90	27.85
Beachview	253	1100	278.30	3.221	352.05	4.07	1232.17	14.26
Clarendon Marine	133	1100	146.30	1.693	185.07	2.14	647.74	7.50
Kini Bay	95	1100	104.50	1.209	132.19	1.53	462.67	5.36
TOTAL	1525.00		1237.50	14.32	1565.44	18.12	5270.31	61.00
ULTIMATE SEAVIEW SUPPLY AREA								
Urban Zone								
Housing Development	250	300	75.00	0.868	94.88	1.10	237.19	2.75
Peri-Urban Zone (P2)								
Beachview West	27	1100	29.70	0.344	37.57	0.43	131.50	1.52
Port Elizabeth Farms	145	1100	159.50	1.846	201.77	2.34	706.19	8.17
Uitenhage Farms	62	1100	68.20	0.789	86.27	1.00	301.96	3.49
Coastal Zone								
Seaview	435	1100	478.50	5.538	605.30	7.01	2118.56	24.52
Kini Bay	66	1100	72.60	0.840	91.84	1.06	321.44	3.72
Seaview West	750	1100	825.00	9.549	1043.63	12.08	3652.69	42.28
Port Elizabeth Farms	1325	1100	1457.50	16.869	1843.74	21.34	6453.08	74.69
Rural Zone (R1 & R2)								
Nil								
Citical Biodiversity (C1 & C2)								
Nil								
TOTAL	3060.00		3166.00	36.64	4004.99	46.35	13922.59	161.14
COMBINED EXISTING & ULTIMATE TOTAL			4403.50	50.97	5570.43	64.47	19192.90	222.14

Table – 7 Reflects the growth within the Seaview Supply Area based on the 2015 time frame. (Refer to layout 8003/011/008)

SUPPLY ZONE	Nº OF ERVEN	ADD/ plot	ADD No of erven x ADD/plot/1000		GADD ADD x Lfr x LO		ADPW GADD x (2.5 or 3.5)	
			kl/day	l/s	kl/day	l/s	kl/day	l/s
FUTURE REQUIREMENTS - 2010 design horison @ 2% growth rate								
Urban Zone (2%)	561	300	168.30	1.948	212.90	2.46	532.25	6.16
Peri-Urban Zone (P1) (2%)	0	1100	0.00	0.000	0.00	0.00	0.00	0.00
Peri-Urban Zone (P2) (2%)	0	1100	0.00	0.000	0.00	0.00	0.00	0.00
Coastal Zone (5%)	1024	1100	1126.13	13.034	1424.55	16.49	4985.92	57.71
Rural Zone (R1 & R2)	0	650	0.00	0.000	0.00	0.00	0.00	0.00
Critical Biodiversity (C1 & C2)	0	0	0.00	0.000	0.00	0.00	0.00	0.00
TOTAL 2015 REQUIREMENTS			1294.43	14.98	1637.45	18.95	5518.17	63.87

Table – 8 Reflects the growth within the Seaview Supply Area based on the 2025 time frame. (Refer to layout 8003/011/008)

SUPPLY ZONE	Nº OF ERVEN	ADD/ plot	ADD No of erven x ADD/plot/1000		GADD ADD x Lfr x LO		ADPW GADD x (2.5 or 3.5)	
			kl/day	l/s	kl/day	l/s	kl/day	l/s
FUTURE REQUIREMENTS - 2020 design horison @ 2%								
Urban Zone (2%)	619	300	185.82	2.151	235.06	2.72	587.65	6.80
Peri-Urban Zone (P1) (2%)	0	1100	0.00	0.000	0.00	0.00	0.00	0.00
Peri-Urban Zone (P2) (2%)	0	1100	0.00	0.000	0.00	0.00	0.00	0.00
Coastal Zone (5%)	1269	1100	1396.19	16.160	1766.18	20.44	6181.62	71.55
Rural Zone (R1 & R2)	0	650	0.00	0.000	0.00	0.00	0.00	0.00
Critical Biodiversity (C1 & C2)	0	0	0.00	0.000	0.00	0.00	0.00	0.00
TOTAL 2025 REQUIREMENTS			1582.01	18.31	2001.24	23.16	6769.27	78.35

Table – 9 Reflects the growth within the Seaview Supply Area based on the ultimate development. (Refer to layout 8003/011/008)

SUPPLY ZONE	Nº OF ERVEN	ADD/ plot	ADD No of erven x ADD/plot/1000		GADD ADD x Lfr x LO		ADPW GADD x (2.5 or 3.5)	
			kl/day	l/s	kl/day	l/s	kl/day	l/s
FUTURE REQUIREMENTS - Ultimate design horison								
Urban Zone (2%)	800	300	240.00	2.778	303.60	3.51	759.00	8.78
Peri-Urban Zone (P1) (2%)	0	1100	0.00	0.000	0.00	0.00	0.00	0.00
Peri-Urban Zone (P2) (2%)	234	1100	257.40	2.979	325.61	3.77	1139.64	13.19
Coastal Zone (5%)	3551	1100	3906.10	45.209	4941.22	57.19	17294.26	200.17
Rural Zone (R1 & R2)	0	650	0.00	0.000	0.00	0.00	0.00	0.00
Critical Biodiversity (C1 & C2)	0	0	0.00	0.000	0.00	0.00	0.00	0.00
TOTAL ULTIMATE REQUIREMENTS			4403.50	50.97	5570.43	64.47	19192.90	222.14

7.2 ANTICIPATED THEORETICAL WATER CONSUMPTION – GREENBUSHES SUPPLY AREA

The following anticipated water demands pertaining to the use of water in the Greenbushes Supply Area is as follows; (Refer to layout 8003/011/003, 004 and 005)

7.2.1 Existing and Ultimate Greenbushes Supply Area

Table – 10 Reflects the demands of the existing and future developments.

SUPPLY ZONE	Nº OF ERVEN	ADD/ plot	ADD No of erven x ADD/plot}/1000		GADD ADD x Lfr x L_O		ADPW GADD x 3.5	
			kl/day	l/s	kl/day	l/s	kl/day	l/s
EXISTING GREENBUSHES AREA								
Urban Zone								
Bridgemead	591	650	384.15	4.446	485.95	5.62	1700.82	19.69
Chade Manor	705	650	458.25	5.304	579.69	6.71	2028.90	23.48
Lavendula	50	650	32.50	0.376	41.11	0.48	143.89	1.67
Rowallan Park	702	650	456.30	5.281	577.22	6.68	2020.27	23.38
Hunja Heath	56	650	36.40	0.421	46.05	0.53	161.16	1.87
Parsons Green	142	650	92.30	1.068	116.76	1.35	408.66	4.73
Masakhane	1739	300	521.70	6.038	659.95	7.64	2309.83	26.73
Greenbushes	326	650	211.90	2.453	268.05	3.10	938.19	10.86
Ericadene	102	650	66.30	0.767	83.87	0.97	293.54	3.40
Progress	107	650	69.55	0.805	87.98	1.02	307.93	3.56
Hunters Retreat	122	650	79.30	0.918	100.31	1.16	351.10	4.06
Kuyga	249	650	161.85	1.873	204.74	2.37	716.59	8.29
Port Elizabeth Farms	150	650	97.50	1.128	123.34	1.43	431.68	5.00
Peri-urban Zone (P1)								
Denholm	33	1100	36.30	0.420	45.92	0.53	160.72	1.86
Colleen Glen	226	1100	248.60	2.877	314.48	3.64	1100.68	12.74
Murray Park	88	1100	96.80	1.120	122.45	1.42	428.58	4.96
Crockarts	116	1100	127.60	1.477	161.41	1.87	564.95	6.54
Dustpan	146	1100	160.60	1.859	203.16	2.35	711.06	8.23
Westlands	53	1100	58.30	0.675	73.75	0.85	258.12	2.99
Butterfield	18	1100	19.80	0.229	25.05	0.29	87.66	1.01
Altona	12	1100	13.20	0.153	16.70	0.19	58.44	0.68
Peri-urban Zone (P2)								
Port Elizabeth Farms	170	1100	187.00	2.164	236.56	2.74	827.94	9.58
Uitenhage Farms	10	1100	11.00	0.127	13.92	0.16	48.70	0.56
TOTAL	5913.00		3627.20	41.98	4588.41	53.11	16059.43	185.87

ULTIMATE GREENBUSHES AREA								
Urban Zone								
Hunters Retreat	300	650	195.00	2.257	246.68	2.86	863.36	9.99
Parsons Vlei	2417	650	1571.05	18.183	1987.38	23.00	6955.82	80.51
The Poplars	27	650	17.55	0.203	22.20	0.26	77.70	0.90
Greenbushes	2671	650	1736.15	20.094	2196.23	25.42	7686.80	88.97
Ericadene	1082	650	703.30	8.140	889.67	10.30	3113.86	36.04
The Siding	505	650	328.25	3.799	415.24	4.81	1453.33	16.82
Klip Rand	155	650	100.75	1.166	127.45	1.48	446.07	5.16
Goedemoeds Fontein	27	650	17.55	0.203	22.20	0.26	77.70	0.90
Kentish Plains	811	650	527.15	6.101	666.84	7.72	2333.96	27.01
Progress	800	650	520.00	6.019	657.80	7.61	2302.30	26.65
Parkholme	601	650	390.65	4.521	494.17	5.72	1729.60	20.02
Progress North	198	650	128.70	1.490	162.81	1.88	569.82	6.60
Swinburne	516	650	335.40	3.882	424.28	4.91	1484.98	17.19
Kuyga	1700	650	1105.00	12.789	1397.83	16.18	4892.39	56.62
Werrington	22	650	14.30	0.166	18.09	0.21	63.31	0.73
Wedgewood	917	650	596.05	6.899	754.00	8.73	2639.01	30.54
Port Elizabeth Farms	5875	650	3818.75	44.198	4830.72	55.91	16907.52	195.69

SUPPLY ZONE	Nº OF ERVEN	ADD/ plot	ADD No of erven x ADD/plot}/1000		GADD ADD x Lfr x L_o		ADPW GADD x 3.5	
			kl/day	l/s	kl/day	l/s	kl/day	l/s
EXISTING GREENBUSHES AREA								
Peri-Urban Zone (P1)								
The Valleys	46	1100	50.60	0.586	64.01	0.74	224.03	2.59
Waterkloof	22	1100	24.20	0.280	30.61	0.35	107.15	1.24
Hopewell	149	1100	163.90	1.897	207.33	2.40	725.67	8.40
Fairview Racecourse	196	1100	215.60	2.495	272.73	3.16	954.57	11.05
The Appex	121	1100	133.10	1.541	168.37	1.95	589.30	6.82
Clinic	3	1100	3.30	0.038	4.17	0.05	14.61	0.17
Surrey Hills	23	1100	25.30	0.293	32.00	0.37	112.02	1.30
Murray Park	3	1100	3.30	0.038	4.17	0.05	14.61	0.17
Tembani	65	1100	71.50	0.828	90.45	1.05	316.57	3.66
Frankfort	117	1100	128.70	1.490	162.81	1.88	569.82	6.60
Ferreira	192	1100	211.20	2.444	267.17	3.09	935.09	10.82
Goedemoedsfontein	18	1100	19.80	0.229	25.05	0.29	87.66	1.01
Denholme	21	1100	23.10	0.267	29.22	0.34	102.28	1.18
Windomayne	168	1100	184.80	2.139	233.77	2.71	818.20	9.47
The Flats	172	1100	189.20	2.190	239.34	2.77	837.68	9.70
Kragga Kamma	112	1100	123.20	1.426	155.85	1.80	545.47	6.31
The Island	13	1100	14.30	0.166	18.09	0.21	63.31	0.73
Griffindel	12	1100	13.20	0.153	16.70	0.19	58.44	0.68
Trig Farm	27	1100	29.70	0.344	37.57	0.43	131.50	1.52
Lake Farm	31	1100	34.10	0.395	43.14	0.50	150.98	1.75
Lakeside	8	1100	8.80	0.102	11.13	0.13	38.96	0.45
Malvern	22	1100	24.20	0.280	30.61	0.35	107.15	1.24
Oshry	19	1100	20.90	0.242	26.44	0.31	92.53	1.07
Goedemoedsfontein East	46	1100	50.60	0.586	64.01	0.74	224.03	2.59
Port Elizabeth Farms	1800	1100	1980.00	22.917	2504.70	28.99	8766.45	101.46
Uitenhage Farms	613	1100	674.30	7.804	852.99	9.87	2985.46	34.55

SUPPLY ZONE	Nº OF ERVEN	ADD/ plot	ADD No of erven x ADD/plot}/1000		GADD ADD x Lfr x L_o		ADPW GADD x 3.5	
			kl/day	l/s	kl/day	l/s	kl/day	l/s
ULTIMATE GREENBUSHES AREA								
Peri-Urban Zone (P2)								
Waterkloof	8	1100	8.80	0.102	11.13	0.13	38.96	0.45
The Valleys	90	1100	99.00	1.146	125.24	1.45	438.32	5.07
Parsons Vlei	18	1100	19.80	0.229	25.05	0.29	87.66	1.01
Stade River	22	1100	24.20	0.280	30.61	0.35	107.15	1.24
Goedemoedsfontein Ea	12	1100	13.20	0.153	16.70	0.19	58.44	0.68
The Camp	13	1100	14.30	0.166	18.09	0.21	63.31	0.73
The Gums	2	1100	2.20	0.025	2.78	0.03	9.74	0.11
Hillside	48	1100	52.80	0.611	66.79	0.77	233.77	2.71
Stone Kraal	54	1100	59.40	0.688	75.14	0.87	262.99	3.04
Griffindel	28	1100	30.80	0.356	38.96	0.45	136.37	1.58
Kragga Kamma	14	1100	15.40	0.178	19.48	0.23	68.18	0.79
Port Elizabeth Farms	105	1100	115.50	1.337	146.11	1.69	511.38	5.92
Uitenhage Farms	121	1100	133.10	1.541	168.37	1.95	589.30	6.82
Coastal Zone								
Nil								
Rural Zone (R1 & R2)								
Nil								
Citical Biodiversity (C1 & C2)								
Nil								
TOTAL	23178.00		17115.00	198.09	21650.48	250.58	75776.66	877.04
COMBINED EXISTING & FUTURE TOTAL			20742.20	240.07	26238.88	303.69	91836.09	1062.92

Table – 11 Reflects the growth within the Greenbushes Supply Area based on the 2015 time frame. (Refer to layout 8003/011/008)

SUPPLY ZONE	Nº OF ERVEN	ADD/ plot	ADD No of erven x ADD/plot/1000		GADD ADD x Lfr x LO		ADPW GADD x (2.5 or 3.5)	
			kl/day	l/s	kl/day	l/s	kl/day	l/s
FUTURE REQUIREMENTS - 2010 design horison @ 10% and 2%								
Urban Zone (10%)	3632	650	2360.93	27.326	2986.58	34.57	10453.02	120.98
Urban Zone (10%)	1913	300	573.87	6.642	725.95	8.40	2540.81	29.41
Peri-Urban Zone (P1) (2%)	706	1100	776.42	8.986	982.18	11.37	3437.62	39.79
Peri-Urban Zone (P2) (2%)	184	1100	201.96	2.338	255.48	2.96	894.18	10.35
Coastal Zone (2%)	0	1100	0.00	0.000	0.00	0.00	0.00	0.00
Rural Zone (R1 & R2)	0	650	0.00	0.000	0.00	0.00	0.00	0.00
Critical Biodiversity (C1 & C2)	0	0	0.00	0.000	0.00	0.00	0.00	0.00
TOTAL 2015 REQUIREMENTS	6434.54		3913.18	45.29	4950.18	57.29	17325.62	200.53

Table – 12 Reflects the growth within the Greenbushes Supply Area based on the 2025 time frame. (Refer to layout 8003/011/008)

SUPPLY ZONE	Nº OF ERVEN	ADD/ plot	ADD No of erven x ADD/plot}/1000		GADD ADD x Lfr x LO		ADPW GADD x (2.5 or 3.5)	
			kl/day	l/s	kl/day	l/s	kl/day	l/s
FUTURE REQUIREMENTS - 2020 design horison @ 10% and 2%								
Urban Zone (10%)	5850	650	3802.30	44.008	4809.91	55.67	16834.69	194.85
Urban Zone (10%)	3081	300	924.22	10.697	1169.14	13.53	4092.00	47.36
Peri-Urban Zone (P1) (2%)	779	1100	857.23	9.922	1084.40	12.55	3795.41	43.93
Peri-Urban Zone (P2) (2%)	203	1100	222.98	2.581	282.07	3.26	987.24	11.43
Coastal Zone (2%)	0	1100	0.00	0.000	0.00	0.00	0.00	0.00
Rural Zone (R1 & R2)	0	650	0.00	0.000	0.00	0.00	0.00	0.00
Critical Biodiversity (C1 & C2)	0	0	0.00	0.000	0.00	0.00	0.00	0.00
TOTAL 2025 REQUIREMENTS	9912.45		5806.74	67.21	7345.53	85.02	25709.34	297.56

Table – 13 Reflects the growth within the Greenbushes Supply Area based on the ultimate development. (Refer to layout 8003/011/008)

SUPPLY ZONE	Nº OF ERVEN	ADD/ plot	ADD No of erven x ADD/plot}/1000		GADD ADD x Lfr x LO		ADPW GADD x (2.5 or 3.5)	
			kl/day	l/s	kl/day	l/s	kl/day	l/s
FUTURE REQUIREMENTS - 2025 design horison @ 10% and 2%								
Urban Zone (10%)	9421	650	6123.64	70.876	7746.41	89.66	27112.44	313.80
Urban Zone (10%)	4962	300	1488.47	17.228	1882.92	21.79	6590.21	76.28
Peri-Urban Zone (P1) (2%)	860	1100	946.46	10.954	1197.27	13.86	4190.44	48.50
Peri-Urban Zone (P2) (2%)	224	1100	246.19	2.849	311.43	3.60	1090.00	12.62
Coastal Zone (2%)	0	1100	0.00	0.000	0.00	0.00	0.00	0.00
Rural Zone (R1 & R2)	0	650	0.00	0.000	0.00	0.00	0.00	0.00
Critical Biodiversity (C1 & C2)	0	0	0.00	0.000	0.00	0.00	0.00	0.00
ULTIMATE REQUIREMENTS	15466.78		8804.76	101.91	11138.02	128.91	38983.07	451.19

7.2.2 Unit Consumption

The Design Criteria for water demands have been based on the data provided by the Nelson Mandela Bay Municipality – Water Master Plan 2005 - 2020.

