ANNEXURE J:

Concept & Viability Design Report (construction of the new pump station) - Lyners Consulting Engineers dated June 2026

GEORGE MUNICIPALITY

CONCEPT AND VIABILITY DESIGN REPORT

FOR

UPGRADING OF THEMBALETHU PUMP STATION 7 AND CONSTRUCTION OF THE NEW THEMBALETHU EAST PUMP STATION

PORTION 2: CIVIL, STRUCTURAL, MECHANICAL & ELECTRICAL WORKS

JUNE 2026

REVISION 3

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REPORT DETAILS :

Lyners Reference No:	C23176
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Keywords:	Parkdene PS 2, 3 & Thembalethu PS 2, B, A, A, 7 & New Proposed Thembalethu East PS

Revision record and date:

Date	Revision	Status	Format	Issued to:
03 March 2025	0	Draft	PDF	M Geyer
07 October 2025	1	Draft	PDF	M Geyer
15 February 2026	2	Draft	PDF	M Geyer
24 February 2026	2	Final	PDF	M Geyer
02 June 2026	3	Final	PDF	M Geyer

PROJECT 23176CG- CONCEPT AND VIABILITY REPORT							
REV	DESCRIPTION	ORIG	REVIEW	LYNERS APPROVAL	DATE	EMPLOYER APPROVAL	DATE
3	CONCEPT AND VIABILITY REPORT	PC DAVIDS	M LE ROUX	APPROVAL SIGNATURE APPROVAL NAME	03/06/26 APPROVAL DATE	APPROVAL SIGNATURE APPROVAL NAME	APPROVAL DATE

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1. INTRODUCTION

1.1 Appointment and Report Limitations

Neil Lyners and Associates (Pty) Ltd (Lyners) was appointed on the 25 August 2023 by George Municipality to execute and manage the process and procedures for the implementation of rehabilitation and upgrades of the Thembalethu eastern bulk gravity sewer infrastructure as part of the sewer master plan approved capital budget.

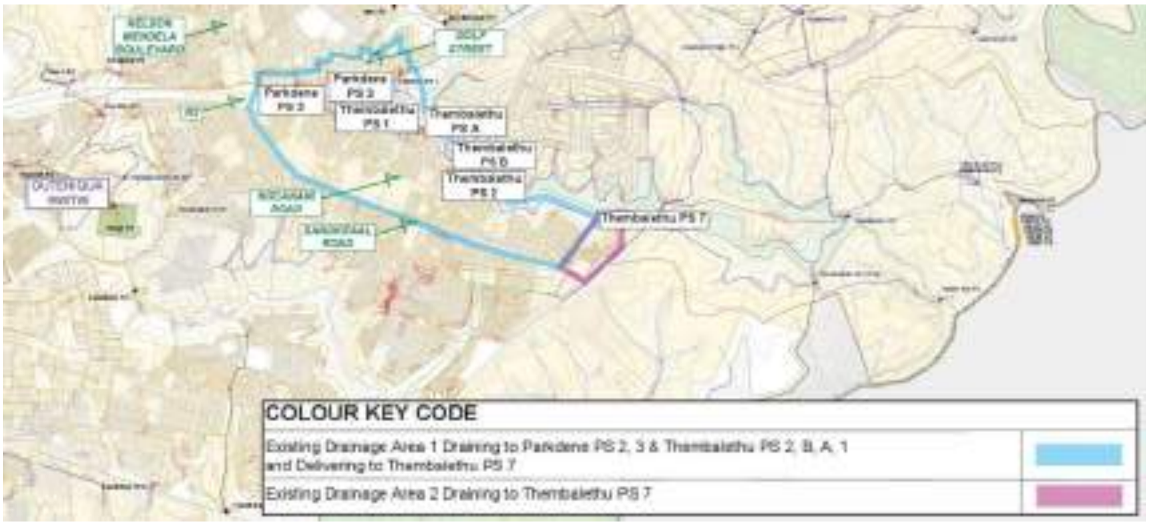
As discussed in section "1.3 Terms of Reference" below, it was decided that the scope of work as per the appointment will be carried out in two portions.

This report only focuses on the "Portion 2" items and is intended to document Lyners understanding of the scope of work of the project, outline the methodology Lyners intends to follow, provide associated concept design proposals, and provide potential order of magnitude cost estimates based on historic tendered rates Lyners has available for similar works for budgeting purposes.

1.2 Background

The Thembalethu settlement situated in the George Municipality in the Western Cape province raw sewage is collected via multiple gravity sewer networks and conveyed via multiple pump stations and associated rising mains in either a series or parallel to ultimately the Outeniqua Waste Water Treatment Works (WWTW).

The existing Eastern region of Thembalethu can be defined from East of Nelson Mandela Boulevard and South of the Meul river which drains sewage from two independent drainage areas. The drainage can be noted as drainage area 1 which is serviced by Thembalethu PS 2, B, A, 1 and drainage area 2 which is serviced by Thembalethu PS 7 as can be gauged by Figure 1 below.



<u>Note(s):</u>

1) *Image Underlay Extracted from George Master Plan Sewerage System, Outeniqua Drainage Area, dated 2024-03, compiled by GLS Consulting (Pty) Ltd*
2) *North direction should be considered "vertically up" on the figure for reference purposes.*

Figure 1: Thembalethu Eastern Portion Drainage Area Pump Station Locations

The collected sewage is conveyed via these pump stations and associated rising mains, with the exception of Thembalethu PS 7, from South to North (towards the N2) from Thembalethu PS 2 to Thembalethu PS 1, with Thembalethu PS A and Thembalethu PS B being position between these pump stations. Thembalethu PS 1 transfers all sewage collected North of the N2 National Road to the Meul PS gravity main (situated along Golf Street, Parkdene).

In addition, a portion of Parkdene drains to Parkdene PS 2 and Parkdene PS 3 respectively which conveys sewage via two individual 150mm diameter AC pipelines to the Meul PS gravity main as well.

Furthermore, Thembalethu PS 7 pumps sewage via an existing 200mm diameter Unplasticized Polyvinyl Chloride (uPVC) rising main to Tabata Street where the rising main transitions to a 235mm diameter uPVC gravity sewer which drains to the Thembalethu PS 6. From Thembalethu PS 6 the sewage is further pumped and conveyed via gravity sewers to the Pacaltsdorp PS 1, which then ultimately transfers the sewage to the Outeniqua WWTW.

The document titled "George Master Plan Sewerage System, Outeniqua Drainage Area", dated "2024-03", compiled by "GLS Consulting (Pty) Ltd" (hereafter referred to as the "Sewer Master Plan 2024") indicated the construction of a bulk gravity sewer that would orientate parallel to the Meul River and drain in a Southern direction. The bulk gravity sewer would "picking up" several intermediate sewer pump stations flows along the way and ultimately reporting to a future new bulk sewerage pump station , namely the Thembalethu East PS, positioned south of Thembalethu PS 7. The new proposed Thembalethu East PS would then convey the collective sewage flow to Thembalethu PS 6 and ultimately on to the Outeniqua WWTW.

It is important to note that the Thembalethu PS 6 is currently being upgraded with the intent that the above additional collective sewage flow will be reporting to the pump station.

Furthermore, the Sewer Master Plan 2024 report and an associated schematic of the system modeled data for the current and future pumping systems is included under Annexure A for information purposes.

1.3 Terms of Reference

1.3.1 Scope of Work and Portioning Thereof

The original construction scope of works included in the original appointment from George Municipality was as follows:

- Construction of bulk collector sewers (gravity and rising mains) ranging in size from 160mm to 500mm diameter;
- Decommissioning 6 or 7 sewer pump stations in terms of the George Municipality's asset disposal plan (Parkdene PS 2 & 3 and Thembalethu PS A, B, 1 & 2, optional Thembalethu PS 7);
- Decommissioning and disconnection of existing rising mains and associated gravity sewers where required;
- Upgrading Thembalethu PS 7 to 48l/s and associated rising main upgrade or construction of the new Destiny Africa (*Note: Now referred to as the Thembalethu East PS*) pump station and associated rising main for 48 l/s (*Note: Section 1.3.2 below assumes this 48 l/s is only for the lower design horizon of 10 years*) .
- Relining/Pipe cracking of the existing rising main (if suitable) to remain in use as an emergency back-up rising main to pump station 7.

The original appointment did not consider factors such as project scale, complexity and nature of work, and therefore it was decided with Lyners that the original construction scope of works will be addressed in two portions, split as follows:

- Portion 1:
    - Construction of bulk collector sewers (gravity and rising mains) ranging in size from 160mm to 500mm diameter;
    - Decommissioning 6 or 7 sewer pump stations in terms of the George Municipality's asset disposal plan (Parkdene PS 2 & 3 and Thembalethu PS A, B, 1 & 2, optional Thembalethu PS 7);

  - Decommissioning and disconnection of existing rising mains and associated gravity sewers where required;
  - Relining/Pipe cracking of the existing rising main (if suitable) to remain in use as an emergency back-up rising main to pump station 7.
- Portion 2:
  - Upgrading Thembalethu PS 7 to 48l/s and associated rising main upgrade or construction of the new Destiny Africa (Note: Now referred to as the Thembalethu East PS) pump station and associated rising main for 48 l/s.

1.3.2 Assumptions relating to the Scope of Work

The appointment and original construction scope of work provided by George Municipality, did not provide all the departure information Lyners requires for concept design, and therefore the following related assumptions are made:

- If Thembalethu East PS is proposed, the concept design will consider placement based on the fact that the following will realize:
  - All development flows North of the Meul river (Destiny Africa, Kraaibosch etc) will drain by gravity to the Thembalethu East PS.
  - Thembalethu PS 7 flow will be incorporated into the Thembalethu East PS.
  - Thembalethu East PS design capacity implementation will be phased over a certain timeframe, considering all future and current flows. The pump station infrastructure must be designed in such a manner to allow for future extensions of it, to increase its capacity.
- The proposed concept design will consider the upgrading required to be as follows:
  - 10-year design horizon where the flow is 48 l/s.
  - 25-year design horizon (development within the urban edge) where the flow is 161 l/s.
  - 50-year horizon (developed outside the urban edge included) where the flow is 253 l/s.
- Portion 1 will implement the following:
  - Relining/Pipe cracking of the existing rising main (if suitable) will be done to ensure the existing pipeline remains in use as an emergency back-up rising main from Thembalethu PS 7 position to the transition manhole conveying to Thembalethu PS 6.
  - Construction of a single or dual new rising main from Thembalethu PS 7 / the Proposed New Thembalethu East PS position to transition manhole conveying to Thembalethu PS 6.
  - The capacity/condition of the existing gravity main downstream of Thembalethu PS 7 at the transition manhole where Thembalethu PS 7 / Proposed New Thembalethu East PS rising main will discharge sewage flow under gravity to the Thembalethu PS 6 will be checked and will be confirmed suitable or be upgraded accordingly to receive any additional flows as a result of the upgraded Thembalethu PS 7 or Proposed New Thembalethu East PS.

1.3.3 Departure to Executing the Scope of Work

This report will only focus on “Portion 2” of the scope of work as defined in section “1.3.1 Scope of Work and Portioning Thereof “above, and will coincide with the assumptions as stated in section “1.3.2 Assumptions relating to the Scope of Work” stated above going forward.

Furthermore, as inferred by the scope of work there is an element of optioneering which needed to be confirmed prior to taking the project forward in that a decision needed to be made between upgrading Thembalethu PS 7 OR constructing a new bulk sewerage pump station at an alternative proposed site East of the Thembalethu PS 7 which will function as then new proposed Thembalethu East PS.

Therefore, as a departure the existing infrastructure at Thembalethu PS 7 will first be visually assessed for suitability for upgrading and then an optioneering process followed on whether to upgrade Thembalethu PS 7 or to consider a new Thembalethu East PS at a greenfield site.

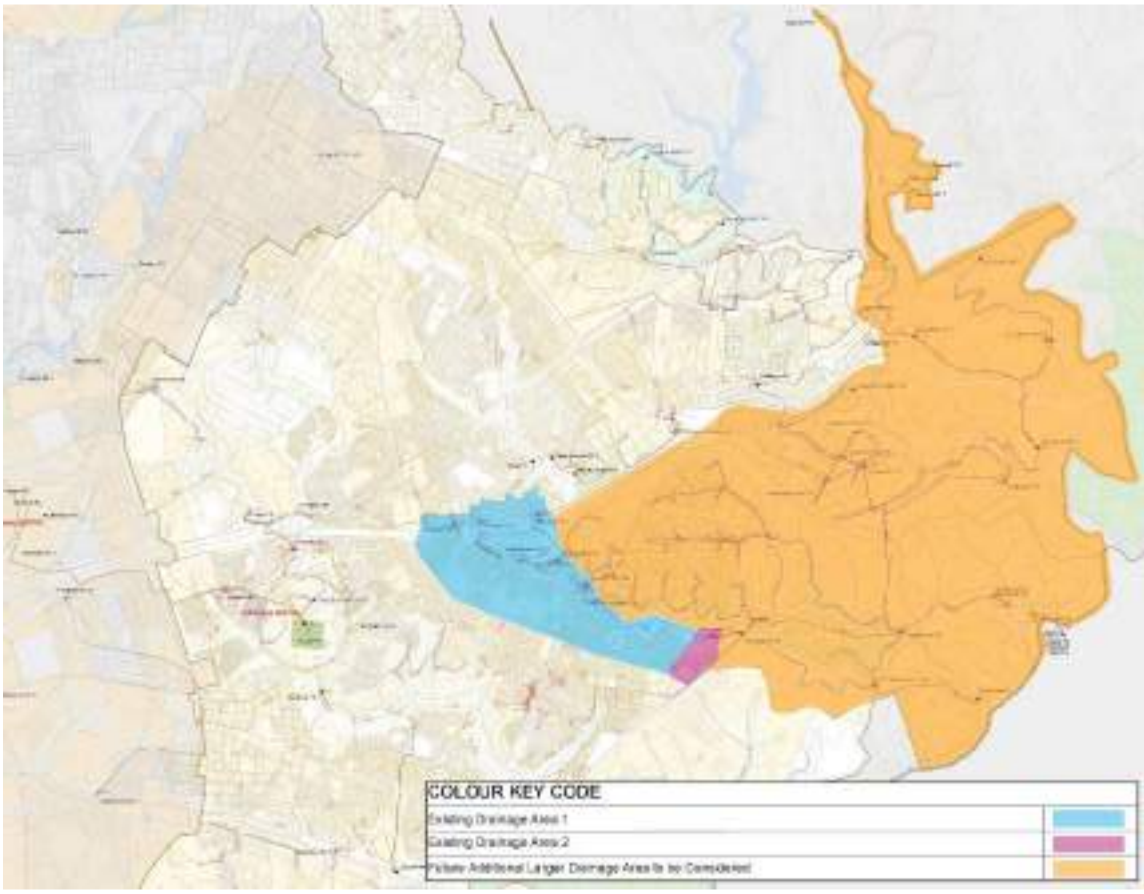
On conclusion of the optioneering, the terms of reference will be revised or adapted to be taken forward for proposed concept designs based on the upgrading or new pump station construction decision.

See section 3.4 Revised Terms of Reference for the revised or adapted terms of reference of this report.

2. EXISTING INFRASTRUCTURE

2.1 Drainage Areas and Associated Considerations

The existing and future drainage areas for the Thembalethu East region are shown in Figure 2 below:



Note(s):

1) *Image Underlay Extracted from George Master Plan Sewerage System, Outeniqua Drainage Area, dated 2024-03, compiled by GLS Consulting (Pty) Ltd*
2) *North direction should be considered "vertically up" on the figure for reference purposes.*

Figure 2 : Existing and Future Drainage Areas for Thembalethu East Region

For orientation purposes, when referencing the above figure the existing drainage area 1 indicated by the "cyan" colour code is serviced by the Parkdene PS 2, 3 and Thembalethu PS A, B, 1, where the existing drainage area 2 indicated by the "magenta" colour code is serviced by Thembalethu PS 7.

Furthermore, the future additional larger drainage area which would need to be accommodated is indicated by the "orange" colour code and would require to drain to a position close to the East of the existing Thembalethu PS 7 and South of the Meul river.

In general, the existing drainage area 1 can be defined as the larger of the two existing drainage areas and encompasses:

- The Southern area of Parkdene which can be roughly stated to be delineated by Golf Street, Taurus Street, Scorpio Street, Sandkraal Road and the Northern edge of the N2 national road, plus
- the Eastern area of Thembalethu which can be roughly stated to be delineated by Nelson Mandela Boulevard, Sofasilahlane Street, Meul River South Boundary and the Southern edge of N2 national road

Furthermore, in general, the existing drainage area 2 can be defined as Meul River South Boundary, Sofasilahlane Street and surrounding green belt.

The future additional larger drainage area can be defined as the entire South-Eastern corner of George including Victoria Bay, Thembalethu, Kraaibosch Ridge, Garden Route City, Woodifields and Saasveld neighborhoods.

In the Sewer Master Plan 2024 report, consideration was given to eradicate existing pump stations in the Thembalethu East Region, and this envisioned draining the existing drainage area 1 past the existing Thembalethu PS 7 to a new bulk sewerage pump station which would require to be situated East of the existing Thembalethu PS 7.

It should be noted that this new PS position would eradicate existing pump stations in the Thembalethu East Region and coincides with the future additional larger drainage area.

2.2 Existing Thembalethu PS 7

2.2.1 General Description

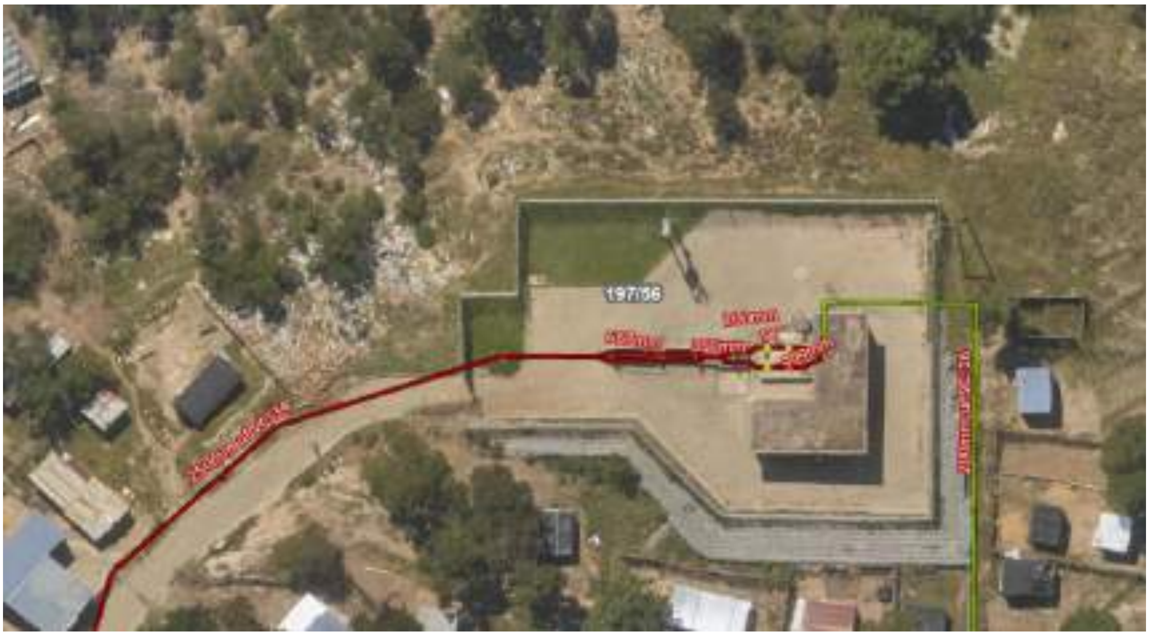
The existing Thembalethu PS 7 receives flow from the existing sewerage infrastructure which drains into the pump station site from the west.

The incoming sewer is a single 250mm diameter uPVC pipeline that discharges flow into an existing concrete Inlet Works which functions as a primary treatment facility for the raw sewage which reports to the pump station.

The screened sewage is then discharged from the inlet works into the pump station wetwell where it is pumped into a single 200mm diameter uPVC rising main pipeline towards NMB.

Furthermore, notable major ancillary features to the Thembalethu PS 7 are that the site consists of only one building structure, has a single pole mounted transformer, the site is encamped by “Clearvu” fencing, has one access controlled gate and the encamped footprint area not occupied is mostely covered by paving.

See Figure 3 below for an aerial view of the existing Thembalethu PS 7 with flow schematic line diagram showing the incoming sewer pipeline (red), Inlet Works channel configuration and outgoing rising main pipeline (green).



Note(s):

1) *Image and Flow Schematic Line Diagram Extracted from George Municipality GIS Viewer Tool*

Figure 3 : Existing Thembalethu PS 7 Aerial View

It should also be noted in the above aerial image there appears to be an encroachment of informal settlements on to the existing Thembalethu PS 7 site boundary.

2.2.2 Existing Inlet Works

The existing Inlet Works consisting out of two parallel channels, a sand trap/sump and diversion chamber which reports to the existing pump station wetwell, as can be seen in the general site picture of the structure included in Figure 4 below.

Figure 4 : General Site Picture of the Existing Thembalethu PS 7 Inlet Works

The raw incoming sewage from the existing sewerage network is directed into two screenings channels, each 500mm wide. In each channel there is a manual hand rake screen installed with a 60mm bar spacing aperture as can be seen in Figure 5 below.

Figure 5 : Picture of the Manual Hand-Raked Screens Installed in Screenings Channels

Furthermore, each channel is equipped with manually operated, channel mounted penstocks upstream and downstream of the respective screen.

The screens are cleaned by the operator’s discretion or when visually seen to be blocked and hampering hydraulics. The screenings debris from cleaning is raked onto a steel platform, from where it is scooped into black bins by means of shovels. The black bins are perforated at the bottom to enable liquid contained within the screenings debris to drain and/or escape from the bin, thereby promoting the likely drying of the screenings from the waterlogged in the debris. The bins are manually emptied out onto the back of the Light Delivery Vehicle (LDV), which transports the screenings debris to the Gwaing Waste Water Treatment Works (WWTW).

Both screenings channels then terminate in a common sand trap / sump that is linked to the diversion chamber.

The diversion chamber has overflow weirs (controlling the flow through the sand trap), each equipped with a channel gate / penstock. The settled grit and larger particles are manually removed from the sump by means of a suction tanker truck.

The diversion chamber feeds two gravity pipelines which convey flow to the existing pump station wetwell which consists of two sumps. The two gravity pipelines which feed the existing pump station wetwell run through a pipe chamber where each pipeline is equipped with a flanged, inline Macerator as can be seen in Figure 6 below.

Figure 6 : Picture of the Inline Macerator Unit Installed in the Pipe Chamber

Each Macerator can be isolated by the two gate valves installed upstream and downstream of each unit.

The sand trap / sump is also equipped with an overflow pipe that is linked to the pump station wetwell.

2.2.3 Existing Pump Station

The existing pump station intake is at two concrete sumps comprising as the existing pump station wetwell and the sumps are linked by means of a bottom orifice type connection which is equipped with a manually operated wall mounted sluice gate.

Furthermore, the wetwell also has a high-level overflow opening in the division wall between the two sumps, and an emergency overflow pipe to environment on the northern sump wall if all else fails.

The existing pump station pump house adjacent to the wetwell houses two self-priming pump sets (Described in further detail in section "2.2.4 Existing Mechanical & Electrical Equipment" below) and the associated suction and delivery pipework, valves, and minor ancillary equipment.

The current design flow of the existing pump station in accordance with the Sewer Master Plan 2024 report is 30 l/s. The volume of the wetwell when combining the sumps is approximately 33.4 m^3, with an estimated operational volume of 3.8 m^3.

Furthermore, as can be seen in Figure 7 below of the pump house, the pump room is accessed via the three doors on the North of the building (Right side in the Picture) and the Motor Control Centre (MCC) room and Generator room via the green two doors on the East of the building (Left side in the Picture).

Figure 7 : Picture of the Pump Station Pump House

It should be noted that the MCC is housed in a dedicated room for limiting contact with gas and liquid from the pump room operations.

A flow meter is installed on the common delivery pipework in the pump room, with the flow meter display mounted on the wall below the manifold. As can be seen in Figure 8 and Figure 9, the flow meter unit appears to be operational and in fair to good condition.

Figure 8 : Picture of the Existing Siemens Flow Meter Installed in the Pump Room

Figure 9 : Picture of the Flow Meter Display on the Wall in the Pump Room below the Flow Meter

The existing sewage pump station is controlled from a single existing MCC unit which is shown in Figure 10 below.

Figure 10 : Picture of the Existing Pump Station MCC unit

Furthermore, the site is currently equipped with an older Spectrum telemetry outstation and other minor mechanical and electrical equipment.

2.2.4 Existing Mechanical & Electrical Equipment

The condition of the mechanical equipment is in fair condition. The two pump sets are of the self-priming type, Gorman Rupp VS3A60-B two stage sewage pump, each coupled to a 45 kW, 4-pole motor by means of a belt drive. These pump sets were installed in 2013-2014, as part of the pump station upgrade. It operates on a one duty, one standby configuration. The pumping equipment were designed to handle a maximum pump rate of 30l/s @ 57m through the existing DN200, Class 16 uPVC rising main.

The pump suction pipework is sized at DN150, which results in relatively high flow velocity of ±1.7 m/s, however this is still acceptable for the current pump's design flow. There is however a very short DN150 x DN100 eccentric reducer installed on the pump suction flange which would cause excessive secondary losses in the suction pipework.

The pump delivery pipework is sized at DN150 and the common delivery is sized at a DN200, which is acceptable for the current pump's design flow of 30 l/s as the flow velocity is ±1.7 m/s and 1.0 m/s respectively.

This flow velocity in the delivery pipes is within the norm for sewage as the industry theoretical norm is a maximum of 1.8 m/s. The suction and discharge pipework are constructed from coated stainless steel and the exterior condition is fair with no signs of corrosion. The internal condition is unknown. The 1.8 m/s velocity is however slightly on the high side for the rising main and will produce higher friction losses and by implication higher energy usage.

The existing MCC is located in the dedicated MCC room as described above and controls the two macerators (star-delta starters) and the pumps (soft starters). It is equipped with and Human Machine Interface (HMI), displaying the operational information.

2.3 Existing Rising Main

The rising main consists of a 200mm diameter uPVC Class 16 Rising main approximately 1,17km in length. The rising main terminates at a transfer structure located in an unnamed road, just off Jonga Street. As-builts are available for this existing rising main and indicate that the pipeline was installed around 2014

2.4 Power Supply

The site is currently supplied via an overhead 11kV line, on a dedicated spur to this remote location. The line terminates onto a set of fuses, feeding a pole-mounted transformer, mounted on a H-pole configuration, within the site boundary. The transformer is a 200kVA 11kV/420V unit, with open, overhead-line terminations.

Figure 11 : Existing Pole-Mounted Transformer

The Low Voltage (LV) supply cables (*Note: Sizing to be confirmed*) supplies the incomer Circuit Breaker (CB) on the existing sewage PS changeover panel (mains incoming CB rated at 250A). A 220 kVA emergency back-up generator is installed in the generator room, complete with control and an indoor day fuel tank and an underground bulk fuel tank. The unit is in fair to good condition.

