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UPGRADING OF GREAT BRAK RIVER WASTEWATER TREATMENT WORKS

PRELIMINARY DESIGN REPORT

FEBRUARY 2022

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EXECUTIVE SUMMARY

The Great Brak River WWTW is currently designed for an average dry weather flow (ADWF) of 1Ml/d and is currently operated overloaded at around 1.4Ml/d ADWF. With the significant growth experienced in the study area, further expansion of the plant to a 4Ml/d plant is necessary.

The existing treatment process consists of an inlet works (preliminary treatment) with a capacity of 270l/s or 8Ml/d; an activated sludge reactor with one aeration basin of 2.1Ml with a treatment capacity of 1Ml/d; a secondary settling tank (SST) of 18m diameter with a treatment capacity of 2Ml/d; six maturation ponds with a total volume of 26.7Ml and two sludge lagoons operated on a duty/standby mode. Final treated effluent is utilized for irrigation by the downstream landowner.

The proposed upgrades consist of the expansion/upgrading of the reactor basin to allow for a 4Ml/d capacity and a new process design; construction of a new 3.15Ml aerobic basin; conversion of the existing 2.1Ml aerobic basin to an anoxic basin; conversion of the existing aerobic process to new Modified Ludzack-Ettinger (MLE) (aerobic/anoxic) process; construction of new (second) 18m diameter 2Ml/d SST; upgrading (refurbishment) of existing (first) SST and upgrading of return-activated-sludge (RAS) pump station. Numerous general upgrades, refurbishment and maintenance works will be conducted.

A water use licence (WUL) application will be performed. This preliminary design report will allow, inform and guide a discussion/meeting now required with the local DWS office to obtain their view on the final effluent requirements. Inputs from DWS will assist with the final process design. It is also appreciated that the final effluent quality will be dictated by the WUL.

An Environmental Impact Assessment (EIA) will be required. A Basic Assessment process will be applied for. This preliminary design report will enable the EIA process and will be instrumental in the EIA application.

The preliminary design stage programme indicates completion of construction for 30 June 2023. It must be stressed however that a large number of unknowns are still present at this early stage of the project and the project programme may change accordingly.

The preliminary design stage cost estimate amounts to R48.7m (incl P&G's, contingencies, escalation & VAT) and will be refined during the detail design stage.

DOCUMENT CONTROL SHEET

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UPGRADING OF GREAT BRAK RIVER WASTEWATER TREATMENT WORKS

PRELIMINARY DESIGN REPORT

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1 INTRODUCTION

1.1 Background

Element Consulting Engineers (ECE) has been appointed by Mossel Bay Municipality (Municipality) as consulting engineers for the professional services for the upgrading of the Great Brak River Wastewater Treatment Works (WWTW) operated by the municipality. Great Brak River and the surrounding areas of Reebok, Tergniet, Suiderkruis, Hersham, Pienaarstrand, Dwarswegstrand and Glentana (the study area) have seen exceptional growth over the past two decades with some reports citing growth rates of upwards of 3%, making it one of the fastest growing areas in the Western Cape and South Africa.

Notwithstanding this tremendous growth rate experienced in the study area, the municipality has, in parallel to the organic growth, commenced with a long-term phased installation of a water-borne sewer network in some of the older areas in the study area, which were and are still utilizing septic tank systems. This further contributes to the growth rate in sewer inflow of larger than 3% being experienced in the inflow volumes at the Great Brak River WWTW.

The study area is serviced with six pumpstations with several more in various phases of implementation as the new sewer networks are gradually implemented. All sewage is eventually pumped to the Great Brak River WWTW.

All of the above has necessitated the upgrading of the Great Brak River WWTW in accordance with the Municipal master planning in order to accommodate the rapidly increasing inflow.

The project hence in summary entails the upgrading of the Great Brak River WWTW to a 4Ml/d facility.

1.2 Locality and access

The Great Brak River WWTW site is located in the upper reaches of a minor valley, directly north of the N2 freeway and approximately 2.8km west of the village of Great Brak River in the Mossel Bay municipal area. The coordinates of the center of the works are approximately 34°03'35.6"S and 22°11'16.4"E.

The area has a moderate climate with rainfall occurring throughout the year with slightly higher rainfall during the summer. The area has a mean annual precipitation in the region of 450 mm per year.

Access may be obtained via Sandhoogte Road, a gravel divisional road on the northern boundary of the site.

The locality of the site is indicated on the drawing below.

Fig 1: Locality of Great Brak River WWTW

Fig 2: Great Brak River WWTW locality and access

1.3 Great Brak River WWTW plant history

Great Brak River WWTW was originally designed and constructed as an oxidation pond system, but was later upgraded with two clarigesters where primary sedimentation and anaerobic digestion is combined in a single unit. Sludge in the clarigesters were desludged into two sludge ponds.

The plant was upgraded in 2006 with the provision of an activated sludge plant and a separate secondary sedimentation tank (SST) as the clarigesters could not cope with the gradually increasing capacity. The clarigesters were abandoned during this upgrade.

The Great Brak River WWTW is currently designed for an average dry weather flow (ADWF) of 1Ml/d and is currently operated at around 1.4Ml/d ADWF. With the significant growth experienced in the study area discussed above, the further expansion of the plant to a 4Ml/d plant, in line with master planning, is now necessary.

1.4 Inception meeting

An inception meeting was conducted electronically via “Teams” on 23 August 2021 at 14h00. The meeting covered all introductory, background, technical, budgetary and programming aspects of the project, all of which will be covered in the following paragraphs. Minutes of the meeting is attached as addendum to the report.

1.5 Terms of reference and scope of works

The terms of reference and scope of work of the project in summary entails the upgrading of the Great Brak River WWTW to a 4Ml/d facility from the current 1Ml/d facility. In order to upgrade the Great Brak River WWTW to a 4Ml/d facility, the proposed upgrading of the WWTW in summary includes the following (details are presented and discussed later in the report):

1. Upgrading/expansion of reactor basin to allow for 4Ml/d capacity and a new process design.
2. Conversion of the existing aerobic process to new process, consisting of either one of a number of options.
3. Construction of new (second) secondary settling tank (SST).
4. Upgrading (refurbishment) of existing (first) secondary settling tank (SST).
5. Upgrading and refurbishment of inlet works.
6. Improve the tanker discharge facility.
7. High security fencing.
8. Environmental impact assessment (EIA) (basic assessment).
9. Water use license (WUL) application.

1.6 Reports, audits, manuals and drawings available

A number of available reports, audits, manuals and drawings were obtained and studied as input into the preliminary design report. These will be presented and discussed in the report where relevant.

1.7 Project budget

The project budget is in the order of R42m but will eventually be a function of the preliminary design, detail design and tender processes.

The project will also be a multi-year tender with funding spread over 3 financial years, i.e. 2021/22, 2022/23 and 2023/24.

A preliminary design stage budget breakdown is provided later in the report.

1.8 Project schedule

The project is envisaged to be implemented during the 2021/22, 2022/23 and 2023/24 financial years. A relatively large number of unknowns are still present at this early stage, specifically on the environmental side.

A preliminary design stage project schedule is provided later in the report.

1.9 Liaison

During the project mobilization phase, the necessary liaising with the necessary client representatives has been performed to obtain a variety of technical inputs into the project, inclusive of available documentation, reports, drawings, etc.

2 EXISTING LAYOUT

The existing layout of the plant is indicated in the diagram below as extract from the preliminary design drawings. A set of preliminary design drawings is attached to the report as addendum.

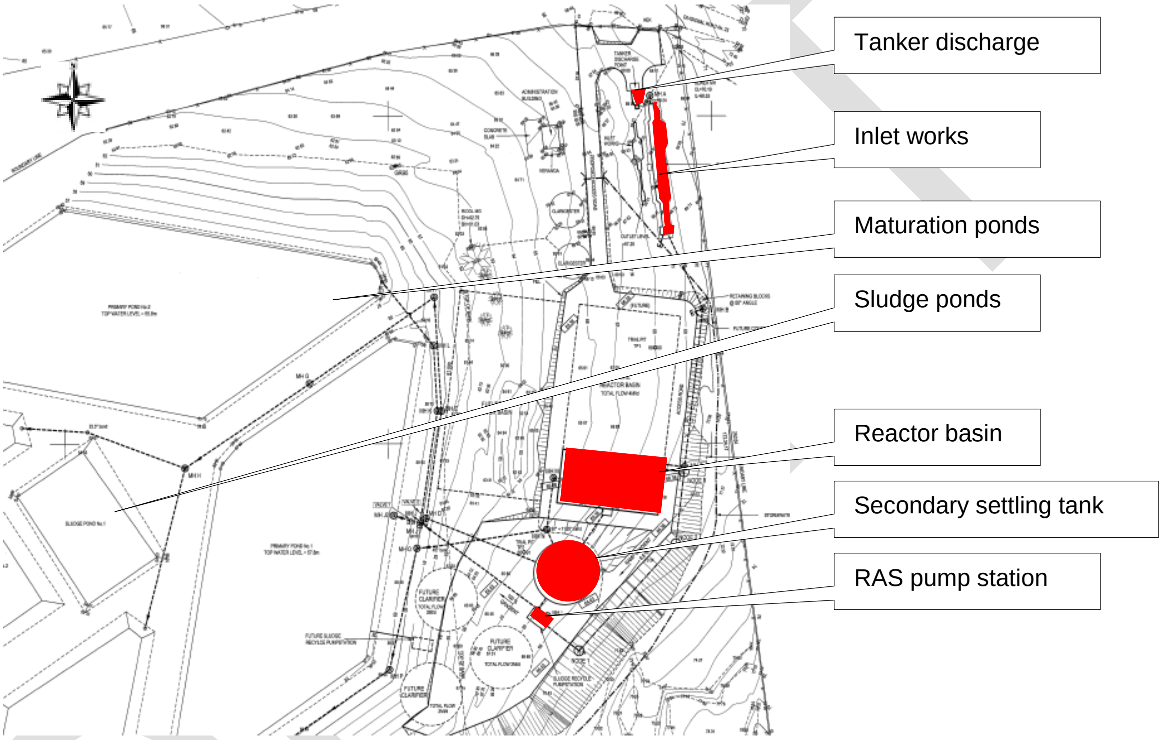


Fig 3: Existing general site layout of Great Brak River WWTW

3 SITE INVESTIGATION

A detailed site investigation was held with the client's full team on 19 October 2021. A full walkthrough and a full discussion were held on all the existing infrastructure, the client's needs and the anticipated upgrades to ensure all stakeholders were on the same level of understanding as to the terms of reference and scope of works. Positions of new infrastructure were identified and confirmed between the parties. Current operating challenges were also discussed and will also be addressed during the designs of the upgrades. Conditions of existing infrastructure were discussed.

All existing civil, mechanical and electrical infrastructure is generally in a good condition. The plant is well operated, well maintained and neatly kept with an overall impressive appearance. The Great Brak River WWTW delivers effluent quality that mostly complies with the required standards notwithstanding the fact that the plant is currently operated at approximately 1.4Ml/d on a 1Ml/d design. The overloading will only increase in the near future as discussed earlier in the report and hence it is critical to expand the capacity of the works.

The site inspection will be discussed at the hand of photographs taken during the day:

Fig 4: Inlet works


Fig 5: Existing reactor basin


Fig 6: Position of new reactor basin

Fig 7: Existing secondary settling tank (SST)

Fig 8: Position of new (second) secondary settling tank (SST)

Fig 9: Sludge pump station

4 CURRENT TREATMENT PROCESS AND PROPOSED UPGRADES

The Great Brak River WWTW is currently designed for an average dry weather flow (ADWF) of 1Ml/d and is currently operated at around 1.4Ml/d ADWF. With the significant growth experienced in the study area discussed earlier in the report, the further expansion of the plant to a 4Ml/d plant is now necessary.

A summary of the existing treatment process is presented below and comprises of the following unit processes:

4.1 Inlet works (preliminary treatment)

Raw wastewater is pumped to the inlet works of the WWTW. Preliminary treatment takes place at the inlet works. Wastewater flows through a course hand-raked screen and rotating drum mechanical screen which has been installed in parallel. Grit is removed in two grit channels operated in duty and standby mode to facilitate cleaning. Screening and grit are removed and taken to an approved landfill site.

Flow is measured by means of an open venturi flume. Provision has been made for two rotating drum screens of which one has been installed.

The maximum hydraulic capacity of the inlet works is estimated at 270l/s and makes provision for the future extension of the plant to an ADWF of 8Ml/d.

Provision has been made for discharges from vacuum tankers right at the entrance of the facility, adjacent to the inlet works, just upstream of the hand raked screen.

4.2 Activated sludge reactor

Primary treated wastewater gravitates to the activated sludge reactor for secondary treatment. One aeration basin of 2.1Ml capacity has been provided equipped with two 31kW surface mounted aerators. The oxidation of carbonaceous material and nitrification takes place in the activated sludge reactor. A waste sludge pump has been installed in the reactor basin and excess sludge is wasted to the original two primary anaerobic sludge ponds. These ponds are operated on a duty and standby basis. The waste sludge is measured by a flow meter which allows the process controller to select the volume of sludge to be wasted to maintain the preferred sludge age. The reactor is equipped with a dissolved oxygen (DO) probe and a pH probe.