These guidelines have been used as a basis for sizing the theoretical capacity for the various elements under consideration. Refer to Section 5, Design Criteria.

7.2.3 Population Projection

A growth rate of 10% is assumed for the Urban Zone. The Coastal, Peri-urban and Rural Zones will not expand at the same rate as the Urban Zone. For these, a growth rate of 2% p.a. has been used.

7.2.4 Water Consumption of the Business Centre

Not Applicable.

7.2.5 Water Consumption of the Industrial Areas

It is assumed that the consumption will be equivalent to domestic consumption for that area.

8. PROPOSED SCHEME: SEAVIEW AND GREENBUSHES BULK WATER REQUIREMENTS – PHASE 1

8.1 PLANNING REPORT – SEAVIEW AND GREENBUSHES SUPPLY AREAS

The Bulk Water Planning Report for Seaview and Greenbushes Supply Areas was submitted in June 2005 and revised / updated and re-submitted in February 2012.

The Planning Report recommended that the Seaview and Greenbushes Supply Areas can be considered as two separate areas. There is no point in pumping water from the Seaview pump station 4,5 km inland to the Greenbushes Reservoir and running the Seaview Area requirements all the way back on the same route. It will be more efficient to supply the Seaview coastal strip directly from the Seaview pump station. The two pumping services however share the pumpstation complex.

It is recommended that the implementation of Phase 1 – Seaview, be considered to develop the bulk water infrastructure of the coastal area as well as Phase 1 – Greenbushes for the augmentation of the supply of bulk water inland by laying a gravity pipeline from Greenbushes Reservoir to the Chelsea pumpstation.

Approval has subsequently been given for the implementation of Phase 1 and is as detailed as follows.

8.1.1 Phase 1 - Seaview

This area is currently supplied from the Seaview pump station sump and via a number of small local schemes drawing directly from the two adjacent Churchill pipelines. A number of developments are under consideration which will need an expansion of the bulk supplies. The intention is to construct those elements of the long term plan which are required now and to eliminate the minor connections from the Churchill pipelines where feasible.

The water will be sourced from an expansion of the Seaview pump station complex.

- The gravitated supply (Zone 1 & 4) and pumped supply from Seaview Complex to the 160 mamsl and gravitated into the Seaview Supply Area, coastal zone (Zone 2 & 5) and includes the following elements, which will be detailed in this section;
- Construction of 2.5Mℓ clear water bulk storage reservoir at the Seaview Complex (TWL = 79.5) to serve zone 1 & 4,
- Augmentation of the existing Seaview pump station (one duty, one standby) to deliver water to the 160 mamsl (53 ℓ/s)
- Construction of 315mmø uPVC rising main (1630m) from the Seaview Pumpstation complex to the 2.5Mℓ bulk storage reservoir at 160 mamsl
- Construction of 2.5Mℓ clear water bulk storage reservoir (TWL = 160) from which Zones 2 and 5 will be supplied by gravity
- Construction of 355mm ø (1500m), 315mm ø (1000m), 200mm ø (2220m) uPVC gravity mains to deliver water from the 2.5Mℓ bulk storage reservoir to Zones 2 and 5.
- Gravity connections from the service reservoirs to existing and proposed reticulation
- Install metering at the Seaview Pump Station.

8.1.2 Phase 1 - Greenbushes

This pipeline is to increase the gravity flow inland to cater for anticipated increased demand as well as a 15Mℓ per day emergency supply to the Chelsea pumpstation.

- Gravity supply main from Greenbushes to Chelsea reservoir branch and interconnect with existing 550mm ø and 375mm ø continuing to Cape Road into the Greenbushes Supply Area, urban zone (Zone 7)
- Construct new 750mm ø gravity main from Greenbushes to Chelsea reservoir branch and interconnect with existing 375mm ø continuing to Cape Road.

8.2 CHANGES DUE TO NEW DEVELOPMENTS AND REVISED PLANNING

The following is currently at design stage or has been constructed,

- CA du Toit were appointed, for the extension of the Seaview pump station.
- The connection 375mm ø pipeline from Chelsea reservoir to Cape Rd has been constructed.

Resulting from discussions with the NMBM Water Engineer, the planning has been slightly modified, namely,

- The proposed Blackrock Coastal Estate will receive water from the proposed gravity main from the 2.5Mℓ bulk storage reservoir at 160 mamsl. The existing connection to the 750kl Beachview reservoir be retained.
- The extension of the Seaview pumpstation has impacted on the layout of the proposed reservoir and pumpstations.
- The proposed pumpstation building at the Seaview pumpstation complex to be moved and catered for in the existing now vacant upper pumpstation area.
- Bosch Stemele, was instructed to investigate other positions for the reservoir within the Seaview complex, and this was approved on 26 May 2014.

The scheme to be implemented now consists of the elements described further in this report.

8.3 SEAVIEW PUMPING COMPLEX

8.3.1 General Description

Part of the coastal strip below 50 mamsl can be supplied by gravity directly from the reservoir/sump of the Seaview Pumping Complex. To serve the rest of the area it is proposed to pump to a bulk supply reservoir at a TWL of 160 mamsl from where Zone 2 & 5 will be supplied by gravity. NMBM has requested that the planning of bulk reservoirs is to be allowed and any service reservoirs could be installed at a later stage if required. Each reservoir will be fitted with a float controlled valve.

The total storage requirement is 48 hours of average daily flow. This will be achieved partly in the service reservoirs and making up the shortfall in the bulk supply reservoir.

In practice such a system works well. The only task of the pumping scheme is to keep the bulk supply reservoir sensibly full. The rest of the distribution works by gravity.

The reservoirs are sited to deliver water at least 30m head during peak flow and not more than 90m during off-peak periods. This defines the supply area of each pressure zone.

Table – 14 Reflects the demands within the various Zones within the Seaview Supply Area based on the ultimate development. (Refer to layout 8003/011/003)

SUPPLY ZONE	N° OF ERVEN	ADD/ plot	ADD No of erven x ADD/plot}/1000		GADD ADD x Lfr x L_O		ADPW GADD x 3.5	
			kl/day	l/s	kl/day	l/s	kl/day	l/s
SEAVIEW AREA								
Zone 1								
Coastal Zone	365	1100	401.50	4.65	507.90	5.88	1777.64	20.57
Peri-Urban Zone (P2)	10	1100	11.00	0.13	13.92	0.16	48.70	0.56
	375		412.50	4.77	521.81	6.04	1826.34	21.14
Zone 2								
Coastal Zone	630	1100	693.00	8.02	876.65	10.15	3068.26	35.51
Peri-Urban Zone (P2)	20	1100	22.00	0.25	27.83	0.32	97.41	1.13
	650		715.00	8.28	904.48	10.47	3165.66	36.64
Zone 3								
Coastal Zone	10	1100	11.00	0.13	13.92	0.16	48.70	0.56
Peri-Urban Zone (P2)	145	1100	159.50	1.85	201.77	2.34	706.19	8.17
	155		170.50	1.97	215.68	2.50	754.89	8.74
Zone 4								
Coastal Zone	1382	1100	1520.20	17.59	1923.05	22.26	6730.69	77.90
Peri-Urban Zone (P2)	9	1100	9.90	0.11	12.52	0.14	43.83	0.51
	1391		1530.10	17.71	1935.58	22.40	6774.52	78.41
Zone 5								
Urban Zone	800	300	240.00	2.78	303.60	3.51	759.00	8.78
Coastal Zone	1164	1100	1280.40	14.82	1619.71	18.75	5668.97	65.61
Peri-Urban Zone (P2)	34	1100	37.40	0.43	47.31	0.55	165.59	1.92
	1998		1557.80	18.03	1970.62	22.81	6593.56	76.31
Zone 6								
Peri-Urban Zone (P2)	16	1100	17.60	0.20	22.26	0.26	77.92	0.90
TOTAL	4585.00		4403.50	50.97	5570.43	64.47	19192.90	222.14

8.3.2 Required Storage

As the primary supply system is pumped, 48 hours storage within the system will be required. Refer to drawing 8003/011/009.

Table – 15 Reflects the reservoir capacity that is required to fulfil the zone requirements.

SEAVIEW AREA – PROPOSED CAPACITIES					
Supply Zone	**ADD kl**	**Top Water Level mamsl**	**Required Capacity kl**	**Supply Zone Limits**	
				Upper Contour	**Lower Contour**
Zone 1	412.5	87.43	825	60	0
Zone 2	715	160	1430	130	50
Zone 3 &6	188.1	270	376	240	120
Zone 4	1530.1	81.5	3060	50	0
Zone 5	1557.8	160	3112	130	50

8.3.3 Design Flows

Pumping flow to Greenbushes reservoir (2025) = 300 ℓ/s

Pumping flow to Greenbushes reservoir (Ultimate) = 425 ℓ/s

Emergency supply to Chelsea pumpstation = 174 ℓ/s

Pumped flow to Seaview High Level reservoir = 53 ℓ/s

Average gravity flow to low level coastal zone = 28 ℓ/s

The ultimate flow in this context is the flow that will be designed for the ultimate development as per the Rural Development Policy plans.

8.3.4 Augmentation of Seaview Pumpstation

To cater for the further development of the Seaview area it is necessary to install pumps to supply the additional higher lying areas. Due to the augmentation of the Seaview pump station (by CA du Toit) it is possible to use the existing now vacant upper pump station area to install the required pumps.

The system will be designed to provide the following operational options.

- Normal operation will supply incoming water to both the proposed 2.5Mℓ reservoir and existing 1.2Mℓ sump/reservoir,
- The augmented pump station will draw water directly from the existing 1.2 Mℓ sump/reservoir,
- The inlet system from the Churchill pipelines must therefore be capable of supplying the total required flow to either reservoir.
- The 2.5Mℓ storage reservoir must have a volume dedicated to supply the low lying areas (Zones 1 and 4) directly by gravity.

8.3.5 Connection from Churchill Pipeline to Seaview Pump Sump

The existing connection from the Churchill pipeline consists of a 610mm ø cement mortar lined steel and a 450mm ø cement mortar lined C.I. pipeline each some 630m long. The flow into the 1.2 Mℓ sump is controlled by a 400mm and a 300mm Baker valve. The Seaview pump station consists of four large

(460 kW - 160 ℓ/s) and four small (205 kW - 75 ℓ/s) pump sets delivering into two rising mains (610mm ø steel and a 450mm ø C.I.) to Greenbushes Reservoir.

The reported pressure level at the Churchill off-take varies between 90 and 140 mamsl. The Seaview pump sump has a TWL of 81.5 mamsl and the minimum available head is thus 8.5m.

8.3.6 Interconnecting Pipeline to Proposed 2.5 Mℓ Reservoir

In normal operation the inflow into the existing 1.2 Mℓ sump and proposed 2.5 Mℓ reservoir will be capable of exceeding requirements by a considerable margin.

It is proposed to have two off-takes from the existing pipelines, 610 mm ø and 450mm ø. A 300mm ø connection from the 610 mm ø will be fitted with a 200mm ø Baker level control valve and run into the new reservoir. The second 300mm ø connection from the 450mm ø pipe will connect to the 300mm ø from the 610mm ø pipe before the Baker valve. The piping from the Baker valve into the reservoir will also be 300mm ø. This size has been selected to avoid an excessive velocities resulting in high turbulence being discharged into the sump.

The two supply pipes 610 mm ø and 450mm ø will continue to deliver to the existing 1.2 Mℓ sump, i.e. (300 + 58 + 28) ℓ/s = 386 ℓ/s. With these flows the total head loss is only 4.9m to the existing reservoir. This is ignoring the emergency flow to Chelsea.

- Pumping flow rate Greenbushes = ADD x ADPW x Lf_r x Lo
  = (148.01 x 1.6 x 1.15 x 1,1)
  = 25.883 Mℓ/(24hr day) (300 ℓ/s)

- Pumping flow rate Zones (2 & 5) (8.28 + 18.03) = ADD(2 & 5) x ADPW x Lf_r x Lo
  = (26.31 x 1.6 x 1.15 x 1,1
  = 4.601 Mℓ/(24hr day) (53.25 ℓ/s)

- Pumping flow rate Zones (3 & 6) (1.97 + 0.20) = ADD(3 & 6) x ADPW x Lf_r x Lo
  = (2.18 x 1.6 x 1.15 x 1,1)
  = 0.381 Mℓ/(24hr day) (4.4 ℓ/s)

Total flow through interconnecting pipeline = 35.814 Mℓ / (24hr day) (414.52 ℓ/s)

With this flow the total head loss is only 4.5m.

The flow for a head loss of 8.5m has also been calculated. The pipeline will pass 520 ℓ/s with a head loss of 8.5m. The supply will thus have surplus capacity for the planning horizon. This will cater further into the future and will allow some emergency flow for Chelsea if it becomes necessary.

The proposed 2.5 Mℓ reservoir will receive a flow of 56.87 ℓ/s, assuming that the peak gravity flow rate is absorbed by the reservoir the total anticipated flow is calculated as follows:

- Gravity flow rate Zones (1 & 4) (4.77 + 17.71) = {ADD(1 & 4)x PF_{retic} x Lf_r x Lo
  = 22.48 x 2 x 1.15 x 1.1
  = 4.914 Mℓ/(24hr day) (56.87 ℓ/s)

This connection to the proposed 2.5 Mℓ reservoir has been checked using the peak demand for Zone 1 & 4, namely 99.55 ℓ/s. The average daily flow being 28.44 ℓ/s.

Table – 16 Reflects the interconnecting pipework at proposed reservoir

Description	Units	Section 1 610mm dia. Pipe	Section 1 450mm dia. Pipe	Section 2 300mm dia. Pipe	Section 3 Level Control	Section 4 300mm dia. Inlet	Formulae
Q = Flow	m^3/s	0.29	0.13	0.06	0.06	0.06	
Pipe Diameter ND and class	mm	610	450	300	200	300	
Pipe material		Steel cement lined	C.I. cement lined	galv. Steel		galv. Steel	
d = ID	m	0.584	0.427	0.268	0.174	0.268	
A = Area of pipe	m^2	0.268	0.143	0.056	0.024	0.056	
V = Velocity	m/s	1.064	0.908	1.010	2.397	1.010	$Q = VA$
L = Length of pipeline section	m	630	630	18		5	
C_H = Hazen-Williams coeff.		120	120	120	50.44	120	
Pipe friction loss	m	1.273	1.367	0.082	0.000	0.023	$h_f = l\left(\frac{3{,}59Q}{C_H d^{2{,}63}}\right)^{1{,}852}$
Energy head	m	0.058	0.042	0.052	0.293	0.052	
K = Minor loss coefficient		4.400	4.400	2.350	3.460	2.900	$h_f = \frac{V^2}{2g}$
Minor losses	m	0.254	0.185	0.122	1.013	0.151	
Total losses	m	1.527	1.552	0.204	1.013	0.174	
Sum of Losses		3.079		1.391			
		4.470					

Table – 17 Reservoir Levels

T.W.L. at 2.5Ml reservoir	79.500	
Incoming Losses	6.55m	
Available Head	Varies 8.5m – 58.5m	
Surplus head (Min)	Varies 1.95m – 51.95m	

8.3.7 Inlet Level Control Valve

Water will flow under gravity through the 610 and 450mm ø interconnecting pipelines into a 300mm ø pipe and through a 200mm ø inlet level control valve. The valve will be opened and closed by a float pilot in the reservoir. The valve will automatically close to stop the flow of water from the delivery pipeline when the water level reaches a pre-determined level in the clear water reservoir. i.e. the TWL at 79.50m. The valve will automatically open once it reaches a pre-determined lower level. The inlet level control valve will be installed in a chamber positioned on the side of the 2.5 Mℓ reservoir.