The changeover panel supplies the 250A rated incomer CB on existing the MCC in the adjacent room (*Note: Sizing of the LV cables to be confirmed*). See **Figure 12** below.

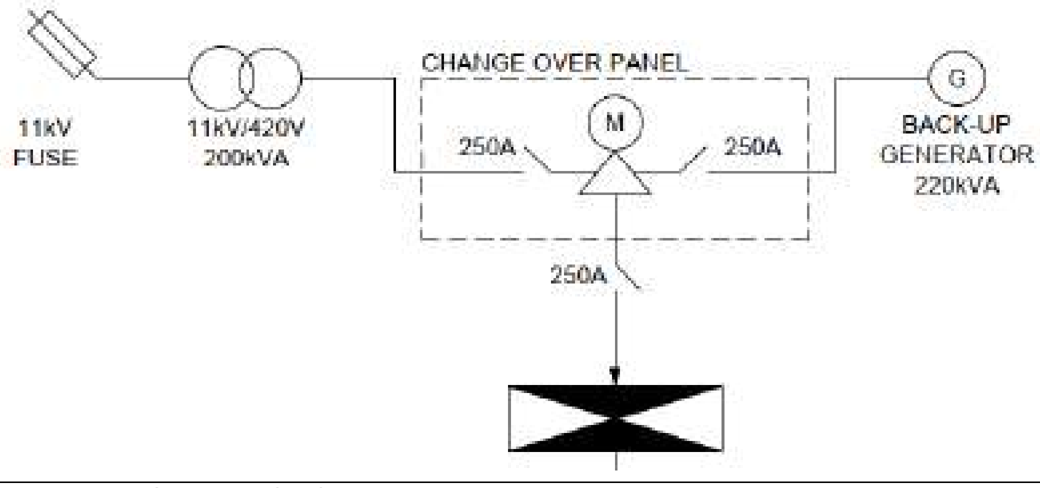


Figure 12 : Existing Generator Configuration

The generator appears to be currently running at around 20% of its available capacity.

2.5 Suitability of Existing Infrastructure for Future Use

Considering the interim and future flow to be accommodated by the pump station (Note: Discussed in more detail in section "4.2 Future System and Future Design Flow" below) it is highly unlikely that the existing pump station installation can be used to accommodate the much higher interim flows into the pump station without upgrading the mechanical and electrical equipment or the ultimate future flows in future without increasing the wetwell sump capacity of the exsting pump station.

The channels are relatively large at 500mm wide and also relatively deep at approximately 750mm deep. Without performing detailed hydraulic calculations, it can be assumed that the channels should have sufficient capacity to accommodate at least the higher interim flows.

2.5.1 <u>Sizing of Pump Station Sump:</u>

The industry norm for the allowable number of start/stops per hour for drywell pumping equipment is a maximum of 6 start/stops per hour. Since allowance will be made for duty and standby pumping with alternating operation between the two pumps, a maximum of 12 starts/stops per hour for the pump station could be possible should both pumps be operational.

Based on the above, the volumes indicated below would be required for 6 starts/stops per hour (based on the total wet well volume - the total for the two sumps combined):

- For 50 l/s, a total volume of 7.5m³ is required,
- For 75 l/s a total volume of 11.25m³ is required.

The estimated available sump volume in the existing wetwell with the current operating levels is 3.8 m³ (the total for the two sumps combined). Should the existing start/stop levels in the wetwell be used for the future flow, it will cause the pump sets to cycle too many times between starting and stopping, estimated at 12 start/stops per hour if both sumps are in operation, when the pumps operate at 50 l/s.

The operating levels in the wetwell can be enlarged by adjusting the start and stop levels. By changing the start level at the sump inlet level of the sump and optimising the stop level, an operational volume of 7.5m³ can be achieved when both sumps are operational.

Therefore, the resultant number of starts based on the available volume of both sumps, would be:

- For 50 l/s, a maximum of 6 starts are anticipated,
- For 75 l/s, a maximum of 9 starts are anticipated.

It must be noted that should a sump be taken out of commissioning for maintenance, the number of starts per hour would be doubled.

Based on the above, the existing wet well is not suitable for the increased flow of 75 l/s without increasing the overall sump capacity.

2.5.2 <u>Pump Station and Equipment:</u>

The existing pump room has sufficient space available to install larger pump sets to suit the required demand.

The existing pump sets would not be suitable for the short term (5 to 10 years) based on the pump characteristics ($NPSH_{Required}$ and maximum permissible pump rate) and therefore the pump sets will need to be upgraded for both the interim and the Ultimate scenarios, with associated pipework changes and changes to plinths to accommodate the larger units. Further to this, the pump suction and discharge pipework will need to be replaced with larger units to cater for the higher pumping rates and prevent the flow velocity to pass 1.8 m/s.

The existing coarse hand rake screens is sufficient to handle the higher flow and can be re-used. The existing DN200 macerators may not be capable of handling the higher flow due to the head loss over the unit.

The existing 11kVA power line and transformer may be sufficient to power the future pump station however the size of the LV cabling must be confirmed to determine if it is required to be replaced. The current generator would possibly be re-used and will be discussed further in the sections below.

The existing MCC's, cannot be re-used for the upgrading of the pump station due to the possible increase in motor sizing and the unit control system being "relay logic" hard wired.

As part of the Municipality's wider telemetry expansion and remote SCADA monitoring and trending. The outstation would not be re-used, with a completely new outstation proposed for the upgraded pump station, including all site signal integration and transmission to the Municipality's central SCADA station.

Upgrading an existing installation while the existing installation needs to be kept fully operational to handle incoming sewage is intricate and must be well planned.

3. OPTIONEERING

As initially mentioned under section "1.3 Terms of Reference", there is an element of optioneering which needed to be confirmed prior to taking the project forward in that a decision needed to be made between upgrading Thembalethu PS 7 or constructing a new bulk sewerage pump station at an alternative proposed site East of the Thembalethu PS 7 which will function as then new proposed Thembalethu East PS.

This leaves George Municipality with a very difficult decision as the existing and future drainage areas for Thembalethu East Region (as can be seen in Figure 2 above in section "2.1 Drainage Areas and Associated Considerations") is very large, as well as the future additional larger drainage area for Thembalethu East Region also mostly encompasses a large number of private developments South-East of the N2 National Road.

Therefore, in order to guide and make a decision on the preferred option to be taken forward, an understanding of current and future flows which would likely be expected at or past these pump stations as modeled in the Sewer Master Plan 2024 should be clarified.

3.1 Confirmation of Flows

In order to understand the current future flows, a workshop with GLS Consulting, the consultants responsible for describing the planning principals and compiling the Sewer Master Plan 2024 with associated model, was arranged. The following flows were confirmed by GLS Consulting, as shown in Table 1 below:

Table 1 : Flows at Thembalethu PS 7 and Thembalethu East PS (from GLS Consulting)

TIMESTEP	INSTANTANEOUS DRY WEATHER FLOW			
	CURRENT FLOW AT		FUTURE MASTER PLAN	
	Thembaletu PS 7 (ℓ/s)	Thembaletu PS 7 with Decommissioned. Parkdene PS 2 & 3, Thembalethu PS 2, B, A & 1 (ℓ/s)	Thembalethu PS 7 (ℓ/s)	Thembalethu East PS (ℓ/s)
0	0.55	9.19	15.72	223.56
1	0.50	8.46	14.37	220.75
2	0.50	7.86	13.29	218.79
3	0.61	8.28	13.50	218.43

TIMESTEP	INSTANTANEOUS DRY WEATHER FLOW			
	CURRENT FLOW AT		FUTURE MASTER PLAN	
	Thembaletu PS 7 (ℓ/s)	Thembaletu PS 7 with Decommissioned. Parkdene PS 2 & 3, Thembalethu PS 2, B, A & 1 (ℓ/s)	Thembalethu PS 7 (ℓ/s)	Thembalethu East PS (ℓ/s)
4	0.89	10.74	15.85	220.63
5	1.20	15.66	22.17	229.37
6	1.32	20.65	32.85	247.43
7	1.49	22.17	36.20	256.27
8	**1.58**	24.89	**40.06**	**259.83**
9	1.55	**25.41**	39.79	257.79
10	1.49	24.82	39.51	256.51
11	1.34	23.56	38.42	255.85
12	1.28	21.48	35.77	252.31
13	1.29	20.81	34.58	250.19
14	1.30	21.32	34.66	249.75
15	1.28	21.44	35.28	251.12
16	1.24	21.07	35.37	251.59
17	1.18	20.40	34.29	250.48
18	1.09	19.22	32.03	247.41
19	1.01	17.54	29.18	244.51
20	0.87	15.76	26.60	241.36
21	0.76	13.51	23.72	237.89
22	0.67	11.56	20.87	233.53
23	0.60	10.19	18.35	228.87
PDDWF (kℓ/d)	**92**	**1 497**	**2 457**	**8 889**
IPWWF (ℓ/s)	**3.16**	**50.82**	**80.12**	**322.94**

From the flow data provided by GLS Consulting in the table above, it can be deduced that the Thembalethu PS 7 on paper has significant spare capacity and the additional current flows once all the upstream pump stations which are targeted to be eradicated are decommissioned will be close to a theoretical Instantaneous Peak Wet Weather Flow (IPWWF) flow of 50.82ℓ/s. Considering the existing infrastructure constraints and limitations of the existing Thembalethu PS7, the IPWWF of 50.82ℓ/s could potentially be accommodated with relatively minimal upgrading to the civil works and moderate upgrading to the Mechanical and Electrical equipment. However, the future theoretical IPWWF of 80.12ℓ/s that is envisioned will be substantially higher than the current pump station capacity and would require extensive upgrading.

Thus, there remains merit in conceptualising potential options based on a potential phasing of flows for a new Thembalethu East PS as well.

3.2 Option Conceptualisation

Considering the confirmation of flows (refer to section 3.1 Confirmation of Flows) as discussed with GLS consulting there are three options which appears feasible as shown graphically in Annexure B and as further discussed below.

3.2.1 Option 1: Upgrade Thembalethu PS 7 to 50 l/s only

For this option one would ensure that the existing Thembalethu PS 7 is upgraded to a pump station capacity of 50 l/s (20ℓ/s upgrade) after which the gravity sewer can be constructed to decommission 6 sewer pump stations including Parkdene pump stations 2 & 3 and Thembalethu pump stations A, B, 1 & 2. This would provide sufficient capacity for the current situation with the pump stations decommissioned.

However this option would not provide sufficient capacity for the future master planning flow that will ultimately drain down to the Thembalethu East PS. This option would also require that a new 350mm diameter gravity sewer be constructed from Tabata Street (where the existing Thembalethu PS 7 rising main ends) to Thembalethu PS 6 as the existing sewers draining to Thembalethu PS 6 are incapable of conveying the increase in sewage from a 20 l/s upgrade, the result is a 50ℓ/s PS reward.

This option would be quicker to implement and would be able to buy the client some time to implement the ultimate sewer masterplan project (i.e. the construction of the new Thembalethu East PS) while decommissioning 6 other pump stations in the short term.

3.2.2 Option 2: Upgrade Thembalethu PS 7 to 80 l/s only

For this option the existing Thembalethu PS 7 is to be upgraded to a pump station capacity of 80 l/s (50ℓ/s upgrade) which would include substantial civil and structural upgrades to construct a larger inlet works, screening facilities and larger sumps after which the gravity sewer can be constructed to decommission 6 sewer pump stations including Parkdene pump stations 2 & 3 and Thembalethu pump stations A, B, 1 & 2.

This would provide sufficient capacity for the future situation with the pump stations decommissioned but would still require an upgrade of the downstream sewers to convey sewage to Thembalethu PS 6 and would also require either an upgrade or a parallel reinforcement of the rising main up to Tabata Street.

This option would be longer to implement, would cost substantially more than option 1 and will enable the client to decommission 6 other pump stations in the short term. However, the capacity created at Thembalethu PS 7 may become redundant once the Thembalethu East PS is constructed.

3.2.3 Option 3: Construct the new Thembalethu East PS (possibly phased in terms of flow) to ± 160ℓ/s per 2 phases

For this option the new Thembalethu East PS will be constructed including substantial civil, structural, mechanical and electrical works associated with the construction of a large pump station inlet works, screening facilities, large sumps, buildings etc. The gravity sewer can be constructed to decommission 7 sewer pump stations which includes Parkdene pump stations 2 & 3 and Thembalethu pump stations A, B, 1, 2 and 7.

A large diameter rising main (or possibly two) would be required to convey the sewage to Thembalethu PS 6 and would also include a large diameter gravity sewer to the pump station.

This option and the capacity thereof will be highly reliant on the development horizon for the private developments earmarked to the southeast of the N2 National Road. Should these developments not launch as quickly as expected the client runs the risk of constructing a very large pump station that will not receive the flows expected.

However, phasing the pump station capacity to service the municipal need only is possible, requiring a 160ℓ/s PS.

3.3 Option Evaluation

The three options identified in section "3.2 Option Conceptualisation" discussed above are further evaluated on a high level side by side by comparing the advantages and disadvantages of each option, as can be seen in Table 2 below.

Table 2 : Comparison of Options Advantages / Disadvantages

Option Number	**Option 1: Upgrade PS 7 to handle 50 L/s**	**Option 2: Upgrade PS 7 to handle 80 L/s**	**Option 3: Construction of New Thembalethu East PS**
Advantages	○ The capacity of the existing wet-well does not need to be increased. ○ Most of the mechanical installation can be done while the pump station remains. ○ Environmentally less of an impact due to additional infrastructure such as sump capacity and rising mains that is not required ○ Comparatively less expensive than Option 2 & 3 ○ Can be implemented quickly to decommission 6 other pump stations	○ The installation can handle the expected growth in the sewer system for a longer period, allowing more time to implement Option 3 ○ Once implemented, 6 pump stations can be decommissioned ○ Cheaper than Option 3	○ Doesn't affect any existing infrastructure at or near the pump station when carrying out construction. ○ Process configuration units will be easily accessible from the road. ○ Little effect on the operation of the existing pump station (after some services are re-routed). ○ Encourages areas North of Meul River to develop more quickly. ○ Once implemented, 7 pump stations can be decommissioned and eradicated. ○ Consolidates all pump station activities and associated health risk and nuisances to one location outside the current urban edge. ○ Allows consideration in design and spatial requirements to have pump station constructed in phases as need
Disadvantages	○ The expected lifetime of the installation is lower than that of Option 2 or 3, as it designed to only handle the current inflows. The expected life span is therefore only estimated at ± 3-5 years or at best 10 years dependent on growth and development. ○ Major complexity in construction to keep the existing pump station active. ○ High risk for spillages and down time during construction.	○ A large capital input is required to increase the capacity of the civil infrastructure, such as sump capacity and a new rising main. ○ Limited available space for the expansion required to enlarge the sump capacity. ○ Intricate wet well design would be needed to allow sufficient sump capacity connected to both existing sumps. ○ Extensive mechanical work will be required, requiring complete shut-down of the existing pump station for an extended period	○ Height of retaining walls is relatively high at around 10m above final ground level on fill. ○ There will be re-routing of all sewers. ○ Electrical supply needs to be relocated some distance from the existing point. ○ Sensitive environmental area as identified by Environmentalist ○ Complete new access road needs to be constructed at each terrace level. ○ Capital Cost very high compared to other options.

Option Number	Option 1: Upgrade PS 7 to handle 50 L/s	Option 2: Upgrade PS 7 to handle 80 L/s	Option 3: Construction of New Thembalethu East PS
	o Will ultimately require a further upgrade in the medium term future o Will not mitigate the need for an additional bulk sewage pump station (i.e. Thembalethu East PS o Funding for future upgrades may not be available or delayed in being acquired.	o Major complexity in construction to keep the existing pump station active. o High risk for spillages and down time during construction. o Will not mitigate the need for an additional bulk sewage pump station (i.e. Thembalethu East PS.	o Implementation Schedule long compared to other options.

Considering Table 2 above it is appealing to favour Option 1 as a quick win due to the possibility of relatively minimal intervention to attain some additional capacity at the existing Thembalethu PS 7 to accommodate and convey the current additional flow from eradicating upstream pump stations as a result of a new bulk gravity sewer. However, working on a brown fields site comes with many risks and the option is only a short-term solution, as it will require further upgrading to accommodate additional future flows from the existing drainage area 1 and 2. Furthermore, the option does not mitigate the need to accommodate the potential future additional flows based on the larger drainage area identified for the Thembalethu East Region. Therefore, upgrading the existing Thembalethu PS 7 to handle 50l/s would require further expenditure for medium term upgrading, and would not mitigate the need for the proposed Thembalethu East PS to be constructed. Thus Option 1 is ultimately <u>not recommended </u>to be pursued.

Option 2 appears to be the next favourable option as it would accommodate the current additional flow from eradicating upstream pump stations as a result of a new bulk gravity sewer as intended with Option 1, as well as it would be able to handle the future flows from the existing drainage area 1 and 2. However, similar to Option 1 working on a brown fields site comes with many risks and as Option 2 would likely require major civil works interventions large spillage and interrupted service risks. Furthermore, this option, similar to Option 1, does not mitigate the need to accommodate the potential future additional flows based on the larger drainage area identified for the Thembalethu East Region. Therefore, regardless of upgrading the existing pump station , there would always be a need for the proposed Thembalethu East PS to be constructed. Thus Option 2 is ultimately <u>not recommended</u> to be pursued.

Option 3 is the final option considered in Table 2, and based on the advantages and disadvantages appears initially to be the least favourable option mainly due to the major capital cost outlay required. However, the option allows all current and future flows for the Thembalethu East Region to be accommodated along with consolidating all sewage flows to one pump station within the area. Furthermore, the future additional larger drainage area for Thembalethu East Region is a very large flow contributor based on the confirmed flows and also encompasses a large number of private developments South-East of the N2 National Road. These developments has been earmarked for many years and has not progressed past the spatial development phase. This leaves George Municipality with a difficult decision, as they require short-term to medium-term intervention for existing and future from the existing drainage areas, but also require to accommodated flows as aligned to the George Municipal Sewer Master Plan.

The pursual of Option 3 would allow the municipality flexibility to construct a new proposed Thembalethu East PS but only based on the current and future flows for the existing drainage area with planning and provision for expansion of the pump station with minimal intervention. Thus Option 3, in spite of being the most expensive option, appears more suited to the municipality planning and flexibility needs and pump station eradication initiative. Therefore, Option 3 is ultimately <u>recommended</u> to be pursued.

Furthermore, it is important to note that the Concept and Viability Report of the gravity pipelines both upstream and downstream of the existing Thembalethu PS 7 and new Thembalethu East PS must be read in conjunction with this report.

3.4 Revised Terms of Reference

Following the recommendation of Option 3, the terms of reference stated in section "1.3 Terms of Reference" above are assumed to be superseded by the following revised terms of reference still approached in portions:

- Portion 1:

  (Note: This Work is Not Part of this Report & is Submitted in its Own Separate Report)

  Construction of a new bulk gravity outfall sewer line to connect several pump stations within Thembalethu East Region to drain towards and past the existing Thembalethu PS 7 to ultimately the new proposed Thembalethu East PS by addressing the following:

  - Construction of bulk collector sewers (gravity and rising mains) ranging in size from 160mm to 500mm diameter;
  - Decommissioning 7 sewer pump stations in terms of the George Municipality's asset disposal plan (Parkdene PS 2 & 3 and Thembalethu PS 2, B, A, 1 & 7);
  - Decommissioning and disconnection of associated gravity sewers where required not addressed under Portion 2;
  - Relining/Pipe cracking of the existing rising main (if suitable) to remain in use as an emergency back-up rising main to pump station 7.

- Portion 2

  Construction of the new Thembalethu East PS for half of the future ultimate IPWWF design flow capacity as indicated in the Sewer Master Plan 2024 as a Phase 1, with the provision of allowing extension of the pump station to the full IPWWF design capacity as indicated in the Sewer Master Plan 2024 if private developments in future realize by addressing the following:

  - Constructing Civil and Structural infrastructure including a new short run of gravity sewer to tie-in the pump station, a new access road, a new platform for the pump station, a new inlet works, a new pump station, etc.
  - Installation of Mechanical equipment and components such as new mechanical screens and auxiliaries, new degritting paddles and auxiliaries, new pumps, new channel gates, sluices gates, stop logs, mechanical pipework and flow measurement instrumentation, etc.
  - Installation of new Electrical, Control & Instrumentation (E,C&I) equipment and components upgrades to accommodate additional electrical loads and demands at the new site including Medium Voltage (MV) transmission and possible transformers, emergency generators, switchgear, etc.
  - Installation of E,C&I equipment and components to accommodate the new mechanical equipment, including new MCC, new flow / pressure / protection instrumentation, new telemetry and SCADA, etc.

    Note: In order to determine all new E, C& I options suited to the potential project, the existing system must be understood which can only be done during detail design once the civil, structural and mechanical designs are finalised.
  - Decommissioning of Thembalethu PS 7 in terms of the George Municipality's asset disposal plan (Once Thembalethu East PS Phase 1 is completed);
  - Decommissioning and disconnection of existing gravity sewers and rising mains and associated where required for Thembalethu PS 7;

4. DESIGN CONSIDERATIONS

4.1 Basis of Concept Design

The basis of the concept design for option 3 will be set-out in this section of the report and will holistically be consider applicable to the full future design flow, with the consideration that implementation may be packaged in two half phases, namely as a Phase 1 to be constructed under Lyners and a future Phase 2 to be constructed when needed in the future.

4.2 Future System and Future Design Flow

The following flows are proposed for each pump station as design flows.

Table 3 : Thembalethu East PS Future Sewage Flows for Phase 1 (GLS Masterplan)

Description	Flow (kℓ/d)	Flow (l/s)
Average Daily Dry Weather Flow (ADDWF)	8889.00	102.88
Average Peak Daily Dry Weather Flow (PDDWF)	11224.66	129.915
Instantaneous Peak Wet Weather Flow (IPDWF)	13951.01	161.47

Table 4 : Thembalethu East PS Future Sewage Flows for Phase 1 and 2 as the Ultimate PS Capacity (GLS Masterplan)

Description	Flow (kℓ/d)	Flow (l/s)
Average Daily Dry Weather Flow (ADDWF)	17 777.66	205.76
Average Peak Daily Dry Weather Flow (PDDWF)	22 449.31	259.8
Instantaneous Peak Wet Weather Flow (IPDWF)	27 902.02	322.94

4.3 Grit and Screenings Removal Need

A large amount of grit, organic material and debris is carried to the existing pump stations in the Thembalethu East Region through the feeding gravity sewers. Altogether grit particles, organic material and debris should ideally be removed from the raw sewage to protect the pumping equipment and associated rising mains.

Therefore, prudent consideration for the allowance of grit and screenings removal at the new Thembalethu East PS should be included as the upstream grit and screenings load from eradicating the 7 identified pump stations will be concentrated at the new proposed pump station.

Furthermore, as various sewage loads are being combined to one central pump station location, it is also proposed that a grit and screenings study be undertaken as part of the detail design to establish what the blended organic and debris loading actually is for the Thembalethu East Region. Quotations will be requested from relevant service providers.

4.3.1 Screenings Removal Motivation

Screening raw sewage prevents large solids, organic material and/or other floating debris from interfering or damaging downstream equipment such as grit handling equipment, isolating components, pumps and pipelines.

Typically screenings removal is done manually, however due to the labour-intensive nature of manual screens, requiring operators to clean them daily and cart away the debris removed from the screen, automated systems should be considered at remote locations to reduce the amount of operator input to maintain reliable constant screenings removal.

Limiting manual intervention will also assist with possible health related risks of handling debris exposed to sewage for the operator. An automated system would consist of automated screens, a conveyor, a washer-compactor, and a waste skip to remove the debris off-site.

Considerations to different kind of automated screens include suitability for the South African conditions, material selections, maintenance requirements, serviceability, and parts availability. Duty and standby configuration should also be considered to ensure full functionality when equipment is taken out of operation for routine maintenance or repairs.

The bar aperture spacing on mechanical or manual screens is determined by the downstream equipment safeguarding requirements. As per example a typical raw sewage pump is usually stated to be capable of handling large objects due to the pump having a solid handling passage of usually ± 80 mm. However, the solids aren't as large as a concern in practice with these pumps, compared to fibrous or string like material which remains an operational problem as they entwine on pump components. A smaller bar aperture opening would promote removing the fibrous or string material and therefore would be advised.

Currently at the existing Thembalethu PS 7 the sand trap requires large floating objects, fibrous material and rags to be removed from the raw sewage to prevent unnecessary settling of inorganic debris in the sand trap. Therefore, the need for screenings at the new Thembalethu East PS is recommended and should be sized suitably to protect any downstream proposed degritting systems in a similar fashion. This will also aid in the protection of other equipment downstream of the screenings facility which has moving components such as sluice gates, penstocks, pumps, etc.

As described in section 3.4 Revised Terms of Reference above, the new Thembalethu East PS layout should allow for the installation for a phased approach covering the identified municipal needs as a Phase 1 and a Phase 2 for the covering the needs of private developments in future if they realize. Together these phases combine into the ultimate design capacity of the pump station and therefore, the screenings facility even though intended to be constructed in two phases, should consider ultimately combined channeling with redundancy for the screening's bays.

Furthermore. based on the flow rate and potentially associated high volume of screenings which may be expected in the raw incoming sewage entering the pump station, a screenings facility would also benefit the older downstream infrastructure and pump stations by not further conveying and concentrating the screenings load along the network and elsewhere.

It should also be noted that if a screenings and grit study is undertaken as advised, the results and recommendations from the study may indicate there be a need to protect the screenings equipment and components from large and heavy objects. If this is required a stone basket or stone/rock settling chamber can be considered upstream of screenings facility channels.

4.3.2 Grit Removal Motivation

Grit referred to in Raw sewage typically includes sand, gravel, cinder, or other heavy solid organic materials that has a higher specific gravity than organic biodegradable solids found in untreated wastewater. Grit can also include eggshells, bone chips, seeds, coffee grounds, and large organic particles, such as food waste.

The removal of grit prevents unnecessary abrasion and wear of mechanical equipment, grit deposition which causes blockages and hydraulic volume reductions in pipelines, channels and sumps. Grit removal facilities in pump stations typically precede the pump station wetwell and follow the screenings facility.

Currently at the existing Thembalethu PS 7 there is a sand trap incorporated in the existing Inlet Works , as well as the majority of the existing, new and proposed pump stations within the George Municipality are including grit removal upstream of the pump station wetwells. This indicates grit is a large characteristic issue within the raw sewage. Therefore, the need for grit removal at the new Thembalethu East PS is recommended to prevent downstream operational issues from arising.

Many types of grit removal systems and approaches exist, such as aerated grit chambering, vortex formed grit removal (hydraulic, paddle assisted or jet induced), detritus tanking (short-term sedimentation basins), velocity-controlled channelling (horizontal flow grit chambers), and cyclonic inertial separation (hydro-cycloning).

Various factors must be taken into consideration when selecting a grit removal process, including the quantity and characteristics of grit, potential adverse effects on downstream processes, head loss requirements, space requirements, removal efficiency, organic content, and cost.

The type of grit removal system chosen for a specific facility should be the one that best balances the above factors on a site-specific basis, and based on the technology the George Municipality is familiar with. There are three more common grit removal systems in South Africa, and to determine the most suitable solution, these will be compared, namely Horizontal Flow Grit Channels or Chambers, Sand / Silt Traps and Vortex Type Grit Chambers.