4.3 Secondary settling tank (SST)

Flow from the reactor gravitates to the 18m diameter secondary settling tank (SST). The SST can accommodate 2Ml/d and is oversized for the 1Ml/d plant design. The SST has been equipped with a bottom scraper and centre sludge hopper. Sludge is allowed to settle and returned to the reactor via the RAS (Return Activated Sludge) pump station. SSTs are generally equipped with a scum removal mechanism, although the SST at Great Brak WWTW is not equipped with such mechanism. The effluent gravitates to the maturation ponds for tertiary treatment.

4.4 Return Activated Sludge (RAS) pump station

A Return Activated Sludge (RAS) pump station returns sludge to the reactor basin. Two self-priming pumps, rated at 11.6 l/s (1:1 recycle ration) have been provided in a dry installation. The pumps operate in a duty/standby mode. Provision has been made in the pumpstation to allow the underflow from a second SST of similar size.

4.5 Maturation ponds

Effluent from the SST gravitates to the maturation ponds for tertiary treatment. Tertiary treatment takes place in the shallow maturation ponds which allow sunlight penetration i.e. natural UV disinfection. This allows for further polishing of effluent. A total of six ponds are utilized with a total volume of 26.7Ml. The depths of the ponds are all 1.5m. Final effluent is eventually discharged into an irrigation water holding dam, from where it is used for irrigation by an adjacent landowner downstream of the facility.

4.6 Disinfection

Due to the long retention in the maturation ponds, disinfection of the final effluent is generally not required.

4.7 Sludge lagoons

Excess sludge is wasted from the reactor to the two ponds at the works which are used as sludge lagoons. The lagoons are operated on a duty/standby mode to allow dewatering and desludging. Supernatant gravitates to the maturation ponds.

4.8 Final treated effluent pumpstation

A final treated effluent pumpstation, rising main and elevated irrigation dam for elevated storage of the final treated effluent has been constructed in 2007. From this irrigation dam, municipal land and other relevant adjacent land, can be irrigated under gravity. This system has however never been used and all the final treated effluent flows to the downstream adjacent landowner for irrigation.

4.9 Process summary of existing plant

A process summary for the Great Brak River WWTW, as presented in the wastewater risk abatement plan (WWRAP) for Great Brak River WWTW (WEC Consult; 2018) is provided in the following table:

Parameter	Size or Capacity
Existing Capacity	**1.0 Mℓ/day**
Total Reactor Volume	**2100 m³**
Module 1: Existing Aerobic Reactor	**2100 m³**
Module 1: Proposed New Anoxic Basin Reactor and additional aeration basins to cope with incoming flow and peak conditions, and A-Cycle to Anoxic Basin	Proposed for next Phase: To be designed after grab samples taken for current flow
Module 2: Anoxic Basin, Aeration Basins and A-Cycle: New Reactor (Anaerobic basin can be added later for every module if re-use for indirect mixing with raw water to WTW becomes an option)	To be designed after grab samples taken for future flow
Module 3: Anoxic Basin and Aeration Basins and A-Cycle: New Reactor	To be designed after grab samples taken for future flow
Settling Tanks	
Existing Settling Tank 1: 18 m diameter	Incoming ADWF of 4 Mℓ/day Peak flow of 4.9 Mℓ/day
Proposed New Settling Tank 2: 18 m diameter (Required for Second Module, but can also be built earlier to cope with short term peaks as flow increases)	Incoming ADWF of 4 Mℓ/day (Total cap (2xSST's) = 8Mℓ/day) Peak flow of 4.9 Mℓ/day (92xSST's) = 9.8 Mℓ/day at peak flow)
Future New Settling Tank 3: 18 m diameter (Third Module)	Incoming ADWF of 4 Mℓ/day (Total cap (3xSST's) = 12Mℓ/day) Peak flow of 4.9 Mℓ/day (3xSST's) = 14.7 Mℓ/day at peak flow)
Settling Tank 1,2,3 Returns to reactor	To be designed with SST

Fig 10: Process summary for the Great Brak River WWTW (WWRAP for Great Brak River WWTW; WEC Consult; 2018)

4.10 Schematic flow diagram of existing plant

A schematic flow diagram of the existing plant, as presented in the process audit report for Great Brak River WWTW (WEC Consult; August 2018), is presented in the following diagram for clarity and discussion.

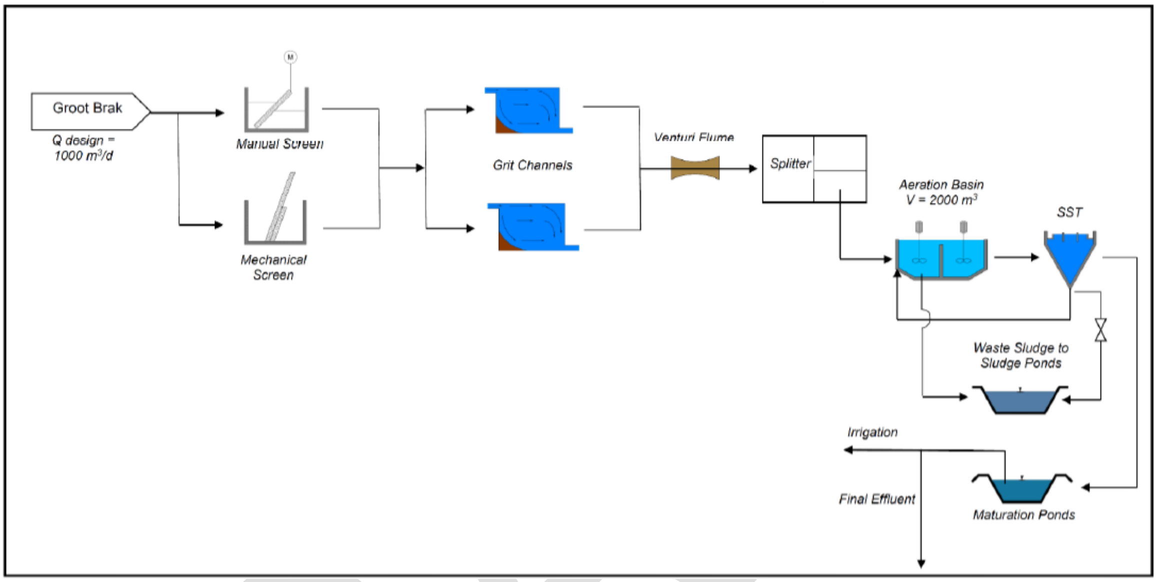


Fig 11: Schematic flow diagram of existing Great Brak River WWTW plant (process audit report for Great Brak River WWTW; WEC Consult; August 2018)

4.11 Proposed upgrades

As discussed earlier in the report, the study area has seen exceptional growth over the past two decades with the growth rate of the inflow at the Great Brak River WWTW in the region of 3%. It must be stated that the background investigation into the growth in the study area and the alternatives investigated is not in the scope of this report.

All of the above has necessitated the upgrading of the Great Brak River WWTW in accordance with the Municipal master planning in order to accommodate the rapidly increasing inflow.

The project hence in summary entails the upgrading of the Great Brak River WWTW to a 4Ml/d facility from the current 1Ml/d facility.

In order to upgrade the Great Brak River WWTW to a 4Ml/d facility, the proposed upgrading of the WWTW in summary includes the following, the design of which is the further subject of this report:

1. Upgrading/expansion of reactor basin to allow for a 4Ml/d capacity and a new process design.
    a. Construction of new aerobic basin.
    b. Conversion of existing aerobic basin to anoxic basin.
2. Conversion of the existing aerobic process to new process, consisting of either one of the following two options:
    a. MLE (aerobic/anoxic) (preferred option)
    b. Nutrient removal process (aerobic/anoxic/anaerobic).
3. Construction of new (second) SST, inclusive of all mechanical and electrical equipment.
4. Upgrading (refurbishment) of existing (first) SST in order to correct all current defects experienced.
5. Upgrading of return-activated-sludge (RAS) pump station to accommodate the future flow.
6. Consideration of future mechanical dewatering of sludge.

Notwithstanding the above upgrades to the treatment process and treatment capacities, the following general upgrades are required in parallel, to improve overall operation and safety at the plant:

1. Improve the tanker discharge facility through relocation and redesigning to allow easy access and discharge.
2. Replacement of the rotary screen with a front raked screen and the provision of a hand raked bypass screen.
3. Replacement of corroded sluice gates and shafts.
4. Replacement/refurbishment of high security fencing
    a. Perimeter fencing.
    b. Fencing surrounding the dams.
    c. Fencing in the central area of works.
5. Check hydraulics from inlet works to reactor. There is a possible blockage or bottle neck.

In parallel to all of the above, an environmental impact assessment (EIA) (basic assessment) will be performed and a water use license (WUL) application will be launched for the upgrades.

5 PRELIMINARY DESIGN

As discussed in the preceding paragraphs, the Great Brak River WWTW need to be upgraded from the current 1Ml/d to a 4Ml/d facility. In order to upgrade the Great Brak River WWTW to a 4Ml/d facility, the preliminary design of the proposed upgrading of the WWTW will be presented and discussed in detail in this chapter.

The overall process design is dictated by the required effluent quality i.e. irrigation standard, special limit or general limit. It is also guided by the raw wastewater inflow quality.

In addition to the above, local conditions, e.g. groundwater, topography, geotechnical conditions, stormwater, etc, play a significant role in defining technical solutions. Whilst honouring these design drivers, cost benefits of alternatives are visited.

Preliminary designs are also required as input into the EIA and WUL applications.

A set of preliminary design drawings is attached for reference and discussion purposes and should be consulted in parallel to the discussions in this chapter.

5.1 As-built drawings and original design reports

The as-built drawings of the last upgrades performed at the Great Brak River WWTW was obtained from Zutari (previously Aurecon). These drawings were studied as input into the preliminary design and preliminary design report.

5.2 Topographical survey

A new topographical survey of the site and all infrastructure has been commissioned and is currently in progess. The new survey will be utilized in the final designs and construction drawings. Existing available survey data was utilized during the preliminary design stage.

5.3 Geotechnical Investigation

A geotechnical investigation has been commissioned to ascertain the founding conditions of the in-situ material on site as well as groundwater conditions. This report is awaited at the time of writing and a detailed discussion of the report will be presented in the final design report.

Existing available geotechnical data was utilized during the preliminary design stage which indicates that the geotechnical founding conditions are adequate. It was hence assumed for the interim that the in-situ bearing capacities of the material on site are adequate as was also indicated by visual inspection during the site investigation. It was also assumed that groundwater conditions on site are favourable for the infrastructure to be constructed as was indicated by visual inspection during the site investigation.

5.4 Operation & Maintenance Manual

The Operation & Maintenance (O&M) manual of the Great Brak River WWTW compiled by Aurecon (undated) was studied as input into this design process. The O&M manual is updated with the latest upgrades to the Great Brak River WWTW. The O&M manual comments on the future upgrades required and contains. An extract of information relevant to this preliminary design report is briefly summarized below:

<u>Existing infrastructure</u>

Inlet Works Peak instantaneous flow of 277l/s which equates to a peak wet weather flow (PWWF) of 23.9Ml/d or an average dry weather flow of 8Ml/d

Design sludge age:	25 days
Design Mixed Liquor Suspended Solids (MLSS):	3300 – 3500 mg/l
Existing reactor volume:	2.025Ml
Aerators:	2 X 31 kW
Settling tank:	1 x 18m diameter
Sludge volume wasted:	81m3/d (2025m3@25d)

<u>Capacity: Existing Works</u>

Average dry weather flow (ADWF):	1.0Ml/d (11,6l/s)
Peak dry weather flow (PDWF):	1.9Ml/d (21,9l/s)
Peak wet weather flow (PWWF):	3.2Ml/d(36, 5l/s)

Capacity: Proposed Second Phase

Average dry weather flow (ADWF):	4.0Ml/d (46,3l/s)
Peak dry weather flow (PDWF):	7,2Ml/dd (83,3l/s)
Peak wet weather flow (PWWF):	11,9Ml/d (138,3l/s)

Process considerations:

Design Mixed Liquor Suspended Solids (MLSS):	3300 – 3500 mg/l
The pH in the reaction rank:	6.9 – 7.2
Dissolved oxygen concentration:	1.5mg/l to 2.5mg/l
Design sludge age:	25 days

Existing ponds:

The table below described the various ponds, dimensions and present purpose.

Type	Surface Area (m2)	Depth (m)	Volume (m3)	Purpose
Primary Dam No 1	6010	1.5	8300	Waste sludge
Primary Dam no 2	6100	1.5	8400	Waste sludge
Primary Dam No 3	3140	1.5	4200	Polishing of effluent
Primary Dam No 4	3200	1.5	4200	Polishing of effluent
Secondary Dam No 1	5200	1.5	7200	Polishing of effluent
Secondary Dam No 2	2800	1.5	3700	Polishing of effluent
Secondary Dam No 3	2800	1.5	3700	Polishing of effluent
Secondary Dam No 4	2800	1.5	3700	Polishing of effluent
Sludge Dam No 1	1100	2.0	1700	Not in use
Sludge Dam No 2	1100	2.0	1700	Not in use

Fig 12: Ponds at Great Brak River WWTW

5.5 Technical report for the upgrading of Great Brak River WWTW

The Technical Report for the Refurbishment and Upgrading of the Great Brak River WWTW compiled by Aurecon (December 2015) was studied as input into this design process. The report discussed the technical background to the decision to upgrade the facility to 4Ml/d, in line with the masterplan.