8.4 RESERVOIR AND PUMP SUMP AT SEAVIEW COMPLEX (81.5MAMSL)

8.4.1 Existing Reservoir Storage

Zone 1 & 4 (0 to 50m) Refer to drawing 8003/011/009

Zone 1

Beachview has a 750kℓ reservoir situated north of Beachview supplying the existing Beachview Township. The reservoir has a T.W.L. of 87.43 mamsl. It is supplied by a direct connection to the Churchill pipelines.

Zone 4

Kini Bay has an existing 700kℓ reservoir situated north east of Kini Bay supplying the area of Kini Bay below the 20m contour. The reservoir has a T.W.L. of 51.7 mamsl and a depth of 1.85m. This reservoir is currently leaking and it is proposed that the reservoir be abandoned once the proposed reservoir is constructed at the Seaview complex.

At the Seaview pumpstation there is a 1200kℓ reservoir/pump sump that supplies Seaview. The reservoir has a T.W.L. of 81.5 mamsl and a depth of 4.57m.

The 3 Nº Seaview lower zone brick reservoirs south of the Seaview pumpstation have a capacity of 750kℓ and supply Seaview and Kini Bay. The reservoirs have a T.W.L. of 81.35 mamsl. These reservoirs are currently not in a good state of repair and it is proposed that the reservoir be abandoned/demolished once the proposed reservoir is constructed at the Seaview complex.

Zone 2 & 5 (50 to 130m) Refer to drawing 8003/011/009

Zone 2

There is currently no storage in this zone.

Zone 5

Claredon Marine is supplied via a connection to the existing 120kℓ Upper Seaview steel Reservoir off the existing Seaview rising mains pumping to Greenbushes / Chelsea. The reservoir has a T.W.L. of 134.5 mamsl and a depth of 2.5m. It is proposed that the reservoir will be abandoned / demolished once the proposed reservoir is constructed at the 160m Contour.

8.4.2 Required Storage

As the primary supply system is pumped, 48 hours storage within the system will be required.

Zone 1 & 4 (0 to 50m) Refer to drawing 8003/011/009

Storage for Zone 1 and 4 will supply residents from the 50m contour and below.

Zone 1

The ADD for Zone 1 (below 50m contour) amounts to 412.5 kℓ/d (see Table 14 page 34) resulting in a total storage volume required of 0.825 Mℓ.

Storage reservoir (kℓ) = ADD Western Zone (81.5 msl) x 48hrs of storage
= 412.5 x 2
= 0.825 Mℓ Reservoir

Zone 4

The ADD for Zone 4 (below 50m contour) amounts to 1530.10 kℓ/d (see Table 14 page 34) resulting in a total storage volume required of 3.060 Mℓ.

Storage reservoir (kℓ) = ADD Eastern Zone (81.5 mamsl) x 48hrs of storage
= 1530.10 x 2
= 3.060 Mℓ Reservoir

Zone 2 & 5 (50 to 130m) Refer to drawing 8003/011/009

Storage for Zone 2 and 5 will supply residents between the 130m and 50m contour.

Zone 2

The ADD for Zone 2 (between 50-130m contour) amounts to 715.0 kℓ/d (see Table 14 page 34) resulting in a total storage volume required of 1.430 Mℓ.

Storage reservoir (kℓ) = ADD Western Zone (160 msl) x 48hrs of storage
= 715 x 2
= 1.43 Mℓ Reservoir

Zone 5

The ADD for Zone 4 (between 50-130m contour) amounts to 1557.80 kℓ/d (see Table 14 page 34) resulting in a total storage volume required of 3.116 Mℓ.

Storage reservoir (kℓ) = ADD Eastern Zone (160 mamsl) x 48hrs of storage
= 1557.80 x 2
= 3.116 Mℓ Reservoir

8.4.3 Proposed Reservoir Storage at the Seaview Pumpstation (0 – 50m)

The existing 1.2 Mℓ reservoir/sump at the Seaview Pumpstation has to be augmented to serve the increasing demands on it. Due to site restrictions, an additional reservoir of only 2.5 Mℓ can be accommodated on the site. Total storage will therefore amount to 3.7 Mℓ. It has to satisfy the following demands.

Inland to Greenbushes Reservoir.

The existing 1.2 Mℓ reservoir/sump will continue to serve as a sump for the high lift pumps which supply the inland area by pumping to Greenbushes Reservoir for onward reticulation.

Expansion of the Urban Edge in Seaview

The existing 1.2 Mℓ reservoir/sump will also serve as a sump for pumps to lift the water requirements for the anticipated expansion of the Urban Edge western and eastern zones. Pumps with a delivery of 53.3 ℓ/s to the proposed 2.5Mℓ Upper Seaview Bulk Storage Reservoir at level 160 are to be installed, from where the water will be distributed by gravity to service reservoirs. Provision is being made for additional pumps when required for Zone 3 & 6.

Zone 1 & 4 (0 to 50m) Refer to drawing 8003/011/009

Zone 1

The existing 0.75Mℓ reservoir supplies the lower Western Zone (zone 1) by gravity.

Referring to Chapter 8, Table 14, the ADD of Zone 1 is 412.5kℓ/d. 48 hours of storage requires reservoir storage of 825kℓ.

Table – 16 Reflects the available storage and required at the Beachview reservoir (Zone 1)

Required gravity reservoir storage	0.825Mℓ
Existing dedicated storage for the gravity zone 1	0.750Mℓ
Shortfall	0.075Mℓ

Zone 4

The proposed 2.5Mℓ reservoir is to supply the lower Eastern Zone (zone 4) by gravity. The existing 700kℓ storage reservoir at Kini Bay will be abandoned and demolished due to the reservoir being beyond repair.

Referring to Chapter 8, Table 14, the ADD of Zone 4 is 1530kℓ/d. 48 hours of storage requires reservoir storage of 3060kℓ.

It is therefore proposed that the existing 1.2Mℓ reservoir/sump will only serve as a sump for the pumping system and the proposed 2.5 Mℓ reservoir to be dedicated to supplying Zone 4 by gravity. Any storage shortfalls will be supplied from the 1.2Mℓ reservoir/sump.

Table – 17 Reflects the available and required storage at the Seaview reservoir complex (Zone 4)

Dedicated pump sump storage	1.200Mℓ
Required gravity reservoir storage	3.060Mℓ
Proposed dedicated storage for the gravity zone 4	2.500Mℓ
Shortfall (to be taken up by 1.2 Mℓ Res)	0.560Mℓ

As the total storage requirement for the Zone 1 and 4 is 3.885 Mℓ and the proposed dedicated storage is 3.250Mℓ with an additional 1.200 Mℓ available for the dedicated pump sump and emergencies, there would be sufficient storage to cater for the future requirements below the 50m contour as detailed on drawing 8003/011/009. Note that the cut-out level of the pumps will be easily adjustable if it is found necessary for the dedicated storage.

Demolishing existing Zone 4 reservoirs

With the construction of the 2.50Mℓ Seaview reservoir there would now be sufficient storage and the Lower Seaview Reservoir site, 3 Nº brick reservoirs and Kini Bay reservoir, should be demolished.

8.4.4 Proposed Upper Seaview Reservoir Storage (50 – 130m)

The existing 1.2Mℓ reservoir/sump will serve as a sump for the pumping system to elevate the water to the proposed 2.5 Mℓ reservoir at the 160 contour to be dedicated to supplying Zone 2 & 5 by gravity.

Zone 2 & 5 (50 to 130m) Refer to drawing 8003/011/009

The proposed 2.5Mℓ upper Seaview reservoir is to supply Zone 2 & 5 by gravity. The existing 120kℓ storage reservoir will be abandoned and demolished due to the reservoir being beyond repair.

Referring to Chapter 8, Table 14, the ADD of Zone 2 and 5 is 2272.8kℓ/d. 48 hours of storage requires reservoir storage of 4546kℓ.

Table – 18 Reflects the available storage and required at the proposed upper Seaview Reservoir ()

Required gravity reservoir storage	4.546Mℓ
Proposed dedicated storage for the gravity zone 2 & 5	2.500Mℓ
Future Shortfall	2.046Mℓ

8.5 PUMP STATION

8.5.1 Proposed Pump Station

The pump station is to be situated within the existing Seaview pump station where there will be sufficient space once the augmentation of the pump station by C A du Toit has been completed. The pump station will cater for both the eastern zones 5 + 6 and western zones 2 + 3. This pump station will be equipped with one standby and one duty pump set for Zones 2 and 5. Sufficient space and the necessary blanked off suction connections would be provided in the pump station for 2 additional pump sets for the future Zones 3 and 6.

8.5.2 Pumping Flow Rate

Ultimate Average Daily Demand

Eastern Zones 5	715.0 kl
Western Zone 2	1557.8 kl
Total:	2272.8 kl

The ultimate pumping rate would be = ADD(160 mamsl) x ADPW x Lf_r x Lo
= 2272.8 x 1.6 x 1.15 x 1.1
= 4600 kl/(24hr day) (53.24 ℓ/s)

8.5.3 Proposed Pump Station

The pump-station will draw water from the existing 1.2Mℓ sump/reservoir and elevate the potable water to the proposed 2.5Mℓ Upper Seaview Bulk Storage reservoir located north of the pump station. The static lift between the pump station and reservoir is approximately 82m (160 - 78). The pump station will be supplied with one standby and one duty pump set, with two additional blanked off suctions and plinths for a future installation for the western zone 3. The motor capacity for the pumps is approximately 75kW each.

8.5.4 Centrifugal Pumps - Pump Parameters

Table – 19 Reflects the flows, levels and head loss at the proposed pump station

Description	Design
Q = Proposed Flow	0.021 m^3/s
Q = Future Flow	0.053 m^3/s
Upper Seaview reservoir inlet I.L (2.5Ml)	160.2
Lower Seaview pump station delivery C.L.	78
F.S.L. 1.2Ml Seaview Pumpstation Reservoir	81.5
L.W.L. 1.2Ml Lower Seaview Reservoir	79.5
Pipe Diameter (Rising Main)	250 uPVC & steel
Static head (Min)	78.7
Static head (Max)	80.7
Suction Head Loss	0.427
Delivery Head Loss	1.821
Pumping Main Head Loss	11.083
Total Head Loss	13.331
Total pumping head (Min)	92.031
Total pumping head (Max)	94.031

8.5.5 Pump

- 1 x Duty and 1 x Standby KSB multistage WKLn 125/3 pump for the following duty :-
- 57 liters / sec to a total Dynamic Head of 92.04 meters.
- Each pump to achieve the full duty, pumping over a 24 hour working day.
- Pumps are driven using direct couple to achieve the required duty.
- Electric motors of approximately 75 kW, 1450r/min, 400 volts, 4-pole, 3-phase will be required and will start preferably Direct-On-Line [ESKOM may not allow this]
- The 200mm ø suction pipe-work of the pumps will be equipped with a gate valve.
- The 200mm ø delivery pipe-work consists of a 16 bar isolating non slam swing non-return valve, Bermad control valve complete with pilot and limit switches and a gate valve fitted with limit switches to prevent the pumps accidentally starting against a closed valve.
- The two pump delivery branches will come into a common 250mm ø manifold.
- The 250mm ø pumping main will have an air release valve within the pump station.
- Once energised, after the pump has been started and reached full speed, the on-board solenoid control will shut off and the water column will gradually start to move up the pump main.

8.5.6 Electrical and Telemetry Controls

- Float or probe switch in the 1.2 Mℓ reservoir/sump will prevent any pump from running if the level is too low.
- Pump controls are to be built into the main board. This board is to be located inside the Pump station.
- Each pump to be equipped with an Emergency Stop Mushroom Head isolator at the pump.
- 3-way selector switch for pumps duty selection :- [Pump 1 / Off / Pump 2]
- Thermal overloads, current monitors
- Direct-On-Line starting for 2 x 75 kW motors. Once a motor has reached run condition, the solenoid on the pump control valve is energised.
- Auto start / stop and power failure stop :-
  - The duty pump starts and stops automatically on a signal from the Aptech Radio Telemetry System.
  - Under normal Shut-Down the pump control valve will be de-energised and start venting back and the water column will gently come to a stop.
  - In the event of a power failure, the pump will come to a *"crash-stop" and* the surge in the pipeline must be dealt with by the pipeline and pipeline check valves - 10 bar surge anticipator valves available.
- Manual-Off-Auto Selector :-
  - Push buttons [Start & Stop] control
  - Current monitor, thermal overload controls all still apply in Manual
  - Once the pump has stopped, it can only be re-started by pressing the button again.
- One ammeter, one mcb, one hour meter per pump

8.6 PUMP STATION SUCTION PIPE-WORK

8.6.1 Suction Pipe-work between 1.2Mℓ Reservoir / Sump and Pump Station

The suction pipe work between the 1.2Mℓ reservoir and the pump station is required to cater for a flow of 20.77 ℓ/s proposed pump station and 53.25 ℓ/s in the future. The suction main is a 600 mm ø pipe over a total distance of 2m in length and a manifold of 450mm ø and 250mm ø pipes to the pumps.

Table – 20 Reflects the proposed suction pipework at the existing reservoir / pump sump

Description	Units	Section 1 650mm dia. Suction	Section 2 450mm dia. Manifold	Section 3 250mm dia. Inlet	Formulae
Q = Flow	m^3/s	0.053	0.053	0.053	
Pipe Diameter ND and class	mm	600	450	250	
Pipe material		galv. Steel	galv. Steel	galv. Steel	
d = ID	m	0.564	0.416	0.224	
A = Area of pipe	m^2	0.250	0.136	0.039	
V = Velocity	m/s	0.212	0.390	1.345	$Q = VA$
L = Length of pipeline section	m	2	6	3	
C_H = Hazen-Williams coeff.		120	120	120	
Pipe friction loss	m	0.000	0.003	0.029	$h_f = l\left(\frac{3{,}59Q}{C_H d^{2{,}63}}\right)^{1{,}852}$
Energy head	m	0.002	0.008	0.092	
K = Minor loss coefficient		1.700	1.000	5.400	$h_f = \frac{V^2}{2g}$
Minor losses	m	0.004	0.008	0.498	
Total losses	m	0.004	0.011	0.526	
Sum of losses			0.541		

Table – 21 Reservoir / pump sump Levels

Friction and minor losses - suction line	0.541
F.S.L. 1.2Ml Reservoir	81.50
F.F.L. 1.2Ml Reservoir	77.00
Pump Station inlet C.L	78.00
Reservoir Static head (Min)	1.50m
Reservoir Static head (Max)	3.50m

8.7 RISING MAIN FROM THE SEAVIEW PUMP STATION TO THE UPPER ZONE RESERVOIRS

8.7.1 Flow Rate

Pumping flow rate for Zone 2 & 5 (160 mamsl) = ADD(160 msl) x ADPW x Lf_r x Lo
= (715 + 1557.8) x 1.6 x 1.15 x 1.1
= 4.600 Mℓ/(24hr day) (53.24 ℓ/s)

8.7.2 Delivery Pipe-work between Pump Station and Rising Main

A pipeline is required to deliver 57.46 ℓ/s from the proposed new pumpstation at the Seaview site to the 2.5Mℓ Upper Seaview Bulk Storage Reservoir at level 160 mamsl.

The delivery pipe work in the pump station is required to cater for a flow of 53.24 ℓ/s. The manifold is to be 200 mm ø and 250 mm ø galvanised steel piping over a total distance of 10m in length.

Table – 22 Reflects the proposed delivery pipework at existing reservoir / pump sump

Description	Units	Section 1 200mm dia. Delivery	Section 2 250mm dia. Manifold	Formulae
Q = Flow	m^3/s	0.05324	0.05324	
Pipe Diameter ND and class	mm	200 4.8mm	250 4.8mm	
Pipe material		galv. Steel	galv. Steel	
d = ID	m	0.210	0.264	
A = Area of pipe	m^2	0.034	0.055	
V = Velocity	m/s	1.544	0.976	$Q = VA$
L = Length of pipeline section	m	4	6	
C_H = Hazen-Williams coeff.		120	120	
Pipe friction loss	m	0.053	0.026	$h_f = l\left(\frac{3{,}59Q}{C_H d^{2{,}63}}\right)^{1{,}852}$
Energy head	m	0.122	0.049	
K = Minor loss coefficient		8.870	1.600	$h_f = \frac{V^2}{2g}$
Minor losses	m	1.078	0.078	
Total losses	m	1.131	0.104	
Sum of losses			1.235	

8.7.3 Proposed Rising Main

The rising main from the pump station to the 2.5Mℓ Upper Seaview Bulk Storage Reservoir at level 160 is required to cater for a flow 53.24 ℓ/s. The rising main is to be a 315 mm ø class 12 pipeline over a total distance of 1630m in length.