4.4 Pumps and Manifold

Different pump types and configurations will be considered to allow expansion for future upgrading to meet the future demand. Submersible and drywell installations are both contenders, which could initially be considered taking maintenance, operation and municipal familiarity with the installations into account.

However, due to the pumping system demand most submersible pump sets are not able to meet the high delivery pressure required due to the specific static head of the system as inherent to the new Thembalethu East PS. Therefore, suction lift and flooded suction pump station configurations will only be considered.

Having an above ground pump station with self-priming pump sets is an option, however this adds complexity in operation that could cause operational issues. Having pumps with flooded suction, all possible priming issues are mitigated and therefore a sunken pump room is preferred with drywell pump sets installed. The pump room would be equipped with drainage pumps to evacuate any spilled sewage or if possible gravity drainage to the downslope.

Dry-well pump sets coupled to standard Totally Enclosed Fan-Cooled (TEFC) motors are proposed for easy maintenance and operability. Due to the timeline of the increase in demand as calculated by GLS Consulting, multiple pumps operating in parallel are considered. Further to this, a 10% pump factor on the PWWF calculated by GLS Consulting is proposed to allow for the pump station to be able to empty the wet wells under peak weather inflow conditions.

Two vs three duty pumps should be considered with a standby pump to allow for an increase in demand over the years.

Pump suction pipework considerations include dedicated suction pipework per pump set and a common suction manifold (where flooded suction is available). Dedicated suction pipework, if sized correctly would have the least amount of frictional and secondary losses however it limits redundancy in a system. Should a suction pipe in the sump require maintenance or if a sump requires maintenance and needs to be taken out of commissioning, depending on the sump configuration, capacity or redundancy in a system would be lost.

However when the second pump sump is constructed by the Developer (or through their development contributions) the risk can be mitigated.

A common suction manifold with isolating valves to separate sumps could be considered if the pumps have flooded suction as it would provide more flexibility in providing access to the sumps for maintenance and keeping pump operational. The common manifold shall be sized to handle 100% of the combined flow rate for the duty pumps.

Dedicated suction pipework is proposed due to the Municipality being previously opposed to a common suction manifold on other historic / current projects Lyners has/is involved in.

4.5 Emergency Storage

South African historical data indicates most pump station overflows are caused by power failures. Guidelines such as the Waterborne Sanitation Design Guide (TT 481/11) as published by the Water Resource Commission (WRC), dictate that when an overflow connection into an adjacent sewer system is not available upstream of the pump station, a storage basin may be provided to retain the flow for a predetermined period of time in order to allow the operations personnel adequate time to restore power to the pump station.

Most guidelines such as TT 481/11 as published by the WRC in South Africa recommend a minimum emergency storage capacity of six hours as a requirement. The emergency storage capacity should be based on future Average Dry Weather Flow (ADWF) into the pumping station with space for ultimate capacity with the maximum high-water elevation in the storage facility to be set lower than the top of the lowest manhole in the upstream system.

For the new Thembalethu East PS Ultimate PS Capacity as ADDWF as shown in Table 4, the volume required to provide 6 hours storage will be approximately 4450 kℓ.

This is not feasible and impractical as it will require the construction of a very large reservoir / tank to provide adequate emergency storage. Furthermore, the emergency storage reservoir /tank would mostly be empty and could pose an huge odour nuisance if not cleaned after each use as a result of sewage residual turning septic.

Therefore, a combination of other redundancies along with emergency storage will be considered, as assisting and alleviating possible pump down time should reduce the need for extensive emergency storage capacity. The George Municipality operations unit has indicated if redundancies are provided, they only require 2 hours of emergency storage (approximately 1485 kℓ) which is a more feasible and practical solution.

4.6 Back-up / Redundancy

Given the impracticality of large emergency storage capacity, to ensure uninterrupted operation for the pump station, standby mechanical equipment will be considered, where feasible and economical. This includes providing standby equipment for the automated mechanical screen and screw conveyors, degritting equipment, pump sets, etc.

The proposed screening facility should as a minimum have two automated screening trains, each equipped with the required mechanical screens, with isolating penstocks to take a screen out of commission for maintenance and repairs.

Further redundancy to the screening facility will be provided by means of a manual bar rake screen installed in an emergency overflow bypass channel should the mechanical screens be blocked or out of commission. Each screening train will be sized to handle 100% of the IPWWF, therefore the screening facility will still be fully operational should one of the screening trains be taken out of operation.

To provide redundancy for the degritting facility, two degritting chambers with associated mechanical equipment are considered, each capable of handling the IPWWF on their own. Multiple vortex degritters would each have dedicated equipment with a duty / standby pump configuration along with the use of a common piping system to allow interoperability to ensure uninterrupted operation.

Furthermore, a standby generator for this site is crucial and the suitability of the repurposing of the existing generator from Thembalethu PS 7 or the requirement for a new unit will be discussed in the sections to follow.

Coupled with the provision of a standby generator, sufficient diesel storage will be allowed on-site to allow extensive operation of the generator if needed during bulk electrical supply interruptions or if diesel supply should experience shortage as a result of load shedding interruptions as was historically experienced by the country.

4.7 Flow Measurement

Typically flow measurement within a sewage pump station occurs by means of a flow meter on the discharge pipe of the pump station. This flow meter is normally a magnetic type flow meter used due to the lack of internal components within the flow path of the meter. Should grit removal in the form of grit channels be considered flow measurement of incoming flows at the Parshall flumes required to maintain the water levels in the grit channels could be implemented.

Should vortex type degritting be proposed flow measurement via channel flow meters could be used, should water levels within the Inlet Works be problematic. Alternatively, Parshall flumes could still be installed downstream of the vortex type degritters.

4.8 Municipal Requirements

Following discussions with George Municipality on the Client specific requirements needed to be incorporated on the new bulk sewage pump stations, the Municipality had the following requests when it comes to the components mentioned above.

4.8.1 Screening Removal

George Municipality requested that a stone trap be provided upstream of the screenings facility.

Furthermore, the Municipality requested that both coarse screening and fine screening be provided for the pump stations screenings facilities. In a conventional pump station Inlet Works it is normal to provide only one screening mechanism with openings suited to the application in the screenings facility.

The Municipality also specifically requested the coarse screens have a ± 30mm bar aperture spacing as a first line of defense followed by finer screens which has a ± 10mm bar aperture spacing.

George Municipality further indicated that they would prefer automated mechanical screens with conveyors and washer compactors (if suitable) for the main channel trains to deposit dried screenings which is collected in skips which the Municipal operational unit could remove via skip truck from the site.

4.8.2 Grit Removal

George Municipality indicated that they are having some difficulty with availability of vacuum trucks to clean existing silt traps within the city. The Municipality noted they do have a term tender for vacuum truck silt removal, but the costs thereof are prohibitive as the service is extremely expensive for continued maintenance at pump stations. Thus, George Municipality would prefer grit handling options which do not require vacuum trucks as a part of the normal operation of the pump station.

Thus, the Municipality indicated that Grit channels/chambers or Vortex Degritters are familiar approaches for them.

The option of grit channels/chambers in this instance is feasible as the depth of the incoming sewers are likely not going to be very deep. However, these grit channels/chambers would be required to be cleaned manually by hand and vacuum truck, and would additionally make the new pump station footprint and site much longer and/or deeper which could require additional earthworks and retaining walls if the site location is position on a steep topography which should be considered.

For vortex type degritting, different grit extraction processes should be considered. These are mainly pumped extraction by means of a centrifugal pump or by means of an air lift system driven by an air blower. A centrifugal pump would either be a submersible unit installed in the sump, connected via flexible hose to the above ground pipework or a self-priming pump set installed aboveground adjacent to the sump, with a suction pipe routed into the centre of the sump. The pump options would be equipped with hardened impeller and the volute shall be coating in a high abrasive resistant coating to handle the highly abrasive pump medium.

The Municipality indicated that self-priming pumps are the preferred method of grit removal.

4.8.3 Incoming Flow measurement

The George Municipality indicated that they would prefer flow measurement both on the incoming flows as well as the outgoing flows to the pump station. The Municipality would like to be able to determine incoming flow hydrographs and perform water balance between inflows and outflows.

Although this is not conventional at raw sewerage pump stations, it could be achieved downstream of the degritters for the combined flows within the inlet works.

4.8.4 Drywell and Pump Suction Manifolds

The Municipality indicated that they would prefer a drywell configuration for ease of maintenance and would also prefer that there is no common suction manifold to the pumps from the sump.

4.8.5 Fuel Storage for Generators

George Municipality indicated that they are experiencing problems with above ground diesel storage facilities for back-up generators with theft being the biggest issue. Above ground fuel storage tanks be located within dedicated buildings for security

4.8.6 General Ease of Maintenance

The Municipality requested that ease of maintenance be considered in all aspects of the proposed solutions where possible or practical.

George Municipality's experience is that if infrastructure and its components are hard to maintain the tendency is that it is neglected.

4.9 Site Selection

The site selection for the new Thembalethu East PS will be impacted by upstream gravity sewers, future pipelines of private developments crossing over the Meul river.

Furthermore, the selection of a potential site for the pump station along with the impact on associated civil and structural elements thereto is a relatively complex discussion.

However, opposed the selection of the mechanical and electrical components for the pump station is largely divorced from the site selection (with some small exceptions) and as such these can be selected first if required as they will remain largely the same irrespective of the site selection and the implications thereof.

5. SITE OPTIONS FOR THE NEW THEMBALETHU EAST PUMP STATION

Due to limited space surrounding the existing Thembalethu PS 7 there was limited viable positions for the proposed new Thembalethu East PS with multiple positioning/layout options. This is evident with the Meul river running along the North of the site and existing residential/ farm area to the South.

Furthermore, due to the steep nature of the area the proposed site must be on the same contour as the existing Thembalethu PS 7 to ensure the existing gravity sewage can drain towards the proposed Thembalethu East PS Inlet works.

5.1 Proposed Area for Potential Pump Station Sites

With the above-mentioned in mind an area to the East of the existing Thembalethu PS 7 was identified that has enough fall for the sewer to gravitate.

The area is indicated in green in the aerial image in Figure 13 below:

Note(s):

1) *Image Extracted from George Municipality GIS Viewer Tool*

Figure 13 : Area for Potential sites

This area would require the sewers that feed the existing Thembalethu PS 7 pump stations from the West to be rerouted North around the existing Thembalethu PS 7 to the new proposed bulk sewer which will follow the same contour to the East to allow flow into the new Thembalethu East PS proposed Inlet Works somewhere along the above area.

5.2 Pump Station Site 1

A new pump station site 1 directly adjacent to the existing Thembalethu PS 7 was identified as can be seen in Figure 14 below.

Figure 14 : Potential Site 1 for Pump Station

The new pump station site is in close proximity to the existing Thembalethu PS 7 which would be advantageous for the extension of the sewerage network, access road and overhead electrical services to the new pump station site.

However, the topography of the new pump station site would entail significant cut to fill and there is a “gorge” just to the East of the Thembalethu PS 7 which would imply that stormwater normally passes through this area which is not desirous for a new pump station site.

There is also a considerable amount of vegetation in the position, and encroachment of informal settlements located on the boundary of the residential area and existing Thembalethu PS 7.

5.3 Pump Station Site 2

A new pump station site 2 approximately 310m to the East of the existing Thembalethu PS 7 was identified as can be seen in Figure 15 below.

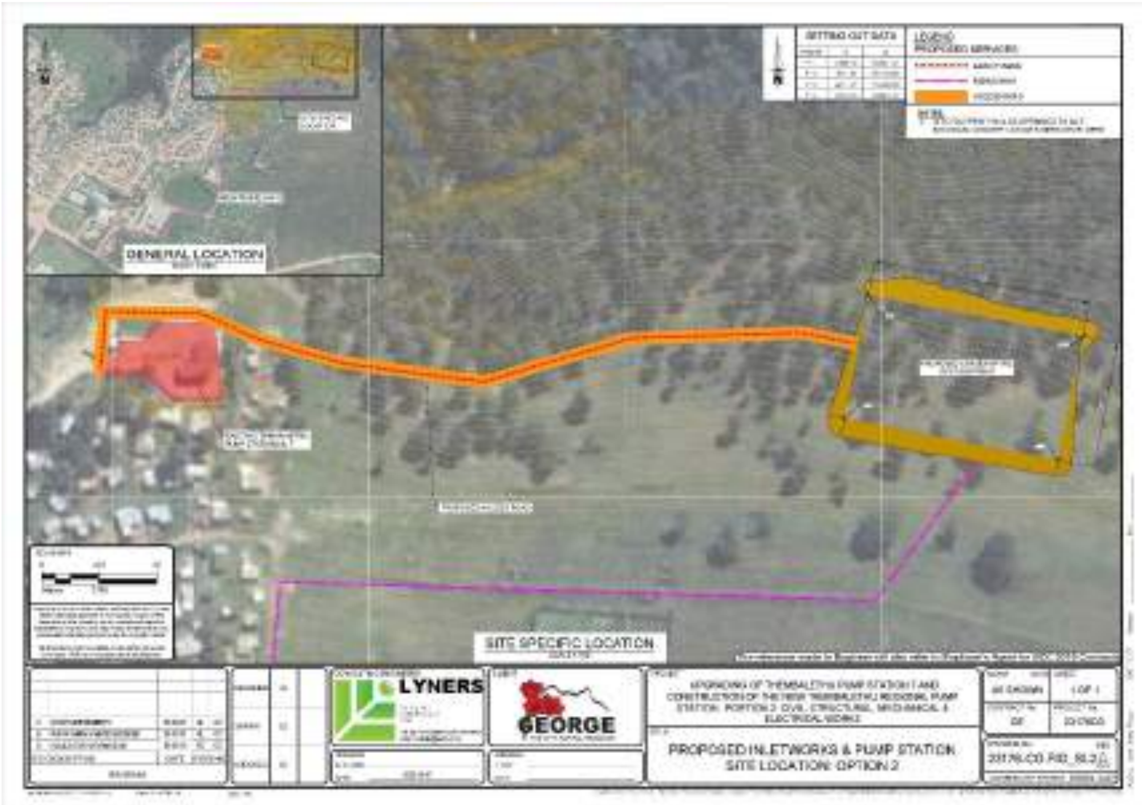


Figure 15 : Potential Site 2 for Pump Station

The new pump station site is in close proximity to the Eastern boundary of Portion 8 of Farm 195 which was identified in the Sewer Master Plan 2024 as the potential crossing point for the sewer from developments to the North of the Meul River. This would be advantageous for the pipeline from the private developments in future, however the access road and the overhead electrical services to the new pump station site would be required to be considerably extended.

Similar to Pump Station Site 1, the topography of the proposed new pump station site would entail significant cut to fill with the exception that there is no gorge and potential for stormwater issues visually.

There also appears to be a considerable amount of vegetation in this new pump station site position which could possess concern for environmental triggers, but the new pump station site is located some distance from the residential area which is favorable.

Furthermore, the lengthy access road to the new pump station site would need to be over existing farmland which could pose a land negotiation issue.

5.4 Pump Station Site 3

As a middle ground, a new pump station 3 site approximately 230m to the East of the existing Thembalethu PS 7 was identified as can be seen in Figure 16 below.

Figure 16 : Potential Site 3 for Pump Station

While the new pump station site is not in close proximity to the Eastern boundary of Portion 8 of Farm 195 which was identified in the Sewer Master Plan 2024 as the potential crossing point for the sewer pipeline from private developments to the North of the Meul River, it is closer to the existing Thembalethu PS 7.

This would be advantageous for the extension of the pipeline, access road and overhead electrical services from Thembalethu PS 7 to the new pump station site.

Similar to Pump Station Site 1 and Pump Station Site 2, the topography of the new pump station site would entail significant cut to fill but there was no gorge and potential stormwater issues visually appear as if they would be located to the West of the new pump station site.

Furthermore, there still appears to be a considerable amount of vegetation based on a conservative new pump station footprint in this new pump station site position, which could possess concern for environmental triggers, but the new pump station site is still located some distance from the residential area which is favorable.

However, if the new pump station footprint can be reduced to be elongated to favour the site being kept as high up as possible on the hill, it would significantly reduce the site to vegetation issue and furthermore mitigate general potential stormwater issues which is unique to this site position.

Furthermore, the length of the access road on a higher contained position would still require access be over existing farmland but would likely be able to follow the natural topography and thereby drastically reduce the impacted area needed for a road reserve.

5.5 Recommended Pump Station Site

Considering the above evaluation of various options for the new pump station site location, the preferred option and recommended site location for the new pump station is Pump Station Site 3.

6. PUMP STATION LAYOUT OPTIONS FOR THE NEW THEMBALETHU EAST PUMP STATION

Various potential layout options for the new Thembalethu East PS were formulated as included in Annexure C.

The potential layouts options were developed independently from the potential sites identified as the environmental considerations may impact the preferred site during authorization application and therefore when reference to site considerations are needed, the concept is based on general visual site conditions which would be similar across all sites.

With reference to Section 3.4 Revised Terms of Reference and 4.1 Basis of Concept Design of above, the Thembalethu East PS will be designed in a two-phase approach. The concept design intent is that allow extension either by duplication in similar number of components or mirror imaging of complete components over a common member, to allow for easier construction in future, if the pump station is constructed in two phase.

6.1 Layout Option 1

6.1.1 <u>Configuration Concept</u>

Layout Option 1 will consist of an inlet box structure that will control the incoming flows to allow for subcritical flow downstream. The flow will traverse over a stone basket and be split into two screenings channels each equipped with coarse and fine screens.

Downstream of the screens the flow will be combine into one channel and be split again into two vortex type degritting structures where after it will flow each in its dedicated channel before entering a common distribution channel which reports into the pump station wet well sumps.

The degritting structure and its outgoing channels will likely be square which could aid in construction simplicity but require internal benching to reduce any dead spots within the process unit and promote vortices in the sewage flow pattern formation to promote grit settling.

The wet well of the pump station is proposed to consist of 2 interconnected medium size sumps that are sized to service half 161.47l/s which is half the ultimate IPDWF of 322.94l/s. The medium sumps then feed to 4 individual smaller pump suction intake sumps.

When private developments to the North of the Meul River proceed, and the additional flow from the future additional larger drainage area starts contributing to the new Thembalethu East PS the proposed Inlet Works and pump station, are intended to be mirrored as an expansion and upgrading to the ultimate capacity.

The Bulk electrical and E,C&I unit rooms, with the exclusion of the MCC rooms, will house the proposed transformers, Ring Main Unit (RMU), <u>Above Ground</u> Fuel Storage and Generator components and will be in an independent dedicated electrical building. The intent would be that the electrical building will be constructed complete for the ultimate capacity needs during Phase 1 and equipped with components by phase.

Each phases units, buildings and components will under normal operation function independently within the site, however interoperability allowances will be implemented as far as possible to ensure flexibility and redundancy if need between the phases.

See Figure 17 below for the ultimate layout/configuration as proposed for Layout Option 1.

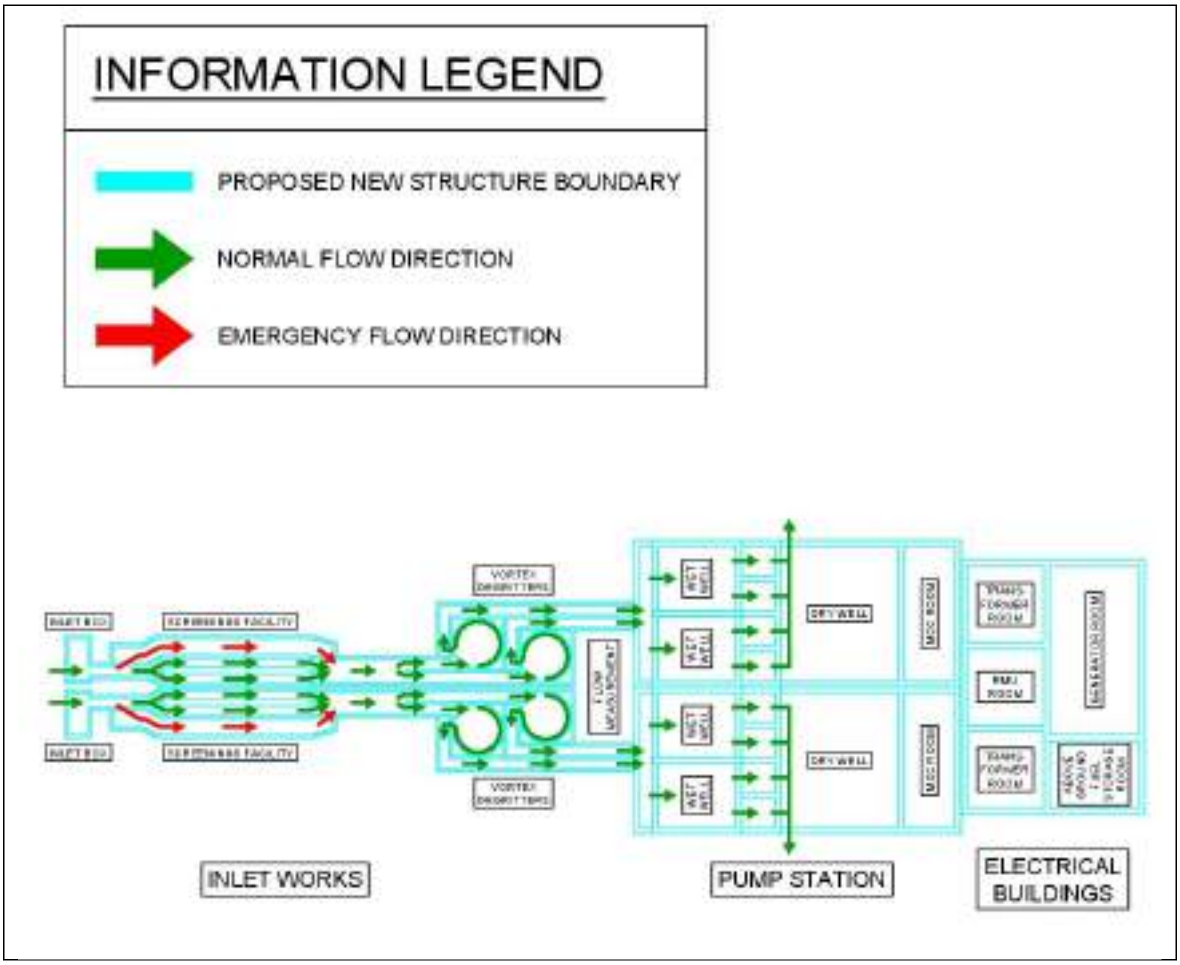


Figure 17 : Layout of Option 1 Inlet Works and PS

6.1.2 Earthworks and Retaining Concept

Unfortunately, the sites identified are inherent topographically to steep slopes which fall towards the Meul river towards the North which is would be likely in the “up direction” when referring to the Concept layout in Figure 17 above.

This implies that there will likely be considerable earthworks required to be undertaken to create a platform suitable for the new pump station.

An initial high-level bulk earthworks design was conceptualised (just for comparative purposes between options) which indicated for Layout Option 1 that:

- a retaining wall approximately 10.4m high on the cut side which is situated on the South boundary of the site would be required, and
- a retaining wall approximately 3.4m high on the fill side which is situated on the North boundary of the site would be required.

Furthermore, the bulk earthworks design estimated that approximately 32 130m^3 of cut would be required to construct the pump station concept in this position.

6.2 Layout Option 2

6.2.1 Configuration Concept

Layout Option 2 will consist of an inlet box structure that will control the incoming flows to allow for subcritical flow downstream. The flow will traverse over a stone basket and be split into two screenings channels each equipped with coarse and fine screens.

Downstream of the screens the flow will be combine into one channel and be split again into two vortex type degritting structures where after it will combine again into one channel before entering a common distribution channel which reports into the pump station wet well sumps.

The degritting structure will likely be round and its outgoing channels likely curved to reduce the use of benching to reduce any dead spots within the process unit and promote vortices in the sewage flow pattern formation to promote grit settling.

The wet well of the pump station is proposed to consist of 2 interconnected larger sumps that are sized for the full ultimate IPDWF of 322.94l/s. The larger sumps then feed to 4 individual smaller pump suction intake sumps.

When private developments to the North of the Meul River proceed, and the additional flow from the future additional larger drainage area starts contributing to the new Thembalethu East PS the proposed Inlet Works are intended to be mirrored as an expansion and upgrading to the ultimate capacity.

The pump station will already be suitably sized for the ultimate capacity, however it must be stated there is a risk that the private developments to the North of the Meul River might never realize or realize at a much later stage closer to the end of the design life of process units and mechanical, E,C& I components.

The bulk electrical and E,C&I unit rooms will house the proposed MCC's, transformers, Ring RMU, Above Ground Fuel Storage and Generator components and will be in an independent dedicated electrical building. The intent would be that the electrical building will be constructed complete for the ultimate capacity needs during Phase 1 and equipped with components by phase.

Each phases Inlet Works and components will under normal operation function independently within the site, however interoperability allowances will be implemented as far as possible to ensure flexibility and redundancy if need between the phases. The pump station will operate as a combined unit.

See Figure 18 below for the ultimate layout/configuration as proposed for Layout Option 2.

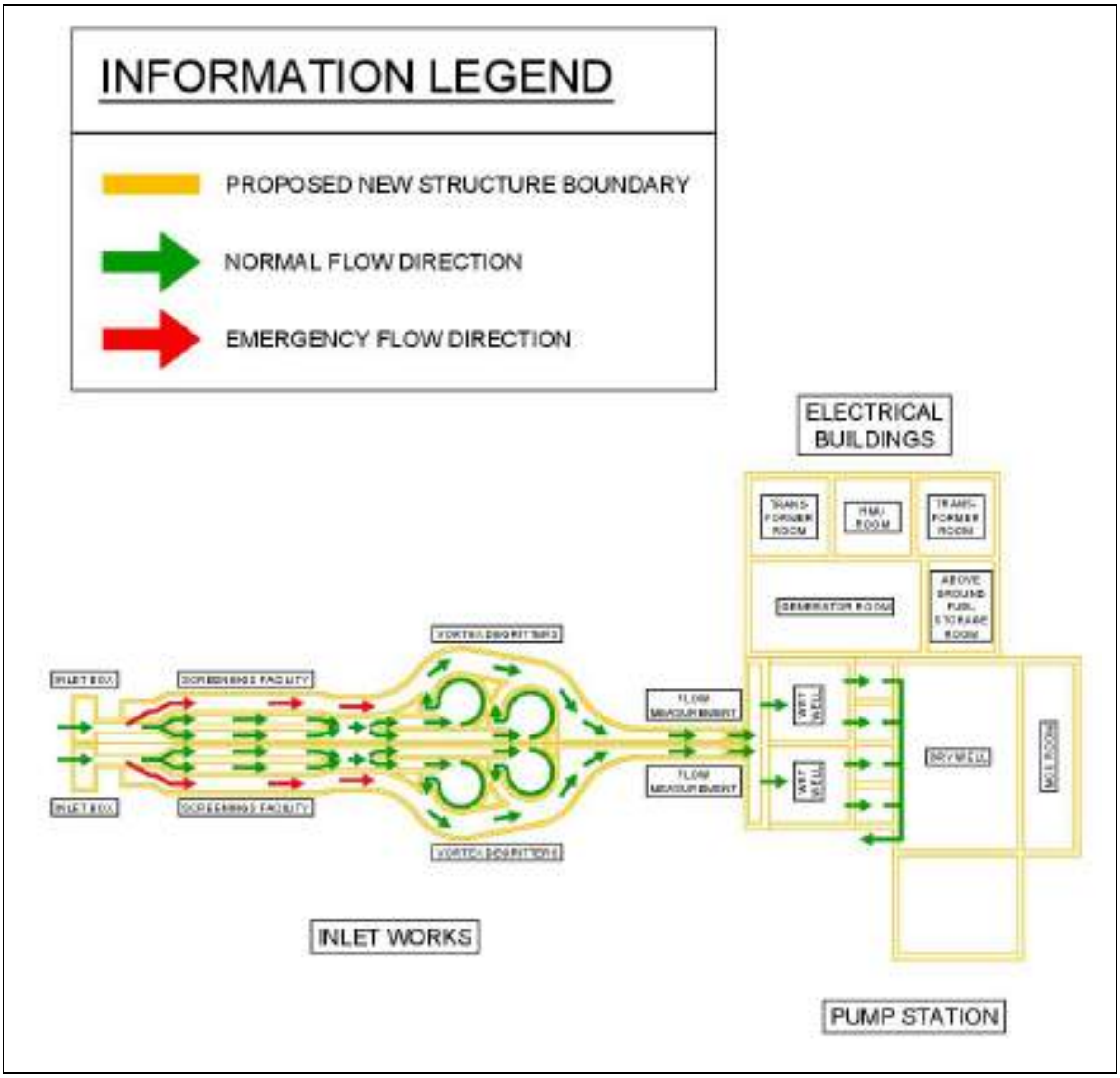


Figure 18 : Layout of Option 2 Inlet Works and PS (ultimate)

6.2.2 Earthworks and Retaining Concept

Unfortunately, the sites identified are inherent topographically to steep slopes which fall towards the Meul river towards the North which is would be likely in the “up direction” when referring to the Concept layout in Figure 18 above.