The report contains a.o. the following information relevant to this preliminary design report:

Average Wastewater Flow Jan 2015 – Sep 2015:	1.477 Ml/d
Raw Wastewater Chemical Oxygen Demand (COD):	1085 kg/d (735 mg/l avg)
Raw Wastewater Chemical Ammonia:	92 kg/d (62 mg/l avg)
Raw Wastewater pH:	7.44

Design sludge age: 25 days

Mixed Liquor Suspended Solids (MLSS): 3500 mg/l.

5.6 Funding application report for the upgrading of Great Brak River WWTW

The funding application report for the upgrading of the Great Brak River WWTW compiled by WEC Consult (September 2018) was studied as input into this design process. The report discussed the technical background and cost estimate for the proposed upgrade of the facility to 4Ml/d, in line with the masterplan.

The report provided the following background information relevant to this preliminary design stage:

- Insufficient nitrification is taking place in the aeration basin as no provision has been made in the reactor to allow for denitrification.
- Plant has been running at an average flow of 28% above its design flow for the period July 2017 to May 2018.
- The average Chemical Oxygen Demand (COD) concentration of the raw wastewater is 938 mg/ℓ for the period of January 2017 to May 2018.
- Multiplying this with the average daily flow for the same period yields a daily COD load of 1202 kg COD/day (110% of the plant's design COD load).
- The average ammonia concentration is 57.6 mg/ℓ, following the same step as above yields an ammonia load of 74 kg N/day and assuming an ammonia/TKN [Total Kjeldahl Nitrogen] ratio of 0,8, the average TKN load to the plant is 92 kgN/day (144% of the plant's design TKN load).
- Plant is organically overloaded.
- The high ammonia concentration (>6 mg/ℓ) indicates insufficient nitrification at the aeration basin. This can be attributed to insufficient aeration, as the plant is already overloaded.
- No provision is made at the existing plant for an anoxic basin and "a"-cycle pumps for the denitrification of nitrates. The high concentration of nitrates in the effluent triggers a requirement to allow for denitrification in proposed upgrade.
- The perimeter fencing require refurbishment.
- Tanker discharge facility requires upgrading/improvement.
- The Wastewater Risk Abatement Plan (WWRAP) has also identified the organic and hydraulic overloading of the works as high-risk hazards.

5.7 Wastewater risk abatement plan

The wastewater risk abatement plan (WWRAP) compiled by WEC Consult (2018) was studied as input into this design process. The report provided the following background information relevant to this preliminary design stage a.o.:

- Cumulative Risk Ratio (CRR): 44%
- It is expected of municipality, as the Water Service Authorities (WSA), to upgrade and refurbish the Great Brak River WWTW to an adequate capacity in order to reduce their current CRR
- According to the sewer master plan, the long-term peak day dry weather flow is estimated at 8,200 m³/d.
- Plant now needs to be upgraded to a 4Ml/d facility in accordance to master planning
- The following specific risks have been identified a.o.:
  - Hydraulic overloading
  - Organic overloading

5.8 Process audit report

The process audit report for Great Brak River WWTW compiled by WEC Consult (August 2018) was studied as input into this design process. The report discussed the description of their current Great Brak River WWTW, location, treatment process, analysis of raw inflow and treated effluent, existing management practices and recommendations to increase the functionality of the plant.

The report provided the following background information relevant to this preliminary design stage:

- Maximum hydraulic capacity of intake works is 270 ℓ/s (PWWF of 23.3 Mℓ/day).
- One existing 2,000 m³ aeration basin with two 31 kW surface mounted aerators.
- Design sludge age is 25 days.
- MLSS concentration of approximately 3500 mg/ℓ.
- Waste sludge pump in reactor basin - excess sludge wasted to the original anaerobic ponds.
- One existing 18m diameter secondary settling tank (SST).

- Sludge recycle pump station returns sludge to reactor, with each of the two pumps having a rated discharge of 11,6 ℓ/s (1:1 recycle ratio.

The report concluded the following:

- The plant is overloaded in term of its organic load.
- There's insufficient nitrification taking place in the aeration basin.
- No provision has been made in the reactor to allow for denitrification.

The report recommended that the Great Brak River WWTW be urgently upgraded to a 4Ml/d plant and that all the above shortcomings be addressed in the designs of the upgrades.

5.9 Inflow and outflow quality

The plant is monitored by means of samples taken from the raw wastewater inflow, aeration basin, settling tank effluent and final effluent release.

Data from the raw wastewater and final effluent from a report from Aurecon (Technical Report for the Refurbishment and Upgrading of the Great Brak River WWTW; Aurecon; December 2015) are tabled below.

Date	Raw Wastewater (mg/ℓ)				Final Effluent (mg/ℓ)						
	pH	COD	Amm	Cond. mS/m	pH	COD	Amm	Cond. mS/m	Nitrate	SS	E.Coli
17/09/2013	7.49	395	44	110	7.81	58	7.2	147	2.2	14	15
08/10/2013	7.33	685	53	119	7.46	64	2	146	4.5	20	11
05/11/2013	7.4	751	86	156	8.21	57	1.2	132	5	18	16
11/12/2013	7.37	1048	82.5	216	7.86	55	0.8	150	1.8	2	21
20/01/2014					7.34	73	0.5	101	9.6	2	148
05/02/2014					7.52	73	3.8	132	0.5	20	19
05/03/2014	7.49	905	57	199	7.48	52	1.6	157	0.5	22	44
24/04/2014					7.29	62	5.8	166	0.8	22	770
27/05/2014					7.49	52	2.4	164	2.7	16	3
12/06/2014	7.58	625	50	340	7.83	47	1	169	3.6	8	3
30/07/2014					7.66	53	4.8	159	2.7	8	2
25/08/2014					8.14	51	1.2	150	0.9	18	2
29/09/2014					8.25	46	1.2	141	5.4	102	167
28/10/2014					8.90	52	1	133	0.5	2	75
24/11/2014					8.83	42	1	127	0.5	2	36
17/12/2014					7.97	55	2.4	140	0.5	2	21
12/01/2015					7.56	87	16.6	144	0.5	16	73
18/02/2014					7.49	69	4.6	132	0.5	9	29
31/03/2015					7.95	53	4	124	0.5	8	56
15/04/2015					7.56	56	5.2	123	0.5	6	53
13/05/2015					7.62	53	4.2	134	0.5	4	51
220/06/2015	7.47	648	62.5	130	8.42	53	1.2	122	2.1	8	4
29/07/2015					7.6	49	2	125	1.8	6	6
17/08/2015					7.87	61	9.4	158	1.3	24	56
29/09/2015					7.65	58	2.6	159	5.2	6	435

Fig 13: Great Brak River WWTW influent and effluent quality (2013-2015):

In terms of the results tabled above, the plant is generally compliant in terms of applicable standards as far as discharge to non-listed streams are concerned. However when compared to the irrigation standards the ammonia requirement of 3 mg/l is not met in several samples. Since January 2015 the plant did not meet the ammonia requirement for several months on end. This is due to the overloaded conditions at the plant. The plant nevertheless performed well even under the continuous overloaded conditions.

Data from the raw wastewater and final effluent from a report from WEC Consult (Process audit report for Great Brak River WWTW; WEC Consult; August 2018) are tabled below and discussed at the hand of the tables.

Raw Wastewater Quality				
Parameter	pH	Cond.	COD	Ammonia
Compliance Limit	5.5 - 9.5	<150	<75	<6
Unit		mS/m	mg/l	mgN/l
Date				
30/01/2017	7.53	168.9	909	87.5
27/02/2017	7.33	109.7	672	57
29/03/2017	7.58	174.4	892	76.5
29/04/2017	7.36	113.5	732	64.5
29/05/2017	7.28	130.4	1021	57.5
29/06/2017	7.37	149.6	1390	73
27/07/2017	7.36	112.3	711	52.5
24/08/2017	7.22	151.9	827	41
28/09/2017	7.75	101.3	133	30.5
26/10/2017	7.46	113	862	64.5
30/11/2017	7.22	160.6	880	61
28/12/2017	7.59	161.4	932	74.5
25/01/2018	7.29	90.5	687	33.5
22/02/2018	7.31	128	662	64
29/03/2018	7.6	118.1	1423	45.5
26/04/2018	7.59	129.4	1459	44.5
31/05/2018	7.43	103.4	751	43

Fig 14: Great Brak River WWTW raw wastewater inflow quality (2017-2018)

In terms of the table above, the average COD concentration of the raw wastewater for the tabled period of January 2017 to May 2018 is 938 mg/ℓ. This yields a COD load of 1202 kg COD/d (110% of the plant's design COD load). Average Ammonia concentration is 57.6 mg/ℓ for the same tabled period. This yields an Ammonia load of 74 kg N/day and assuming an Ammonia/TKN ratio of 0,8, the average TKN load to the plant is 92 kg N/day (144% of the plant's design TKN load). From the results it is clear the works is organically overloaded.

Final Effluent								
Parameter	pH	Cond.	COD	Ammonia	Nitrate & Nitrite	O- P	SS	E. coli
Compliance Limit	5.5 - 9.5	<150	<75	<6	<15	-	<25	<1000
Unit		mS/m	mg/l	mgN/l	mgN/l	mgP/l	mg/l	#/100ml
Date								
30/01/2017	7.34	106.7	60	8.6	1.6	-	4	35
27/02/2017	7.13	103.6	61	3	5.7	-	2	39
29/03/2017	7.4	106.2	46	2	16.9	-	20	104
29/04/2017	7.08	102.7	49	2.2	14.3	-	14	26.9
29/05/2017	6.96	106.9	48	3	21.2	-	20	601.5
29/06/2017	6.89	115	58	5.4	27.3	-	12	24.1
27/07/2017	7.09	101.2	65	1	13.6	-	48	86
10/08/2017	7.15	99.2	60	0.56	11.1	-	18	105
24/08/2017	7.15	100	77	4.7	13.4	-	12	111.9
28/09/2017	7.14	100.8	69	3.15	12.7	-	2	24.9
26/10/2017	7.26	111.1	55	1.36	10.3	-	6	76.2
30/11/2017	7.44	129.7	88	6.6	6.68	-	8	77.1
28/12/2017	7.44	116	89	6.2	1.01	-	4	27.9
25/01/2018	7.31	108.6	95	12.6	0.253	-	10	>2419.6
22/02/2018	8.6	104.8	73	0.15	6.07	-	10	6.3
29/03/2018	7.9	120.8	75	0.6	15.9	-	0.6	38.4
26/04/2018	7.51	120.4	75	0.19	19.5	-	4	64.4
31/05/2018	7.73	131.1	75	0.21	21.2	-	6	7.5

Fig 15: Great Brak River WWTW final effluent quality (2017-2018)

According to the table above, the high ammonia (>6 mg/ℓ) indicate insufficient nitrification at the aeration basin. This is most probable caused by insufficient aeration as the plant is overloaded. No provision is made at the existing plant for an anoxic zone for the denitrification of nitrates. The high concentration of nitrates in the final treated effluent triggers a requirement to allow for denitrification in the proposed upgrade of the plant.

Present treated effluent quality analysis results were obtained from the municipality and is presented in the table below:

Parameter General Limit	pH @ 25°C 5.5-9.5	Conductivity @ 25°C (mS/m) 70 - 150	TSS (mg/l) 25	Physical Compliance %	COD (mg/l) 75	Ammonia (mg/l as N) 3	Nitrate + Nitrite (mg/l as N) 15	 10	Chemical Compliance %	E.coli / 100ml 1000
25/01/2018	7.31	109	10	100%	95	13	0.3	4	50%	2420
22/02/2018	8.60	105	10	100%	73	0	6.1	1	100%	6
29/03/2018	7.90	121	16	100%	75	1	15.9	1	75%	38
26/04/2018	7.51	120	4	100%	75	0	19.5	2	75%	64
31/05/2018	7.73	131	6	100%	75	0	21.2	1	75%	8
28/06/2018	8.24	144	8	100%	94	0	35.7	1	50%	3
26/07/2018	7.87	139	2	100%	75	0	22.4	1	75%	11
30/08/2018	8.81	138	4	100%	79	0	23.9	1	50%	6
27/09/2018	9.05	137	18	100%	80	0	11.7	1	75%	2
25/10/2018	8.83	138	2	100%	110	0	6.5	1	75%	101
29/11/2018	7.63	127	2	100%	86	6	1.8	2	50%	66
2018-12-20	7.53	131	4	100%	84	3.00	0.167	1.60	75%	88
31/01/2019	7.99	157	18	67%	93	4	1.2	1	50%	126
28/02/2019	7.99	165	24	67%	92	0.35	0.750	1.02	75%	138
28/03/2019	7.83	153	12	67%	92	0.61	1.33	1.26	75%	64
25/04/2019	7.64	154	10	67%	105	1	4.3	0.90	75%	50
30/05/2019	7.56	156	42	33%	95	2	18.8	1.47	50%	77
27/06/2019	7.57	202	2	67%	107	1	27.5	1.80	50%	28
25/07/2019	7.61	217	4	67%	127	2	22.3	1.70	50%	32
29/08/2019	7.85	208	12	67%	126	0	23.3	1.60	50%	134
26/09/2019	8.36	207	8	67%	80	0	18.4	1.80	50%	49
31/10/2019	8.92	218	16	67%	79	1	2.7	1.00	75%	96
28/11/2019	8.48	211	4	67%	107	0	1.7	1.25	75%	47
19/12/2019	8.40	204	6	67%	84	0.100	0.2	2.30	75%	26
30/01/2020	7.65	182	8	67%	100	2.650	2.8	0.70	75%	59
27/02/2020	8.16	283	10	67%	192	0.050	6.5	1.16	75%	104
26/03/2020	7.71	264	8	67%	115	0.100	17.0	0.80	50%	46
30/04/2020	7.56	255	6	67%	50	0.100	29.7	1.100	75%	46
28/05/2020	7.91	249	2	67%	79	0.090	27.9	0.740	50%	179
25/06/2020	7.92	240	12	67%	93	0.080	9.0	0.820	75%	179
23/07/2020	8.14	254	34	33%	91	0	19.7	1	50%	104
27/08/2020	7.42	243	2	67%	88	1	14.1	0	75%	104
2020-09-17	7.79	228	4	67%	100	0	9.2	1	75%	91
2020-10-29	7.94	205	10	67%	84	0	8.5	0	75%	115
2020-11-26	7.56	186	6	67%	87	0	6.2	0.680	75%	142
2020-12-30	7.62	188	2	67%	146	18	0.3	2	50%	2419
2021-01-28	7.72	195	10	67%	146	21	0.0	2	50%	1203
2021-02-25	7.88	198	14	67%	123	31	0.8	2	50%	161
2021-03-25	7.83	194	12	67%	110	42	0.2	2	50%	96
2021-04-29	7.80	192	2	67%	98	20	0.8	1	50%	727
2021-05-27	7.60	217	56	33%	88	5	8.6	0	50%	1203
2021-06-24	7.48	231	6	67%	91	7	16.0	0	25%	2419
2021-07-29	7.87	213	16	67%	128	21	3.5	0	50%	1986
2021-08-26	7.50	186	2	67%	87	5	7.3	1	50%	64
2021-09-30	7.47	233	22	67%	126	5	10.8	1	50%	133
2021-10-14	7.23	211	8	67%	118	2	17.7	1	50%	153
2021-11-25	7.43	169	12	67%	96	7	3.6	0	50%	224
2021-12-30	7.53	239	12	67%	115	23	0.4	3	50%	2420
2022-01-27	7.79	255	24	67%	116	25	0.3	2	50%	199

Fig 16: Great Brak River WWTW final effluent quality (2018-2021):

The table clearly reflects the increasingly poor performance of the plant due to the constant overloading experienced.

- Conductivity has generally been over limit since January 2019.
- COD has generally been over limit since August 2018.
- Ammonia has generally been over limit since December 2020.
- E-coli has been over the limit a number of times since December 2020.

Present inflow quality results were obtained from the municipality and will be utilised in the process design of the upgrades to the plant. The results are presented in the following table:

Date	pH @ 25°C	Conductivity @ 25°C (Ms/m)	COD (mg/L)	Ammonia (mg/L)
28/01/2021	7.37	196.4	931	61
25/02/2021	7.33	118	782	67
25/03/2021	7.13	114.6	396	63.5
29/04/2021	7.58	151.6	60	75.5
27/05/2021	7.81	221	1217	19.5
24/06/2021	7.55	356	586	47
29/07/2021	7.52	197.1	858	60.5
26/08/2021	7.81	157.6	384	101.5
30/09/2021	7.89	176.1	690	94
14/10/2021	7.45	236	425	65.5
25/11/2021	7.74	137.1	981	51
30/12/2021	7.3	227	444	82.5
27/01/2022	6.62	143.7	590	98

Fig 17: Great Brak River WWTW inflow quality (2021):

A composite sample of the raw wastewater inflow will be drawn during the detail design stage to inform the detail process design. The composite sample will either be a 24hr sample, or, if funds allow, a 7-day sample.

5.10 Water Use Licence (WUL)

The Great Brak River WWTW operates under a General Authorisation in terms of Section 39 of the National Water Act (Act 36 of 1998) as promulgated by the Department of Water Affairs and Forestry (now Department of Water and Sanitation (DWS)) under Government Gazette no 26187 dated 26 March 2004 (Regulation no 399). The plant may operate under a General Authorisation up to a volume of 2Ml/d.

According to a letter from the Department of Water Affairs (now Department of Water and Sanitation (DWS)) dated 30 March 2012, the Great Brak River WWTW is operated under General Authorisation for a capacity of 0.53Ml/d. It is unsure if this is the latest communication with and from DWS, but was the latest provided by the municipality for purposes of this preliminary design process. The 0.53Ml/d is significantly lower than the current 1.4Ml/d the plant is operated at, albeit far within the General Authorisation limit of 2Ml/d.

According to the treatment permit, treated effluent has to be disposed of by irrigation in the valley downstream of the WWTW and the treated effluent may not be discharged into the Little Brak River approximately 3.9km west of the works.

With the proposed upgrade to 4 Ml/d, DWS must provide a clear directive of the required effluent quality. Consideration must be given that the final effluent will be irrigated and that the irrigation standard is applicable. Previous experience with DWS has shown that final effluent may only be irrigated if for beneficial use. The implication of that is that no irrigation may occur during rain. This implies that during rain the final effluent must either be stored or released into the nearest tributary. Seeing that final effluent may not be released into the Little Brak River as per the current directive, all final effluent shall be stored during rain. If the farmer, who utilises the final effluent, can confirm that he will irrigate all the final effluent, and that he has sufficient storage for effluent during rain, it is most likely that the required effluent standard will be the irrigation standard. Such a letter shall be obtained from the farmer during the detail design stage. (If any effluent is going to be released to the nearest tributary, the final effluent will most likely have to comply with the General Limit.)

A water use licence (WUL) application will be performed for the capacity increase of the WWTW to 4Ml/d.

The plant currently operates at approximately 1.4Ml/d and this is well within the General Authorisation volume of 2Ml/d.

Construction of the new expansion may hence proceed (from a WUL perspective), in parallel, whilst the WUL application is submitted and approval awaited.

The new WUL application will address all of the above.

This preliminary design report will allow, inform and guide a discussion/meeting now required with the local DWS office to get their view on the final effluent requirements. Inputs from DWS will assist with the final process design. It is also appreciated that the final effluent quality will be dictated by the WUL, however the WUL normally takes several months before it is issued.

5.11 Design report for current WWTW

The original design report for the latest upgrades to the Great Brak River WWTW could not be obtained. The latest design drawings were however obtained as discussed earlier in the report. Sufficient parallel information is available for this not to detract from the design solution to be delivered for this project.

5.12 Final effluent disposal

Treated effluent is disposed of by irrigation in the valley downstream of the WWTW and the treated effluent may not be discharged into the Little Brak River approximately 3.9km west of the works.

The agreement with the adjacent land-owner for disposal of the treated effluent by irrigation, must also be updated for the upgraded works, i.e. for the 4Ml/d.

5.13 Other existing infrastructure

A detailed investigation of other existing infrastructure (electrical, mechanical, telemetry, water, etc) is outstanding and will be completed during the final design stage. A municipal medium voltage (MV) electrical substation and overhead lines are located on the site and adjacent to various boundaries of the site.

5.14 Availability of construction materials

All construction materials required for this project, ie sand, gravel, cement, concrete, bricks, steel, etc are available commercially in viable close vicinity to the site.

5.15 Legislation that regulates wastewater treatment

Legislation that regulates wastewater collection, treatment and disposal in South Africa and which are relevant to this design and upgrades to the Great Brak River WWTW, is listed below:

- Water services act (No.108 of 1997)
- Regulation 2834 (currently under review): Requires owners of WWTW's to classify and register WWTW's, operators & process controllers with DWS.
- Municipal structures act (No.117 of 1998): Functions and powers of municipalities, a.o. water services.
- National health act (No.61 of 2003)
- National water act (No.36 of 1998): Water resources management in South Africa.

- National water resource strategy (2004): Framework for management of water resources and catchments.

5.16 Alternatives considered during feasibility stage

A number of options have been considered during the feasibility stage, prior to this current preliminary design stage. It is not part of the scope of works and terms of reference of this report and it suffices to comment that it was investigated:

1. Do nothing alternative – This alternative is not an option as the WWTW is at capacity and the increase in inflow is to be accommodated and addressed in accordance with the relevant legislation.
2. Pumping of raw sewer to Hartenbos Regional WWTW (and closing Great Brak River WWTW) – This option was investigated internally by the client and was shown to be unfeasible due to numerous challenges.
3. Pumping of partially treated sewer to Hartenbos Regional WWTW (and operating Great Brak River WWTW at "over capacity") – This option was investigated internally by the client and was shown to be unfeasible due to numerous challenges.
4. Upgrading of Great Brak River WWTW to 4Ml/d – This option was shown to be most feasible and hence chosen for implementation. This option is also in line with the masterplan of the facility and the municipality.

5.17 Alternatives considered during preliminary design stage

A number of options have been considered during the preliminary design stage, briefly discussed below:

1. Option 1: Membrane Bioreactor
   This option provides a very small footprint, with a very high-quality effluent. The downside is that the operational costs are significantly higher then conventional activated sludge due to high energy costs and membrane replacements.

2. Option 2: Nereda Process
   This process provides a very good quality effluent. It is a proprietary process with was developed in the Netherlands by Nereda. There are two installations in South Africa i.e. Gansbaai and Wemmershoek. The Wemmershoek installation has been

problematic. The big concern is that the Nereda process is proprietary and not well tested in South Africa.

3. Option 3: Conventional Activated Sludge (CAS)
   Conventional Activated Sludge is a tried and tested technology in South Africa. Within the ambient of CAS there are the UCT, Modified UCT, Johannesburg, Bardenpho and Modified Ludzack-Ettinger (MLE) processes. The raw water quality i.e. TKN/COD guides the process selection.

5.18 Preferred alternative

Subsequent to careful consideration of all of the available options discussed above, the available data indicated the most feasible option to be Conventional Activated Sludge (CAS).

This preferred alternative will be the subject of the remainder of this preliminary design report.

5.19 Preliminary design

In order to upgrade the Great Brak River WWTW from a 1Ml/d to a 4Ml/d facility, in line with all the preceding discussions, the following design elements are considered for the preliminary design:

5.19.1 Treated effluent quality requirements

The final treated effluent at the Great Brak River WWTW must comply with the general standards of the water act. The standards provided in the table below is indicative of what DWS might require and will guide the process design.

Parameter	Irrigation	Discharge to non-listed stream
Max flow (m3/d)	<2000	<2000
Chemical oxygen demand COD (mg/l)	<75	<75
pH	5.5 – 9	5.5 – 9.5
Ammonia (mg/l)	<3	<6
Nitrate (mg/l)	<15	<15
Ortho phosphate (mg/l)	<10	<10
Total suspended solids (TSS) (mg/l)	<25	<25
Free chlorine	0.25	0.25
Feacal coliforms (no/100ml)	<1000	<1000
Electrical conductivity (EC) (mS/m)	<150	<150

Fig 18: Final treated effluent indicative standards

In line with section 39 of the National Water Act (Act 36 of 1998), treated effluent flow of less than 2Ml/d is covered by the general authorisation. Due to the fact that the upgraded Great Brak River WWTW will be designed for a total flow of 4Ml/d, and hence will exceed the stated maximum of 2Ml/d, it is accepted that the effluent will have to at least comply with the requirements for discharge to a non-listed stream as indicated in the table above. It is furthermore accepted that approval for the irrigation of the final effluent will have to be acquired from the Department of Water and Sanitation (DWS). All of the above will be discussed with the DWS during the WUL application that will be launched with the aid of this preliminary design report.

5.19.2 Process design

From a process design perspective, and considering all available preliminary design data, the provision of a Modified Ludzack-Ettinger (MLE) process will most likely suffice for the upgrading of the Great Brak River WWTW to 4Ml/d. This will entail the conversion of the existing 2.1Ml reactor into an anoxic reactor and to provide a new aerobic reactor. With the MLE process, the split between the anoxic and aerobic sections would be 40/60. Given that the existing aeration basin is 2.1Ml, and will be converted to an anoxic basin, the resulting required new aerobic volume will be 3.15Ml.

A composite sample of the raw wastewater inflow will be drawn during the detail design stage to inform the detail process design. The composite sample will either be a 24hr sample, or, if funds allow, a 7-day sample. This information will help to optimise the process volumes and reduce costs.

If the composite sample of the raw wastewater inflow shows that a greater volume than 2.1Ml is required for the anoxic fraction, the additional volume can be provided with the new aerobic zone.

Notwithstanding the above, the report of Aurecon (Technical Report for the Refurbishment and Upgrading of the Great Brak River WWTW; Aurecon; December 2015) proposed to convert the existing aerobic reactor to an anaerobic reactor, with a new anoxic and aerobic reactor. This will include nitrification, denitrification and phosphate removal. Phosphate in the final effluent is beneficial for irrigation. The farmer would prefer to retain the phosphates. It would then not make sense to remove it in the upstream process; If a nutrient removal process is implemented, and the phosphates are captured in the waste activated sludge, it ends up in the sludge ponds. In the sludge ponds, anaerobic cold fermentation occurs, and the phosphates are again released from the sludge. The supernatant from the sludge ponds flow to the maturation ponds. This implies that the phosphates end up in the final effluent in any case. Given this, it would not make sense to remove it in the process. If the WUL recommends a nutrient removal process, a good split would be 15/35/50 anaerobic/anoxic/aerobic. With this option, the existing aerobic volume could be converted to the anaerobic or anoxic basin.