Table – 23 Reflects the proposed pumping main pipework

Description	Units	Section 1 315mm dia. Pipeline	Section 2 315mm dia. Pipeline	Section 3 250mm dia. Inlet	Formulae
Q = Flow	m^3/s	0.05324	0.05324	0.05324	
Pipe Diameter ND and class	mm	315 class 16	315 class 12	250	
Pipe material		uPVC	uPVC	galv. Steel	
d = ID	m	0.277	0.286	0.210	
A = Area of pipe	m^2	0.060	0.064	0.034	
V = Velocity	m/s	0.883	0.829	1.544	$Q = VA$
L = Length of pipeline section	m	630	1000	5	
C_H = Hazen-Williams coeff.		120	120	120	
Pipe friction loss	m	2.154	2.926	0.067	$h_f = l\left(\frac{3{,}59Q}{C_H d^{2{,}63}}\right)^{1{,}852}$
Energy head	m	0.040	0.035	0.122	
K = Minor loss coefficient		2.100	0.920	12.000	$h_f = \frac{V^2}{2g}$
Minor losses	m	0.084	0.032	1.459	
Total losses	m	2.238	2.958	1.525	
Sum of losses			6.721		

Table – 24 Reservoir / pump sump Levels

Friction and minor losses - suction line	0.541
Friction and minor losses - delivery line	1.235
Friction and minor losses – pumping main	6.721
Total minor losses	8.50
F.S.L. 2.5Ml Reservoir (Proposed)	162.00
L.W.L. 1.2 Ml Reservoir (Existing)	78.00
Static Head	84.00
Total head	92.50m

8.8 GRAVITY BULK SUPPLY PIPELINE FROM 2.5Mℓ RESERVOIR (160MAMSL)

8.8.1 Proposed Bulk Gravity Pipeline

A bulk gravity supply pipeline is required from the 2.5Mℓ Bulk Supply reservoir situated along the Seaview access road with a TWL of 160mamsl to transfer the water to above the Seaview pumping complex where the flow splits to Zone 2 and Zone 5.

8.8.2 Flow requirements

The ADD of the area of supply of the pipeline is as detailed below:

From 2.5Ml Reservoir to Tee above Seaview pumping complex

Gravity Flow = ADD x PF_{phb} x Lf_r x Lo
= 2272.8 x 2.5 x 1.15 x 1.1
= 7188 kℓ/ (24hr day) (83.19 ℓ/s)

From the Tee above Seaview pumping complex to Zone 2

Gravity Flow = ADD x PF_{phb} x Lf_r x Lo
= 715 x 2.5 x 1.15 x 1.1
= 2261 kℓ/ (24hr day) (26.17 ℓ/s)

From the Tee above Seaview pumping complex to Zone 5

Gravity Flow = ADD x PF_{phb} x Lf_r x Lo
= 1557.8 x 2.5 x 1.15 x 1.1
= 4927 kℓ/ (24hr day) (57.02 ℓ/s)

The pipeline will be required to deliver the Average Day Peak Week flow plus the conveyance/ reticulation losses and an allowance for other users.

8.8.3 Detailed Analysis for the Proposed Gravity Main from 2.5Mℓ Reservoir (160mamsl)

The Gravity main is required to be a 350mmø class 12 uPVC pipe from the proposed 2.5 Mℓ Upper Seaview reservoir 160mamsl to connect into the existing and future pipe-work.

Table – 25 Reflects the proposed gravity pipework

Description	Units	Section 1 350mm dia. Res Outlet	Section 2 350mm dia. Pipeline	To Zone 2 200mm dia. Pipeline	To Zone 5 315mm dia. Pipeline	Formulae
Q = Flow	m^3/s	0.08319	0.08319	0.02617	0.05702	
Pipe Dia and class	mm	350	350 class 12	200 class 12	315 class 12	
Pipe material		Steel	uPVC	uPVC	uPVC	
d = ID	m	0.350	0.322	0.177	0.279	
A = Area of pipe	m^2	0.096	0.081	0.025	0.061	
V = Velocity	m/s	0.865	1.021	1.063	0.933	$Q = VA$
L = Length of pipeline	m	5	1300	2450	500	
C_H = Hazen-Williams coeff.		120	130	130	120	
Pipe friction loss	m	0.013	4.208	17.175	1.874	$h_f = l\left(\frac{3{,}59Q}{C_H d^{2{,}63}}\right)^{1{,}852}$
Energy head	m	0.038	0.053	0.058	0.044	
K = Minor loss coefficient		3.550	0.000	0.000	10.900	$h_f = \frac{V^2}{2g}$
Minor losses	m	0.135	0.000	0.000	0.483	
Total losses	m	0.148	4.208	17.175	2.357	
Sum of losses		4.355				

8.9 GRAVITY BULK RETICULATION PIPELINE FROM 2.5Mℓ RESERVOIR AT SEAVIEW COMPLEX (79.5MAMSL)

8.9.1 Proposed Bulk Gravity Pipeline

A bulk gravity supply pipeline is required from the 2.5Mℓ Bulk Supply reservoir situated at the Seaview complex with a TWL of 79.5 to transfer the water to Zone 1 and Zone 4.

8.9.2 Flow requirements

The ADD of the area of supply of the pipeline is as detailed below:

From 2.5Ml Reservoir at Seaview Complex to Zone 1 & 4

Gravity Flow = ADD (81.5 Zone) x Lf_r x Lo x PF_{sm}
= 1943 x 1.15 x 1.1 x 2.5
= 6.143 Mℓ/(24hr day) (71.11 ℓ/s)

Detailed Analysis for the Proposed Gravity Main from 2.5Mℓ Reservoir (79.5mamsl)

The Gravity main is required to be a 350mmø class 12 uPVC pipe from the proposed 2.5 Mℓ reservoir at the Seaview complex to connect into the existing and future pipe-work below the reservoir. The design flow is 71.11 ℓ/s at 0.88 m/s over a distance of 330m.

Table – 26 Reflects the proposed gravity pipework

Description	Units	Section 1 350mm dia. Pipeline	Section 2 355mm dia. Pipeline		Formulae
Q = Flow	m^3/s	0.07111	0.07111		
Pipe Diameter ND and class	mm	350	355 class 9		
Pipe material		Steel	uPVC		
d = ID	m	0.350	0.322		
A = Area of pipe	m^2	0.096	0.081		
V = Velocity	m/s	0.739	0.873		$Q = VA$
L = Length of pipeline section	m	2	330		
C_H = Hazen-Williams coeff.		130	130		
Pipe friction loss	m	0.003	0.799		$h_f = l\left(\frac{3{,}59Q}{C_H d^{2{,}63}}\right)^{1{,}852}$
Energy head	m	0.028	0.039		
K = Minor loss coefficient		2.100	1.920		$h_f = \frac{V^2}{2g}$
Minor losses	m	0.058	0.075		
Total losses	m	0.062	0.873		
Sum of losses			0.935		

8.10 GRAVITY BULK PIPELINE FROM GREENBUSHES RESERVOIR TO CHELSEA RESERVOIR

8.10.1 Existing Infrastructure

The present situation and proposals are fully set out in the Seaview Bulk Water Planning Report of June 2005. The following is a summary.

Greenbushes Reservoir of 24.95Mℓ capacity has a top water level of 264.19 mamsl and is situated on the highest point in the area. The area has no significant high or low points. The levels are up to about 230m amsl near Greenbushes Reservoir but further north they range generally between 170m and 210m. This means that the whole area can be reticulated from the reservoir provided the losses in the reticulation can be limited.

There are no high points in the vicinity, inside or outside the Seaview area, close to the probable main area of development and at a suitable level for a reservoir. This means that the whole area must be reticulated from Greenbushes reservoir

There are two gravity pipelines, of 525mm and 375mm diameter, to the supply area but the 525mm line is dedicated to an emergency supply to the Chelsea Reservoir, which has a function outside the area of concern.

With the likely developments inland up to and beyond the Cape Road it is now necessary to augment the reticulation of water to this area. In order to serve consumers up to the 210m contour with a minimum pressure of 30m, allowing for losses in the sub-reticulation (10m) and for the reservoir being say half full (2m), it is necessary to limit losses in the new pipeline to about 12m.

8.10.2 Proposed Gravity Main

The Gravity main is required to be a 750mm ø steel pipeline 3500m long from the Greenbushes reservoir to the existing pipe-work at the Chelsea Reservoir site. The further reticulation is being done as a separate project.

The reservoir will be broken into and a 600mm ø galvanised steel pipe inserted to serve as a new outlet. It will be fitted with a gate valve and a blanked off Tee for a future connection before being enlarged to 750mm ø. The flows of the old 375mm ø and new 750mm ø lines are as follows for a head loss of 12m.

Table – 27 Reflects the proposed gravity pipework

Description	Units	Section 1 Existing 300mm dia. Outlet	Section 2 Existing 375mm dia. Pipeline	Section 1 600mm dia. Outlet	Section 2 750mm dia. Pipeline	Formulae
Q = Flow	m^3/s	0.082	0.082	0.655	0.655	
Pipe Diameter ND and class	mm	300	375	600	750 class 9	
Pipe material		Steel	FC	Steel	Steel	
d = ID	m	0.300	0.312	0.600	0.724	
A = Area of pipe	m^2	0.071	0.076	0.283	0.412	
V = Velocity	m/s	1.160	1.072	2.316	1.591	$Q = VA$
L = Length of pipeline section	m	4	3500	4	3500	
C_H = Hazen-Williams coeff.		120	135	120	135	$h_f = l\left(\frac{3{,}59Q}{C_H d^{2{,}63}}\right)^{1{,}852}$
Pipe friction loss	m	0.021	11.994	0.033	9.324	
Energy head	m	0.069	0.059	0.273	0.129	$h_f = \frac{V^2}{2g}$
K = Minor loss coefficient		3.250	0.700	3.250	0.700	
Minor losses	m	0.223	0.041	0.889	0.090	
Total losses	m	0.243	12.035	0.922	9.414	
Sum of losses			12.278		10.336	

This pipeline will increase the peak flow delivered into the area from 82 ℓ/s by 655 ℓ/s to 737 ℓ/s. Using a peak factor of 3.5 for reticulation this amounts supplying an average of 18 200 Mℓ/day into the area. We are not concerned about the high velocity in the pipeline which slightly exceeds the maximum pipeline velocity of 1.5 m/s of the Design Criteria.

8.10.3 Reticulation from the Greenbushes to Chelsea gravity main.

The planner of any reticulation from this main should take the limitations listed above and in the Planning Report of June 2005 into account.

8.11 ACCESS ROAD

A 3m wide gravel access road is required at the 2.5Ml reservoir at upper Seaview 160mamsl.

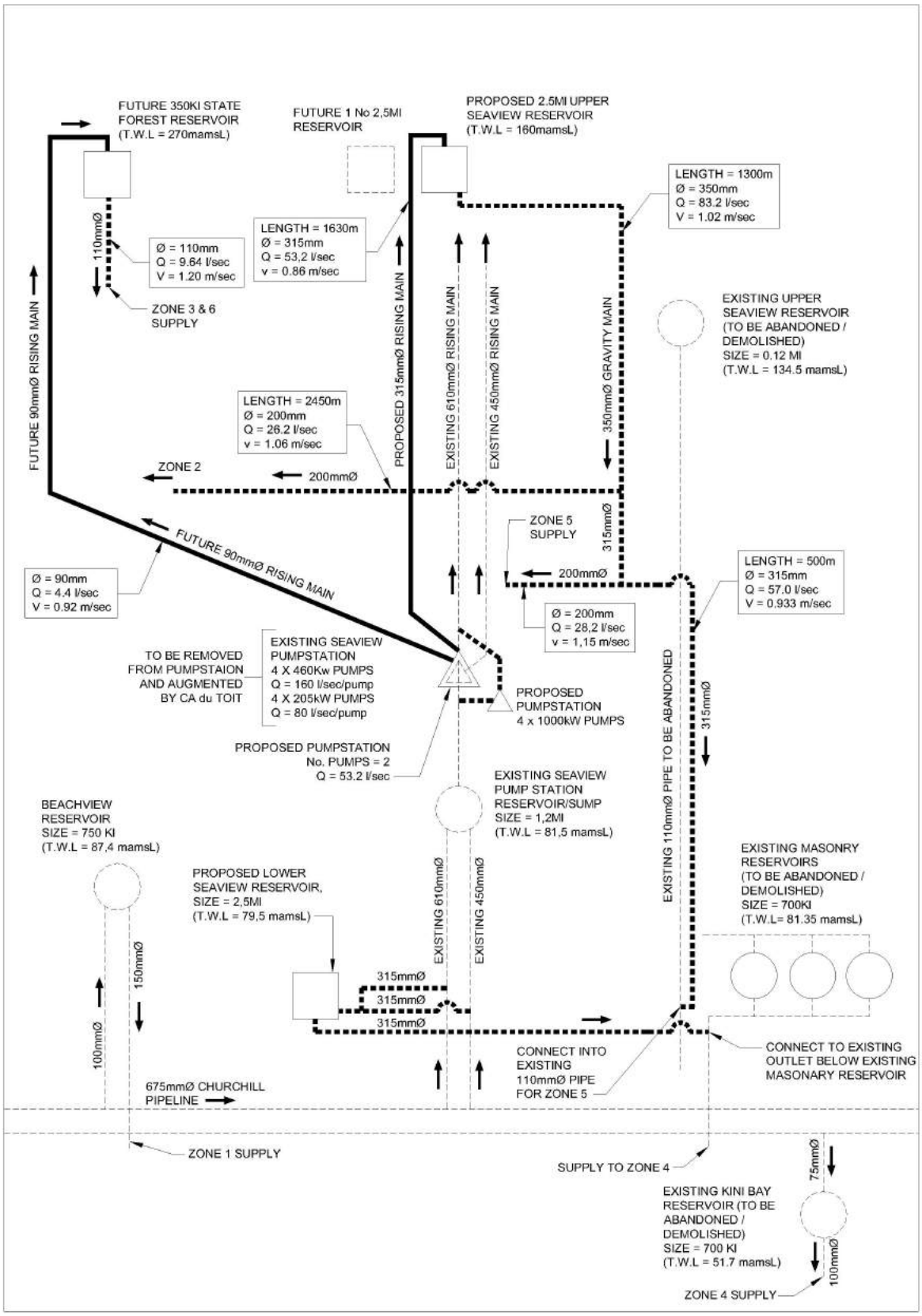
8.12 POWER SUPPLY

There is an existing power supply at Lower Seaview pump station. NMBM would be contacted to determine whether there is spare capacity for the proposed requirements.