This implies that there will likely be considerable earthworks required to be undertaken to create a platform suitable for the new pump station.

An initial high-level bulk earthworks design was conceptualised (just for comparative purposes between options) which indicated for Layout Option 2 that:

- a retaining wall approximately 9.8m high high on the cut side which is situated on the South boundary of the site would be required, and
- a retaining wall approximately 2.1m high on the fill side which is situated on the North boundary of the site would be required.

Furthermore, the bulk earthworks design estimated that approximately 28 250m^3 of cut would be required to construct the pump station concept in this position.

6.3 Layout Option 3

6.3.1 Configuration Concept

Layout Option 3 will consist of an inlet box structure that will control the incoming flows to allow for subcritical flow downstream. The flow will traverse over a stone basket and be split into two screenings channels in Phase 1 with an emergency bypass channel which will be extended to a total of three screenings channels with an emergency bypass channel for the ultimate capacity, each equipped with coarse and fine screens.

Downstream of the screens the flow will be combine into one channel and be split again into two vortex type degritting structures in Phase 1 which will be extended to a total of three vortex type degritting structures if needed for the ultimate capacity. At the outlet of the vortex type degritting structures, each units received flow will be conveyed in its own dedicated channel before entering a common distribution channel which reports into the pump station wet well sumps.

The degritting structure and its outgoing channels likely be square which could aid in construction simplicity but require internal benching to reduce any dead spots within the process unit and promote vortices in the sewage flow pattern formation to promote grit settling.

The wet well of the pump station is proposed to consist of 2 interconnected medium size sumps that are sized to service half 161.47l/s which is half the ultimate IPDWF of 322.94l/s for Phase 1. The medium sumps then feed to 4 individual smaller pump suction intake sumps.

When private developments to the North of the Meul River proceed, and the additional flow from the future additional larger drainage area starts contributing to the new Thembalethu East PS the proposed pump station, are intended to be mirrored as an expansion and upgrading to the ultimate capacity.

The bulk electrical and E,C&I unit rooms, with the exclusion of the MCC rooms, will house the proposed transformers, Ring Main Unit (RMU), Above Ground Fuel Storage and Generator components and will be in an independent dedicated electrical building. The intent would be that the electrical building will be constructed complete for the ultimate capacity needs during Phase 1 and equipped with components by phase.

Each phases pump stations and components will under normal operation function independently within the site, however interoperability allowances will be implemented as far as possible to ensure flexibility and redundancy if need between the phases.

See Figure 19 below for the ultimate layout/configuration as proposed for Layout Option 3.

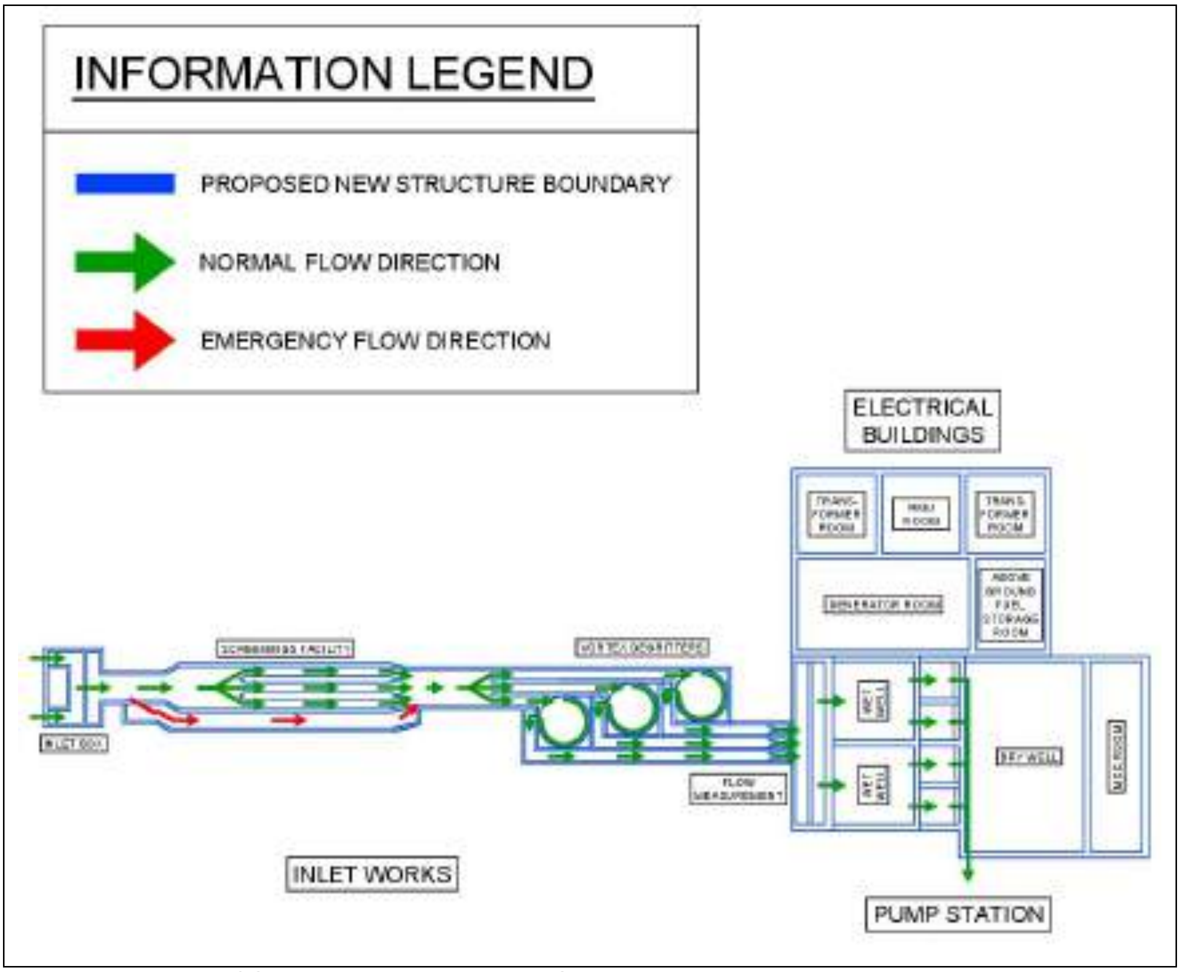


Figure 19 : Layout of Option 3 Inlet Works and PS

6.3.2 Earthworks and Retaining Concept

Unfortunately, the sites identified are inherent topographically to steep slopes which fall towards the Meul river towards the North which is would be likely in the “up direction” when referring to the Concept layout in Figure 19 above.

This implies that there will likely be considerable earthworks required to be undertaken to create a platform suitable for the new pump station.

An initial high-level bulk earthworks design was conceptualised (just for comparative purposes between options) which indicated for Layout Option 3 that:

- a retaining wall approximately 10.1m high high on the cut side which is situated on the South boundary of the site would be required, and
- a retaining wall approximately 6.2m high on the fill side which is situated on the North boundary of the site would be required.

Furthermore, the bulk earthworks design estimated that approximately 30 050m^3 of cut would be required to construct the pump station concept in this position.

6.4 Layout Option 4

6.4.1 Configuration Concept

As an alternative the Municipality requested that a combination of Layout Option 1 pump station and Layout Option 2 Inlet Works be considered as they preferred individual Inlet Works and pump station operability with curved channels to reduce any dead spots.

Based on the above, Layout Option 4, will consist of an inlet box structure that will control the incoming flows to allow for subcritical flow downstream. The flow will traverse over a stone basket and be split into two screenings channels each equipped with coarse and fine screens. Downstream of the screens the flow will be combine into one channel and be split again into two vortex type degritting structures where after it will combine again into one channel before entering a common distribution channel which reports into the pump station wet well sumps.

The degritting structure will likely be round and its outgoing channels likely curved to reduce the use of benching to reduce any dead spots within the process unit and promote vortices in the sewage flow pattern formation to promote grit settling.

The wet well of the pump station is proposed to consist of 2 interconnected medium size sumps that are sized to service half 161.47l/s which is half the ultimate IPDWF of 322.94l/s. The medium sumps then feed to 4 to individual smaller pump suction intake sumps.

When private developments to the North of the Meul River proceed, and the additional flow from the future additional larger drainage area starts contributing to the new Thembalethu East PS the proposed Inlet Works and pump station, are intended to be mirrored as an expansion and upgrading to the ultimate capacity.

The bulk electrical and E,C&I unit rooms, with the exclusion of the MCC rooms, will house the proposed transformers, Ring Main Unit (RMU), Above Ground Fuel Storage and Generator components and will be in an independent dedicated electrical building. The intent would be that the electrical building will be constructed complete for the ultimate capacity needs during Phase 1 and equipped with components by phase.

Each phases units, buildings and components will under normal operation function independently within the site, however interoperability allowances will be implemented as far as possible to ensure flexibility and redundancy if need between the phases.

The Inlet Works will enter the sumps with a splitter box that would ultimately divide the flow evenly between the 4 sumps. Inlet box structure that will control the incoming flows to allow for subcritical flow downstream.

See Figure 20 below for the ultimate layout/configuration as proposed for Layout Option 4.

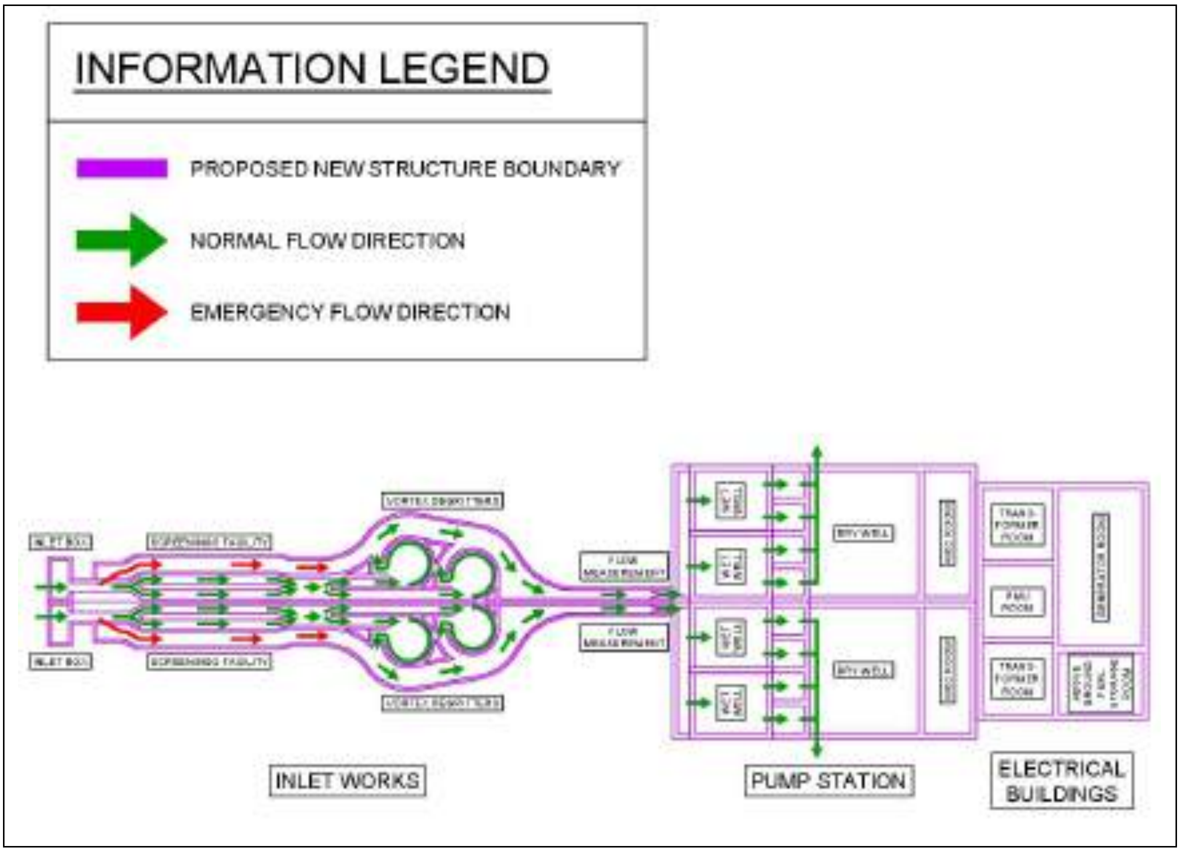


Figure 20 : Layout of Option 4 Inlet Works and PS (ultimate)

6.4.2 Earthworks and Retaining Concept

Unfortunately, the sites identified are inherent topographically to steep slopes which fall towards the Meul river towards the North which is would be likely in the "up direction" when referring to the Concept layout in Figure 20 above.

This implies that there will likely be considerable earthworks required to be undertaken to create a platform suitable for the new pump station.

An initial high-level bulk earthworks design was conceptualised (just for comparative purposes between options) which indicated for Layout Option 4 that:

- a retaining wall approximately 10.3m high high on the cut side which is situated on the South boundary of the site would be required, and
- a retaining wall approximately 3m high on the fill side which is situated on the North boundary of the site would be required.

Furthermore, the bulk earthworks design estimated that approximately 30 600m^3 of cut would be required to construct the pump station concept in this position.

6.5 Recommended Layout Option

Considering the above evaluation of various layout options for the new pump station configuration, the preferred option and recommended configuration for the new pump station is Layout Option 3.

The main driving reason for the above recommendation is that even though the earthworks and retaining concept indicates the cut and fill requirements to be very similar to the other options, there is a benefit that the Inlet Works can be upgraded with a relatively minor comparable undertaking and will also ultimately require less mechanical equipment and components as a result of the fewer screenings channels and vortex degritters required.

Furthermore, all other flexibilities and implementation benefits such as mirroring and only equipping when needed as discussed in Layout Option 1 and Layout Option 4 are also retained for the pump station and electrical building. This will assist in managing implementation by phasing to limit unnecessary expenditure due to the uncertainty of when private developments to the North of the Meul River will proceed and the additional flow from the future additional larger drainage area will need to be accommodate at the new Thembalethu East PS.

7. MECHANICAL EQUIPMENT FOR THE NEW THEMBALETHU EAST PUMP STATION

As previously discussed, the proposed option for the Thembalethu East PS will be a phased approach. The pump station would be designed such that the future demand of 322 l/s, as per the Master Plan, is met after the full implementation is complete. It is proposed, that the first half of the pump station is initially implemented (also broken up in two phases) to meeting current and interim design horizon.

A single DN630mm rising main will be constructed, meeting the interim and future demands of the pump station.

The DN630mm diameter would allow for flow velocities not to be too high for the ultimate flows (when the fully implemented pump station in operational) but still able to maintain scouring velocities during the interim when only one portion of the pump station is in operation.

Currently, the first phase of the pump station would be for the first half of the pump station. The intention is that the Municipality implement the first half of the pump station, suited and phased to meet their demand, with the potential developer(s) north of the Meul River implementing the second half of the pump station when the need arises based on their development’s implementation.

As such, the following section describes the full implementation, with the Detail Design stage addressing the first phases to be implemented by the Municipality.

The installation generally consists out of an inlet works and a pump station

The inlet works consists out of two main mechanical components to address the debris and grit content in the incoming sewage. First is the screening facility with the screens and associated screened material handling equipment to convey the material to a central point on site for removal off site.

As per the proposed Layout 3, there will be four screening channels in total, 2x duty automated channels, 1x automated standby channel and 1x bypass channel with manuals screens.

Second is the grit removal facility including the associated grit handling equipment for the removal of extracted grit from site.

7.1 Screening Facility

7.1.1 <u>Screens</u>

a) Mechanical

Under normal operation, mechanical screens will be used to remove floating or suspended debris from the raw sewage prior to the pump station wet well, reducing the risk of pump blockages and the associated down time and potential damage.

As part of the design brief and philosophy discussed above, the facilities are designed to include automated, mechanical screen train(s) for normal operation and a manual front rake screen on the overflow bypass channel for standby operation. A very coarse hand rake screen will be installed upstream of the screening channels to protect the automated screen from large floating objects.

The mechanical screens will be of the front rake bar type and two screen trains in parallel shall be sized to handle the Ultimate IPWWF. From discussions with the Municipality, fine screens are requested due to the large number of rags in the sewage, causing pump blockages at other pump station installations. Fine screening is generally not required due to the pumps solid handling capability of ± 80 mm but it is however a specific Client request for operational safeguard against rags.

The third automated screen channel will enable one of the duty channel to be taken out of operation for maintenance purposes.

For the first phase, two automated screening trains are proposed, each consisting out of a medium screen and a fine screen (with 30 mm and 10 mm bar spacing respectively) installed in series, and the manual bypass channel

The screens are positioned in adjacent channels as this is the most efficient setup for the waste removal system and still allows sufficient space for operators to move around within the facility. Sufficient space has also been allowed between the units for day-to-day operational access and maintenance.

As a minimum the equipment should be sized to handle a solid loading of at least 4 m³/h to ensure longevity of the equipment.

The mechanical screen frame sizes shall be designed to reach the screw conveyor to deposit the screened material into the conveyors.

General maintenance is required on the mechanical screens and components based on the Original Equipment Manufacturer (OEM)'s requirements, therefore items such as the gearboxes, motors, drive shafts, bearings and the chain tensioners must be easily accessible for maintenance and the relevant equipment put in place to remove components when required. The screen's inherent design allows for access to wear or serviceable parts for general maintenance to be completed, without the need to remove the entire screen unit.

The material of construction shall be selected for highly corrosive environments and South African sewage characteristics, therefore as a minimum grade 316L Stainless Steel shall be used on all components.

b) Manual

One manual hand rake screen shall be installed in the common channel upstream of the automated screening channels. The proposed bar spacing is 100-150mm to reduce the need operator intervention with cleaning purposes.

Two manual hand rake screens shall be installed in the emergency bypass channel, and sized to handle the peak inflow at the pump station. The bar spacing on the manual screens shall be 30 mm and 10 mm respectively to be in line with the automated screen. The screen would span the entire width of the channel. A platform with draining holes would be provided onto which the each screen terminates.

7.1.2 Screenings Waste Removal Equipment

Mechanical screens (medium and fine):

Centerless screw conveyors are proposed to transfer screened debris from the respective sets of mechanical (medium and fine) screens to the washer compactor units. To add redundancy in the conveyor systems, two screw conveyors (operating in parallel) are proposed for each of the medium – and fine mechanical screen sets. It would be possible for a screen to deposit the debris into either of the two conveyors by means of an adjustable flap that directs the discharge debris onto either conveyor.

It is proposed to operate the two screw conveyors on a duty-standby configuration, therefore, should one of the conveyors for a screen set be out of operation, there is a standby unit that can convey the debris from the screens.

For the coarse mechanical screens, a centerless, wash press type screw conveyor is proposed to handle the large rags and larger objects that is generally collected by a coarse screen. This unit sprays down the debris before dewatering it into a dedicated skip. This type of conveyor eliminates the need for a conventional shafted washer compactor that has a risk of damage due to large objects getting stuck on the screw.

For the fine mechanical screen, centerless conveyors would transport the debris to two separate washer compactors. The washer compactor units will discharge the washed and dewatered debris into a common skip. The washer compactors shall be of the continues operating type to eliminate buildup of debris in the washing compartment prior to a washing and compacting process. Therefore, these units will operate in time with the conveyors to wash and compress the debris as it is deposited into the machine.

The conveyors and washer compactors' rated solids loading would be in line with the mechanical screens sizing for robustness.

The wash water from the washer compactors shall be routed by means of drainage pipes to the sewage channels or emergency storage tank downstream, as proves most feasible at detail design.

General maintenance is required on the equipment and components based on the Original Equipment Manufacturer (OEM)'s requirements, therefore items such as the gearboxes, motors, drive shafts, bearings, etc. must be easily accessible for maintenance and the relevant equipment put in place to remove components when required.

The material of construction shall be selected for highly corrosive environments and South African sewage characteristics, therefore as a minimum grade 316L Stainless Steel shall be used on all components for the washer-compactor and conveyor (excluding the conveyor screw which is proposed to be coated mild steel due to material properties more suited for the forces associated with the screw).

The dolly system, driven by an electrical motor (manual start intervention by the operator) will house a single skip and shall transport the skip away from the washer-compactor discharge chutes, to be removed from site with a vehicle/truck. A minimum skip size of 6 m^3 is recommended to prevent a high turn around frequency but the size can be confirmed at detail design stage.

Manual bar screen:

In emergency overflow conditions when the manual bar rake screen is in use, the debris shall manually be removed by the operator by raking it onto a platform onto which the screen terminates and transferred to the skip. From the platform the debris can be scooped up by means of a shovel and deposited into a conveyor to transport it to a washer-compactor. One of the conveyors would allow for an additional chute through which the debris can be deposited.

7.2 Grit Removal Facility

Due to expected high volume of grit, sand and silt entering the sewers, a grit removal system is required to prevent excessive wear on the pump internal parts (volute and impeller).

The choice of grit removal is therefore quite important. As discussed earlier in the report Sand / Silt traps are largely not desirous from the Municipality's requirements.

Thus, the only two acceptable grit removal options are therefore Grit Channels / Chambers or Vortex Type Degritters.

Some advantages and disadvantages of the two removal options are shown in Table 5 below.

Table 5 : Comparison between Grit Channels / Chambers and Vortex Degritting

Type of Grit Removal	Advantages	Disadvantages
Grit Channels / Chambers	• Flexible because they allow performance to be altered by adjusting the outlet flow control device. • Grit that does not require further classification may be removed with effective flow control. • Require little mechanical equipment to function meaning lower operational cost.	• It is difficult to maintain a 0.3 m/s velocity over a wide range of flows. Requires special flow area designs. • Channels without effective flow control will remove excessive amounts of organic material that require grit washing and classifying. • Head loss is large or excessive (typically 30 to 40 percent of flow depth). • High velocities may be generated at the channel bottom with the use of proportional weirs, leading to bottom scour. • Manual cleaning of the channels has health related risks as people will be working with sewage containing grit. • Grit channels require long lengths to provide sufficient settling and storage space for grit.
Vortex Type Degritters	• These systems remove a high percentage of fine grit, up to 73 percent of 140-mesh (0.11 mm diameter) size. • Vortex grit removal systems have consistent removal efficiency over a wide flow range. • There are no submerged bearings or parts that require maintenance. • The “footprint” (horizontal dimension) of a vortex grit removal system is small relative to other grit removal systems, making it advantageous when space is an issue. • Headloss through a vortex system is minimal, typically 6 mm (0.25 in). These systems are also energy efficient.	• Vortex grit removal systems are usually of a proprietary design, which makes modifications difficult. • Paddles tend to collect rags if not screened. • Vortex units usually require deep excavation due to their depth, increasing construction costs, especially if hard rock is present. • The grit sump tends to clog and requires high-pressure agitation using water or air to loosen grit compacted in the sump.

As stated above grit channels are not advantageous as cleaning would be by hand. Furthermore, the Grit channels would also lengthen the Inlet Works in order to provide sufficient grit volumes in the channels. This lengthening will also increase the earthworks and retaining wall requirements to create the platform for the long channels.

Due to the space restraints of the site, vortex degritters are proposed due to the smaller footprint required as well as less requirement for grit storage volumes due to the constant grit removal (versus storage and back removal). The disadvantage of deep excavation could be accepted as the excavation required for the pump sump itself will also be quite deep. Furthermore, rags should be removed through the screening process identified above and clogging of the grit sump can be mitigated by the use of correct grit pumping solutions (with redundancy as discussed above).

Therefore, it is suggested that Vortex Degritting be selected as the preferred degritting measure.

In a Vortex degritter sewage enters the chamber and is kept at a constant velocity by means of a paddle system rotating in the same direction of the flow. The paddle drive (geared motor) shall be installed above ground on the slab above the chamber, with access available to the equipment for operation and maintenance.

Grit, sand and silt will be collected in the hopper shaped bottom of the chamber. During the extraction process, high pressure sparge water will be used to bring the settled particles into suspension to be removed.

Ideally, due to the high anticipated grit content and the requirement for redundancy, two degritters would be required to operate in a duty / standby configuration to protect the downstream equipment for one unit to be taken out of commissioning for maintenance and possible repairs. A bypass channel is to be provided where the chamber would be bypassed should both the degritters be out of operation.

Due to the location of the pump station and possible frequency of cleaning, a permanently installed grit removal pump system is proposed to extract grit from the degritters above manually cleaning the sumps by means of vacuum tanker trucks. The extracted grit shall be pumped into a grit classifier. A dedicated extraction pump per degritter is proposed.

For the self-priming pump system, a dedicated complete pump set would be installed for each degritter. The pump's material of construction would be specific to highly abrasive pump media to suit the specific application and ensure longevity of the equipment. Due to the redundancy in the system (with the two degritters and the bypass channel available), standby self-priming pump sets would not be required but could be provided on client request.

The extracted grit shall be deposited into two grit classifiers to be washed and then dewatered by means of the integrated discharge screw conveyor. Two grit classifiers are proposed, one dedicated per degritter for redundancy in the system. The washed and dewatered grit from the two grit classifiers shall be deposited into a skip placed on a skip dolly system for easy removal. The dolly system, driven by an electrical motor (manual start intervention by the operator) will house a single skip and shall transport the skip away from the grit classifiers' discharge chute, to be removed from site with a truck. A minimum skip size of 6m³ is recommended to prevent a high turn around frequency.