If the composite sample of the raw wastewater inflow shows that there is <10mg/l of Orthophosphates in the raw water, it is proposed to rather provide a MLE process as the preferred alternative.

The final process selection will also be guided by the WUL requirements.

5.19.3 Expansion & upgrading of reactor basin

The expansion and upgrading of the reactor basin to a 4Ml/d MLE process entails the following:

- Conversion of the existing 2.1Ml reactor into an anoxic reactor
- Construction of new 3.15Ml aerobic basin directly adjacent to the existing reactor.
- Providing new surface aerators for new aerobic basin
- Providing mixers for the converted aerobic basin

- Provide “a”-recycle pumps to recycle to aerobic basin

The proposed utilisation of the existing 2.1Ml basin to convert the WWTW to a 4Ml/d MLE process, can be summarised as follows (existing 2.1Ml basin indicated in italics):

Zone	Volume (m^3)	Fraction
Anoxic	*2100*	*0.4*
Aerobic	3150	0.6
	5250	

Fig 19: MLE Process (Option 1)

For the limited possibility that an anaerobic/anoxic/aerobic process has to be provided, the split would be 15/35/50 anaerobic/anoxic/aerobic. Two options will then be possible in terms of the utilization of the existing 2.1Ml basin, i.e. the existing basin can be utilized as either the anoxic basin or the anaerobic basin. These two options are summarised in the following tables (existing 2.1Ml basin indicated in italics):

Zone	Volume (m^3)	Fraction
Anaerobic	900	0.15
Anoxic	*2100*	*0.35*
Aerobic	3000	0.50
	6000	

Fig 20: Nutrient Removal (Option 2A)

Zone	Volume (m^3)	Fraction
Anaerobic	*2100*	*0.15*
Anoxic	4900	0.35
Aerobic	7000	0.50
	14000	

Fig 21: Nutrient Removal (Option 2B)

Options 2A & 2B provides for a significant difference in total basin volume, i.e. 6m3 vs 14m3. If option 2 is required, option 2A will most probably be the option utilized. However, the final selection of volume and aerator capacity will be dictated by the composite sample of the raw wastewater inflow.

5.19.4 Construction of new (second) secondary settling tank (SST)

Construction of the new (second) secondary settling tank entails the following:

- Construction of a new 18m diameter 2Ml/d secondary settling tank (SST).
- All mechanical and electrical equipment.
- Construct new treated effluent connection line to the existing treated effluent outfall line.

5.19.5 Upgrading (refurbishment) of existing (first) secondary settling tank (SST)

Upgrading and refurbishment of the existing SST will entail mostly general maintenance and replacement of broken and damaged mechanical equipment.

Refurbishment of the existing SST will be performed subsequent to the construction and commissioning of the new SST when the existing SST can be temporarily taken out of service for this purpose.

Maintenance and defects will be assessed in detail during construction after the SST has been cleaned and washed.

5.19.6 Upgrade return activated sludge (RAS) pump station

The present capacity of each of the two sludge return pumps is 11.6 l/s i.e. a recycle ratio of 1:1 for a 1 Ml/d works. The intention is to replace existing pumps with pumps that each have a capacity suitable for an average dry weather flow of 4 Ml/d. This will in effect quadruple the current RAS pumpstation capacity. Available reports confirm that the dimensions of the existing pumpstation and rising main has been originally designed such that it can accommodate the proposed upgraded pumps and that provision has been made in the existing pumpstation to allow the underflow from a second settling tank of similar size to the existing tank. This will be confirmed during the detail design stge.

5.19.7 Maturation Ponds

The treated effluent outfall that takes the overflow from the SST to the maturation ponds have been sized to accommodate the expected flow from a 4 Ml/d plant. The total volume of the six maturation ponds is 26.7Ml i.e. a retention time of 6.7 days for a 4 Ml/d works. No upgrades required to the outfall line or maturation ponds.

5.19.8 Consideration of future mechanical dewatering of sludge

Waste sludge is discharged to the two primary ponds which are used as sludge lagoons. The lagoons are operated on a duty/standby mode to allow dewatering and desludging. The current sludge pond system is sufficient for the current flow of 1.4 Ml/d. The system will however not be sufficient for the future design flow of 4Ml/d. The following short-, medium- and long-term solutions are proposed for a phased approach:

i. The current sludge pond system is sufficient for the current flow of 1.4 Ml/d and will be sufficient for the short- to medium term.
ii. Once the two primary ponds run out of capacity in the medium term, it is recommended to utilise one of the secondary ponds for sludge storage and drying as well. This implies that 3 ponds will then be used on a rotational basis;
iii. As the future flow gradually increases to the design flow of 4 Ml/d, mechanical dewatering can be provided in the long term. Once the mechanical dewatering system is in place in the future, the primary ponds and secondary pond can be reinstated as maturation ponds.

It is not recommended to provide mechanical dewatering under this current phase of the project as it is not required currently and will not be required for the medium term. It is more important to provide additional treatment capacity for the funding available. By adopting the phased approach discussed above, the capital layout is staggered, and the existing infrastructure is utilised to maximum benefit.

A final decision will be reached during the final design stage.

5.19.9 Electrical supply

Electrical supply, both low voltage (LV) and medium voltage (MV) is available on site. Capacity required for the upgraded mechanical equipment discussed in this report is available on site.

5.20 General upgrades

Notwithstanding the above upgrades to the treatment process and treatment capacities, the following general upgrades are required in parallel, to improve overall operation and safety at the plant:

5.20.1 Tanker discharge facility

Improve the tanker discharge facility through relocation and redesigning to allow easy access and discharge.

5.20.2 Screens

Replacement of the rotary screen with a front raked screen and the provision of a hand raked bypass screen.

5.20.3 Sluice gates

The existing sluice gates and shafts are badly corroded and needs replacement.

5.20.4 High security fencing

A number of shortcomings have been identified in the high security fencing in and around the Great Brak River WWTW. The following fencing has been identified for replacement with 1.8m Clearvu high security fencing.

1. Perimeter fencing.
2. Fencing surrounding the dams.
3. Fencing in the central area of works

5.20.5 Roads

The site is serviced with and existing gravel access road and a gravel internal road system. Minor alternations to the internal roads are foreseen, specifically around the new reactor basin.

5.20.6 Stormwater

External stormwater runoff onto the site is currently controlled by an existing cut-off drain system which will be kept in place as-is. An existing stormwater channel system in existence on the site will be minimally added to as required.

A problem with stormwater ingress onto the site from Sandhoogte Road (divisional road) at the main entrance will be solved by provision of a new gravel v-drain along the divisional road with a pipe culvert underneath the main access.

5.20.7 Hydraulics from inlet works to reactor

Check hydraulics from inlet works to reactor. There is a possible blockage or bottle neck.

5.21 General layout masterplan

Infrastructure general layout planning has been performed by previous designers as part of master-planning of the Great Brak River WWTW and has been indicated on previous layout plans. During the site investigation, it was unanimously resolved to use the proposed positions of the new and upgraded infrastructure as indicated on the master plans.

5.22 Construction methodologies

Construction methodologies for the proposed new infrastructure as well as upgrades and refurbishments for this project is typical and no problems are foreseen. No special consideration is required for construction methodologies during the design.

5.23 Environmental Impact Assessment (EIA)

An Environmental Impact Assessment (EIA) will be required. A Basic Assessment process will be applied for due to the fact that construction will be an expansion on an existing facility, inside the zoned grounds of the existing facility and holistically that the infrastructure is municipal infrastructure included in official masterplanning. The largest trigger of the EIA will be the increased capacity of the facility.

Sharples Environmental Services, a specialist environmental services provider, has been appointed to conduct the EIA. This preliminary design report will enable the commencement of the EIA process and will be instrumental in the EIA application.

5.24 Other salient issues

The following salient issues will be considered during the detail design stage:

- Appropriate landscaping details and specifications
- Wayleaves and servitudes (none anticipated)
- Relocation of existing services (none anticipated)

5.25 Preliminary design drawings

A set of preliminary design drawings have been prepared for the preliminary design stage and is attached to this report as addenda. A number of extracts from the preliminary design drawings are provided below:

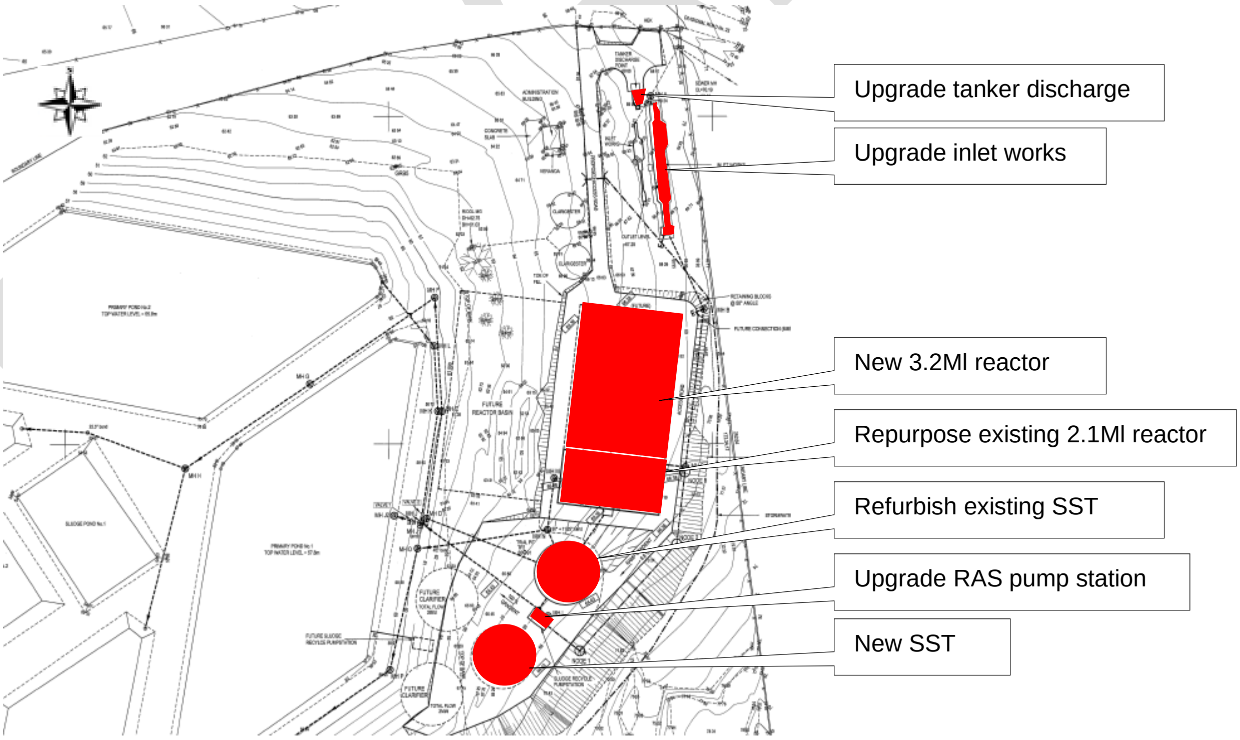


Fig 22: General site layout of new and upgraded infrastructure

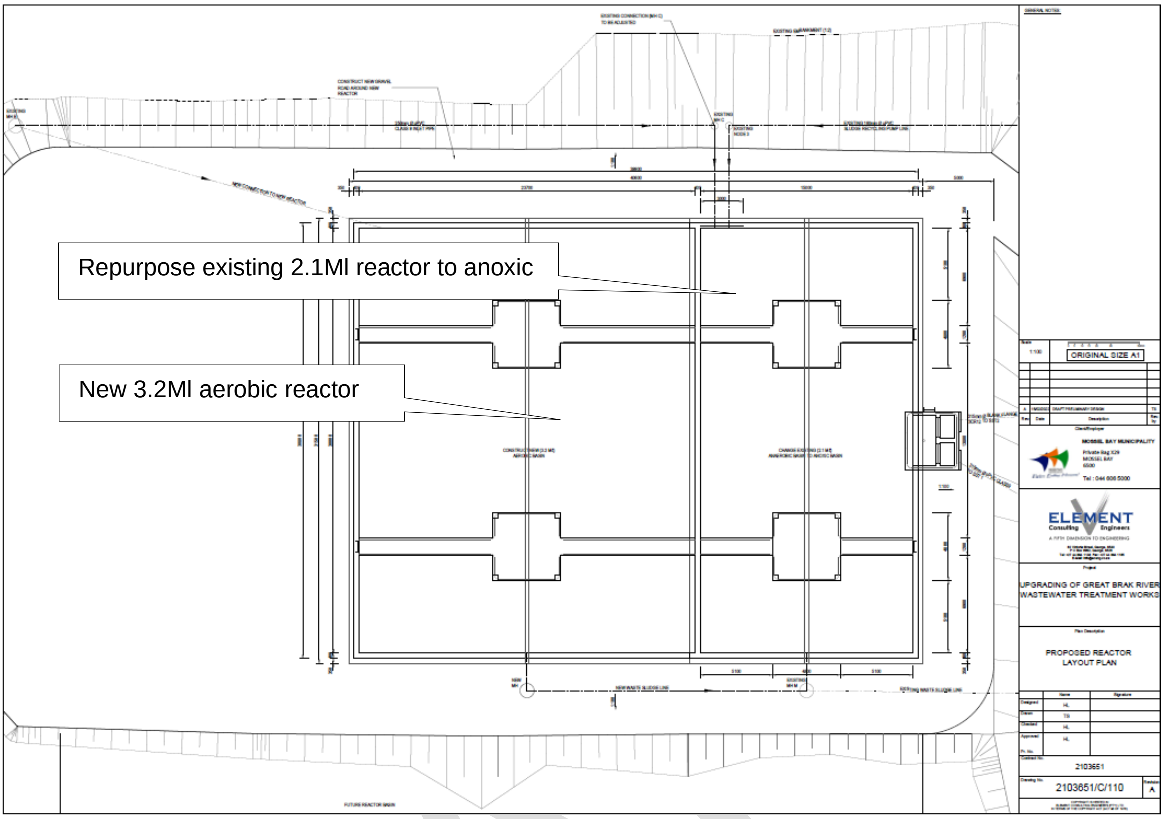


Fig 23: Layout of new reactor

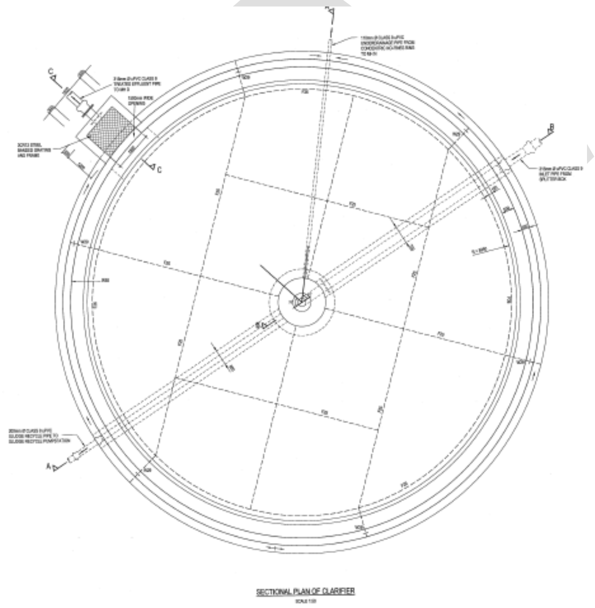


Fig 24: Layout of new 18m 2Ml/d SST

6 PROGRAMME

A project programme has been drafted for the preliminary design report stage. A large number of unknowns are still present at this early stage of the project and the project programme may change accordingly. A summary of the programme is presented in the following table:

Appointment	Aug 2021
Inception stage	Sep – Oct 2021
Site investigation	Oct 2021
Preliminary design	Nov 2021 – Feb 2022
Preliminary design report	Feb 2022
Consultation with DEADP	Feb 2022
Consultation with DWS	Feb 2022
EIA (basic assessment)	Mar – Aug 2022
WULA	Mar 2022 – Jun 2023
Detail design	Mar 2022 – May 2022
Documentation	Mar 2022
Procurement	Apr 2022 – Jun 2022
Appointment of contractor	Jun 2022
Contract administration	1 Jul 2022 – 30 Jun 2023
Construction monitoring	1 Jul 2022 – 30 Jun 2023
Close-out report	30 Jun 2023

7 COST ESTIMATE AND CASHFLOW

A preliminary design stage cost estimate has been performed and will be refined during the detail design stage. The preliminary design stage cost estimate rates are based on construction of similar works. Allowance has been made for preliminary and general (P&G's), contingencies, estimating contingencies and escalation. A detailed cost estimate will be presented during the detail design stage.

Preliminary and General	5,398,468
Site clearance and earthworks	970,000
Upgraded tanker discharge facility	450,000
Expanded reactor basin	8,652,954
New clarifier/SST	2,199,921
Upgrading/refurbishment of existing clarifier/SST	470,000
RAS pumpstation	115,616
Pipework & fittings	1,321,156
Roadworks and stormwater	720,000
High security fencing	1,750,000
Administration building refurbish	80,289
General civil	250,000
Mechanical dewatering equipment (mech/elec)	-
Reactor tank (mech/elec)	9,147,375
Settling tank (mech/elec)	1,493,377
Recycle pumpstation (mech/elec)	132,116
Screening equipment (mech/elec)	802,891
Telemetry	500,000
Electrical installation (MV & LV)	2,700,000
Subtotal	37,154,163
Plus : Contingencies & estimating contingencies (12.5%	4,644,270
Sub-total	41,798,433
Plus : Escalation (Feb - May 2022)(1.5%)	626,976
Total (excl VAT)	42,425,409
VAT (15%)	6,363,811
Total (incl VAT)	48,789,221

Fig 25: Preliminary design cost estimate

As can be concluded from the table, the preliminary design stage cost estimate totals R42.4m (excl VAT) and R48.8m (incl VAT), inclusive of P&G's, contingencies, estimating contingencies and escalation. All infrastructure discussed in this report have been incorporated in this cost estimate, except for the mechanical dewatering equipment.

A large number of unknowns are still present at this preliminary design stage and hence an estimating contingency of 2.5% has been added to the general 10% contingency for a total of 12.5% contingency. All unknowns will be finalized during the detail design stage. and a final cost estimate will be presented in the final design report.

8 WAY FORWARD

The way forward is anticipated as presented below but may vary depending on various outcomes of the preliminary design approval process and particularly the EIA and WULA processes:

8.1 Detail design

- On acceptance of the preliminary design report, the project can continue to the detail design stage.
- Finalization of all of the above preliminary designs and data into detail designs.
- Detail specifications and drawings facilitated by the above detail designs.
- Monthly progress reports.
- Draft detail design report as output from the above processes, containing all of the above detail design parameters, detail specifications, detail drawings, project overview and final cost estimate and updated project program
- Discussion with and approval of the above by client
- Agree on implementation timeframes and project budget and cashflow with client
- Final detail design report

8.2 Procurement

- Compile tender document (inclusive of all construction specifications, designs, drawings and construction schedule) in line with agreed standards
- Facilitate and manage tender process
- Tender adjudication and report
- Discuss tender report with client and agree on all outstanding issues
- Obtain written instruction from client to proceed with appointment of relevant contractor

8.3 Implementation

- Facilitate construction commencement by appointed contractor
- Construction monitoring

- Contract management during the construction stage, including but not limited to the following (refer ECSA guidelines):
    - Monthly progress reports
    - Budgetary (and cashflow) monitoring and reporting
    - Programming and progress monitoring and reporting
    - Quality control of all construction specifications, designs & drawings
    - Payment certificates
    - Chairing of site meetings
    - Minutes
    - Keeping of all required construction and legislative statistics
    - Labour statistics management and records keeping (if required)
- Manage Health and Safety (H&S / OHS) during construction
- As built drawings and documentation

8.4 Project completion and commissioning

- Completion of all activities
- Commissioning to specifications
- Completion and submission of as-built drawings (record drawings) and other record data required by the client
- Project completion report
- Compilation of Operations and Maintenance manual

9 CONCLUSIONS AND RECOMMENDATIONS

9.1 Conclusions

The following can be concluded from the preliminary design report for the upgrading of the Great Brak River WWTW:

1. The Great Brak River WWTW is currently designed for an average dry weather flow (ADWF) of 1Ml/d and is currently operated at around 1.4Ml/d ADWF. With the significant growth experienced in the study area, further expansion of the plant to a 4Ml/d plant is necessary.
2. An inception meeting was conducted on 23 August 2021.
3. The terms of reference and scope of work of the project in summary entails the upgrading of the Great Brak River WWTW to a 4Ml/d facility from the current 1Ml/d facility.
4. A number of available reports, audits, manuals and drawings were obtained and studied as input into the preliminary design report. These are discussed in the report and extracts presented where relevant.
5. A detailed site investigation was held with the client's full team on 19 October 2021. A full walkthrough and a full discussion were held on all the existing infrastructure, the client's needs and the anticipated upgrades to ensure all stakeholders were on the same level of understanding. Positions of new infrastructure were identified and confirmed between the parties. Current operating challenges were discussed. Conditions of existing infrastructure were discussed.
6. The existing treatment process are summarised as follows:
    a. Inlet works (preliminary treatment) with a capacity of 270l/s or 8Ml/d.
    b. Activated sludge reactor with one aeration basin of 2.1Ml with a treatment capacity of 1Ml/d.
    c. Secondary settling tank (SST) of 18m diameter with a treatment capacity of 2Ml/d.
    d. Six maturation ponds with a total volume of 26.7Ml.
    e. Two sludge lagoons operated on a duty/standby mode.
    f. Final treated effluent is utilized for irrigation by the downstream landowner.
7. Numerous datasets of raw wastewater inflow and final effluent were presented and discussed. Current datasets (2018-2021) confirm that the WWTW is overloaded. A composite sample of the raw wastewater inflow will be drawn during the detail design

stage to inform the detail process design. The composite sample will either be a 24hr sample, or, if funds allow, a 7-day sample.

8. A water use licence (WUL) application will be performed for the capacity increase of the WWTW to 4Ml/d. This preliminary design report will allow, inform and guide a discussion/meeting now required with the local DWS office to obtain their view on the final effluent requirements. Inputs from DWS will assist with the final process design. It is also appreciated that the final effluent quality will be dictated by the WUL.
9. A number of process design alternatives were investigated and included membrane bioreactor, Nereda process and Conventional Activated Sludge (CAS). Subsequent to careful consideration of all of the available options, the available data indicated the most feasible option to be a Conventional Activated Sludge (CAS) process.
10. Treated effluent quality requirements were considered and presented in tabular format. The standards guided the process design.
11. From a process design perspective, and considering all available preliminary design data, the provision of a Modified Ludzack-Ettinger (MLE) process will most likely suffice for the upgrading of the Great Brak River WWTW to 4Ml/d. The MLE process is thus the preferred alternative. This will entail the conversion of the existing 2.1Ml reactor into an anoxic reactor and to provide a new aerobic reactor of 3.15Ml. A composite sample of the raw wastewater inflow will be drawn during the detail design stage to inform the detail process design. This information will help to optimise the process volumes and reduce costs.
12. The proposed upgrades are summarised as follows:
    a. Expanion/upgrading of reactor basin to allow for a 4Ml/d capacity and a new process design. Construction of new 3.15Ml aerobic basin. Conversion of existing 2.1Ml aerobic basin to anoxic basin.
    b. Conversion of the existing aerobic process to new Modified Ludzack-Ettinger (MLE) (aerobic/anoxic) process as the preferred option.
    c. Construction of new (second) 18m diameter 2Ml/d SST, inclusive of all mechanical and electrical equipment.
    d. Upgrading (refurbishment) of existing (first) SST in order to correct all current defects experienced and perform general maintenance.
    e. Upgrading of return-activated-sludge (RAS) pump station to accommodate the future flow of 4Ml/d.
    f. Numerous general upgrades, refurbishment and maintenance works, inclusive of tanker discharge facility, screens, .sluice gates, high security fencing, roads and stormwater.

13. An Environmental Impact Assessment (EIA) will be required. A Basic Assessment process will be applied for. This preliminary design report will enable the commencement of the EIA process and will be instrumental in the EIA application.
14. A project programme was presented and briefly discussed. A large number of unknowns are still present at this early stage of the project and the project programme may change accordingly. The preliminary design stage programme indicates completion of construction for 30 June 2023.
15. A preliminary design stage cost estimate has been performed and will be refined during the detail design stage. The preliminary design stage cost estimate amounts to R48.7m (incl P&G's, contingencies, escalation & VAT).

9.2 Recommendations

The following are recommended for the preliminary design report for the upgrading of the Great Brak River WWTW:

1. That the Great Brak River WWTW be upgraded to a 4Ml/d capacity.
2. That the terms of reference and scope of works for the project, as set out in this report, be accepted.
3. That a 7-day composite sample of the raw wastewater inflow be drawn by a reputable laboratory and that this appointment be made as soon as possible. That this composite sample be used to inform and conclude the final process design.
4. That a Conventional Activated Sludge (CAS) process- and in particular a Modified Ludzack-Ettinger (MLE) process be utilized as the preferred alternative, depending on the outcome of the composite sample.
5. That a discussion/meeting be held with the local DWS office to get their view on the final effluent requirements, informed and guided by this preliminary design report. Inputs from DWS will assist with the final process design.
6. That a water use licence (WUL) application for the capacity increase of the WWTW to 4Ml/d be prepared and submitted on the back of this preliminary design report and the discussions with DWS.
7. That, depending on the final process design, the following final designs be performed for the detail design stage to increase the Great Brak River WWTW to a 4Ml/d capacity.
    a. New 3.15Ml aerobic basin.
    b. Conversion of existing 2.1Ml aerobic basin to anoxic basin.
    c. New (second) 18m diameter 2Ml/d SST.