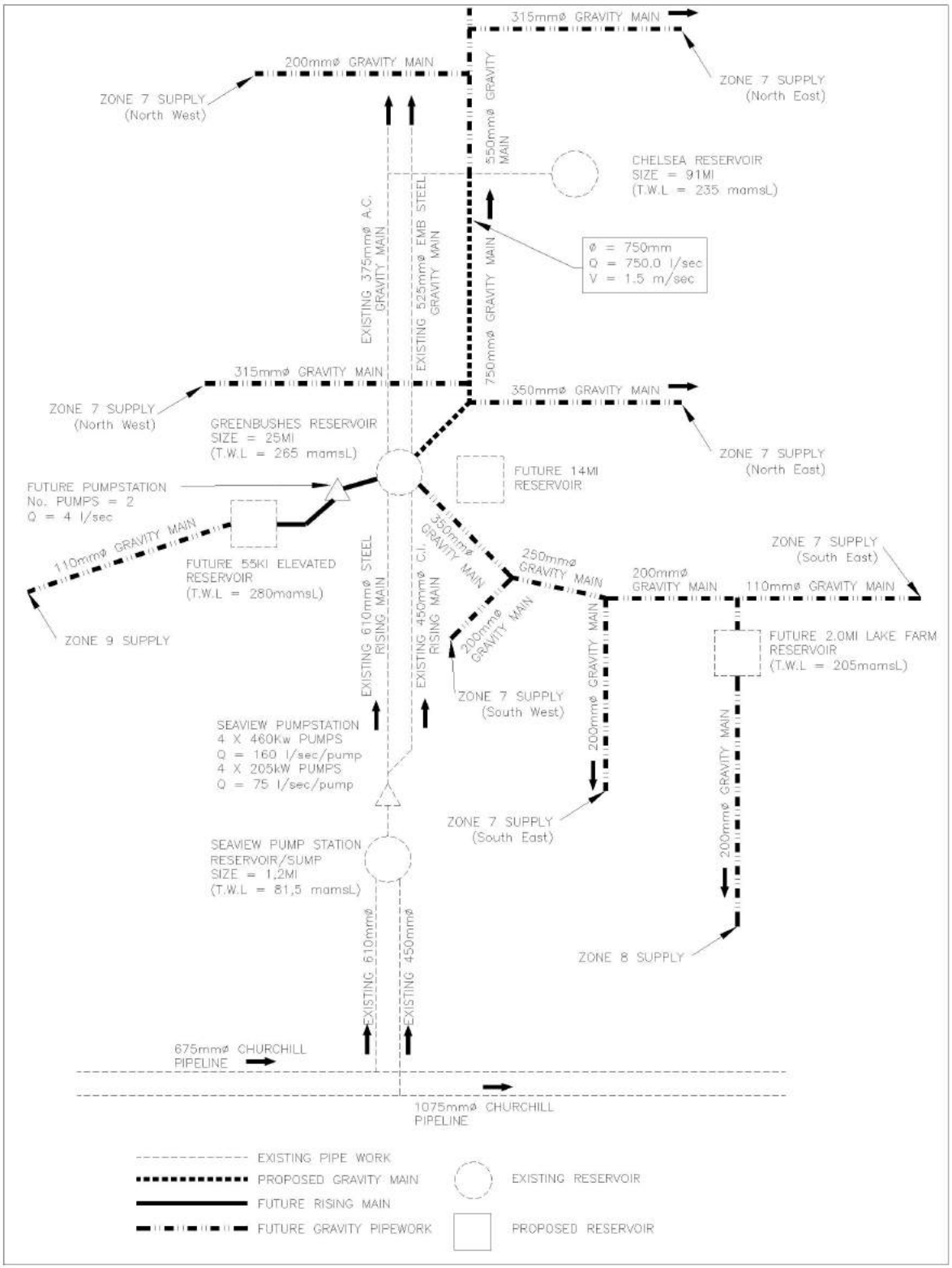
8.13 OFFICE AND STORE

The works will utilise the existing office and store.

The schematic diagram reflects the existing and proposed infrastructure for the Seaview Supply Area.



The schematic diagram reflects the existing and proposed infrastructure for the Greenbushes Supply Area.



8.14 BUDGET COST ESTIMATE

Table - 28 reflects the budget cost estimate for the Seaview Bulk Water Supply – Phase 1.

	DESCRIPTION	AMOUNT	% of Total Cost
	Phase 1a		
a	300mm and 200mm ø interconnecting pipe-work between existing pipeline and proposed reservoir / pump sump (25m)	R 450 000.00	1.2 %
b	300mmø interconnecting pipe-work between proposed reservoir / pump sump and existing pump Station (35m)	R 250 000.00	0.7 %
c	Construction of pump station (53 l/s)	R 1 200 000.00	3.3 %
d	Interconnecting pipework, pumps and motors	R 1 600 000.00	4.4 %
e	Construction of 2.5 Mℓ clear water reservoir / pump sump	R 4 500 000.00	12.3 %
f	Reservoir pipework and chambers	R 300 000.00	0.8 %
g	Construction of 315mmø class 16 and 12 uPVC rising main (1630m) from pumpstation to 2.5Ml reservoir	R 1 010 000.00	2.7 %
h	Construction of 2.5Mℓ clear water storage at 160 mamsl	R 4 500 000.00	12.3 %
i	Reservoir pipework and chambers	R 300 000.00	0.8 %
j	Construction of 350mmø class 12 uPVC gravity main (1500m) from 2.5Ml reservoir to Tee above P.S.	R 1 400 000.00	3.8 %
k	Construction of 250mmø class 12 uPVC gravity main (2720m) from Tee above P.S. to Zone 2	R 1 400 000.00	3.8 %
l	Construction of 315mmø class 12 uPVC gravity main (442m) from Tee above P.S. to existing brick reservoir connection	R 640 000.00	1.7 %
m	Access Road	R 1 000 000.00	2.7 %
n	Fencing	R 400 000.00	1.1 %
o	Electrical	R 450 000.00	1.2 %
	Sub - Total	R 19 400 000.00	52.8 %
	Preliminary and General 20%	R 3 880 000.00	10.6 %
	Sub-Total	R 23 280 000.00	63.4 %
	Escalation during construction (12months @1.0% per month)	R 2 793 600.00	7.6 %
	Sub-Total	R 26 073 600.00	71.0 %
	Contingencies 10%	R 2 607 360.00	7.1 %
	Sub-Total	R 28 680 960.00	78.1 %
	VAT @ 14%	R 4 015 334.40	10.9 %
	Construction Sum (Incl. VAT)	**R 32 696 294.40**	89.0 %
	Primary Fee (R10,000,000 to R25,000,000)	R 975 000.00	2.7 %
	Secondary Fee (R18,049,680 - R10,000,000) x 8%	R 1 494 476.80	4.1 %
	Additional Fees: reinforced concrete (R3 500 000)		0.0 %
	Primary Fee (R3,250,000 to R9,450,000)	R 50 000.00	0.1 %
	Secondary Fee (R3,500,000 - R1,000,000) x 5%	R 125 000.00	0.3 %
	Sub-Total	R 2 644 476.80	7.2 %
	Category Factor of 1,0		0.0 %
	Total of % Based Professional Fees	R 2 644 476.80	7.2 %
	Disbursements (Time based, travel, printing, etc)	R 90 000.00	0.2 %
	Site Supervision (R60,000 x 12 Months)	R 720 000.00	2.0 %
	Land survey, Environmental and Geotechnical requirements	R 85 200.00	0.2 %
	Sub-Total of Fees and Disbursements	R 3 539 676.80	9.6 %
	VAT	R 495 554.75	1.3 %
	Total Professional Fees Estimate (Incl. VAT)	**R 4 035 231.55**	11.0 %
	Total Project Budget Estimate (Incl. VAT)	**R 36 731 525.95**	100.0 %

Table - 29 reflects the budget cost estimate for the Greenbushes Reservoir to Chelsea Reservoir Gravity Main.

DESCRIPTION		Amount	% OF TOTAL COST
Phase 1a			
a	750mmø Steel gravity pipeline (3600m) Internal Dia = 700mm	R 16 500 000.00	42.8 %
b	Interconnecting pipe-work at Greenbushes reservoir and Chelsea off-take	R 1 000 000.00	2.6 %
c	Pipe Jacking and sleeve (100m)	R 4 500 000.00	11.7 %
Sub-Total		R 22 000 000.00	57.1 %
Preliminary and General 20%		R 4 400 000.00	11.4 %
Sub-Total		R 26 400 000.00	68.5 %
Escalation during construction (6 months @ 1.0% per month)		R 1 584 000.00	4.1 %
Sub-Total		R 27 984 000.00	72.6 %
Contingencies 10%		R 2 798 400.00	7.3 %
Sub-Total		R 30 782 400.00	79.9 %
VAT @ 14%		R 4 309 536.00	11.2 %
Construction Sum (Incl. VAT)		**R 35 091 936.00**	91.0 %
Primary Fee (R10,000,000 to R25,000,000)		R 975 000.00	2.5 %
Secondary Fee (R18,049,680 - R10,000,000) x 8%		R 1 662 592.00	4.3 %
Additional Fees: reinforced concrete (R750 000)			0.0 %
Primary Fee (R400,000 to R1,000,000)		R 20 000.00	0.1 %
Secondary Fee (R750,000 - R400,000) x 5%		R 17 500.00	0.0 %
Sub-Total		R 2 675 092.00	6.9 %
Category Factor of 1,0		R 0.00	0.0 %
Total of % Based Professional Fees		R 2 675 092.00	6.9 %
Disbursements (Time based, travel, printing, etc)		R 50 000.00	0.1 %
Site Supervision (R45,000 x 6 Months)		R 270 000.00	0.7 %
Land survey, Environmental and Geotechnical requirements		R 35 000.00	0.1 %
Sub-Total of Fees and Disbursements		R 3 030 092.00	7.9 %
VAT		R 424 212.88	1.1 %
Total Professional Fees Estimate (Incl. VAT)		**R 3 454 304.88**	9.0 %
Total Project Budget Estimate (Incl. VAT)		**R 38 546 240.88**	100.0 %

8.15 ANTICIPATED CASH FLOW

Table - 30 reflects the Anticipated Cash flow for Seaview Pump Station, Rising Main and Reservoirs project.

MONTH	FEES AND DISBURSMENTS	CONSTRUCTION	TOTAL	ACCUMULATIVE
Preliminary Design	904 248	0	904 248	904 248
Design	904 248	0	904 248	1 808 496
Working Drawings	452 124	0	452 124	2 260 620
CONSTRUCTION				
Month 1	135 356	2 656 550	2 791 906	5 052 526
Month 2	135 356	2 656 550	2 791 906	7 844 432
Month 3	135 356	2 656 550	2 791 906	10 636 338
Month 4	135 356	2 656 550	2 791 906	13 428 244
Month 5	135 356	2 656 550	2 791 906	16 220 150
Month 6	135 356	2 656 550	2 791 906	19 012 056
Month 7	135 356	2 656 550	2 791 906	21 803 962
Month 8	135 356	2 656 550	2 791 906	24 595 868
Month 9	135 356	2 656 550	2 791 906	27 387 774
Month 10	135 356	2 656 550	2 791 906	30 179 680
Month 11	135 356	2 656 550	2 791 906	32 971 586
Month 12	135 356	2 656 550	2 791 906	35 763 492
COMPLETION				
	150 708			35 914 200
END DEFECTS LIABILITY PERIOD				
Month 22		817 400	817 400	36 731 600
	4 035 600	32 696 000		

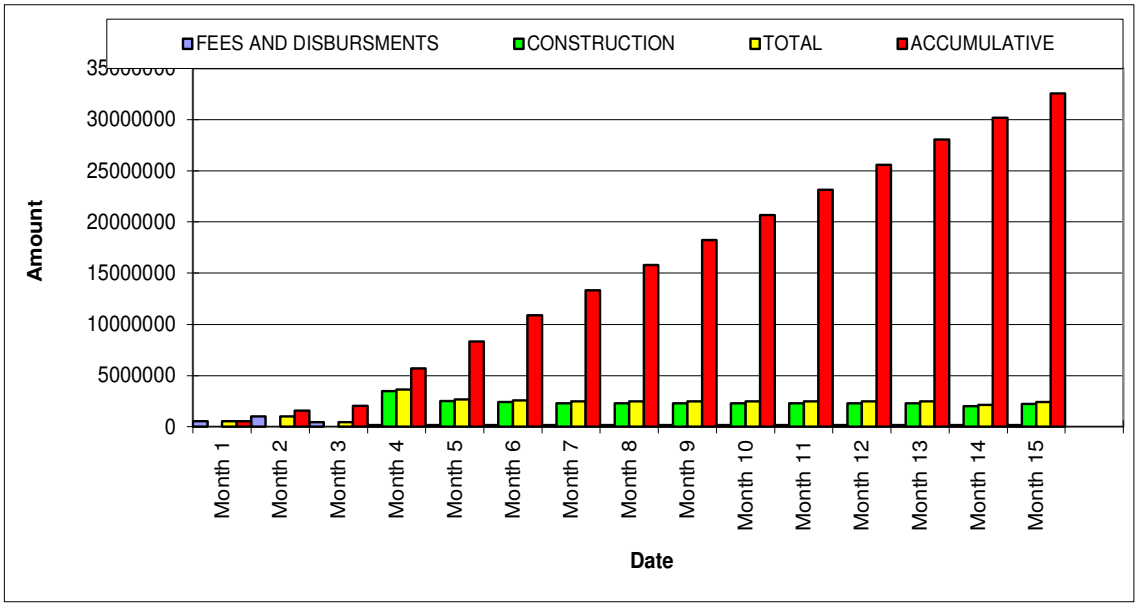
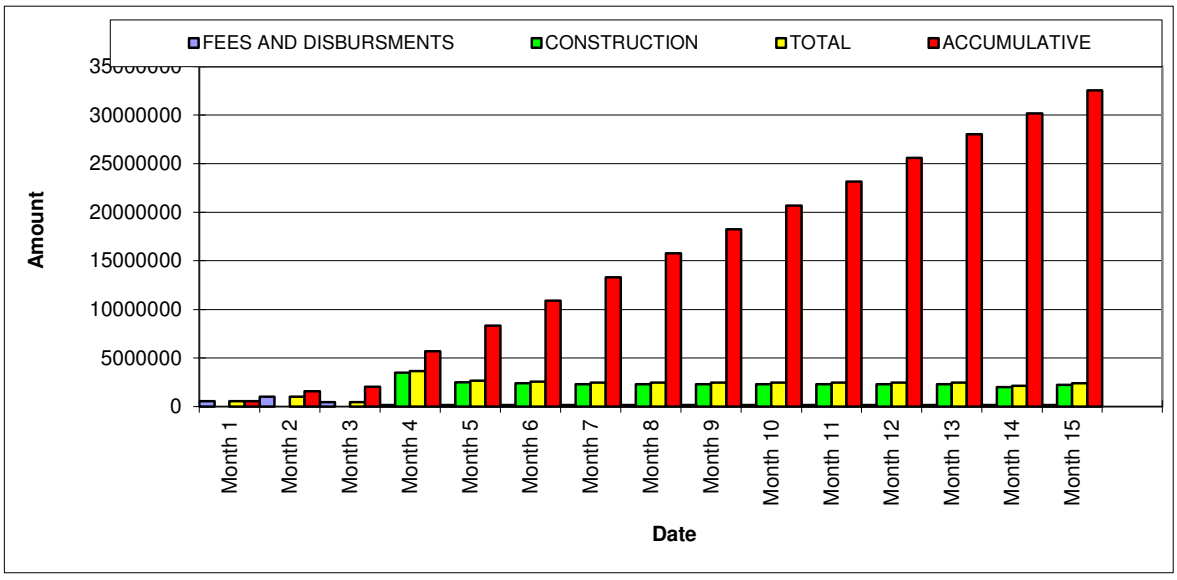


Table - 31 reflects the Anticipated Cash flow for Greenbushes to Chelsea 700mm dia. Gravity Main project.

MONTH	FEES AND DISBURSMENTS	CONSTRUCTION	TOTAL	ACCUMULATIVE
Preliminary Design	914 850	0	914 850	914 850
Design	914 850	0	914 850	1 829 700
Working Drawings	457 425	0	457 425	2 287 125
CONSTRUCTION				
Month 1	84 550	2 851 225	2 935 775	5 222 900
Month 2	84 550	2 851 225	2 935 775	8 158 675
Month 3	84 550	2 851 225	2 935 775	11 094 450
Month 4	84 550	2 851 225	2 935 775	14 030 225
Month 5	84 550	2 851 225	2 935 775	16 966 000
Month 6	84 550	2 851 225	2 935 775	19 901 775
Month 7	84 550	2 851 225	2 935 775	22 837 550
Month 8	84 550	2 851 225	2 935 775	25 773 325
Month 9	84 550	2 851 225	2 935 775	28 709 100
Month 10	84 550	2 851 225	2 935 775	31 644 875
Month 11	84 550	2 851 225	2 935 775	34 580 650
Month 12	84 550	2 851 225	2 935 775	37 516 425
COMPLETION				
	152 475			37 668 900
END DEFECTS LIABILITY PERIOD				
Month 22		877 300	877 300	38 546 200
	3 454 200	35 092 000		



8.16 ANTICIPATED PROGRAM

Table - 32 reflects the Anticipated Program for Seaview Pump Station, Rising Main and Reservoirs project.

ITEM	To Date	Feb 2016	Mar 2016	Apr 2016	May 2016	Jun 2016	Jul 2016	Aug 2016	Sep 2016	Oct 2016	Nov 2016	Dec 2016
Preliminary Design Report												
Approval of Preliminary Design Report												
Survey												
EIA												
Geological Investigation												
Design Report												
Approval of Design Report												
Design and Drawings												
Approval of Design and Drawings												
Approval of Tender Documents												
Advertise Tender and Tender Period												
Adjudication and Award of Tender												
Contractor on site												
Pump Station, Res. & Pipelines Construction period												
Anticipated Cashflow (R x 1000)	1230	30	323	328	323	318	218	2220	2220	2220	2220	2220

ITEM	Jan 2017	Feb 2017	Mar 2017	Apr 2017	May 2017	Jun 2017	Jul 2017	Aug 2017	Sep 2017	Oct 2017	Nov 2017	Dec 2017
P. S, Res. & Pipelines Construction												
Greenbushes to Chelsea Construction period												
Commission Works												
"As Built" Drawings												
Operation and Maintenance Manuals												
Defects Liability Period												
Anticipated Cashflow (R x 1000)	2 220	5 648	5 648	5 648	5 648	5 648	5 648	0	200	0	0	0

ITEM	Jan 2018	Feb 2018	Mar 2018	Apr 2018	May 2018	Jun 2018	Jul 2018	Aug 2018	Sep 2018	Oct 2018	Nov 2018	Dec 2018
Defects Liability Period												
Anticipated Cashflow (R x 1000)	0	0	0	0	0	0	1900	0	0	0	0	0

9. PHASED PROGRAM

9.1 TIMING (PHASES, PROGRAMME)

The following table reflects the implementation programme for the various phases, timing and budget expenditure per financial year.