7.3 Ancillary Equipment

Wash-water should be provided to the washer-compactor and high-pressure washer by means of a connection to the municipal water network. The sparge water to the grit chamber shall also be connected to the municipal water network.

7.4 Pumps and Pipework

The Sewer Master Plan (date) indicate a total demand of 322 l/s for the future IPWWF from the Municipal sewer system and the future developments north of the Meul River. The one half of the pump station (municipal phase current need) shall be designed for 50% of this flow, meaning 161 l/s plus a 10% pump factor, therefore a design pump rate of 177 l/s.

7.4.1 Pump Station Configuration and suction pipework

From a workshop with the Municipality, it was agreed that the wet well will consist of four separate sumps, with one pump extracting from a dedicated sump. The interconnecting configuration will allow for any sump to be taken out of operation and still be able to equalise the sewage level between the sumps that remain in operation.

Each pump will have a dedicated suction pipe, sized to have a maximum flow velocity of 1.2 m/s (355ℓ/s), with a preference to be around 1.0 m/s (177ℓ/s) for the interim.

The sizing of pumps, and the number of operational pumps takes into account the phasing of the pump station to meet the growing demand through the serviceable life of the pump station. Therefore, the pump station structure and sumps would allow for four installed pumps for the ultimate design horizon, operating on a three-duty and one-standby configuration. For the interim phase, three pumps would be installed, operating on a two-duty and one-standby configuration.

It could be considered, for the future pump's suction pipe to be partially installed by allowing for the puddle pipe to be casted into the wall with the other pipework. It would be blanked off on both sides to prevent possible leaks / build-up of settled debris.

Pipework shall be flanged and manufactured from grade 316L Stainless Steel. Isolating valves shall be of the flanged resilient seat type gate valve, with a minimum of a PN10 rating.

7.4.2 Preliminary Pump Selection

The preliminary pump selections were based on the calculated demand as per the Sewer Master Plan, with a 10% pump factor on the IPWWF. The interim selection is based on the 20-year horizon and the final selection is based on the 40-year horizon.

As discussed previously, the pump preliminary selections are based on a progressive increase in duty pumps, allowing for the increase in demand. The interim and final selections is therefore based on the same pump set model, with the associated motor sizing to suit the duty, with the number of duty pumps increasing to the final selection.

It would be possible to re-use the proposed Cornell pump sets that is installed in the Thembalethu no 7 pump station, after refurbishing them and changing the operating speed to suit the new system curve, however an additional pump would be required for the interim phase. This also does not allow for the interim period that Thembalethu PS no 7 must remain active prior to commissioning the Thembalethu East PS. The old pumps could conceivably be used as spares for the new pump station which would be more advantageous.

Preliminary selection for the pump sets is given below. Note that these are only provisional selections and final pump selections would be based on the appointed contractor's design during the construction phase.

Optimisation of the number of operational pumps will be looked at during the detail design stage.

Provisional (Cornell Pumps) option:

From the Cornell Pumps range of solids handling pumps, the 4 NHTB range (single-stage pump) can handle the interim and future demands in line with the phased design approach. For the future phase 132kW motor would be required.

See Figure 21 below for the preliminary pump selection on the estimated system curve for the rising main, showing the ultimate design. For the interim phase, a maximum of 3x pumps will operate at a reduced speed to suit the demand.

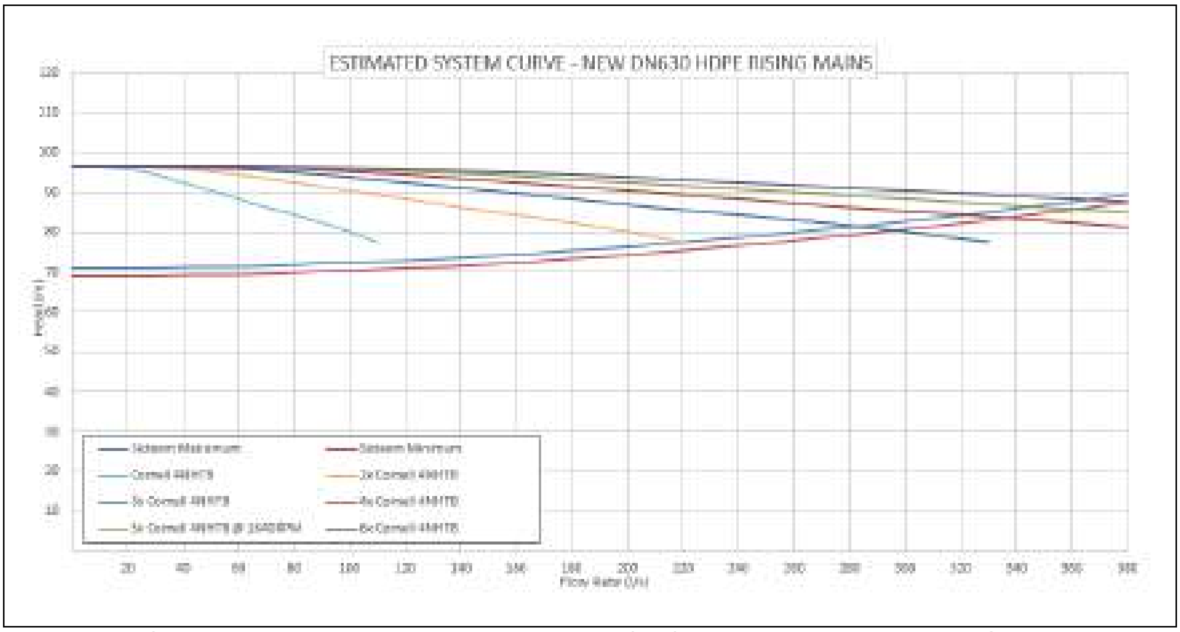


Figure 21 : Combined pump curve on system curve for future Thembalethu East PS phase 1 and 2 (Cornell Pumps)

7.4.3 Delivery Pipework

Each pump set shall be connected to the common delivery manifold and equipped with a non-return valve and isolating valve. The pump delivery pipework, valves and common delivery manifold shall be sized to have a flow velocity lower than 1.8 m/s. The common manifold shall be situated inside the pump room.

The pipework outside the pump station shall house the rising main's air-release valve, isolating - and non-return valve as well as an over-pumping connection point situated in underground chambers.

Pipework shall be flanged and manufactured from grade 316L Stainless Steel. Isolating valves shall be of the flanged resilient seat type gate valve, with a minimum of a PN16 rating. All tees and bends would be strengthened to handle maximum pressures in the system.

8. ELECTRICAL, CONTROL AND INSTRUMENTATION FOR THE NEW THEMBALETHU EAST PUMP STATION

8.1 Design Principle

As per the previous sections, the new pump station and accompanying Inlet Works will be designed for at least 20 years + lifetime. The equipment will however now be phased for an initial 20-year period, whereafter, based upon inflow forecasts, an additional upgrade will be required. To allow for this sufficient space and other measures such as false floors in the MCC rooms could be used to ensure that extensions can occur with minimal disruption in future.

The civil and structural elements will however be sized for the future and thus final capacity. The mechanical pumps will be phased, with additional units possibly installed once the developments north of the Meul River are implemented.

For the electrical, control and instrumentation, it is proposed that only the bulk electrical and supply cables be sized for the full future loading capacity. The MCC with Variable Frequency Controllers (VFC's), along with instrumentation and even the generator is generally designed for a 20-year lifetime (maximum), depending upon maintenance and service intervals.

The final phasing of the pump station must still be determined and therefore the implementation of the equipment shall be confirmed accordingly.

8.2 Bulk Supply

Based on the location selected for the new pump station, the existing overhead line will need to be relocated. The existing line was erected along most of the possible new sites for the new pump station. As such, this line will need to be either relocated, or a new section built, or a new section be taken underground, to allow construction of the new pump station whilst allowing the existing pump station to remain operational.

With the newly created pump station location, a new T-off structure, with fuses, will need to be created, feeding a new indoor transformer(s) adjacent to or on the pump station building via a new section of underground MV-cable.

The Municipality's Electrical Engineering Services (EES) Directorate has confirmed that a new 66KV substation is being built in close proximity to the new pump station and that a dedicated supply would be available. As such, it proposed that a ring-feed be provided to the pump station, one from this new underground supply, and the other from the existing line extension/relocation.

The indoor transformer(s) is proposed to be a 500/630kVA 11kV/420V unit, with boxed ends. An indoor switchgear unit would also be required, with earthing and metering, to supply the two transformers and ensure adequate network switching. The MV cable can be either cross linked polyethylene (XLPE) or paper insulated lead covered (PILC), depending upon the Municipality's design requirements at the time and this will be clarified with the EES Department during the detailed design stage.

It is envisioned that one transformer unit will be installed under Phase 1, and a second unit will be installed under Phase 2. For redundancy, each unit will be sized to handle the full load of the site.

LV supply cables will feed the change-over panel, before feeding the new MCC.

8.3 Emergency Generator

The new recommended set(s) will be of the indoor type, complete with standalone changeover system, internal day tank and bulk external tank. The final sizing of the unit shall be confirmed once the phasing of the installation is determined.

The re-fueling system, between bulk and day tank, must be discussed in further detail, whether being underground (as requested), or above-ground. Factors such as safety, theft, pumping constraints, cleaning and leakage must be assessed during detail design. Final sound ratings also to be discussed, but provisional standard ratings of 65dBA @ 5m are proposed.

Each bulk fuel tank shall be sized to give roughly 3 days' worth of emergency backup capacity available on-site.

From discussion with the Municipality, they requested for two smaller units with above-ground bulk fuel tanks (one per unit), each sized and dedicated to one half of the pump station and implemented as part of the applicable phase. For now, it is therefore allowed that separate generators will be used for each pump station building (i.e. each phase). This will be workshopped further with the Client during the Detail Design Stage.

8.4 Motor Control Centre (MCC)

The new MCC must be equipped with all necessary protections, starters and control feeds for the new inlet works, as well as sewage pumps equipment. VFCs are proposed where either flow or pressure control is required, or in conditions where reversal of direction is advantageous. Smaller motor loads can be supplied with Direct Online (DOL) starters only. The MCC will be rated at the correct fault rating, taking site cascading into account.

The MCC will be located in a dedicated room adjacent to the pump room. It is proposed that one complete unit (per pump station phase or one in full for full phase) be provided for the pumps and Inlet Works equipment, with field control stations at each piece of equipment.

A redundant air-conditioning system is proposed for the MCC room, to provide controlled environmental conditions for the large VFC's. Final factors such as harmonics, heat mitigation and control requirements will be developed during detailed design.

False floors are suggested to allow for future expansions with ease.

8.5 Site Control

A new Programmable Logic Controller (PLC) and Human Machine Interface (HMI) combination is proposed for the site, designed and implemented by one entity, thus keeping lines of responsibility clear. Level control will be provided from the applicable sumps, with all necessary standby functionality provided between the respective duty pumps. Discussions around level and flow control will need to be held during detailed design stage.

The new Inlet Works equipment would operate on a fully automated basis, through a combination of levels and timers. Local control would be provided, per equipment piece, via control stations equipped with start and E-Stop pushbuttons. Final discussions will need to take place on redundancy of inlet streams, and whether they alternate per stream, or whether both systems run, and which input signals would dictate transfer to standby solutions.

8.6 Telemetry and SCADA

Since it is a completely new site, a new outstation is proposed for the site, including all site signal integration and transmission to the Municipality's central SCADA station.

The central SCADA currently displays, monitors and trends all digital and analogue signals from the pump station. A new pump station page would be developed to include the new pump station, as well as all new inlet work equipment. The generator will also be incorporated, as well as all necessary analogue signals, for trending and reporting purposes.

8.7 Instrumentation

The new pump station is to be supplied complete with dual sump level sensors, backup float level switches and pump delivery electromagnetic flow meter and pressure sensor. All the data is to be displayed and trended on the SCADA.

Pump and motor protection will be provided by means of a combination of temperature and vibration protection, with controllers integrated into PLC and Variable Frequency Controllers (VFCs) respectively.

The new Inlet Works would be supplied with its own differential level sensors, per screen channel, to allow secondary control if primary timer control was ineffective. All values would be displayed on the local HMI, as well as remote SCADA.

The client has requested that the flow upstream of the pump station sumps, which has been conveyed through the inlet works, be measured and trended as a means to assist in determining possible infiltration from the combined incoming reporting sewage network systems.

Various options were considered for flow measurement, namely weir structures, Parshall type flumes and velocity area meter equipment. With this being a new works and a certain amount of head being available, a Parshall flume was considered the most appropriate with the flume located just after the vortex degritters. The Parshall flume will provide accurate flow measurement on the incoming flows.

As the Inlet Works is designed with redundancy in mind there will be two channels from the two degritters and thus two Parshall flumes will be installed.

The sewage pump rising main will be metered by means of an electromagnetic flow meter for the interim phase of the pump station, with another electromagnetic flow meter for the additional rising main for the ultimate phase of the pump station.

8.8 Electrical Ancillaries

The new pump station buildings and site will be provided with the following ancillary electrical equipment:

- Holistic site lighting design, integrated with fencing and CCTV requirements.
- Site electric fencing, if required integrated with an armed response system (OPS). System to be confirmed in detailed design.
- CCTV for perimeter protection, integrated with armed response system, to act as alarming system as well.
- Internal pepper gas system, per area, to keep unauthorised users out.
- Building lighting and power design. Internal lighting to be minimum 300lux at operational points, with minimum 400lux provided at any electrical/control areas.

All smaller electrical ancillaries such as earthing, bonding, cable tray, control stations and finishes have been included in the preliminary cost estimates.

9. CIVIL AND STRUCTURAL DESIGN BASED ON TECHNOLOGY OPTIONS

With the Mechanical and Electrical equipment considerations being mostly fixed, the associated Civil and Structural considerations can now be addressed

The concept design in this report covers the design for the ultimate future requirement of the new Thembalethu East PS to service an IPWWF of ±323ℓ/s, and is structured in such a manner to allow for the pump station to be constructed in two phases as and when required.

As per section 6.5 Recommended Layout Option, the Civil and Structural Concept Design will be based on Layout Option 3.

See Figure 22 below proposed plan view of option 3 major process units, buildings and components for re-orientation.

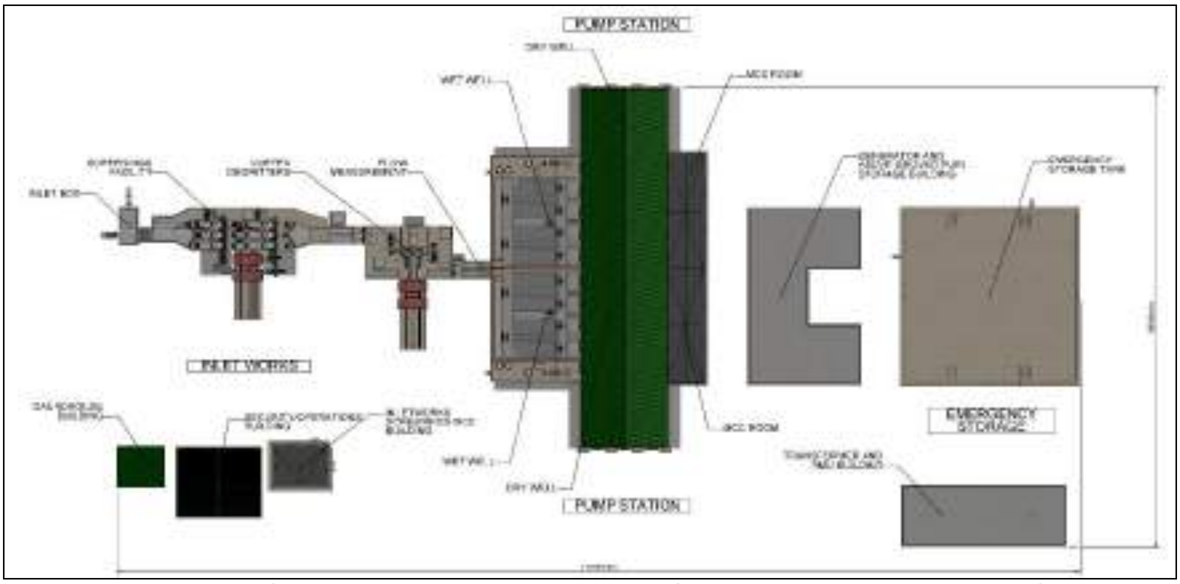


Figure 22 : Plan View of the Proposed Thembalethu East PS Process Units, Buildings and Components

9.1 Inlet Works

9.1.1 Inlet Box

The proposed Inlet Works will start with an Inlet Box which will incorporate a stone trap that will also function as a stilling basin into which the incoming sewers will discharge. The Inlet Box will also include an emergency bypass weir which overflow in to an attached dual-purpose emergency bypass box which can also be used to bypass flow from around the Inlet Works.

During normal operation the raw incoming sewers invert level must be above the top water level in the Inlet Box determined by the ADDWF. This will minimize the risk of backwater into the sewer networks and ensure free draining of the sewer to the Inlet Works.

In an emergency situation the Inlet Box will surcharge and hydraulically overflow as a safeguard to the dual-purpose emergency bypass which will be able to report to the emergency storage tank. The emergency bypass can also be operated manually with a bypass valve and pipe or hydraulically via an emergency overflow in a catastrophic event where no flow should (or could) be conveyed to the inlet works.

Refer to Figure 23 below showing a section through the proposed Inlet Box.

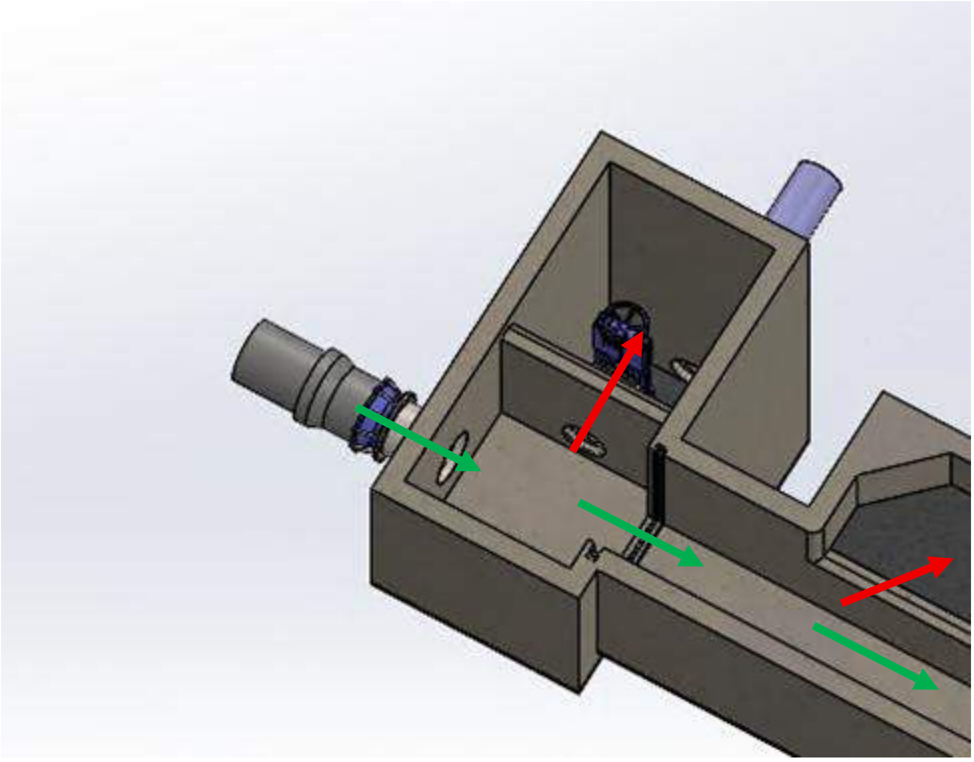


Figure 23 : Section Through Inlet Box

9.1.2 <u>Screenings Facility</u>

Downstream of the Inlet Box, the Screenings Facility will be positioned.

With the drive for redundancy described in the preceding sections of the report, the Screenings Facility will be designed to have a one duty one standby normal operating channel philosophy in Phase 1, and a 2 duty and 1 standby normal operating channel philosophy by the Ultimate capacity.

The Screenings Facility will also include and emergency overflow channel, to ensure that flows can be conveyed to the pump station even in the event of catastrophic failure such as if all normal operating screenings channels where left closed or more than 50% of the combine channel areas are blocked.

As previous noted to in the earlier sections of the report, mechanical screens in a series will be provided in each of the screenings channels with medium screens (with 30mm bar aperture spacing) position first and followed by finer screens (with 10mm bar aperture spacing) secondaly. Hand raked screens in the same series with the same bar aperture spacing as per the screenings channels will also be provided in the emergency overflow channel.

Furthermore, to allow for maintenance channel gates and stop logs will be provided upstream and downstream of each screenings channel train. This will allow flow to be diverted from one channel to the other if desired, and thereby allowing dry working conditions in the isolated screenings channel train.

To ensure redundancy in the Screens Facility, interoperability between screenings channels will be provided through the use of channel gates and stop logs between all channels division walls upstream of the finer screens. This will allow flow to be diverted from one channel to the other behind per screen type if it is not desired to remove a full screenings channel train.

The above would allow for significant redundancy by allowing interoperability in the screenings channels, albeit this would be at an increased cost due to additional channel gates and stop logs.

The plan view of the Screens Facility and possible flow directions in the screenings channels and emergency overflow are shown in Figure 24 and Figure 25 below:

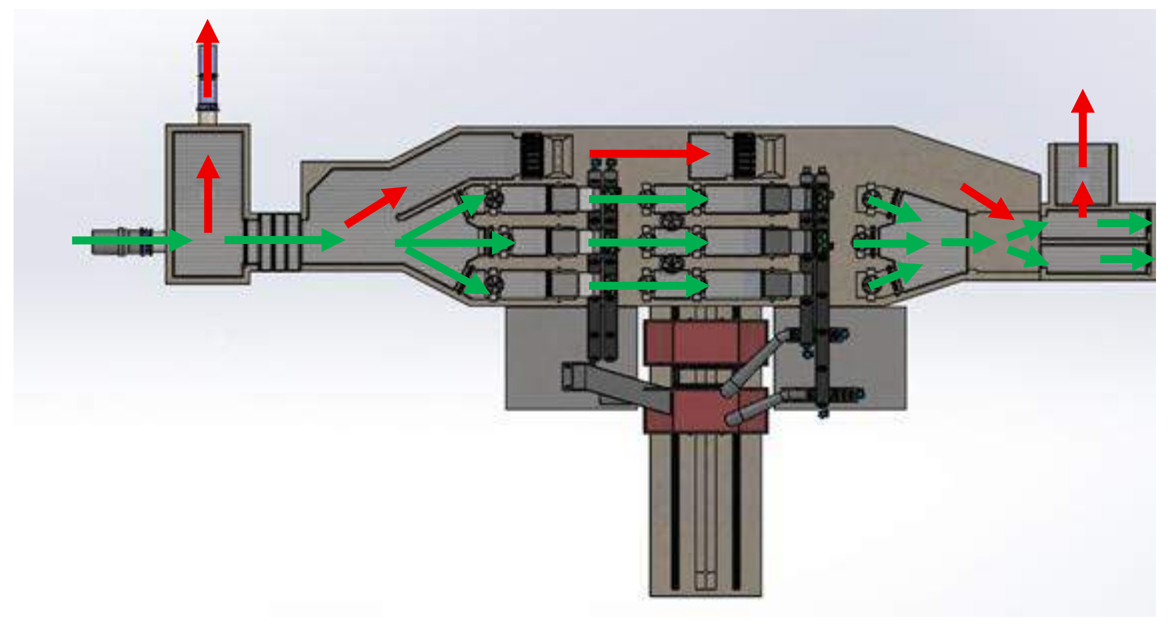


Figure 24 : Plan View of Screening Facility at Ultimate Capacity

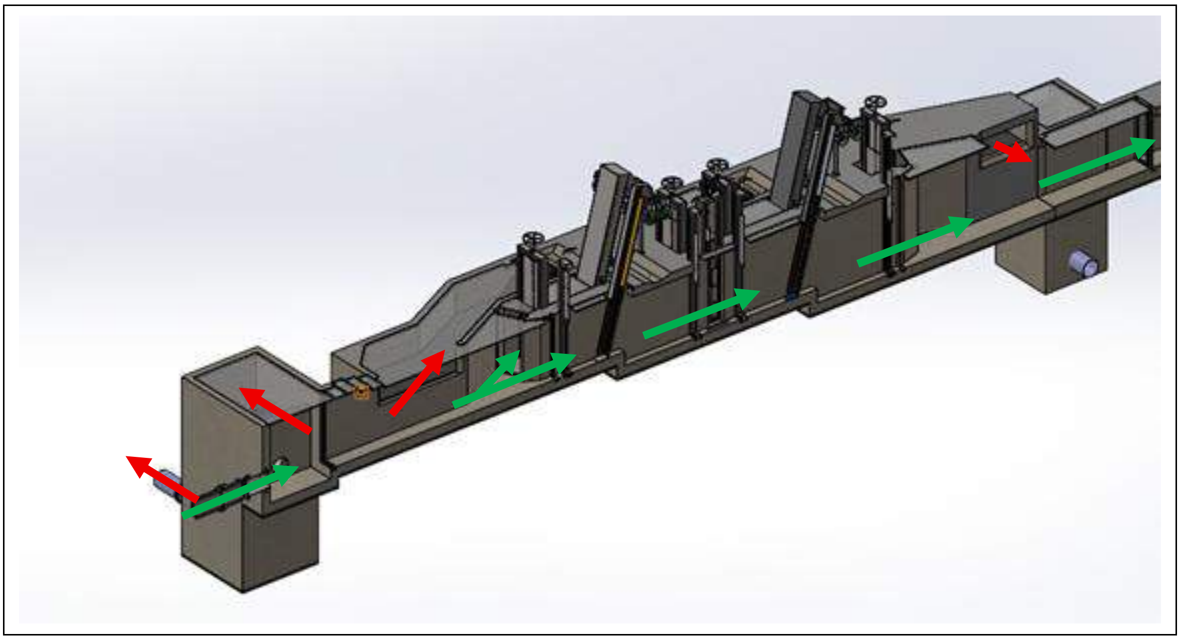


Figure 25 : Layout and Section through Screening Channels

The screenings channels will be intended to be sized to allow for scouring velocity (at least 0.6m/s) where possible to aid the facilitation of grit transport to the vortex degritters downstream.

Furthermore, a step will be provided in the floor at each of the mechanical screens to ensure that grit is washed through the screens and transported downstream.

9.1.3 Vortex Degritters

Downstream of the Screenings Facility, the Vortex Degritters will be positioned. With the drive for redundancy described in the preceding sections of the report, the Vortex degritters will be designed to have a one duty one standby vortex degritter normal operating philosophy.

A 360-degree inlet to outlet Vortex Degritter flow configuration is proposed, as the flow folding back on itself aids grit removal due to the theoretically longer path the grit needs to follow and thus higher likelihood that the target grit particle size has settled sufficiently within the water body to be retained in the degritter.

The Vortex Degritter upper chamber per unit based on preliminary estimates for settling a maximum targeted solids particle size of 2.0mm and minimum targeted particle size of 0.3mm is approximately 4m in diameter. However, exact sizing of the Vortex Degritter will be confirmed during detail design following the recommendations as would be received from the proposed grit and screenings study.