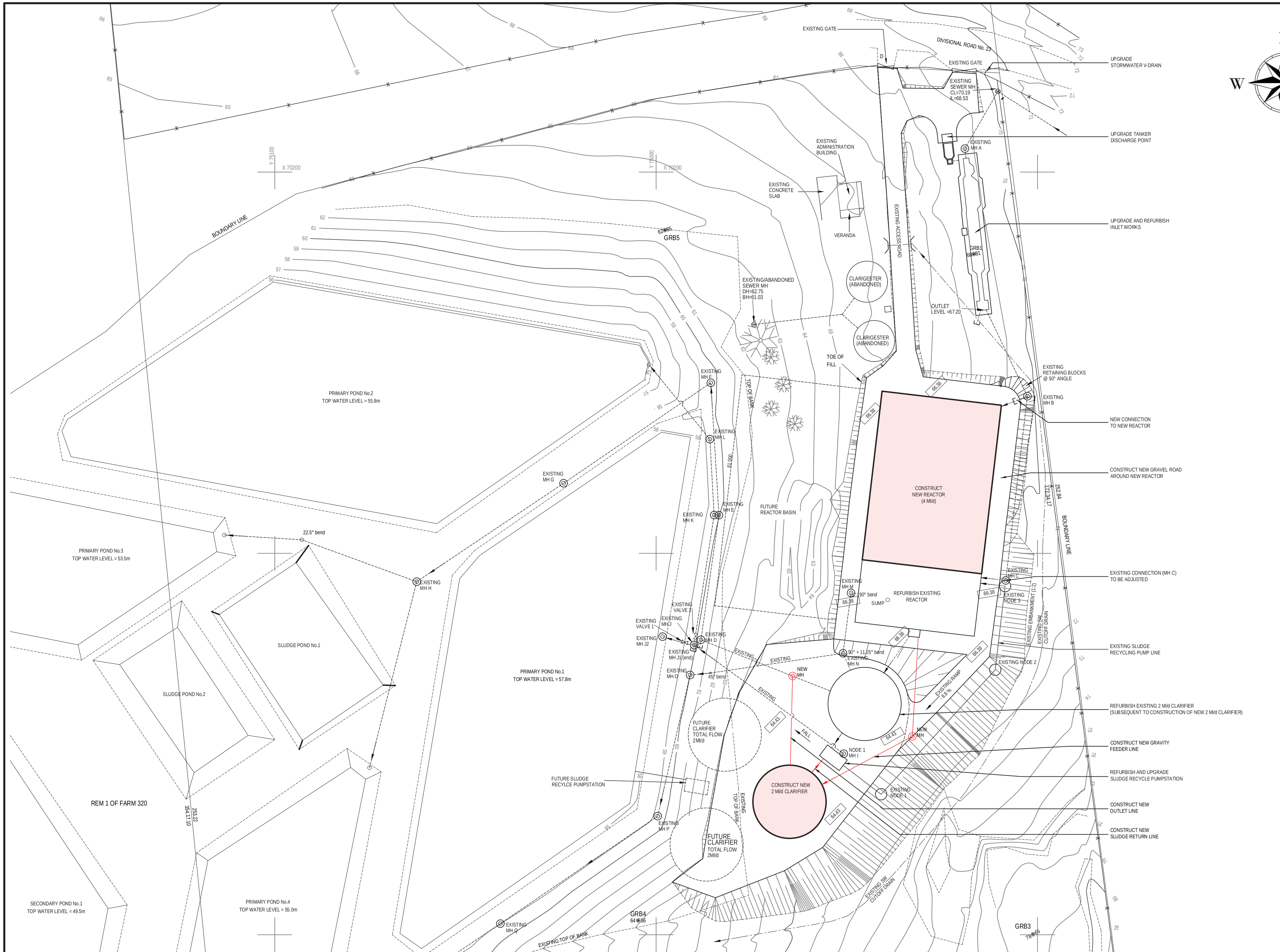
d. Upgrading (refurbishment) of existing (first) SST.
e. Upgrading of return-activated-sludge (RAS) pump station to 4Ml/d.
f. Numerous general upgrades, refurbishment and maintenance works, inclusive of tanker discharge facility, screens, .sluice gates, high security fencing, roads and stormwater.

8. That an Environmental Impact Assessment (EIA) process for the capacity increase of the WWTW to 4Ml/d be launched on the back of this preliminary design report.
9. That the procurement process be commenced in parallel to the EIA, WULA and detail design stage.

10 ADDENDA

10.1 Addendum 1 – Preliminary design drawings

10.2 Addendum 2 – Inception meeting minutes



CO-ORDINATE LIST FOR STATIONS :

POINT	Y	X	Z
GRB1	74916.738	70221.506	68.81
GRB2	74997.798	70104.320	75.68
GRB3	74901.195	70399.905	78.65
GRB4	75004.720	70396.250	64.86
GRB5	74997.725	70215.253	62.85

CO-ORDINATE LIST FOR SEWER :

NAME	Y	X	Z	BEND
MH P	74999.606	70368.913	58.384	
MH G	75024.287	70281.624	58.002	
MH H	75062.774	70307.418	57.148	
MH R	75082.540	70425.137	55.622	
MH O	74991.103	70331.897	58.808	
MH D	74988.309	70322.348	59.313	
MH E	74983.528	70289.976	59.067	
MH F	74985.668	70255.276	58.857	
Bend	75092.924	70296.429	54.357	22.5°
Pond 3	75113.231	70295.181	53.475	
Pond 4	75075.174	70356.214	55.017	
MH J	74990.035	70324.033	58.512	
MH K	74984.785	70289.966	58.139	
MH L	74985.905	70270.062	57.990	
Pond 2	75001.879	70250.512	56.029	
Sump	74939.274	70312.199	61.111	
MH M	74948.906	70310.381	60.442	
Bend 1	74948.362	70311.056	60.371	90°
Bend 2	74950.230	70326.577	60.013	90° + 11.25°
MH N	74950.997	70326.204	60.002	
Bend 3	74985.759	70331.369	58.797	45°
MH J1 (END)	74990.133	70324.276	58.330	
MH J2	74998.337	70321.839	57.858	
Valve 1	74992.493	70323.339	59.086	
Valve 2	74989.693	70321.720	59.248	

INTERCONNECTING PIPEWORK

DESCRIPTION	ITEM	COVER LEVEL (m)	INVERT LEVEL (m)	DEPTH (m)	PIPE (uPVC CLASS 9)	GRADIENT	LENGTH (m)
WASTEWATER : OUTFALL SEWER MH A TO INLET WORKS	MH A	68.70	67.995	0.71	400 Ø	1:6.358	2
	INLET WORKS	68.58	67.680	0.90			
SCREENED WASTEWATER : INLET WORKS TO REACTOR BASIN	INLET WORKS	68.18	66.480	1.70	400 Ø	1:266.70	25
	MH B	67.40	66.386	1.01	250 Ø	1:266.70	48
	MH C	67.40	66.206	1.19	250 Ø	1:266.70	7
	REACTOR BASIN	66.38	66.180	0.20			
MIXED LIQUOR SUSPENDED SOLIDS : REACTOR BASIN TO CLARIFIER	REACTOR BASIN	66.38	61.980	4.4	315 Ø	1:12.90	11
	CLARIFIER	64.43	61.130	3.3			
SETTLED SLUDGE : CLARIFIER TO PUMPSTATION	CLARIFIER	64.43	61.430	3.0	200 Ø	-1:4.00	5
	PUMPSTATION	64.43	62.680	1.75			
EFFLUENT : CLARIFIER TO MH H	CLARIFIER	64.43	62.630	1.8	315 Ø	1:10.81	36
	MH D	60.30	59.313	1.0	500 Ø	1:160	33
	MH E	60.00	59.067	0.91	500 Ø	1:160	35
	MH F	59.80	58.857	0.93	400 Ø	1:55	47
	MH G	58.70	58.002	0.68	400 Ø	1:55	47
	MH H	58.40	57.148	1.23			
EFFLUENT : MH H TO PRIMARY POND No.3	MH H	58.40	57.148	1.23	315 Ø	1:15	32
	22.5° BEND	-	-	-	315 Ø	1:15	21
	PRIMARY POND No.3	-	53.500	TOP WATER LEVEL			
EFFLUENT : MH H TO PRIMARY POND No.4	MH H	58.40	57.148	1.23	315 Ø	1:25	51
	PRIMARY POND No.4	-	55.000	TOP WATER LEVEL			
WASTE SLUDGE : PUMPSTATION TO MH J	PUMPSTATION	64.43	61.880	2.55	200 Ø	1:15.09	2
	MH I	64.43	61.747	2.68	200 Ø	1:15.09	49
	MH J	59.60	58.512	1.10			
WASTE SLUDGE : MH J TO PRIMARY POND No.1	MH J	59.60	58.512	1.10	200 Ø	1:12.86	8
	MH J2	59.00	57.858	-	200 Ø	1:12.86	2
	PRIMARY POND No.1	-	57.800	TOP WATER LEVEL			
WASTE SLUDGE : MH J TO PRIMARY POND No.2	MH J	59.60	58.512	1.10	200 Ø	1:100	34
	MH K	59.50	58.139	1.34	200 Ø	1:100	20
	MH L	59.10	57.990	1.13	200 Ø	1:100	25
	PRIMARY POND No.2	-	55.800	TOP WATER LEVEL			
DRAINAGE WATER : REACTOR BASIN TO MH R AND DAY LIGHT	REACTOR BASIN	66.38	60.480	5.9	160 Ø	1:35.61	2
	MH M	66.38	60.442	5.9	160 Ø	1:35.61	16
	MH N	64.43	60.002	4.42	160 Ø	1:35.61	43
	MH O	60.00	58.808	1.19	160 Ø	1:100	40
	MH P	59.20	58.384	0.99	160 Ø	1:100	50
	MH Q	59.20	57.903	1.10	160 Ø	1:100	50
	HW R	56.922	55.622	0.60			
DRAINAGE WATER : CLARIFIER TO MH N	CLARIFIER	-	61.030	-	110 Ø	1:100	16
	MH N	64.43	60.002	4.42			

RISING MAIN :

DESCRIPTION	GROUND LEVEL (m)	INVERT LEVEL (m)	DEPTH (m)	PIPE (uPVC CLASS 9)	GRADIENT	LENGTH (m)
PUMPSTATION	64.43	64.280	0.15	160 Ø	1:43.68	11
NODE 1	65.43	64.530	0.90	160 Ø	1:43.68	46
NODE 2	67.38	65.530	1.85	160 Ø	1:43.68	20
NODE 3	67.38	66.043	1.34	160 Ø	1:43.68	6
REACTOR BASIN	66.38	66.180	0.20			

Rev.	Date	Description	Rev. by
A	15/02/2022	DRAFT PRELIMINARY DESIGN	TS

ELEMENT Consulting Engineers
A FIFTH DIMENSION TO ENGINEERING
82 Victoria Street, George, 6530
P O Box 9962, George, 6529
Tel: +27 44 884 1138
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E-Mail: info@eceng.co.za

Client/Employer

MOSSELBAAI Explore Endless Horizons!

MOSSEL BAY MUNICIPALITY
Private Bag X29
MOSSEL BAY
6500
Tel : 044 606 5000

Project

UPGRADING OF GREAT BRAK RIVER WASTEWATER TREATMENT WORKS

Plan Description

PROPOSED UPGRADES AND REFURBISHMENT - GENERAL LAYOUT

	Name	Signature
Designed	HL	
Drawn	TS	
Checked	HL	
Approved	HL	
Pr. No.		

Scale 1:500

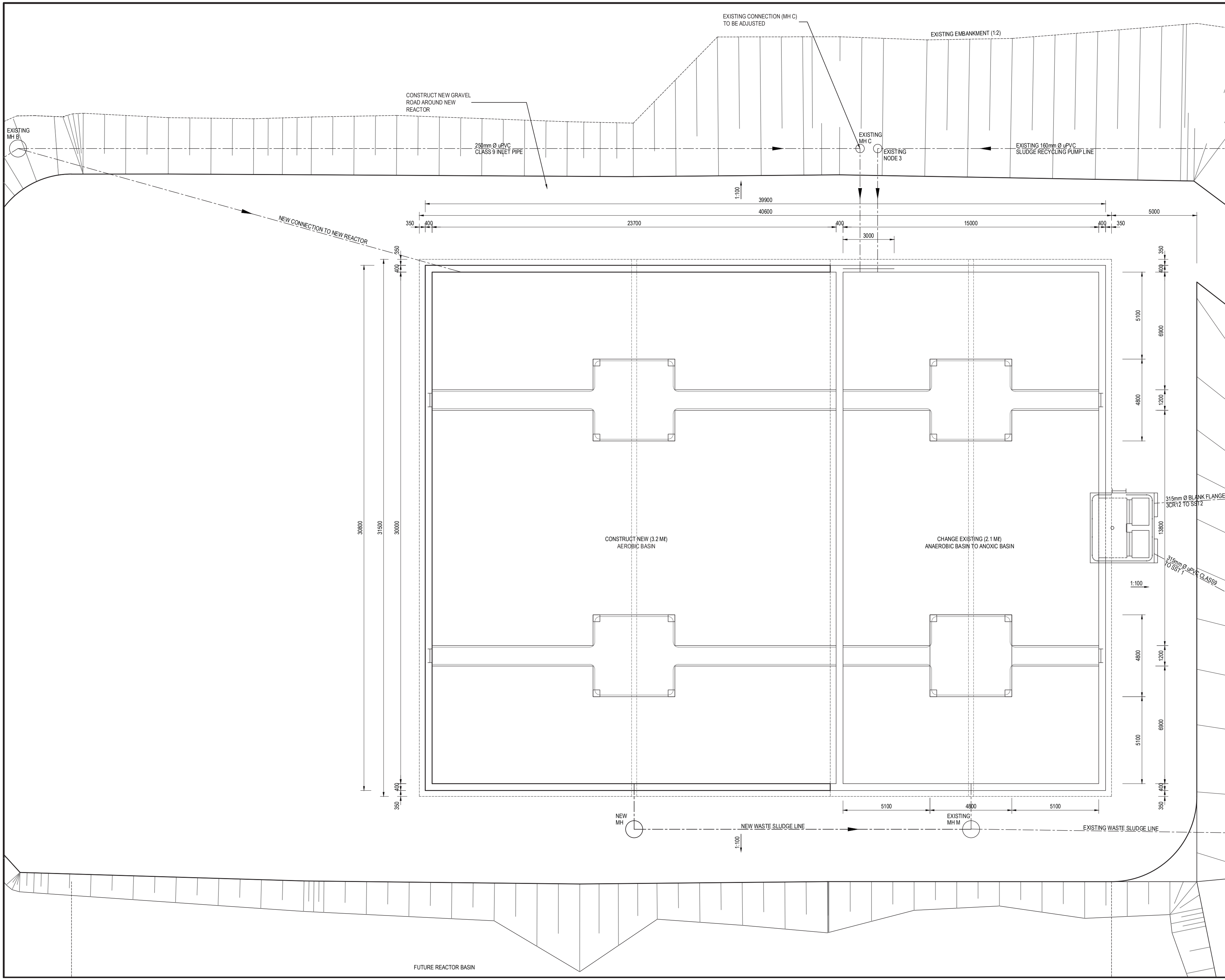
0 5 10 15 20 30 50mm

ORIGINAL SIZE A1

Contract No. 2103651

Drawing No. 2103651/C/100

Revision A



GENERAL NOTES:

Scale	
1:100	ORIGINAL SIZE A1

Rev.	Date	Description	Rev. by
A	15/02/2022	DRAFT PRELIMINARY DESIGN	TS

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Project

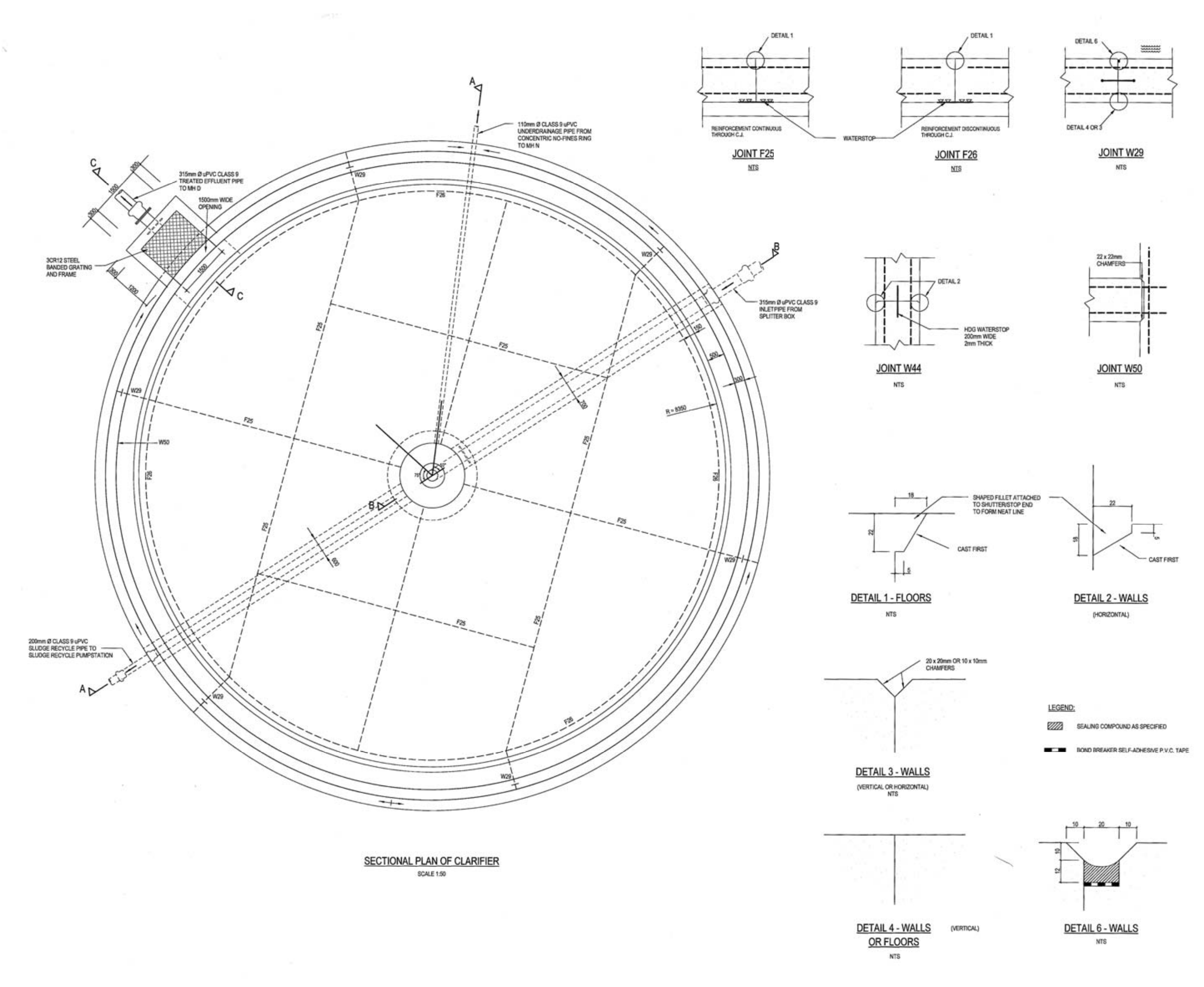
UPGRADING OF GREAT BRAK RIVER WASTEWATER TREATMENT WORKS

Plan Description

PROPOSED REACTOR LAYOUT PLAN

	Name	Signature
Designed	HL	
Drawn	TS	
Checked	HL	
Approved	HL	
Pr. No.		
Contract No.	2103651	
Drawing No.	2103651/C/110	Revision A

P:\2021\2103651 (P21036S) - Great Brak River WWTW Capacity Increase\D - Drawings\D8 - Working Drawings\2103651-C-110-A-Upgrades And Refurbishment_Reactor Basin Layout - 15Feb2022.dwg



GENERAL NOTES:

Scale: AS SHOWN

ORIGINAL SIZE A1

Rev.	Date	Description	Rev. by
A	17/02/2022	FOR APPROVAL	TS

Client/Employer

MOSSEL BAY MUNICIPALITY
Private Bag X29
MOSSEL BAY
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Project

UPGRADING OF GREAT BRAK RIVER WASTEWATER TREATMENT WORKS

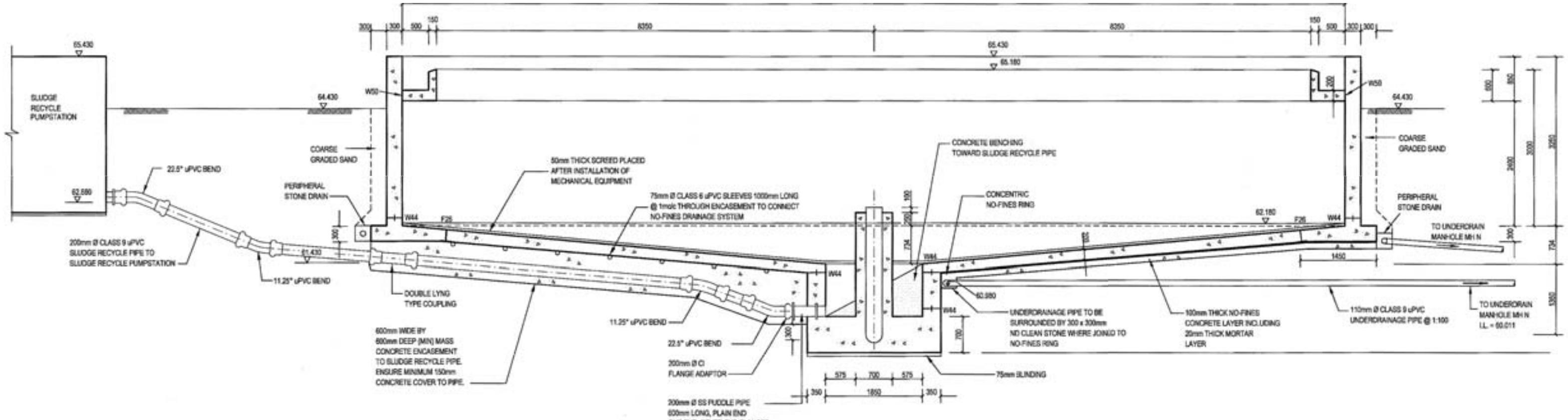
Plan Description

PROPOSED CLARIFIER LAYOUT AND DETAILS

	Name	Signature
Designed	HL	
Drawn	TS	
Checked	HL	
Approved	HL	
Pr. No.		

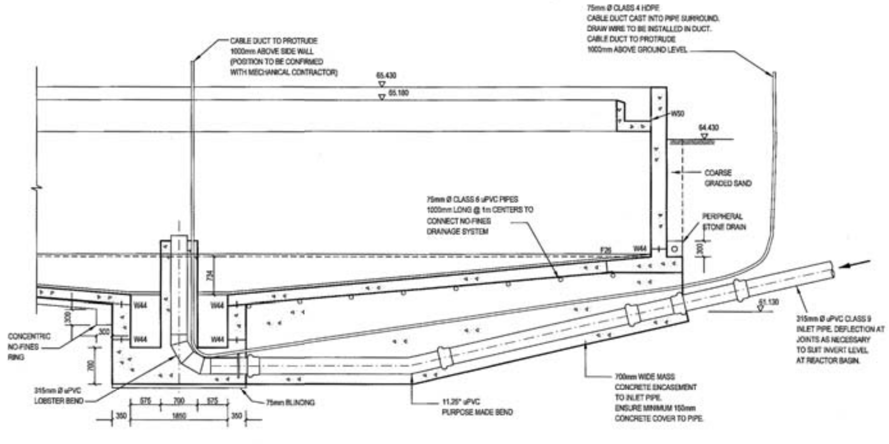
Contract No. 2103651

Drawing No. 2103651/C/120 Revision A



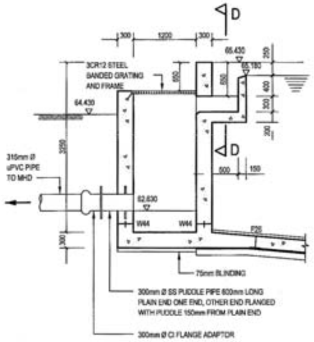
SECTION A-A

SCALE 1:50



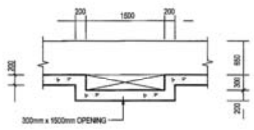
SECTION B-B

SCALE 1:50



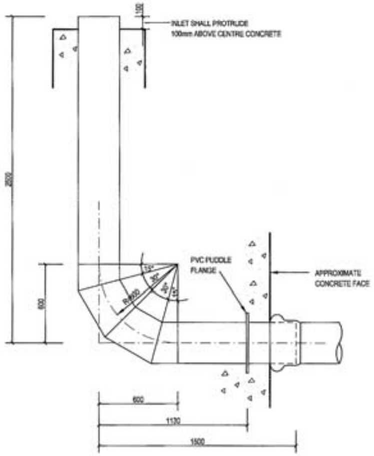
SECTION C-C

SCALE 1:50



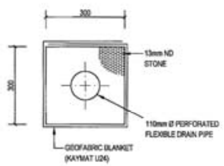
SECTION D-D

SCALE 1:50



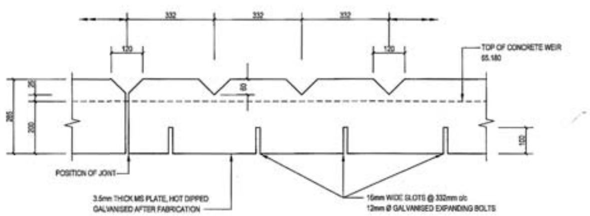
DETAIL OF 315mm Ø uPVC LOBSTER BEND

SCALE 1:20



DETAIL D1
PERIPHERAL UNDERDRAIN DETAIL

SCALE 1:10



DETAIL OF WEIR PLATE

(BY MECHANICAL CONTRACTOR)

SCALE 1:10

GENERAL NOTES:

Scale	
AS SHOWN	ORIGINAL SIZE A1

Rev.	Date	Description	Rev. by
A	17/02/2022	FOR APPROVAL	TS

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Plan Description

CLARIFIER SECTIONS

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Designed	HL	
Drawn	TS	
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Pr. No.		
Contract No.	2103651	
Drawing No.	2103651/C/130	Revision A

P:\2021\2103651 (P210365) - Great Brak River WWTW Capacity Increase\D - Drawings\D6 - Working Drawings\2103651-C-130-A-Upgrades And Refurbishment_Clarifier - 15Feb2022.dwg