Table - 33 reflects the Anticipated Program for all Phases

Item	Year 2015	Year 2016	Year 2017	Year 2018	Year 2019	Year 2020	Year 2021	Year 2022	Year 2023	Year 2024	Year 2025
Phase 1											
Phase 2											
Phase 3											
Budget Cost	**R2.2m**	**R17.5m**	**R47.8m**	**R29.0m**	**R14.7m**	**R15.7m**	**R21.4m**	**R25.0m**	**R30.8m**	**R24.3m**	**R 24.0m**

10. PROJECT COST & BUDGET ALLOCATION

Table - 34 reflects the estimated budget cost for all phases

PHASING	SEAVIEW	GREENBUSHES	TOTAL	STAGE
Phase 1	R 36 731 000	R 38 546 000	R 75 277 000	Design
Phase 2a	R 9 350 000	R 12 060 000	R 21 410 000	Planning
Phase 2b	R 5 075 000	R 5 750 000	R 10 825 000	Planning
Phase 2c	R 0	R 19 580 000	R 19 580 000	Planning
Phase 2d	R 0	R 11 400 000	R 11 400 000	Planning
Phase 3a	R 12 200 000	R 68 700 000	R 80 900 000	Planning
Phase 3b	R 14 500 000	R 4 800 000	R 19 300 000	Planning
Phase 3c	R 5 260 000	R 19 200 000	R 24 460 000	Planning
TOTAL	**R 83 116 000.00**	**R 180 036 000.00**	**R 263 152 000.00**	

11. COMPLETION DATE

The completion of the project is dependent on when tenders are awarded and obtaining DEDEA approval.

12. MAINTENANCE PLAN

A complete operation and maintenance manual with a training programme will be supplied in duplicate by the Engineer to the Nelson Mandela Bay Municipality on commissioning of the project.

Nelson Mandela Bay Municipality will be responsible for the operation and maintenance of the proposed infrastructure.

13. SPECIAL PROBLEMS

No special problems are envisaged.

14. DRAWINGS

Drawings issued within this report:

8003/011/001	Locality Plan
8003/011/002	Supply Area Boundaries
8003/011/003	Existing + Future Reservoir Supply Zones
8003/011/004	Existing Water Infrastructure (1 of 2)
8003/011/005	Existing Water Infrastructure (2 of 2)
8003/011/006	Urban Edge
8003/011/007	Development Trends
8003/011/008	Proposed Developments Time Frame
8003/011/009	Existing + Future Reservoir Supply Zones

Drawings issued separately:

8003/011/012	General Site Layout Plan
8003/011/013	Seaview Pumpstaion Site Layout: Existing Infrastructure
8003/011/014	Masonry Resevoirs Site Layout: Existing Infrastructure
8003/011/015	Seaview Site Layout : 2,5Ml Reservoir & Pumpstation
8003/011/016	Masonry Reservoirs Site Layout: Interconnecting Pipework
8003/011/017	Clarendon Marine Reservoirs Site Layout: Proposed Reservoir
8003/011/018	Rising Main and Gravity Main: Layout Plan (Sheet 1 of 2)
8003/011/019	Rising Main and Gravity Main: Layout Plan (Sheet 2 of 2)
8003/011/020	315mm ø uPVC Gravity Main: Plan & Long Section (Sheet 1 of 2)
8003/011/021	315mm ø uPVC Gravity Main : Plan & Long Section (Sheet 2 of 2)
8003/011/022	315mm dia uPVC Rising Main: Plan & Long Section (Sheet 1 of 3)
8003/011/023	315mm dia uPVC Rising Main: Plan & Long Section (Sheet 2 of 3)
8003/011/024	315mm dia uPVC Rising Main: Plan & Long Section (Sheet 3 of 3)
8003/011/025	315mm ø uPVC Gravity Main: Plan & Long Section (Sheet 1 of 8)
8003/011/026	315mm ø uPVC Gravity Main: Plan & Long Section (Sheet 2 of 8)
8003/011/027	315mm ø uPVC Gravity Main : Plan & Long Section (Sheet 3 of 8)
8003/011/028	315mm ø uPVC Gravity Main: Plan & Long Section (Sheet 4 of 8)
8003/011/029	315mm ø uPVC Gravity Main: Plan & Long Section (Sheet 5 of 8)
8003/011/030	315mm ø uPVC Gravity Main: Plan & Long Section (Sheet 6 of 8)
8003/011/031	315mm ø uPVC Gravity Main: Plan & Long Section (Sheet 7 of 8)
8003/011/032	315mm ø uPVC Gravity Main: Plan & Long Section (Sheet 8 of 8)
8003/011/033	2.5Ml Reservoir: Layout Plan
8003/011/034	2.5Ml Reservoir: Sections of 2.5Ml Reservoir
8003/011/035	2.5Ml Reservoir: Underdrain Details
8003/011/036	2.5Ml Reservoir: Inlet Control Chamber
8003/011/037	2.5Ml Reservoir: Outlet Details
8003/011/038	2.5Ml Reservoir: Scour and Overflow
8003/011/039	2.5Ml Reservoir: Concrete Sections and Details
8003/011/040	2.5Ml Reservoir: Ladder Details
8003/011/041	Clear Water Pumpstation: Layout and Details (Sheet 1 of 2)
8003/011/042	Clear Water Pumpstation: Layout and Details (Sheet 2 of 2)
8003/011/043	Clear Water Pumpstation: Details
8003/011/044	Clear Water Pumpstation: Pipework Details (Sheet 1 of 2)
8003/011/045	Clear Water Pumpstation: Pipework Details (Sheet 2 of 2)

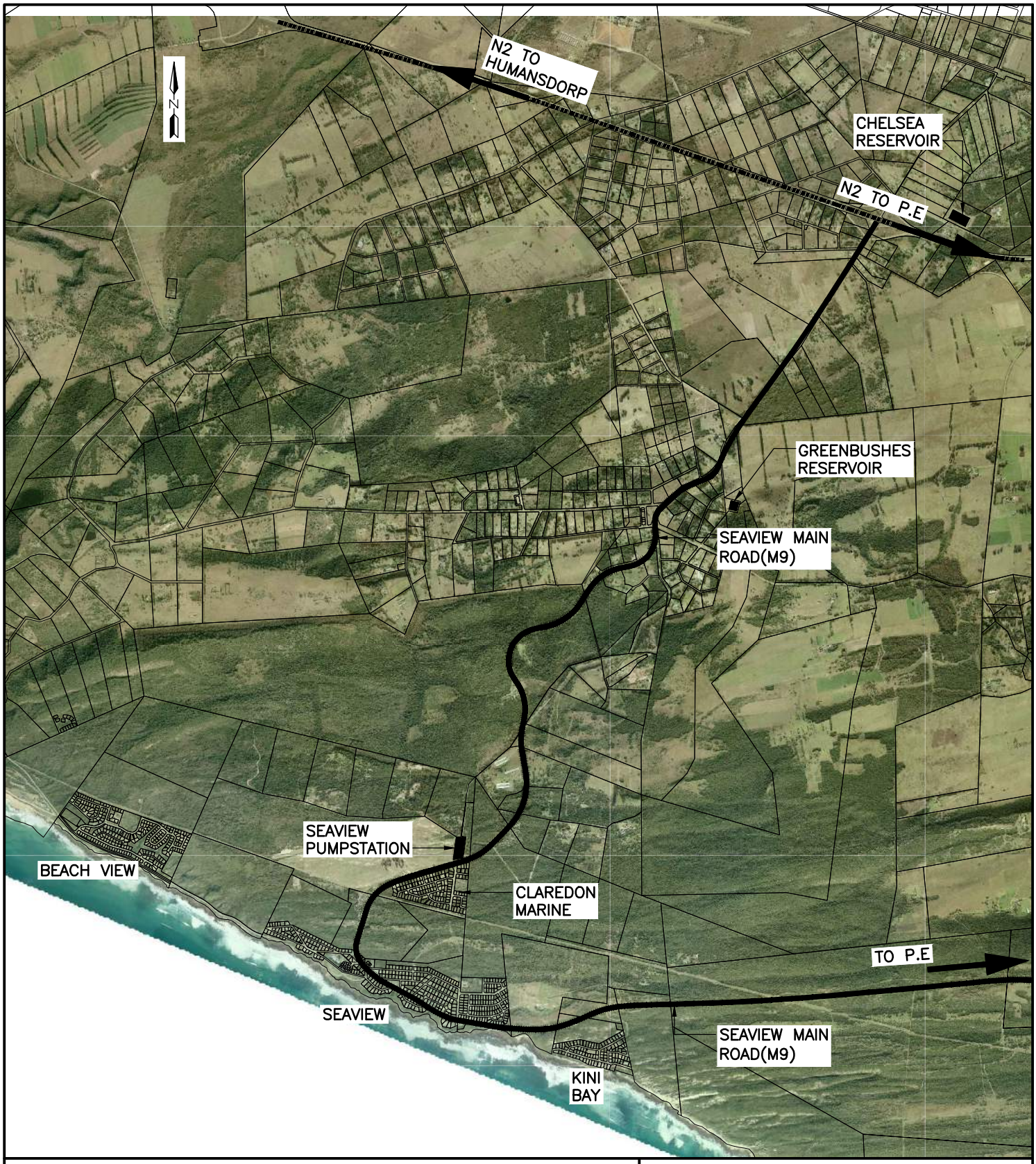
8003/011/046	2,5Ml Reservoir: Layout and Details (Sheet 1 of 3)
8003/011/047	2,5Ml Reservoir: Layout and Details (Sheet 2 of 3)
8003/011/048	2,5Ml Reservoir: Details (Sheet 3 of 3)
8003/011/055	Access Cover to Reservoir & Manholes 900x1200mm (1 of 3)
8003/011/056	Access Cover to Reservoir & Manholes 900x1200mm (2 of 3)
8003/011/057	Access Cover to Reservoir & Manholes 900x1200mm (3 of 3)
8003/011/058	Access Cover to Reservoir & Manholes 600x600mm (1 of 2)
8003/011/059	Access Cover to Reservoir & Manholes 600x600mm (2 of 2)
8003/011/060	Access Cover to Reservoir & Manholes 600x900mm (1 of 2)
8003/011/061	Access Cover to Reservoir & Manholes 600x900mm (2 of 2)
8003/011/062	Access Cover to Reservoir & Manholes 600x1200mm (1 of 2)
8003/011/063	Access Cover to Reservoir & Manholes 600x1200mm (2 of 3)
8003/011/064	Access Cover to Reservoir & Manholes 600x1200mm (3 of 3)
8003/011/065	Air Valve & Vacuum Break Chamber
8003/011/066	Electrical Duct Installation
8003/011/067	Typical Road Crossing Details
8003/011/068	Valve Chamber for Pipes 200mm dia - 400mm dia
8003/011/069	Non Return Valve Chamber
8003/011/070	Typical Thrust Block Details for uPVC Pipes
S 401	Precast Concrete Valve Marker Post
S 439	Locking Strip and Precast Valve Chamber Valve
S 467	Typical Scour Valve & Chamber Deatails for 75mm dia Pipelines
S 469	Bedding Details
S 519	Standards for Handrails & Walkways
S 505	Light and Heavy Duty Circular Precast Concrete Manhole C & F
S 500	Details of Jet Disperser for Scour Valve
GN 430	Locking Bar Details
GN 482	Subsoil Drains Details
GN 484	Precast Concrete Coping
GN 485	Roof Vent Details
GN 486	Box - out : Typical Detail
GN 489	Typical Detail of Frame for Open Grid Flooring
GN 490	Pipe Maker Post
GN 492A	External Ladder Details Security
GN 492 B	External Ladder Details Security
GN 493	Internal ladder details
GN 494	General Details of 2.10m : High Security Fence
GN 495	Details of Gate Catch
GN 496	Details of Double Leaf 2.1m : High Security Fence
GN 497	Details of Post for 2.10m : High Security Fence
GN 517	Details of steelwork for covers, grates and drains
GN 523	Double door to suit crawl beam
GN 527	Earth Berm
PSL 1/1	Pre - Cast Concrete Chambers for Hydrants and Gate Valves
PSL 1/2	Pre - Cast Concrete Chambers for Hydrants and Gate Valves

For and on behalf of :

BOSCH STEMELE (PTY) LTD

R D BODE (Pr Tech Eng)

Project Engineer

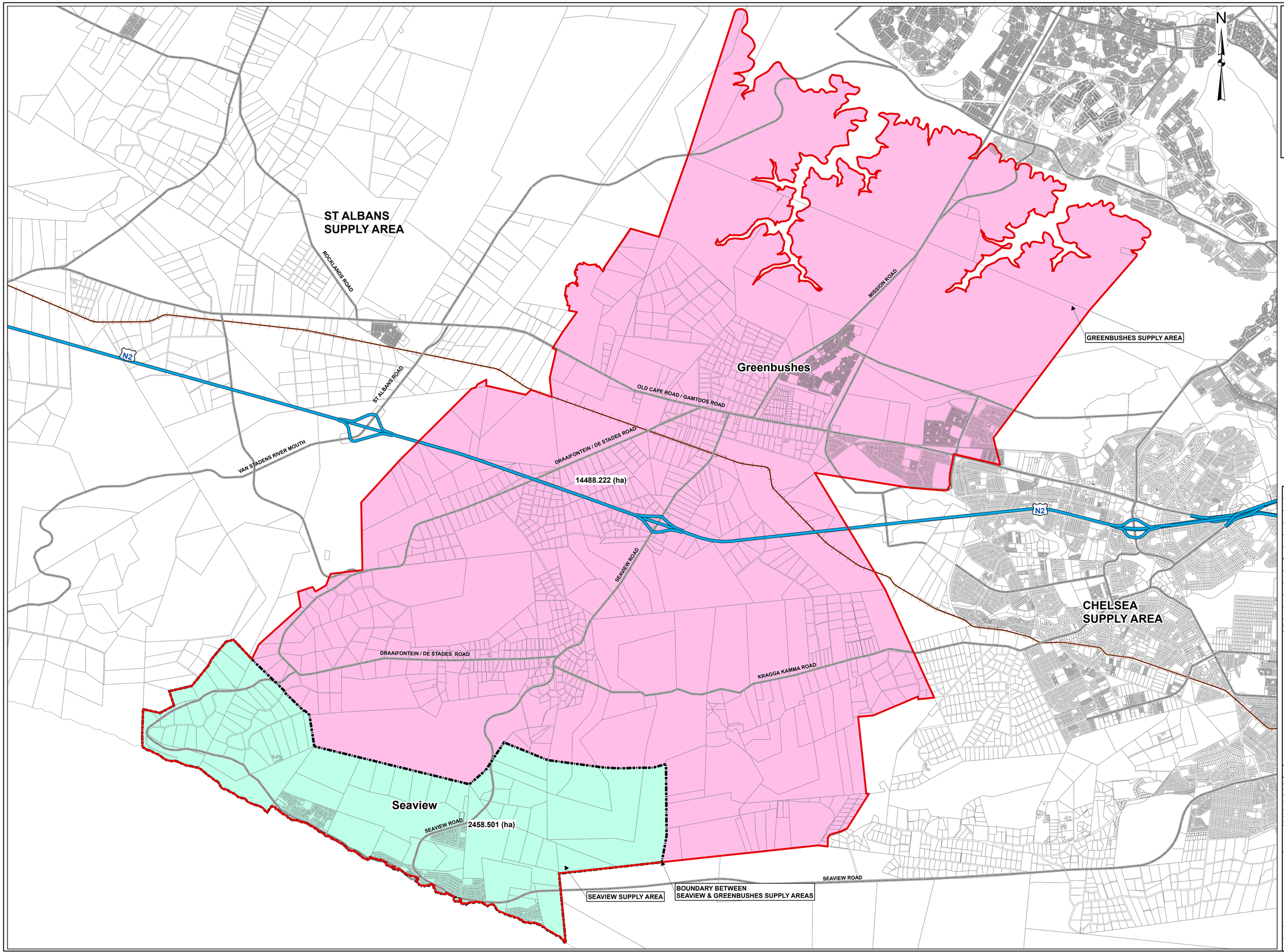


NELSON MANDELA BAY MUNICIPALITY
SEAVIEW BULK WATER

LOCALITY PLAN

BOSCH STEMELE
Consulting Engineers • Project Managers

DESIGNED	R.B.	APPROVED	
DRAWN	S.M.		
CHECKED	G.C.	DRAWING No.	REV
SCALE	1 : 50 000	8003/011/001	1
DATE	19/11/2008		



REV.	DESCRIPTION	DATE	APPR'D
0	FOR COMMENT	JUN 09	

DRG. No | REFERENCE DRAWING

BOSCH STEMELE

Consulting Engineers • Project Managers

BOSCH STEMELE (PTY) LTD.
P.O.BOX 27158, GREENACRES, P.E, 6057.
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E-mail: bspe@boschstemele.co.za
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REGIONAL OFFICES IN:
CAPE TOWN • DURBAN • EAST LONDON • JOHANNESBURG