It is currently assumed only two Vortex Degritter units would be needed as each unit is sized large enough so that each unit has sufficient hydraulic capacity to be able to handle the full ultimate capacity flows for the targeted particle sizes.

However, if the above grit and screenings study impacts preliminary design by recommendations such as the minimum particle size should be smaller or settleability relating to the specific grit is more poor, a third Vortex Degritter would be required to be implemented. In this scenario, a two duty Vortex Degritter and one standby will be adopted, with the capability that two of the Vortex Degritters operational can handle the full ultimate capacity flows.

Furthermore, to allow for maintenance channel gates and stop logs will be provided upstream and downstream of each Vortex Degritter unit. This will allow flow to be diverted from one channel feeding the Vortex Degritters to the other if desired, and thereby allowing dry working conditions in the isolated Vortex Degritter unit.

The plan view of the Vortex Degritters and possible flow directions in the channels and units are shown in Figure 26 below:

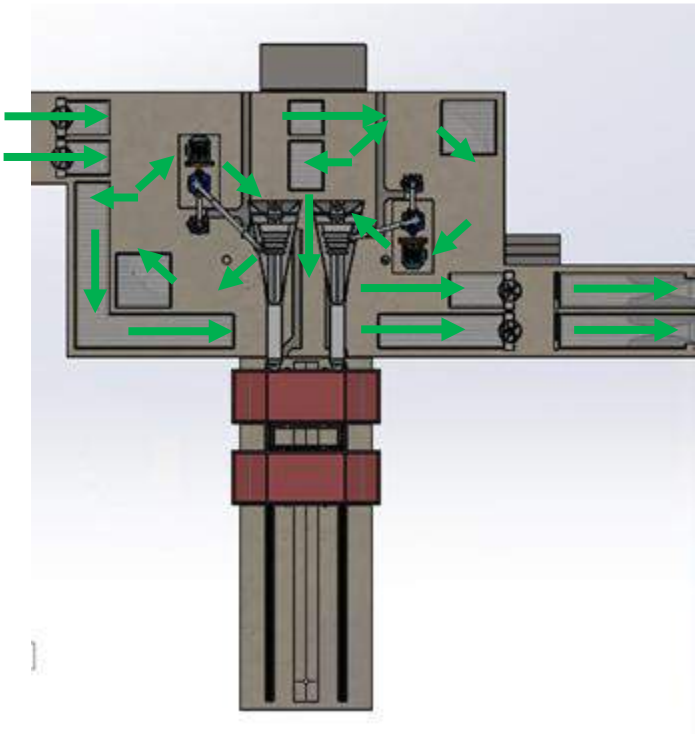


Figure 26 : Plan View of the Vortex Degritters at Ultimate Capacity

It should also be noted that an emergency overflow around the Vortex Degritters (See Figure 25) is also to be provided for further redundancy but with each degritter being sized for the full future flow this may be considered superfluous.

The emergency overflow around the Vortex Degritters is shown in Figure 24 above under section 9.1.2 Screenings Facility as it seems most practical to have this placed just downstream of the screenings channel due to access logistics.

This Vortex Degritter configuration shown in Figure 26 also allows sufficient space for the preferred self-priming pumping equipment which can lift grit to either side of the Vortex Degritters over the structures channels to be placed on a top slab over the Vortex Degritter.

Furthermore, the ancillary equipment for washing and compacting grit as removed by the pumping equipment will also be housed on the top slab over the Vortex Degritter.

9.1.4 Flow Measurement

As this is a new Inlet Works and some hydraulic head can be made available, it was determined prudent to install an open channel flow measuring structure, such as a Flume to accurately measure incoming flows into the pump station.

As there is effectively only one flow stream coming from each of the Vortex Degritters, only one flume would be required to be installed per Vortex Degritters channel. These flumes are also required to control the even flow splitting upstream between the Vortex Degritters channel trains.

For the flume a Parshall flume design is preferred as based on the typical supplier best practice installation guides only requires 10 – 20 times the throat width in approach length for accurate measurements which is comparatively short against other hydraulic structures used for flow measurement in open channel.

To ensure the flume is not submerged on the downstream side, as this is a best practice based on the typical supplier installation guides, it is proposed that the common distribution channel to the pump station wetwell sumps be at a lower level after the flume.

Based on the flow configurations discussed above a preliminary throat width of 9 inches seems suitable but needs to be confirmed at detail design.

The plan view of the Parshall flumes and possible flow directions in the channels are shown in Figure 27 below:

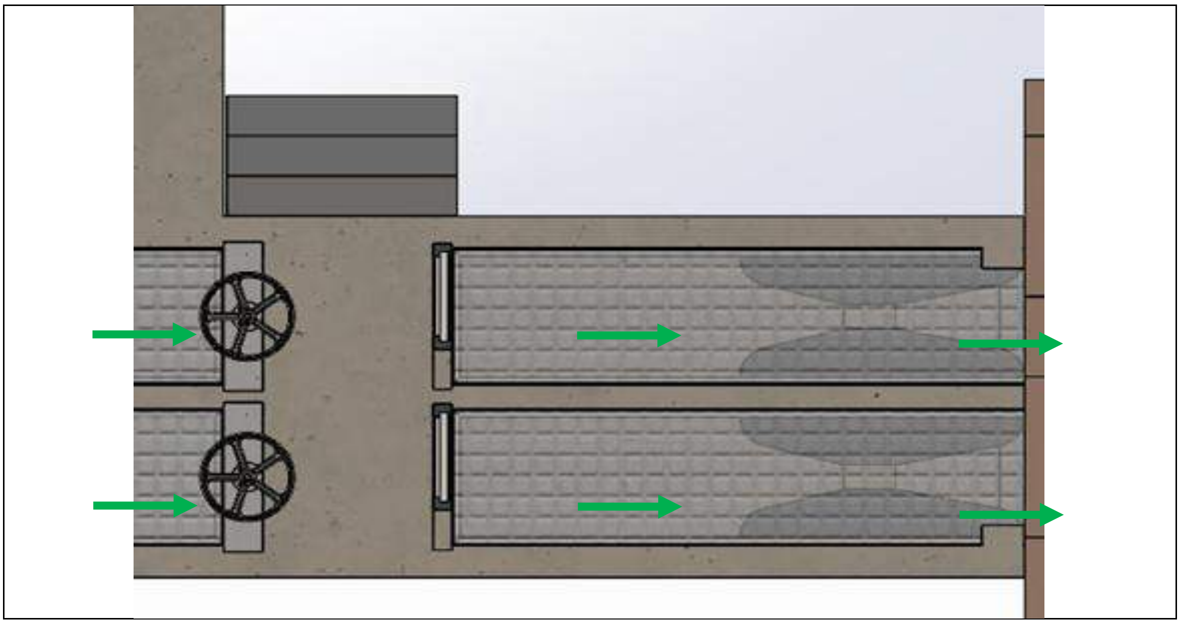


Figure 27 : Plan View of Parshall Flume Installation at Ultimate Capacity

An outflow meter will be installed on the rising main.

9.2 Pump Station

9.2.1 Wet Well Sump

Following the Parshall flume, downstream the screened and degritted sewage flow will enter the pump station common distribution channel and flow through a pair of orifice openings the sumps.

It is envisioned that two sumps will be provided for this first phase of Thembalethu East PS which will allow for redundancy in handling of flows. In future the entire sump structure could be mirrored for the future phases to be implemented by the developer.

The two sumps must be connected to allow for hydraulic balancing of the water levels between the sumps under normal operation.

In order to interconnect the two sumps either a hole in the connecting wall between the two sumps with a sluice gate or and interconnecting pipe between the sumps with a valve is required. To make the decision on which option to use one must also consider the benching to be employed to avoid dead spots in the sump specifically below the normal stop level of the sump.

The suction pipe proposed for the sumps consists of a 500mm diameter bell feeding into a 300mm pipe per pump. Submergence calculations indicate that a minimum submergence of approximately 750mm is required for a suction flow of 70 l/s through each of the suction pipes.

Furthermore, as discussed above approximately 31.5 m^3 is required for active volume above the submergence level to allow for only 3 starts per hour. Assuming a 1.5m deep active volume section this would equate to a sump which is roughly 4.6 x 4.6m.

The typical sump water philosophy is shown in Figure 28 below with a proposed sluice gate position for the interconnection.

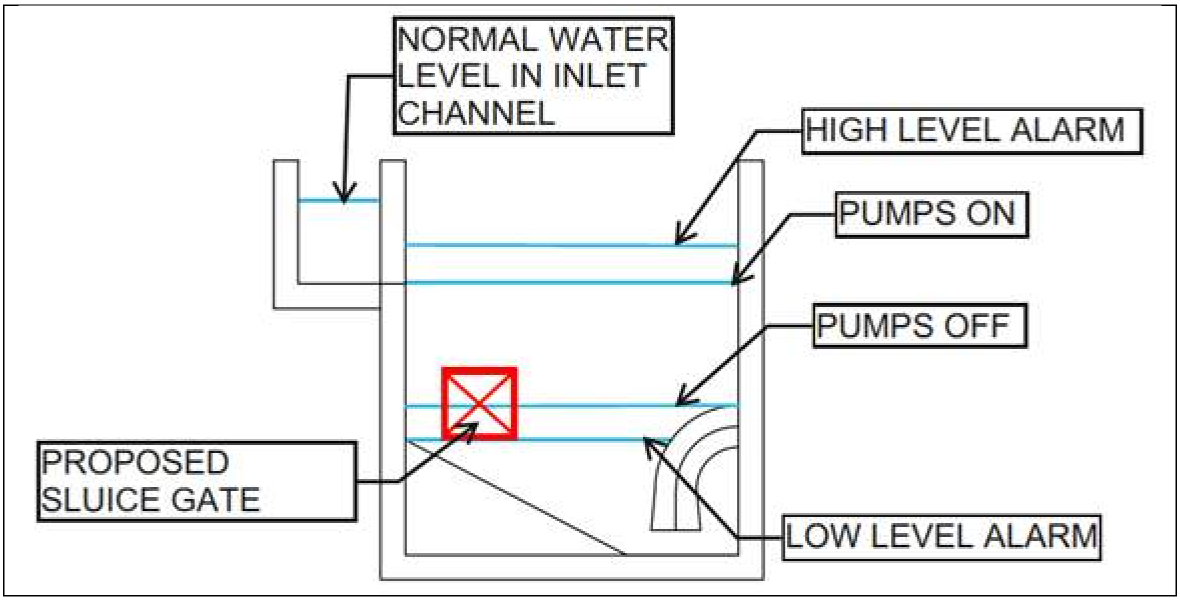


Figure 28 : Typical Sump Water Level Sketch with Sluice Gate

The bottom section of the sump below the low-level alarm will be benched towards the bell at the suction pipe to prevent any possible sludge from accumulating in the corners of the sump which will require regular cleaning. It is further envisioned that the sumps will be closed with either Green colour Glass Reinforced Plastic (GRP) pultruded grids on a steel subframe or a similar steel grating structure which will allow for visual verification of sump levels as well ease of access for maintenance.

Such gratings could be used throughout the inlet structure which can also later be retrofitted for negative pressure odour control systems.

9.2.2 Dry Well and MCC Room

Due to the head requirements of the pumps and to avoid possible Net Pressure Suction Head (NPSH) issues, a dry well with the pumps located below normal full water level in the sumps was chosen.

The dry well must provide sufficient working space around the suction manifold, the pipes and the delivery manifold within the dry well sump. A proposed layout of the dry well sump is shown in the Figure 29 below.

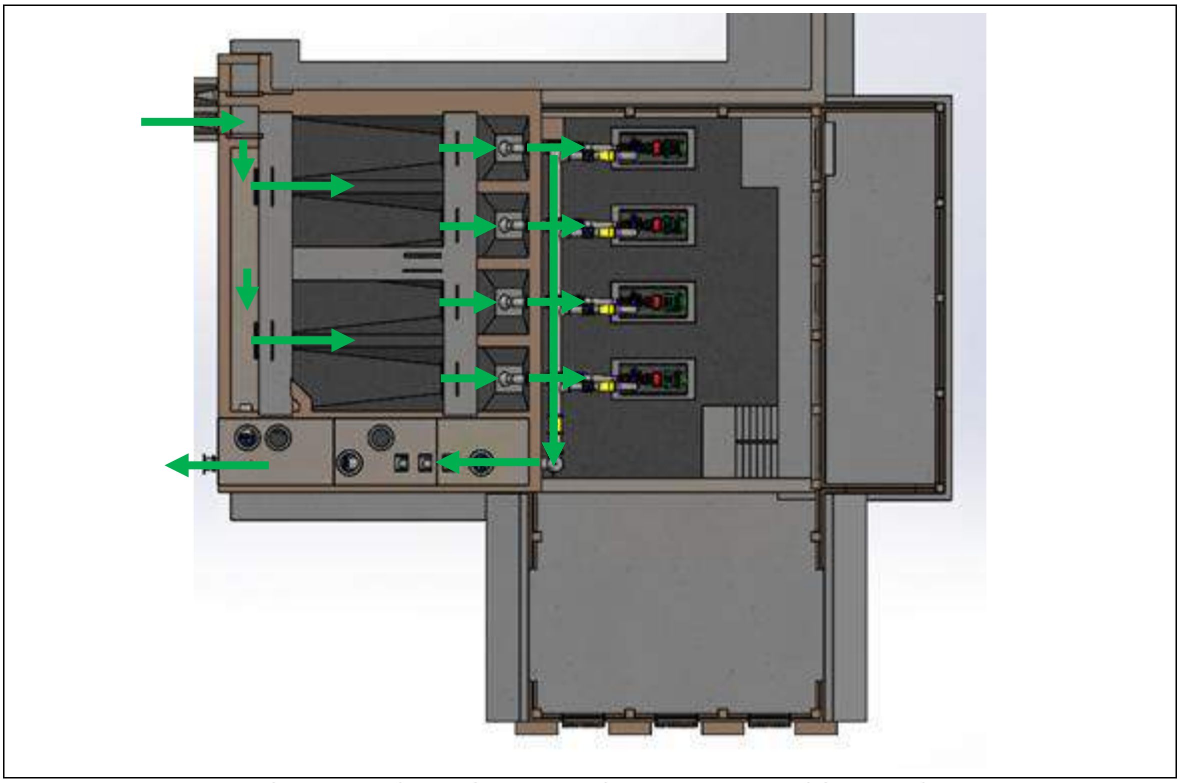


Figure 29 : Plan View of a Phase of the PS Wet Well & Dry Well with MCC Room & Loading Bay

As the dry well is expected to be well below ground level, lifting equipment in the form of a traveling crane will need to be provided. This crane cannot exit the building and as such the building has an extended drive in loading area where pumps or other equipment can be transferred from the traveling crane directly onto a transport vehicle to avoid double handling and the associated risks.

It is proposed that access be provided with a walkway along the long wall of the dry well which will enable access to the bottom of the dry well via stairs.

Space must be provided for the MCC's and for the proposed emergency generator discussed in earlier sections of the report and provision has been made off of the dry well for the MCC as shown in the Figure 30 below.

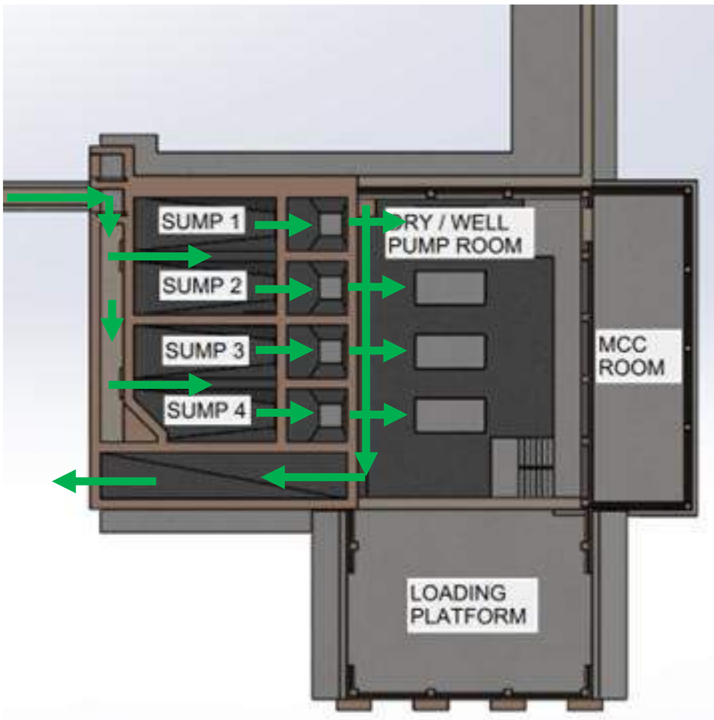


Figure 30 : Typical Layout of a Phase of the PS Wet-well & Drywell with MCC Room & Loading Bay

The MCC room will have false floors for feeding cables into the dry well which will have cable racks to each of the pump sets.

9.3 Electrical Buildings and Ancillary Structures

Additional structures will be required near the inlet works and behind the main pump station structure / building for smaller buildings on the site that are to be used to house electrical equipment or for security - and operational purposes. **Figure 22** above and the layout drawings in Annexure D, shows the positions of the respective buildings on the site described below. The Guardhouse, Security / Operations building and three electrical buildings are described in the sections below.

Located closest to the entrance gate is the Guard House -, Security / Operations – and the MCC room for the Inlet Works which is the first electrical building. The generator building is situated adjacent to the main pump station MCC room, behind the pump station building, and the combined Transformer and RMU building is located at the back of the site adjacent to the emergency storage tank.

9.3.1 <u>Electrical Buildings</u>

Apart from the MCC room attached to the pump station there are three independent buildings relating to the Electrical Buildings which can be collectively referred to as the Bulk electrical and E,C&I unit rooms.

These buildings are conceptualized to be:

a) <u>Inlet Works Screenings MCC Building</u>

The Inlet Works screenings MCC building will consist of a single Inlet Works screenings MCC room as shown in Figure 31 below.

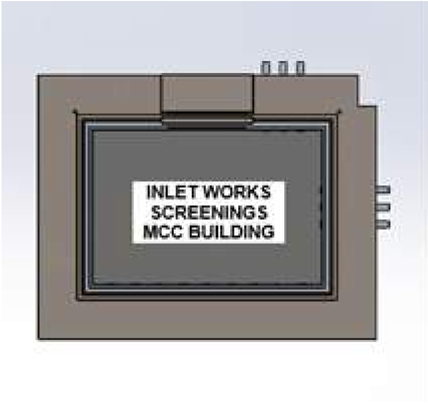


Figure 31 : Typical Layout of the Inlet Works Screenings MCC Building at Ultimate Capacity

The Inlet Works screenings MCC room will have a sunken raft type floor to allow the new MCC unit to be installed on an elevated false floor assembly.

As the equipment is critical for control of the Inlet Works equipment the building will be provide with a concrete roof to deter vandalism.

b) Transformer and Ring Main Unit (RMU) Building

The transformer and RMU building will consist of a two separate transformer rooms and one separate RMU room as shown in Figure 32 below.

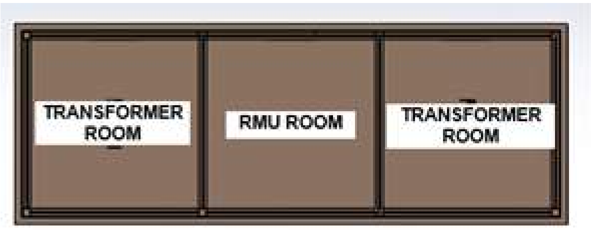


Figure 32 : Typical Layout of the Transformer and RMU Building at Ultimate Capacity

Each transformer room will be equipped as per the relevant construction phase i.e. phase 1 or phase 2 as described in section 8.2 Bulk Supply.

The transformer and RMU rooms will have a plinth for the new equipment to be installed on and will have a granolithic floor screeded to protect the concrete from any potential oil spillages.

As the equipment is critical for Bulk Electrical supply and if faulty could pose a major explosion risk due to the high voltages and current, the building will be provided with a concrete roof to deter vandalism and aid containment of fires or explosion.

c) Generator and Above Ground Fuel Storage Building

The generator and above ground fuel storage building will consist of two separate generator rooms and two separate above ground fuel storage room as shown in Figure 33 below.

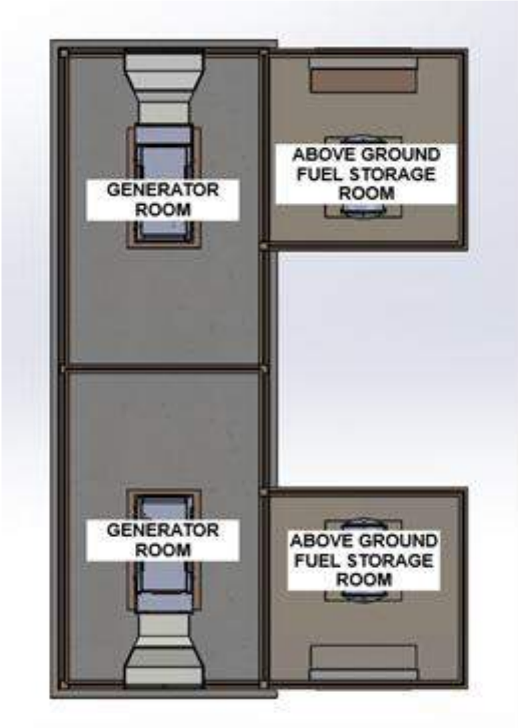


Figure 33 : Typical Layout of the Generator and Above Ground Fuel Storage Building at Ultimate Capacity

Each generator and above ground fuel storage room will be equipped as per the relevant construction phase i.e. phase 1 or phase 2 as described in section 8.3 Emergency Generator.

The generator rooms will have a plinth for the new generator to be installed on and will have a floor screeded to a sump in the unlikely event of a diesel spillage.

The above ground fuel storage rooms will have a plinth for the fuel tank to be installed on and will have a concrete raft type floor which is bunded along the edges, and screeded to a sump depression in the floor to contain the diesel tanks volume and allow an easily accessible area for retrieving the spilled diesel if needed.

As the generators and diesel storages tanks to be installed in separate rooms and the diesel storage room will necessitate a concrete roof (due to fire regulation restrictions) it was deemed prudent to provide a concrete roof for the entire building.

Furthermore, the generators require clean air to pass adjacently through the rooms, and therefore the design of the building considered is a U-shape which would promote cross dragging of natural air for intake and expulsion for the generator rooms.

9.3.2 <u>Ancillary Structures</u>

It is proposed that a separate security/operations building be provided at the entrance of the pump station to allow an overview of the work site and should include a security/operations monitoring office, individual men and women locker room with a toilet, basin and shower, as well as a kitchenette. This will be refined during the detail design stage.

Furthermore, a separate guardhouse will also be included and will also be constructed at the entrance of the Inlet Works

The proposed layout of each building is shown in Figure 34 below.

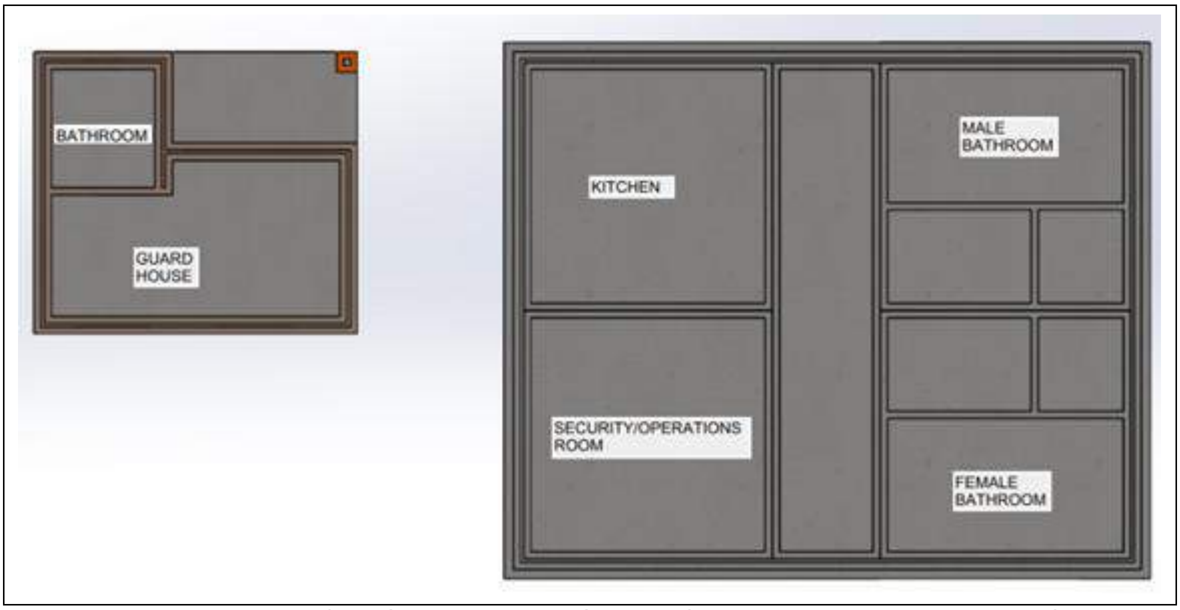


Figure 34 : Typical Layout of the Guardhouse and Security/Operations Building at Ultimate Capacity

Both these buildings can be installed slightly higher than the general platform for the rest of the pump station site as it will aid in sight lines over the footprint of the site area and most outdoor mechanical and electrical equipment.

As the space may be occupied, it made more sense to place the building at the entrance of the Inlet Works on ground level to ensure easy access as well as easy fire escape.

The operations room will not necessarily have access to the remainder of the building.

9.4 Emergency Storage

Emergency storage of sewage is required at the site. The tank is proposed on an enclosed concrete tank for odour control purposes and rectangular in shape to allow adjusting of the tank constraints to suite the site footprint as can be seen in Figure 35 below.

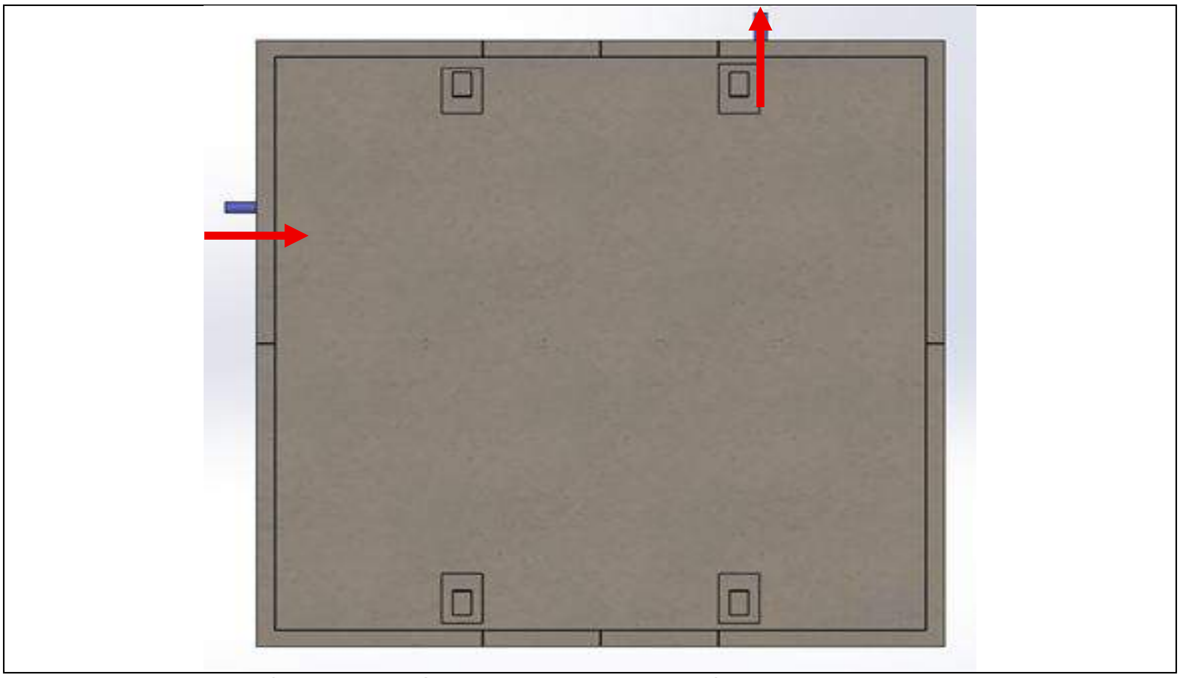


Figure 35 : Plan View of Emergency Storage Tank at Ultimate Capacity

The concrete tank will be sized accommodate 2 hours of ADDWF flow as on agreed suitable volume with the George Municipality, to accommodate downtime of the new pump station.

The tank concept design includes consideration for phasing allowing half of the tank footprint to be constructed in Phase 1, which can then be extended by mirror duplication for the additional emergency storage volume when required at the implementation of the future phase for the ultimate capacity.

9.5 3D Overview of the Proposed Pump Station Concept

Considering the above Civil and Structural components discussed, a preliminary 3D overview of the pump station concept was developed as shown in Figure 36 below

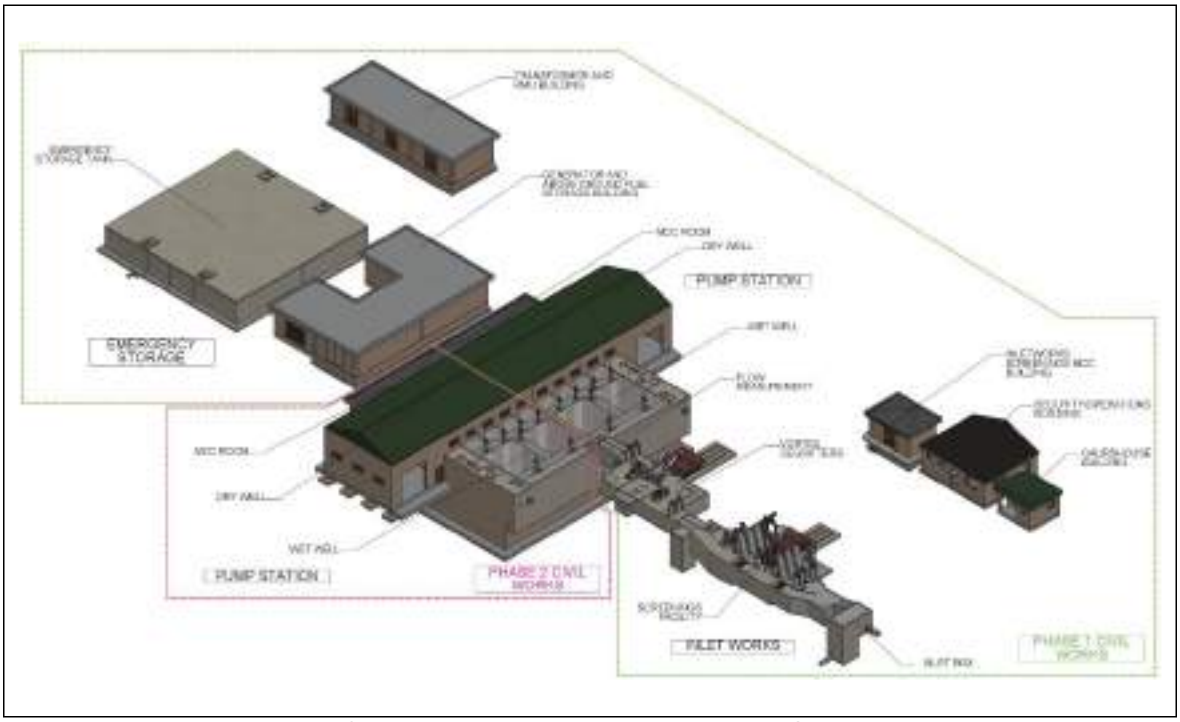


Figure 36 : Full 3D View of the Proposed Thembalethu East PS Process Units, Buildings and Components

Further 3D details of the model overview are shown in isometric drawings included in Annexure D

9.6 Access Road

See ***Figure 37*** below for an overview of the proposed new preliminary access road to the Thembalethu East PS.

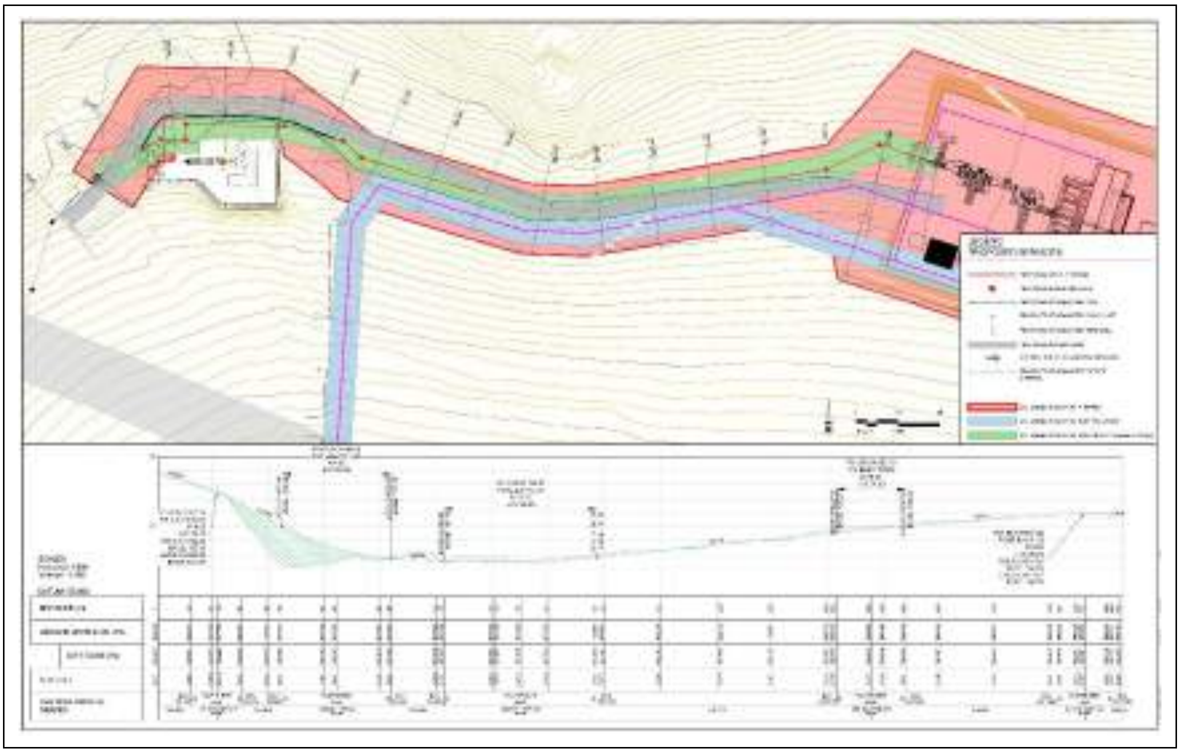


Figure 37 : Full 3D View of the Proposed Thembalethu East PS Process Units, Buildings and Components

The proposed wearing course material for the access road to the new pump station site will be heavy duty interlocking paving placed on an engineered fill inside the PS fenced area.

The access to the site will start at the existing Thembalethu PS 7 road, and will follow the natural contour as far as possible to the new Thembalethu East PS position, concrete road.

Access to the new pump station will be controlled by a wide automated security sliding gate which can allow large vehicles to pass in two directions.

The normal direction of traffic when inside the fenced area and footprint of the new pump station site is envisioned to be one directional traffic flow, likely counterclockwise from the entrance gate.

9.7 Bulk Water Supply and Connection

The new pump station site will require a potable bulk water supply for washwater, day to day operations, odour control , domestic use, etc.

The provision for the potable bulk water supply was discussed and confirmed with GLS Consulting to establish there is adequate capacity in the existing network, adequate pressure in the existing network and where the closest feasible and preferred connection point near the existing Thembalethu PS 7 would be

GLS Consulting indicated that the closest link for potable bulk water would be the existing 50 mm Ø HDPE-10/PE80 supply pipeline to Thembalethu PS 7, however this pipeline would need to be replaced with a 90 mm Ø pipe and extended to the new Thembalethu East PS site along the proposed route of the new proposed Themabalethu East PS rising main.

GLS Consulting also noted there is currently not adequate source storage capacity at the Thembalethu West tower which supplies the network and ultimately the 50 mm Ø HDPE-10/PE80 link pipe, however the first of two Thembalethu East reservoirs and the Thembalethu East tower which is currently being constructed is nearing commissioning.

The surrounding network, including the Thembalethu PS 7 pipeline is to be moved the from the Thembalethu West tower zone to the new tower zone once this is completed and this switch of supply source will provide ample capacity to meet the demand requirements.

Refer to Annexure E for further details as obtained from GLS Consult.

10. ENVIRONMENTAL CONSIDERATIONS

An Environmental Assessment Practitioner (EAP), Greenfire Enviro was appointed in April 2024. The EAP appointment includes compliance with NEMA and the NWA (if applicable), as well as the provision of a separate Notice of Intent to Develop (NID) application, Environmental Assessment application and Water Use License (WUL) application. All applications are currently underway at the time of writing this report.

Final recommendations from the Environmental Process will be received once the assessments have been completed and the Environmental Assessment Practitioner (EAP) will be engaged to advise the requirements and/or considerations which should be incorporated into the detailed design.

The timeline for obtaining authorizations is included in the programme as indicated in sections 14 below of this report.

11. GEOTECHNICAL INVESTIGATIONS

No Geotechnical investigation has been undertaken at the time of writing this report. A Geotechnical investigation will only be undertaken once the concept option and preferred site option have been accepted by George Municipality to avoid inapplicable information being obtained and unnecessary expenditure.

The proposed Scope of work for the Geotechnical investigation will be discussed and finalized with George Municipality prior to obtaining quotations and requesting services from market.

12. COST ESTIMATE

In order to determine which conclude on which Layout Option would be preferred and recommended to be carried forward to detail design, a potential high-level cost estimates for each option was compiled based on an order of magnitude for similar types of works for the ultimate implementation of the Thembalethu East Pump Station (i.e. the full capacity of 322l/s).

It should be noted, that the Mechanical and Electrical works will stay largely the same between the Layout Options, apart from Layout Option 3, as the major cost differences will be mainly on the Civil and Structural works.

Furthermore, the Layout Options were compared not considering a preferred Pump Station Site as the final site may change based upon Environmental Applications and regulatory conclusions.

12.1 Cost Estimate Breakdown

A potential high-level construction cost estimate for each layout option as discussed in section “6 Pump Station Layout Options for the New Thembalethu East Pump Station” was compiled and is included Annexure F showing the order of magnitude considerations.

A summary of the potential high-level construction cost estimate can be seen in Table 6 below:

Table 6 : Summary of Potential High-Level Construction Cost Estimate for Each Option

LYNERS POTENTIAL HIGH-LEVEL PROJECT EXPENDITURE									
ITEM	DESCRIPTION	Option 1		Option 2		Option 3		Option 4	
		AMOUNT (ZAR) - 2024/12		AMOUNT (ZAR) - 2024/12		AMOUNT (ZAR) - 2024/12		AMOUNT (ZAR) - 2024/12	
		Civil	Mechanical/ Electrical	Civil	Mechanical/ Electrical	Civil	Mechanical/ Electrical	Civil	Mechanical/ Electrical
A	**PRELIMINARY AND GENERAL**	**R16 906 000.00**	**R9 347 292.22**	**R17 010 000.00**	**R9 347 292.22**	**R15 732 500.00**	**R9 347 292.22**	**R16 724 500.00**	**R9 347 292.22**
B	**SITE WORKS**	**R30 029 000.00**		**R27 825 000.00**		**R28 821 000.00**		**R28 705 000.00**	
C	**INLETWORKS**	**R13 612 000.00**	**R16 106 000.00**	**R11 952 000.00**	**R16 106 000.00**	**R10 126 000.00**	**R16 106 000.00**	**R12 284 000.00**	**R16 106 000.00**
D	**RISING MAIN**	**R850 000.00**		**R850 000.00**		**R850 000.00**		**R850 000.00**	
E	**PUMP STATION**	**R12 483 000.00**	**R11 361 200.00**	**R16 763 000.00**	**R11 361 200.00**	**R12 483 000.00**	**R11 361 200.00**	**R14 409 000.00**	**R11 361 200.00**
F	**EMERGENCY STORAGE**	**R10 400 000.00**		**R10 400 000.00**		**R10 400 000.00**		**R10 400 000.00**	
G	**ELECTRICAL**		**R18 669 261.08**		**R18 669 261.08**		**R18 669 261.08**		**R18 669 261.08**
#	**SUBTOTAL A**	**R84 280 000.00**	**R55 483 753.30**	**R84 800 000.00**	**R55 483 753.30**	**R78 412 500.00**	**R55 483 753.30**	**R83 372 500.00**	**R55 483 753.30**
	Add 10% Contingencies on Sub-total A	R8 428 000.00	R5 548 375.33	R8 480 000.00	R5 548 375.33	R7 841 250.00	R5 548 375.33	R8 337 250.00	R5 548 375.33
#	**SUBTOTAL B**	**R92 708 000.00**	**R61 032 128.63**	**R93 280 000.00**	**R61 032 128.63**	**R86 253 750.00**	**R61 032 128.63**	**R91 709 750.00**	**R61 032 128.63**
	Add Contract Price Adjustment (CPA) for 2 year at 8% per annum on Sub-total B for Civil	R15 426 611.20		R15 521 792.00		R14 352 624.00		R15 260 502.40	
	Add Contract Price Adjustment (CPA) for 2 year at 16% per annum on Sub-total B for Mechanical/Electrical		R21 092 703.65		R21 092 703.65		R21 092 703.65		R21 092 703.65
1	**POTENTIAL HIGH-LEVEL CONSTRUCTION TOTAL CONSTRUCTION TOTAL**	**R190 259 443.48**		**R190 926 624.28**		**R182 731 206.28**		**R189 095 084.68**	
	Estimated Professional Costs including 10% discount								
	- Civil and Structural Fees	R7 129 214.76		R7 168 244.83		R6 688 812.88		R7 061 099.77	
	- Additional fees for Reinforced Concrete and Structural Steel	R1 803 207.19		R1 916 736.48		R1 652 221.74		R1 829 134.35	
	- Mechanical Fees	R3 865 567.59		R3 865 567.59		R3 865 567.59		R3 865 567.59	
	- Electrical Fees	R1 986 658.06		R1 986 658.06		R1 986 658.06		R1 986 658.06	
	- Electronic Fees	R969 790.61		R969 790.61		R969 790.61		R969 790.61	
	Construction Monitoring Level 3 @24 Months	R1 500 000.00		R1 500 000.00		R1 500 000.00		R1 500 000.00	
	Geotechnical Investigation	Included under Portion 1 Fees		Included under Portion 1 Fees		Included under Portion 1 Fees		Included under Portion 1 Fees	
	Topographical Survey	Included under Portion 1 Fees		Included under Portion 1 Fees		Included under Portion 1 Fees		Included under Portion 1 Fees	
	Environmental Applications	Included under Portion 1 Fees		Included under Portion 1 Fees		Included under Portion 1 Fees		Included under Portion 1 Fees	
	OHS Client Agent	R255 000.00		R255 000.00		R255 000.00		R255 000.00	
	ECO	R360 000.00		R360 000.00		R360 000.00		R360 000.00	
	Recoverable Expenses	N/A		N/A		N/A		N/A	
2	**POTENTIAL PROJECT TOTAL ESTIMATE (EXCL. VAT)**	**R208 128 881.69**		**R208 948 621.86**		**R200 009 257.16**		**R206 922 335.05**	
	Add 15% VAT	R31 219 332.25		R31 342 293.28		R30 001 388.57		R31 038 350.26	
3	**POTENTIAL PROJECT TOTAL ESTIMATE (INCL. VAT)**	**R239 348 213.94**		**R240 290 915.14**		**R230 010 645.73**		**R237 960 685.31**	
4	POTENTIAL HIGH-LEVEL CONSTRUCTION TOTAL FOR PHASE 1	R131 641 517.67		R180 218 186.35		R149 506 919.73		R130 878 376.92	

Notes:

1) High-Level Cost Estimates for Each Option was completed in December 2024 and escalation has been allowed for two years.
2) "Potential High-Level Construction Total for Phase 1" assumed to be the following percentage of the "Potential High-Level Construction Total for Ultimate Design Capacity":
a) For Option 1 and 4 = 55%, b) For Option 2 = 75%, c) For Option 3 = 65%.
3) This table is only to be used to gauge an order of magnitude cost for strategic planning and Lyners shall outright not be held accountable for a degree of accuracy of the estimate nor be bound to the estimate. The estimate shall furthermore be re-calibrated and realigned as design development progress, however actual cost can only be confirmed if George Municipality ventures to sought prices from the market.

The potential high-level construction cost for the ultimate design capacity indicates that Layout Option 3 would be the lowest overall work undertaking, however due to the requirement of a larger Inlet Works portioning for the first phase, the potential high-level construction total for Phase 1 is the second highest.

The Phase 1 cost would initially not make this option the most desirable, however the Layout Option 3 was the preferred option and recommended configuration as indicated for various reasons in section 6.5 Recommended Layout Option.

Therefore, Layout Option 3 remains the preferred and recommended option to be taken forward as the initial cost may be higher but in the long-term there would be a saving both capitally and operationally.

13. PRELIMINARY PROGRAMME

The actual project and construction period are dependent on the amount of funding received in each financial year, as can only be confirmed by the Municipality closer to the start of the approaching financial year.

Therefore, the below preliminary programme is provided only for planning purposes and should be noted is based on the assumption that the detail design will be undertaken for the ultimate design capacity of the Thembalethu East PS and Procurement to Close-out will only continue for Phase 1 work.

Refer to Table 7 below for the major project milestones and estimated time frames.

Table 7 : Preliminary Programme indicating Major Project Milestones & Estimated Time Frames

DESCRIPTION	PLANNED START DATE	PLANNED END DATE	MUNICIPAL FINANCIAL YEAR
Stage 1: Inception	04-2024	05-2024	23/24 FY
Stage 2: Concept & Viability	05-2024	02-2026	23/24 FY- 25/26 FY
Stage 3: Design & Development	03-2026	06-2026	25/26 FY
Stage 4: Documentation & Procurement	06-2026	09-2026	26/27 FY
Tender Advertisement	07-2026	08-2026	26/27 FY
Stage 5: Contract Administration & Inspection	10-2026	05-2028	26/27 FY - 27/28 FY
Appointment of Contractor	10-2026	-	26/27 FY
Construction Period	10-2026	05-2028	26/27 FY - 27/28 FY
Construction Complete	-	05-2028	27/28 FY
Stage 6: Close-out	06-2028	06-2028	27/28 FY
Heritage Western Cape NID Application	04-2024	02-2025	23/24FY - 24/25 FY
Environmental & WUL Application	04-2024	03-2027	23/24FY - 26/27 FY

14. PROCUREMENT STRATEGY

For a project of this complexity, the procurement strategy used to obtain tender submissions from prospective contractors is critical to the successful delivery of the project

However, at this stage of the project life cycle, there still requires substantial development of the accepted concept design to detail with associated costing, and confirmation of available budget and cashflow for implementation.

Therefore, a potential procurement strategy cannot be recommended in this report, however due to the fact that this project is multi-disciplinary (i.e. contains both large scale civil and mechanical & electrical and building works) the National Treasury Standard of Infrastructure Procurement and Delivery Management (National Treasury Department of South Africa, October 2015) will be followed after detail design as a guideline to derive a specific procurement strategy by holistically considering the following:

- Procurement Objectives.
- Packing Strategy.
- Contracting Strategy.
- Pricing Strategy.

15. CONCLUSION AND WAY FORWARD

This Concept And Viability design report will form the basis of further discussion with George Municipality to firm up the required scope and guide the detailed design of the recommended Layout Option 3 on the proposed Pump Station Site 3.

Furthermore, this report should assist the Municipality on planning project fund allocations and if the need arises to apply for future funding.

We are available to workshop the above at client's earliest convenience.

Should you have any queries please do not hesitate to contact us.

Yours sincerely,

PREPARED BY, FOR LYNERS:

Mr. PC Davids, Pr.Eng *Project Director* **ROLE: APPROVER / REPRESENTATIVE**	Mr. J Pleass, Pr.TechEng *Civil Technologist* **ROLE: CIVIL**
Mr. P Joubert, BEng *Mechanical Engineer* **ROLE: MECHANICAL**	Mr. A Steenkamp, Pr.Eng *Electrical, Control and Instrumentation Engineer* **ROLE: E,C&I**

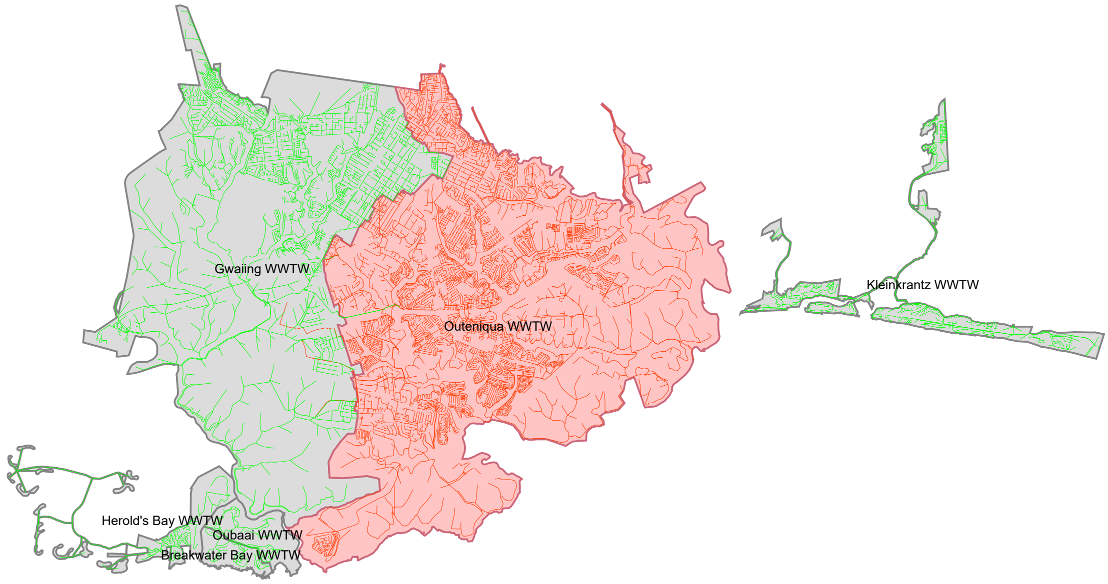
16. APPROVAL CONFIRMATION

APPROVED BY, FOR GEORGE MUNICIPALITY:	
Name and Surname:	**Name and Surname:**
……………………………………..	……………………………………..
Title, Directorate:	*Title, Directorate:*
……………………………………..	……………………………………..
ROLE:	**ROLE:**
……………………………………..	……………………………………..

ANNEXURE A :

GLS Consulting Sewer Master Plan 2024 Report

GEORGE MUNICIPALITY



MASTER PLAN
SEWERAGE SYSTEM

George

Outeniqua drainage area

2024-03

OUTENIQUA DRAINAGE AREA

STRATEGIC

For this evaluation and planning it was assumed that all future sewer flows have to be accommodated at the existing Outeniqua WWTW.

Incorporate the existing privately owned Saasveld sewer flow in the future Outeniqua drainage area which discharges to the Outeniqua WWTW.

MASTER PLAN

Upgrading of the outfall sewers towards the Rooiriver PS.

Downsizing of existing pump stations in order to reduce the potential pump peaks on downstream pipes.

Upgrading of existing pump stations in order to accommodate future development areas.

Various link sewers linking into the existing sewer system to accommodate future developments are needed.

A number of main sewers linking to the outfall system are required to extend the drainage area for future developments.

The two diversions on the perimeter (DS-03 and DS-04) must be set to divert 100% of the flow to the Gwaiing drainage area.

25 New pump stations (incl. Le Grand PS and Victoria Bay PS 2) and various link sewers linking into the main outfall sewers to accommodate future developments, are needed.

Decommissioning of the WTP Sludge flow (ě 1 950 kL/d) to the Eden George PS.

Elimination of pump stations

The following pump stations are to be eliminated in the future system:

ð Bos-en-Dal PS (to Pacaltsdorp Ext.3A PS - from Gwaiing drainage area)

ð Pacaltsdorp PS 2 (to Groeneweide Ext. PS F2 - to Gwaiing drainage area)

ð Pacaltsdorp PS 4 (to Gwayang River Estate3 PS - to Gwaiing drainage area)

ð Pacaltsdorp PS 6 (to Pacaltsdorp PS 3)

ð Parkdene PS 1 (to Destiny Africa PS)

ð Parkdene PS 2 (to Destiny Africa PS)

ð Parkdene PS 3 (to Destiny Africa PS)

ð Rosedale PS 1 (to Pacaltsdorp PS 1)

ð Rosedale PS 2 (to Pacaltsdorp Ext.3A PS)

ð Saasveld PS 6 (Private) (to Woodifields PS F3)

ð Tamsui PS (to Pacaltsdorp Ext.3A PS)

ð Thembalethu PS 1 (to Destiny Africa PS)

ð Thembalethu PS 2 (to Destiny Africa PS)

ð Thembalethu PS 5 (to Pacaltsdorp PS 1)

ð Thembalethu PS 7 (to Destiny Africa PS)

ð Thembalethu PS A (to Destiny Africa PS)

ð Thembalethu PS B (to Destiny Africa PS)

Investigation of pumping stations

Investigations are required at the following pump stations regarding their flow capacity:

ð Glenwood PS

ð Pacaltsdorp PS 2

ð Pacaltsdorp PS 6

ð Saasveld PS 1 (Private)

ð Saasveld PS 2 (Private)

ð Saasveld PS 3 (Private)

ð Saasveld PS 4 (Private)

ð Tamsui PS

ð Thembalethu PS 1

ð Thembalethu PS 6

ð Thembalethu PS 7

ð Thembalethu PS A

ð Thembalethu PS B

Upgrading/ Downsizing of pump stations

The following pump stations are to be upgraded in the future system:

ð Blue Mountain PS 1

ð Blue Mountain PS 2

ð Glenwood PS (Investigate)

ð Meul PS

ð Pacaltsdorp PS 1

ð Pacaltsdorp PS 3

ð Saasveld PS 4 (Private) (Investigate)

ð Schaapkop PS

ð Thembalethu PS 6 (Investigate)

The following pump stations are to be downsized in the future system:

ð None

New pumping stations

The following new pump stations are required:

ð Ballots Bay PS

ð Destiny Africa PS

ð George Erf 195/325 PS

ð George Erf 464 PS F1

ð George Erf 464 PS F2

ð Hansmoeskraal2 PS

ð Hansmoeskraal4 PS

ð Hansmoeskraal5 PS 1

ð Hansmoeskraal5 PS 2

ð Kraaibosch3 PS

ð Kraaibosch4 PS

ð Kraaibosch5 PS

ð Kraaibosch Ridge PS 1

ð Le Grand PS (Rising Main and pump installations)

ð Le Grand1 PS

ð Le Grand2 PS F1

ð Le Grand2 PS F2

ð Pacaltsdorp Ext.3A PS

ð Thembalethu Ext.10 PS

ð Thembalethu Ext.11B PS

ð Thembalethu Ext.12A PS

ð Victoria Bay PS 2 (Rising Main installation)

ð Woodifields PS F1

ð Woodifields PS F2

ð Woodifields PS F3

ð Woodifields PS F4

The following new interim pump stations are required:

ð Hansmoeskraal1 PS (to accomodate Hansmoeskraal (1a), -202/58-59-61 and -(6) developments)

ð Pacaltsdorp West PS (to accomodate Pacaltsdorp Erf 325 (West) and Pacaltsdorp Erf 323 developments - to Gwaiing drainage area)

ð Kraaibosch Ridge PS 2 (to accommodate Kraaibosch Ridge development)

ð Kraaibosch Ridge PS 3 (to accommodate Aan de Meulen and Kraaibosch Ridge developments)

ð Kraaibosch Ridge PS 4 (to accommodate Aan de Meulen and Kraaibosch Ridge developments)

WWTW

The following items are required regarding WWTW's:

ð Outeniqua WWTW: Upgrade from existing capacity of 25 000 kL/d to 45 000 kL/d (additional 20 000 kL/d, 2 phases), excl. WTP Sludge @ ě 1 950 kL/d.