DESIGNED	RB	DRAWN	SM
CHECKED	GC	CIVIL ENGINEER	RB
STRUCTURAL ENGINEER	N/A	MECHANICAL ENGINEER	N/A
ELECTRICAL ENGINEER	N/A	CO-ORDINATION ENGINEER	N/A

APPROVED

PROJECT MANAGER DIRECTOR

NELSON MANDELA BAY MUNICIPALITY

SEAVIEW AND GREENBUSHES BULK WATER SUPPLY

SUPPLY AREA BOUNDARIES

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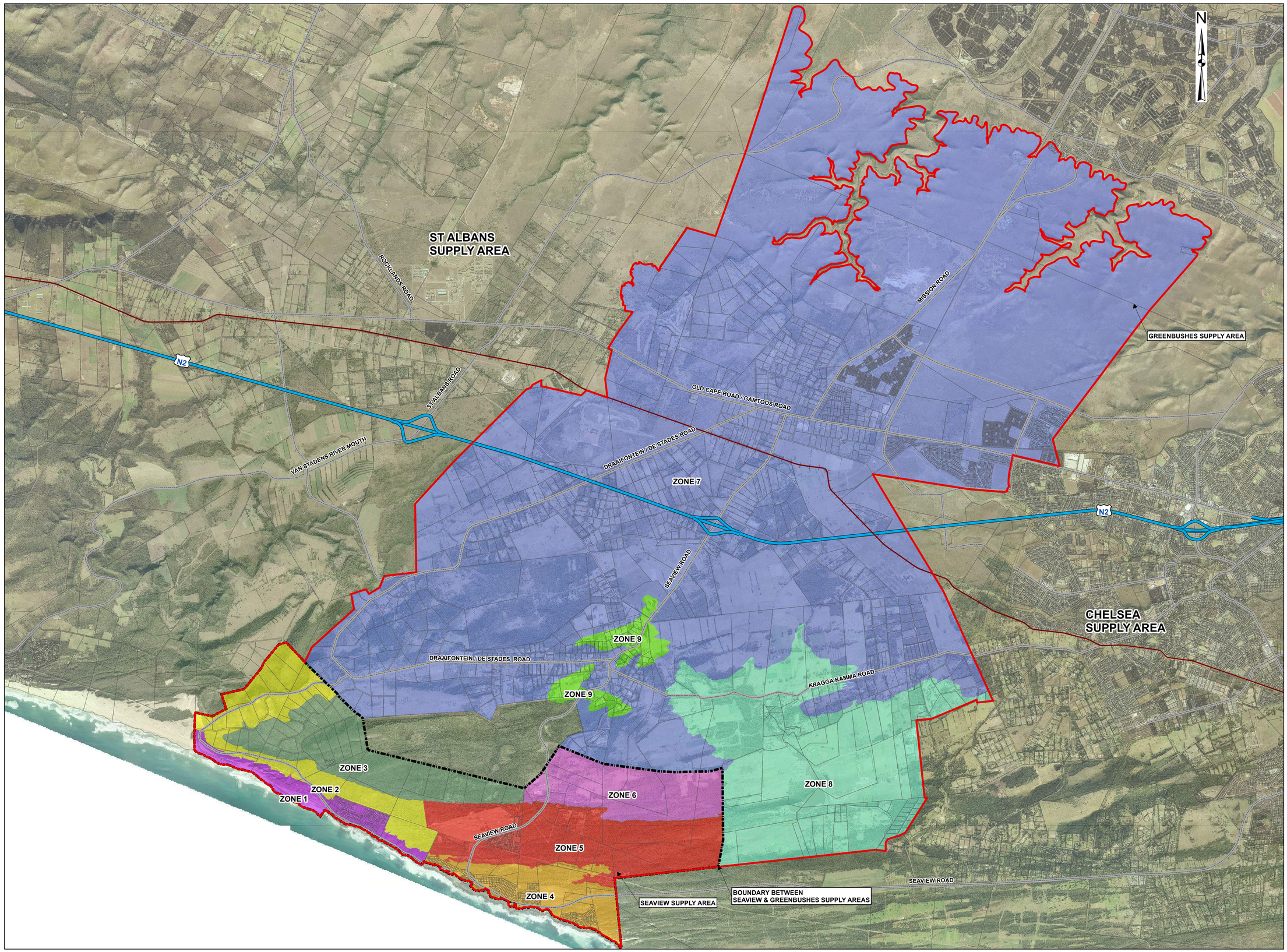
DRAWING NUMBER	8003/011/002	A1	REVISION 0



Legend

- Study Area
- Seaview
- Rail Narrow Guage
- N2
- Roads
- Cadastral Erven

Reservoir Supply Zones

- Supply Zones 1
- Supply Zones 2
- Supply Zones 3
- Supply Zones 4
- Supply Zones 5
- Supply Zones 4
- Supply Zones 6
- Supply Zones 7
- Supply Zones 8
- Supply Zones 9

REV.	DESCRIPTION	DATE	APPR'D
0	FOR COMMENT	JUN 09	

DRG. No | REFERENCE DRAWING

BOSCH STEMELE

Consulting Engineers • Project Managers

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DESIGNED	RB	DRAWN	SM
CHECKED	GC	CIVIL ENGINEER	RB
STRUCTURAL ENGINEER	N/A	MECHANICAL ENGINEER	N/A
ELECTRICAL ENGINEER	N/A	CO-ORDINATION ENGINEER	N/A

APPROVED

PROJECT MANAGER DIRECTOR

NELSON MANDELA BAY MUNICIPALITY

SEAVIEW AND GREENBUSHES BULK WATER SUPPLY

SUPPLY ZONES

SCALE	1:36 000	DATE:	08 JUNE 12
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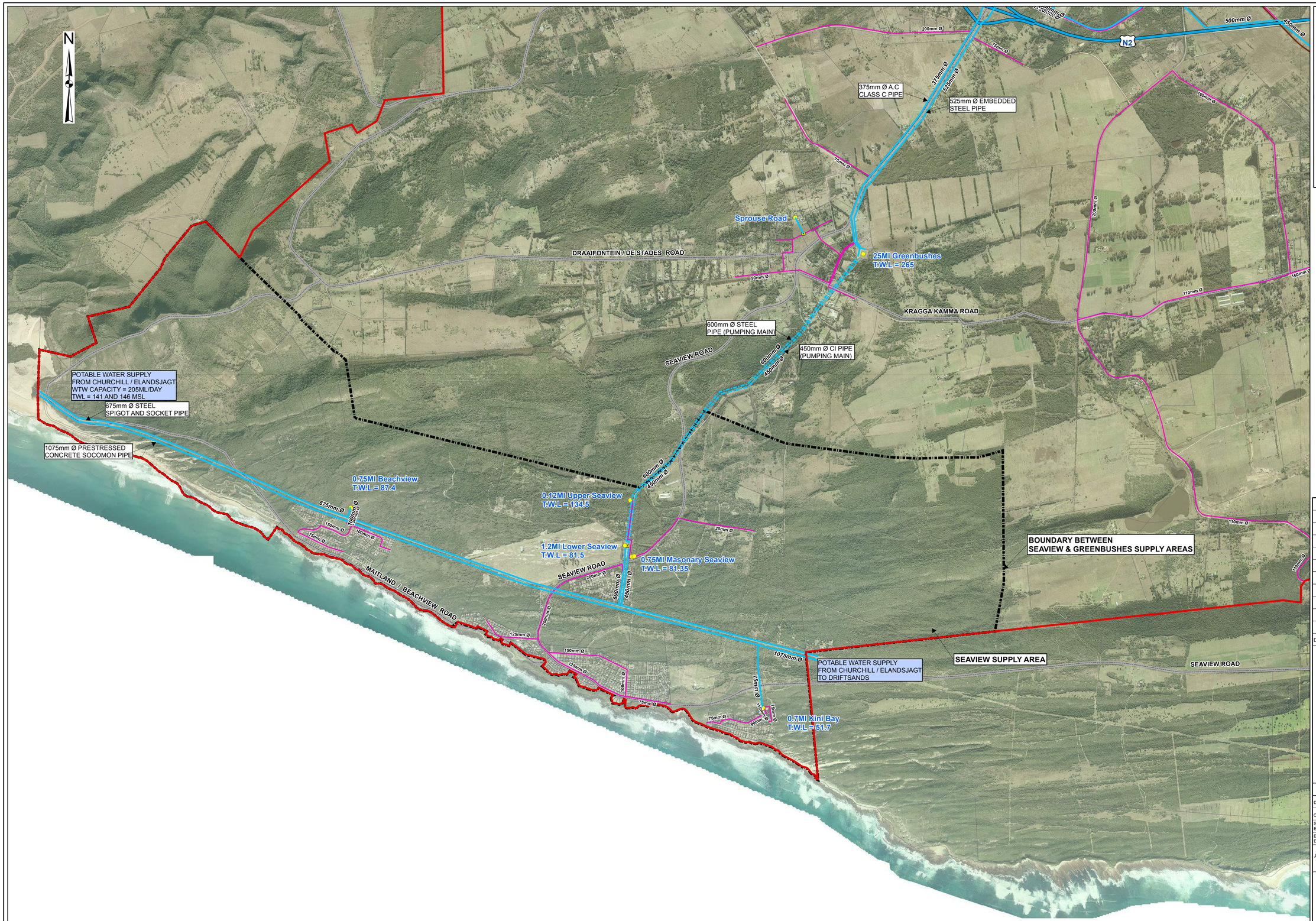

Legend

- SBA Study Area
- Seaview
- N2
- Roads
- Rail Narrow Guage
- Existing Reservoir
- Existing Pumpstation
- Cadastral Erven
- Existng Water

Existing Bulkwater Pipeline

- Bulkwater (Gravity)
- Bulkwater (Pumping Main)
- Flow Direction

REV.	DESCRIPTION	DATE	APPR'D
0	FOR COMMENT	JUN 09	

DRG. No | REFERENCE DRAWING

BOSCH STEMELE

Consulting Engineers • Project Managers

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DESIGNED	RB	DRAWN	SM
CHECKED	GC	CIVIL ENGINEER	RB
STRUCTURAL ENGINEER	N/A	MECHANICAL ENGINEER	N/A
ELECTRICAL ENGINEER	N/A	CO-ORDINATION ENGINEER	N/A

APPROVED

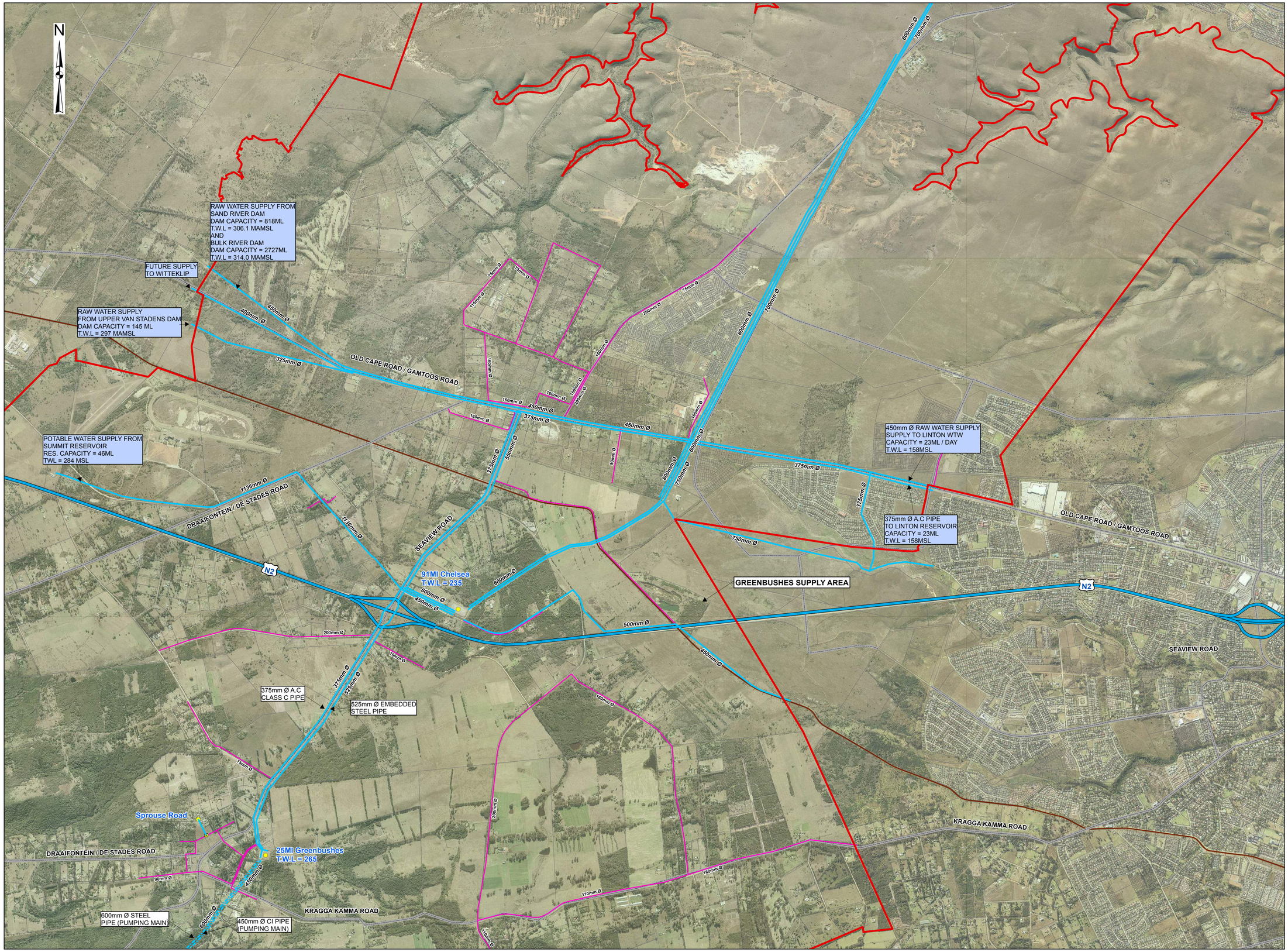
PROJECT MANAGER DIRECTOR

NELSON MANDELA BAY MUNICIPALITY

SEAVIEW AND GREENBUSHES BULK WATER SUPPLY

EXISTING WATER INFRASTRUCTURE (Sheet 1 of 2)

SCALE	1:20 000	DATE:	08 JUNE 12
DRAWING NUMBER	8003/011/004	A1	REVISION 0



Legend

- SBA Study Area
- Seaview
- N2
- Roads
- Existing Reservoir
- Existing Pumpstation
- Rail Narrow Guage
- Cadastral Erven
- Existng Water

Existing Bulkwater Pipeline

- Bulkwater (Gravity)
- Bulkwater (Pumping Main)
- Flow Direction

REV.	DESCRIPTION	DATE	APPR'D
0	FOR COMMENT	JUN 09	

DRG. No | REFERENCE DRAWING

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REGIONAL OFFICES IN:
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DESIGNED	RB	DRAWN	SM
CHECKED	GC	CIVIL ENGINEER	RB
STRUCTURAL ENGINEER	N/A	MECHANICAL ENGINEER	N/A
ELECTRICAL ENGINEER	N/A	CO-ORDINATION ENGINEER	N/A

APPROVED

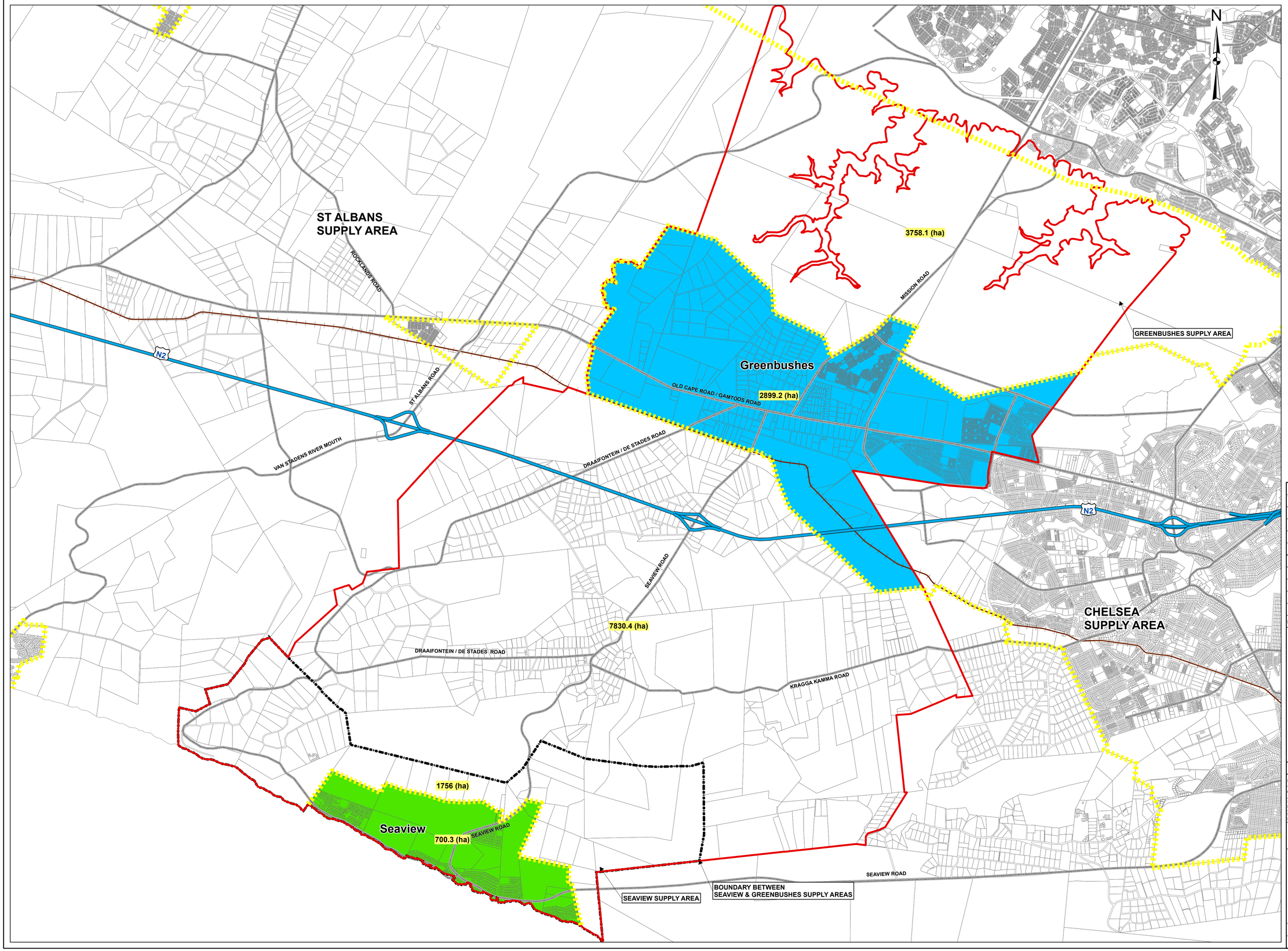
PROJECT MANAGER | DIRECTOR

NELSON MANDELA BAY MUNICIPALITY

SEAVIEW AND GREENBUSHES BULK WATER SUPPLY

EXISTING WATER INFRASTRUCTURE (Sheet 2 of 2)

SCALE	1:20 000	DATE:	08 JUNE 12
DRAWING NUMBER	8003/011/005	A1	REVISION 0



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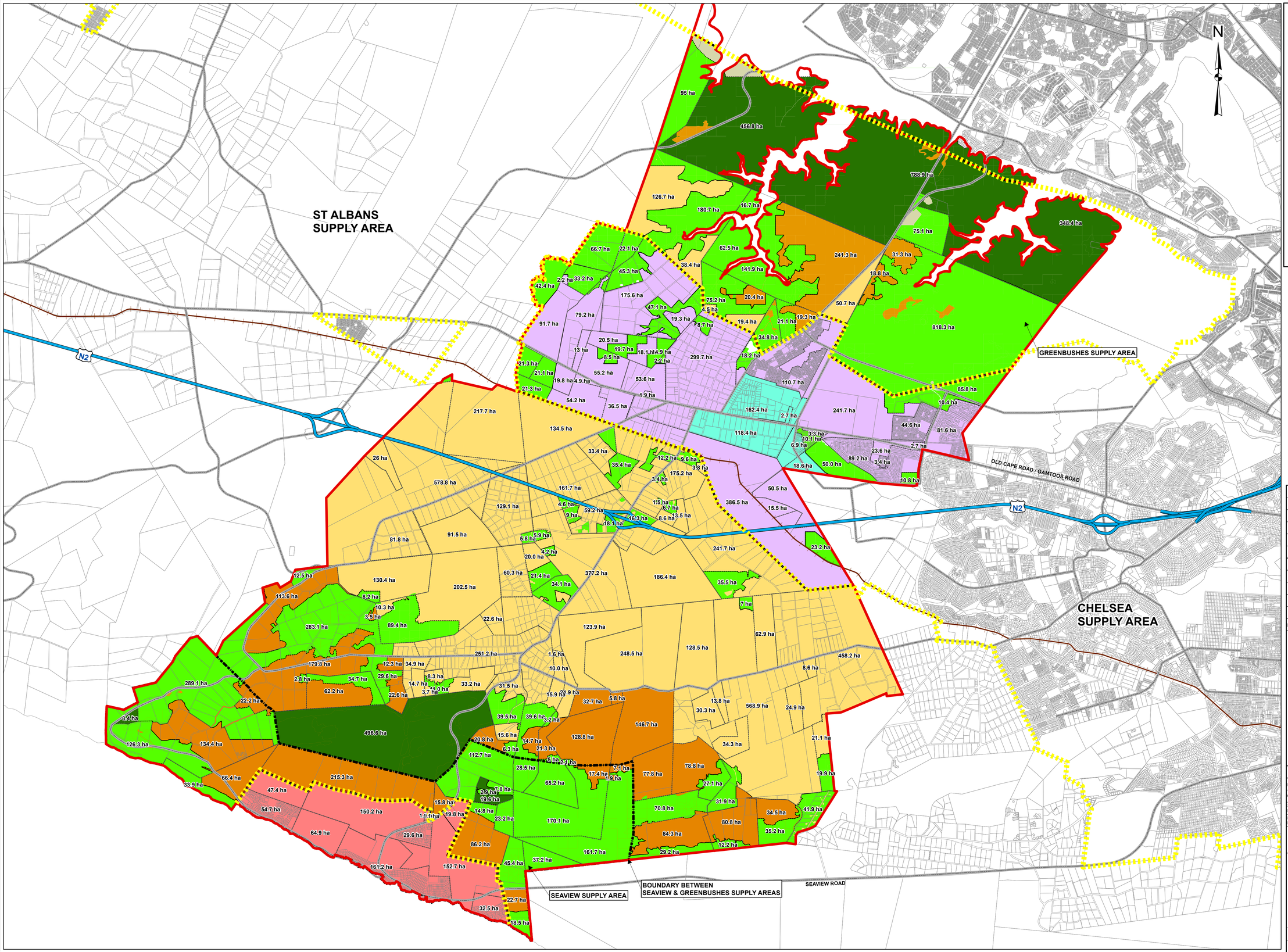
SEAVIEW AND GREENBUSHES BULK WATER SUPPLY

URBAN EDGE

SCALE	1:36 000	DATE:	08 JUNE 12
DRAWING NUMBER	8003/011/006	A1	REVISION 0



Legend

- Study Area
- Seaview
- N2
- Roads
- Rail Narrow Guage
- Urban Edge
- Cadastral Erven
- UrbanEdge
- Coastal Villages

Rural Policy Areas

- Agriculture
- Critical Biodiversity Area (C1+C2)
- Madiba Bay
- No Development
- Peri Urban (P1)
- Peri Urban (P2)
- Rural (R1)
- Rural (R2)
- Light Industrial
- Urban

REV.	DESCRIPTION	DATE	APPR'D
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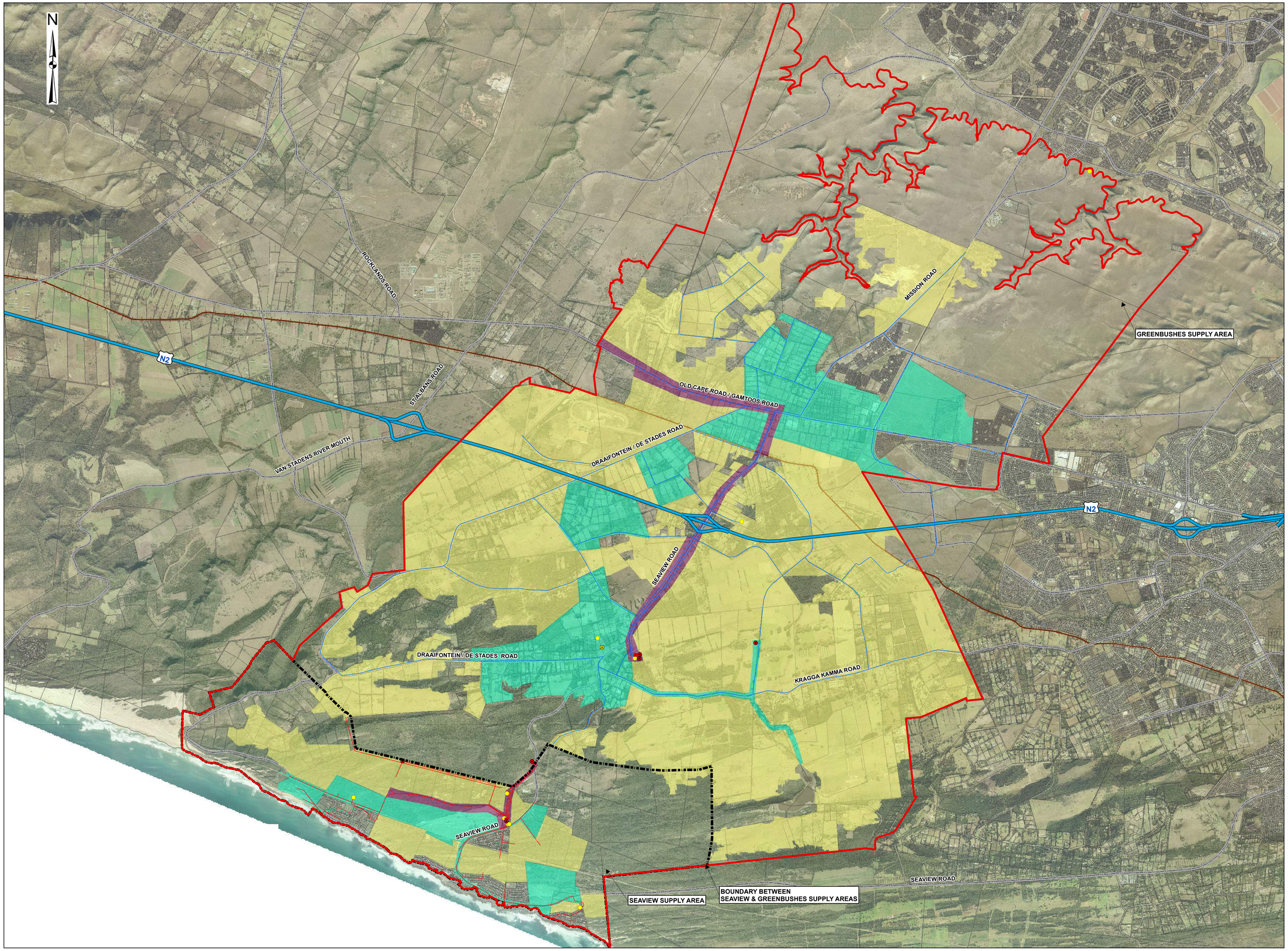
SEAVIEW AND GREENBUSHES BULK WATER SUPPLY

URBAN EDGE

SCALE	1:36 000	DATE:	08 JUNE 12
DRAWING NUMBER	8003/011/007	A1	REVISION 0



Legend

- SBA Study Area
- Seaview
- N2
- Roads
- Rail Narrow Guage
- Cadastral Erven
- Proposed Reservoirs
- Proposed Pumpstation
- Existing Reservoir
- Existng Pumpstation

Time Frame

- 2010
- 2020
- Ultimate

Proposed Water Line

- Greenbushes Supply Zone
- Prop. Lake Farm Supply Zone
- Seaview Supply Zone

REV.	DESCRIPTION	DATE	APPR'D
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APPROVED

PROJECT MANAGER DIRECTOR

NELSON MANDELA BAY MUNICIPALITY

SEAVIEW AND GREENBUSHES BULK WATER SUPPLY

PROPOSED DENSIFICATION TIME FRAME

SCALE	1:36 000	DATE:	08 JUNE 12
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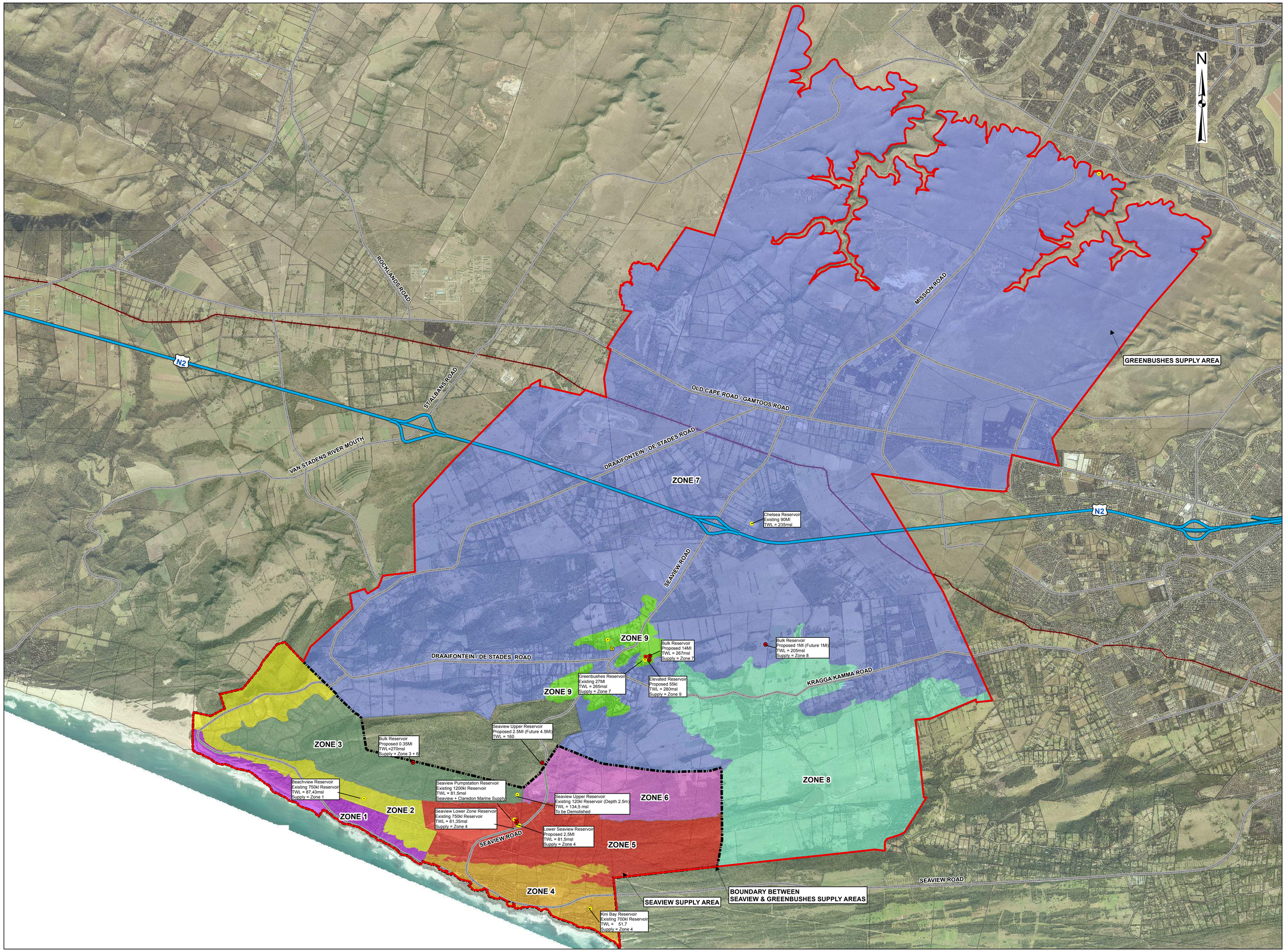

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PROJECT MANAGER DIRECTOR

NELSON MANDELA BAY MUNICIPALITY

SEAVIEW AND GREENBUSHES BULK WATER SUPPLY

EXISTING + FUTURE RESERVOIR SUPPLY ZONES

SCALE	1:36 000	DATE:	08 JUNE 12
DRAWING NUMBER	8003/011/009	A1	REVISION 0