OTHER CONSIDERATIONS

Integrity levels:

ð It is recommended that field tests be carried out to verify pump duty points at all the pumping stations. The unknown pipe diameters and invert levels should also be determined in order to improve the confidence levels of the models.

Elimination of the following existing pump stations in the Outeniqua system:

ð Glenwood PS to future George Erf 464 PS F1 system

WWTW:

ð A new ě 10 000 kL/d WWTW in the vicinity of Thembaletu and Ballots Bay to eliminate the proposed Thembalethu / Pacaltsdorp outfall sewer and PS upgrades. This will reduce the required upgrading of the existing Outeniqua WWTW by ě 9 000 kL/d.

Master Plan Drainage Areas

Drainage Area	Present AADD (kL/d)	Present PDDWF (kL/d)	Present PDDWF (%)	Theoret. AADD (kL/d)	Theoret. PDDWF (kL/d)	Theoret. PDDWF (%)	Fully Occ. AADD (kL/d)	Fully Occ. PDDWF (kL/d)	Fully Occ. PDDWF (%)	Future AADD (kL/d)	Future PDDWF (kL/d)	Future PDDWF (%)	Future Increase PDDWF (kL/d)	Area (ha)	Present PDDWF/ha (kL/ha/d)	Future PDDWF/ha (kL/ha/d)
Outeniqua WWTW				20 581	18 113	88%	23 145	19 662	85%	54 160	41 996	78%	23 883	7 943	2	5
Saasveld PS 6				0	5	0%	0	5	0%	0	5	0%	0	1	4	4
Kraaibosch 195/62 PS F1				0	0	0%	0	0	0%	261	236	90%	236	64	0	4
Welgelegen PS				300	296	98%	347	321	92%	1 136	984	87%	689	214	1	5
George Erf 195/325 PS				0	0	0%	0	0	0%	28	19	68%	19	1	0	19
Kraaibosch PS				1 019	912	89%	1 133	975	86%	3 017	2 418	80%	1 505	466	2	5
George Erf 464 PS F1				0	0	0%	0	0	0%	2 201	1 391	63%	1 391	54	0	26
George Erf 464 PS F2				0	0	0%	0	0	0%	886	548	62%	548	44	0	12
Glenwood PS				324	249	77%	339	257	76%	5 234	3 434	66%	3 185	316	1	11
Blue Mountain PS 1				65	59	91%	71	63	88%	303	241	80%	182	32	2	7
Blue Mountain PS 2				2	3	183%	8	7	81%	8	7	81%	4	34	0	0
George WTP Sludge				0	1 260	0%	0	1 260	0%	0	0	0%	-1 260	0	0	0
Eden George PS				2 040	2 852	140%	2 096	2 882	137%	2 158	1 681	78%	-1 170	404	7	4
Meul PS				7 270	7 179	99%	7 700	7 424	96%	15 407	11 438	74%	4 259	1 818	4	6
Schaapkop PS				10 489	9 807	94%	11 699	10 541	90%	20 347	15 210	75%	5 402	2 423	4	6
Woodifields PS F1				0	0	0%	0	0	0%	137	94	69%	94	33	0	3
Woodifields PS F2				0	0	0%	0	0	0%	410	285	69%	285	157	0	2
Saasveld PS 1				3	2	72%	3	2	64%	3	2	64%	-0	0	4	4
Saasveld PS 2				24	16	68%	25	15	60%	25	15	60%	-2	5	4	3
Saasveld PS 3				8	5	68%	8	5	60%	8	5	60%	-1	5	1	1
Saasveld PS 4				16	11	67%	16	10	59%	16	10	59%	-1	8	1	1
Woodifields PS F3				231	172	75%	235	156	67%	651	435	67%	263	143	1	3
Woodifields PS F4				231	172	75%	235	156	67%	1 540	1 063	69%	891	576	0	2
Kraaibosch5 PS				231	172	75%	235	156	67%	1 895	1 305	69%	1 133	785	0	2
Victoria Bay Injector PS				6	3	49%	6	3	49%	6	3	49%	0	0	8	8
Victoria Bay PS				16	10	65%	18	11	63%	16	10	62%	-0	10	1	1
Victoria Bay PS 2				16	11	70%	103	57	55%	614	388	63%	376	298	0	1
Parkdene PS 2				0	0	0%	0	0	0%	0	0	0%	0	0	1	1
Parkdene PS 3				0	0	0%	0	0	0%	0	0	0%	0	0	1	1
Thembalethu PS 2				0	0	0%	0	0	0%	0	0	0%	0	0	2	2
Thembalethu PS B				0	0	0%	0	0	0%	0	0	0%	0	0	1	1
Thembalethu PS A				0	0	0%	0	0	0%	0	0	0%	0	0	1	1
Thembalethu PS 1				0	0	0%	0	0	0%	0	0	0%	0	0	2	2
Thembalethu PS 7				0	3	0%	0	3	0%	0	3	0%	0	0	33	33
Destiny Africa PS				2 001	1 600	80%	2 225	1 714	77%	11 605	8 980	77%	7 381	2 300	1	4
Thembalethu Ext.12A PS				0	0	0%	0	0	0%	2 192	2 000	91%	2 000	361	0	6
Thembalethu Ext.11B PS				0	0	0%	0	0	0%	2 328	2 131	92%	2 131	417	0	5
Thembalethu PS 6				4 520	3 648	81%	4 938	3 889	79%	17 131	13 645	80%	9 997	3 002	1	5
Le Grand PS 1				45	46	101%	202	127	63%	202	127	63%	81	21	2	6
Le Grand PS 2				61	66	108%	271	176	65%	271	176	65%	110	31	2	6
Le Grand1 PS				0	0	0%	0	0	0%	170	99	58%	99	79	0	1
Le Grand2 PS F1				0	0	0%	0	0	0%	109	68	62%	68	55	0	1

Le Grand2 PS F2				0	0	0%	0	0	0%	483	362	75%	362	97	0	4
Le Grand PS				61	66	108%	271	176	65%	1 033	705	68%	639	263	0	3
Hansmoeskraal5 PS 1				0	0	0%	0	0	0%	359	238	66%	238	225	0	1
Hansmoeskraal5 PS 2				0	0	0%	0	0	0%	443	327	74%	327	104	0	3
Hansmoeskraal1 PS				0	0	0%	0	0	0%	0	0	0%	0	21	0	0
Hansmoeskraal2 PS				0	0	0%	0	0	0%	1 946	1 500	77%	1 500	500	0	3
Pacaltsdorp PS 6				0	0	0%	0	0	0%	0	0	0%	0	0	1	1
Hansmoeskraal4 PS				0	0	0%	0	0	0%	652	427	66%	427	293	0	1
Pacaltsdorp PS 3				1 316	1 242	94%	1 740	1 489	86%	8 720	6 914	79%	5 673	1 566	1	4
Pacaltsdorp PS 2				0	0	0%	0	0	0%	0	0	0%	0	0	0	0
Pacaltsdorp PS 4				0	0	0%	0	0	0%	0	0	0%	0	0	1	1
Rosedale PS 1				0	0	0%	0	0	0%	0	0	0%	0	0	1	1
Pacaltsdorp PS 1				8 293	7 060	85%	9 578	7 836	82%	30 904	24 737	80%	17 678	5 199	1	5
Tamsui PS				0	5	0%	0	5	0%	0	5	0%	0	1	5	5
Rosedale PS 2				0	0	0%	0	0	0%	0	0	0%	0	0	5	5
Pacaltsdorp Ext.3A PS				1 799	1 229	68%	1 868	1 269	68%	2 880	2 015	70%	786	274	4	7
Sludge PS				0	1 950	0%	0	1 950	0%	0	1 950	0%	0	5	426	426

Master Plan Item Table

Note: Costs include P&G's, Contingencies & Fees exclude EIA studies, registration of servitudes and/or land acquisition, protection, monitoring and VAT.

Type	Item	Project	Year	Description	Existing Nom Diam (mm)	Existing Min Slope (%)	Total Length (m)	Design Flow (L/s)	Comment	Name	Par Pipe Nom Diam (mm)	Par Pipe Cost Inc. (R)	New Pipe Nom Diam (mm)	New Pipe Cost Inc. (R)	Other Cost Desc.	Other Cost Inc. (R)	Extra Cost Inc. (R)	Total Cost Inc. (R)
MP	OT_24.01a	BLK_OT_001	2038	Upgrade existing Flow Diversion				1 540.5	Inlet Works	Future Outeniqua WWTW		0		0	Diversion: (Max. Size: 999mm)	825 000	0	825 000
MP	OT_24.01c	BLK_OT_001	2038	New Treatment Plant				10 000.0		Outeniqua WWTW		0		0	Treatment Plant	231 500 000	0	231 500 000
MP	OT_24.01b	BLK_OT_002	2038	New Gravity	0	0.0	19.6	338.4			0	0	525	147 000		0	81 000	228 000
MP	OT_24.02a	BLK_OT_002	2053	New Gravity	0	0.0	20.2	338.4			0	0	525	151 000		0	81 000	232 000
MP	OT_24.02b	BLK_OT_002	2053	New Treatment Plant				10 000.0		Outeniqua WWTW		0		0	Treatment Plant	231 500 000	0	231 500 000
MP	OT_03.01	BLK_OT_005	2023	Upgrade existing Pump Station				468.7	Upgrade existing pump flow	Meul PS		0		0	Pump(s) only	9 640 000	0	9 640 000
MPi	OT_03.02	BLK_OT_005	2023	Upgrade existing Rising (Investigate first)	450		483.1	468.7	Investigate (high flow velocity)	Meul PS	400	3 775 000	650	7 437 000	Investigate	0	904 000	8 341 000
MPi	OT_09.01	BLK_OT_006	2023	Upgrade existing Gravity (Investigate first)	700	0.0	17.7	475.4	Not required (SWMM)		750	264 000	1 000	384 000	Investigate	0	334 000	718 000
MPi	OT_09.02	BLK_OT_006	2023	Upgrade existing Gravity (Investigate first)	700	0.0	25.5	476.0	Not required (SWMM)		900	497 000	1 000	555 000	Investigate	0	334 000	889 000
MPi	OT_09.04	BLK_OT_006	2033	Upgrade existing Gravity (Investigate first)	700	0.0	259.8	483.5	Not required (SWMM)		450	2 110 000	825	4 395 000	Investigate	0	244 000	4 638 000
MPi	OT_09.03	BLK_OT_007	2023	Upgrade existing Gravity (Investigate first)	600	0.0	13.9	498.1			750	207 000	900	270 000	Investigate	0	283 000	553 000
MP	OT_10.01	BLK_OT_008	2023	Upgrade existing Pump Station				590.7	Upgrade existing pump flow	Schaapkop PS		0		0	Pump(s) only	11 055 000	0	11 055 000
MP	OT_10.02	BLK_OT_008	2023	Upgrade existing Rising	500		154.0	590.7	River crossing (major 20m)	Schaapkop PS	450	2 321 000	650	3 556 000		0	900 000	4 456 000
MPi	OT_10.03	BLK_OT_009	2023	Upgrade existing Gravity (Investigate first)	999	0.0	315.3	591.7	Investigate (locality)		0	0	1 000	0	No Standard Cost	0	0	0
MPi	OT_10.04	BLK_OT_009	2023	Upgrade existing Gravity (Investigate first)	999	0.0	31.8	837.1	Investigate (locality)		0	0	1 000	0	No Standard Cost	0	0	0
MPi	OT_10.05	BLK_OT_009	2023	Upgrade existing Gravity (Investigate first)	999	0.0	8.2	1 536.1	Investigate (locality)		0	0	1 000	0	No Standard Cost	0	0	0
MPi	OT_10.06	BLK_OT_009	2023	Upgrade existing Gravity (Investigate first)	999	0.0	3.7	698.9	Investigate (locality)		0	0	1 000	0	No Standard Cost	0	0	0
MPi	OT_60.01	BLK_OT_010	2028	Upgrade existing Gravity (Investigate first)	250	0.0	864.2	338.2			525	6 460 000	525	6 460 000	Investigate	0	166 000	6 625 000
MPi	OT_60.02	BLK_OT_010	2028	Upgrade existing Gravity (Investigate first)	315	0.0	1 351.6	357.9			675	14 883 000	675	14 883 000	Investigate	0	202 000	15 085 000
MPi	OT_60.03	BLK_OT_010	2028	Upgrade existing Gravity (Investigate first)	315	0.0	7.3	357.9			450	48 000	525	55 000	Investigate	0	166 000	221 000
MPi	OT_60.04	BLK_OT_010	2028	Upgrade existing Gravity (Investigate first)	315	0.0	15.7	494.4			750	235 000	750	235 000	Investigate	0	223 000	457 000
MPi	OT_61.01	BLK_OT_011	2028	Upgrade existing Pump Station (Investigate first)				494.7	Upgrade existing pump station (Investigate flow)	Thembalethu PS 6		0		0	Pump Station Investigate	20 543 000	30 000	20 573 000
MPi	OT_61.02a	BLK_OT_011	2028	Upgrade existing Rising (Investigate first)	250		350.1	494.7	Investigate (locality)	Thembalethu PS 6	600	4 601 000	650	5 390 000	Investigate	0	904 000	6 294 000
MPi	OT_61.02b	BLK_OT_011	2028	Upgrade existing Rising (Investigate first)	250		30.1	494.7	Investigate (locality)	Thembalethu PS 6	600	396 000	650	464 000	Investigate	0	904 000	1 368 000

MPi	OT_61.02c	BLK_OT_011	2028	Upgrade existing Rising (Investigate first)	250		329.1	494.7	Investigate (locality)	Thembalethu PS 6	600	4 325 000	650	5 067 000	Investigate	0	904 000	5 970 000
MP	OT_37.01	BLK_OT_012	2068	Upgrade existing Gravity	700	0.0	18.0	502.3			600	192 000	900	350 000		0	279 000	629 000
MP	OT_37.02	BLK_OT_012	2068	Upgrade existing Gravity	700	0.0	56.0	503.4			750	835 000	900	1 089 000		0	279 000	1 368 000
MP	OT_37.03	BLK_OT_012	2068	Upgrade existing Gravity	700	0.0	54.2	502.3			525	496 000	825	917 000		0	240 000	1 157 000
MP	OT_37.04	BLK_OT_012	2068	Upgrade existing Gravity	315	0.1	7.6	494.7			355	48 000	450	62 000		0	147 000	209 000
MP	OT_20.01	BLK_OT_013	2063	Upgrade existing Pump Station				873.6	Upgrade existing pump flow	Pacaltsdorp PS 1		0		0	Pump(s) only	14 740 000	0	14 740 000
MP	OT_20.02	BLK_OT_013	2068	Upgrade existing Rising	400		3.9	873.6		Pacaltsdorp PS 1	700	67 000	800	87 000		0	1 191 000	1 278 000
MP	OT_20.03	BLK_OT_013	2068	Upgrade existing Rising	500		11.9	873.7		Pacaltsdorp PS 1	650	183 000	800	262 000		0	1 191 000	1 453 000
MP	OT_20.04	BLK_OT_013	2068	Upgrade existing Rising	500		1.7	698.9		Pacaltsdorp PS 1	550	21 000	750	35 000		0	1 128 000	1 163 000
MPi	OT_16.02	BLK_OT_014	2028	Upgrade existing Gravity (Investigate first)	450	0.0	70.3	244.6			525	526 000	675	775 000	Investigate	0	202 000	976 000
MP	OT_17.01	BLK_OT_015	2028	Upgrade existing Pump Station				244.8	Upgrade existing pump station (Complete)	Pacaltsdorp PS 3		0		0	Pump(s) only	6 646 000	0	6 646 000
MP	OT_17.02	BLK_OT_015	2028	Upgrade existing Rising	225		1 662.6	244.8		Pacaltsdorp PS 3	400	10 709 000	450	14 293 000		0	474 000	14 767 000
MP	OT_19.01	BLK_OT_016	2023	Upgrade existing Flow Diversion				244.9	Investigate	Bougainvillea St		0		0	No Standard Cost	0	0	0
MPi	OT_19.02	BLK_OT_016	2023	Upgrade existing Gravity (Investigate first)	250	0.0	96.3	244.9			600	857 000	600	857 000	Investigate	0	181 000	1 037 000
MP	OT_19.03	BLK_OT_016	2043	Upgrade existing Gravity	250	0.0	3.5	245.6			315	15 000	355	18 000		0	129 000	147 000
MP	OT_19.04	BLK_OT_016	2023	Upgrade existing Gravity	800	0.0	285.7	873.6			400	1 984 000	900	5 558 000		0	279 000	5 837 000
FM	OT_F32.01	BLK_OT_017	2033	New Gravity	0	0.0	217.3	93.2			0	0	315	930 000		0	62 000	992 000
FM	OT_F32.02	BLK_OT_017	2033	New Gravity	0	0.1	611.8	94.6			0	0	200	1 783 000		0	56 000	1 838 000
FM	OT_F32.03	BLK_OT_018	2028	New Gravity	0	0.0	250.3	157.7			0	0	315	1 071 000		0	62 000	1 133 000
FM	OT_F32.04	BLK_OT_018	2028	New Gravity	0	0.1	71.3	207.8			0	0	315	306 000		0	62 000	367 000
FM	OT_F35.01	BLK_OT_019	2028	New Pump Station				207.8	New pump station	Kraaibosch4 PS		0		0	Pump Station	14 168 000	0	14 168 000
FM	OT_F35.02	BLK_OT_019	2028	New Rising	0		1 441.7	207.8		Kraaibosch4 PS	0	0	450	12 394 000		0	237 000	12 631 000
FM	OT_F36.01	BLK_OT_020	2028	New Gravity	0	0.1	213.9	210.5			0	0	315	915 000		0	62 000	977 000
FM	OT_F36.02	BLK_OT_020	2028	New Gravity	0	0.0	212.4	257.8	River Rail road crossing		0	0	525	4 763 000		0	81 000	4 844 000
FM	OT_F36.03	BLK_OT_020	2028	New Gravity	0	0.3	19.2	336.1			0	0	315	82 000		0	62 000	144 000
FM	OT_F37.01	BLK_OT_021	2028	New Pump Station				336.1	New pump station	Destiny Africa PS		0		0	Pump Station	18 685 000	0	18 685 000
FM	OT_F37.02	BLK_OT_021	2028	New Rising	0		1 213.8	336.1		Destiny Africa PS	0	0	550	12 769 000		0	333 000	13 102 000
MPa	OT_22.01	RET_GW_063	2043	Abandon existing Pump Station				0.0	Abandon existing pump station (Investigate flow)	Pacaltsdorp PS 2		0		0	Abandon	287 000	0	287 000
MPa	OT_22.02	RET_GW_063	2043	Abandon existing Rising	160		2 105.8	0.0	Abandoned	Pacaltsdorp PS 2	0	0	160	0	Abandon	10 000	0	10 000
MPa	GW_35.01	RET_GW_071	2028	Abandon existing Pump Station				0.0	Abandon existing pump station	Pacaltsdorp PS 4		0		0	Abandon	287 000	0	287 000
MPa	GW_35.02	RET_GW_071	2028	Abandon existing Rising	200		2 023.1	0.0	Abandoned	Pacaltsdorp PS 4	0	0	250	0	Abandon	10 000	0	10 000
MPa	GW_35.03	RET_GW_071	2028	Abandon existing Gravity	200	0.0	5.0	0.0	Abandoned		0	0	250	0	Abandon	10 000	0	10 000
FA	GW_F74.01	RET_GW_107	2028	New Flow Diversion (Alternative)				590.8	New interim pump (Design Flow = 80 L/s)	Future Schaapkop (Interim)		0		0	No Standard Cost	0	0	0

MP	GW_58.01	RET_GW_111	2033	Upgrade existing Flow Diversion				50.4	Divert flow			0		0	No Standard Cost	0	0	0
MP	GW_58.02	RET_GW_111	2033	New Gravity	450	0.0	79.3	50.5			0	0	450	521 000		0	74 000	595 000
MPa	GW_58.03	RET_GW_111	2033	Abandon existing Gravity	450	0.0	158.5	0.0	Abandoned		0	0	525	0	Abandon	59 000	0	59 000
MPp	GW_58.04	RET_GW_111	2023	New Gravity (In progress)	0	0.0	6.7	1.1	Under construction		0	0	160	0	No Standard Cost	0	0	0
MPp	GW_58.05	RET_GW_111	2023	New Gravity (In progress)	0	0.0	105.0	51.6	Under construction		0	0	525	0	No Standard Cost	0	0	0
MPi	OT_02.01	RET_OT_001	2033	Upgrade existing Pump Station (Investigate first)				126.8	Upgrade existing pump flow (Investigate flow)	Glenwood PS		0		0	Pump(s) only Investigate	4 086 000	30 000	4 116 000
MPi	OT_02.02	RET_OT_001	2033	Upgrade existing Rising (Investigate first)	250		1 399.0	126.8		Glenwood PS	200	3 190 000	355	7 383 000	Investigate	0	292 000	7 675 000
MPi	OT_65.00	RET_OT_001	2033	Upgrade existing Gravity (Investigate first)	200	0.0	7.8	112.5			400	44 000	450	52 000	Investigate	0	151 000	202 000
FA	GW_F58.01	RET_OT_002	2023	New Flow Diversion (Alternative)				4.6	Operational problems	Future Rooibekkie St (Alternative)		0		0	No Standard Cost	0	0	0
FA	GW_F58.02	RET_OT_002	2023	New Gravity (Alternative)	0	0.1	73.0	0.0	Operational problems		0	0	160	0	No Standard Cost	0	0	0
FA	GW_F57.01	RET_OT_003	2023	New Flow Diversion (Alternative)				5.1	Operational problems	Future co Lamprecht St KamassieSt (Alternative)		0		0	No Standard Cost	0	0	0
FA	GW_F57.02	RET_OT_003	2023	New Gravity (Alternative)	0	0.1	41.2	0.0	Operational problems		0	0	160	0	No Standard Cost	0	0	0
FA	GW_F57.03	RET_OT_003	2023	New Gravity (Alternative)	0	0.1	194.4	0.0	Operational problems		0	0	160	0	No Standard Cost	0	0	0
MPi	OT_42.00	RET_OT_004	2023	Upgrade existing Gravity (Investigate first)	149	0.0	172.3	0.1	Investigate (locality)		0	0	160	0	No Standard Cost	0	0	0
MPi	OT_41.00	RET_OT_005	2028	Upgrade existing Gravity (Investigate first)	99	0.0	35.4	0.2	Investigate (locality)		0	0	110	0	No Standard Cost	0	0	0
MPi	OT_40.01	RET_OT_006	2023	Upgrade existing Gravity (Investigate first)	149	0.0	33.1	17.8	Investigate (locality)		160	85 000	200	97 000	Investigate	0	115 000	211 000
MPi	OT_40.02	RET_OT_006	2023	Upgrade existing Gravity (Investigate first)	149	0.0	502.0	40.7	Investigate (locality)		200	2 014 000	355	3 123 000	Investigate	0	133 000	3 256 000
MPi	OT_40.03	RET_OT_006	2023	Upgrade existing Gravity (Investigate first)	160	0.0	287.3	15.6	Investigate (locality)		110	903 000	315	1 590 000	Investigate	0	127 000	1 716 000
MPi	OT_23.01	RET_OT_007	2033	Upgrade existing Gravity (Investigate first)	200	0.0	216.9	21.5			200	632 000	250	751 000	Investigate	0	121 000	872 000
MPs	OT_23.02	RET_OT_008	2023	Investigate existing Rising	200		1 609.9	37.0	Investigate (diameter)	Welgelegen PS	0	0	200	0	No Standard Cost	0	0	0
MPi	OT_34.02	RET_OT_009	2023	Upgrade existing Gravity (Investigate first)	315	0.0	63.7	17.0	Investigate (full flow velocity)		1 200	1 447 000	1 200	1 447 000	Investigate	0	457 000	1 903 000
MPi	OT_34.03	RET_OT_009	2033	Upgrade existing Gravity (Investigate first)	315	0.0	41.8	89.9			0	0	450	275 000	Investigate	0	151 000	425 000
MP	OT_35.01	RET_OT_010	2038	Upgrade existing Pump Station				95.7	Upgrade existing pump flow - Alternative (Design flow + 100 l/s)	Kraaibosch PS		0		0	No Standard Cost	0	0	0
MP	OT_47.01	RET_OT_011	2023	Upgrade existing Pump Station				7.7	Upgrade existing pump flow	Blue Mountain PS 1		0		0	Pump(s) only	1 300 000	0	1 300 000
FA	OT_47.03	RET_OT_011	2023	New Rising (Alternative)	0		160.9	0.0	Alternative (Design Flow = 12 L/s, divert flow)	Blue Mountain PS 1	0	0	110	0	No Standard Cost	0	0	0
MP	OT_26.01	RET_OT_012	2023	Upgrade existing Pump Station				7.9	Upgrade existing pump flow	Blue Mountain PS 2		0		0	Pump(s) only	1 305 000	0	1 305 000
MP	GW_51.02	RET_OT_014	2028	Upgrade existing Gravity	160	0.0	42.2	21.0			110	92 000	200	123 000		0	111 000	234 000
MP	GW_51.04	RET_OT_014	2028	Upgrade existing Gravity	150	0.0	75.1	24.1			110	163 000	200	219 000		0	111 000	330 000

FM	OT_F106.01	RET_OT_015	2028	New Flow Diversion				9.2	Abandoned PS	Future Bos-en-Dal PS (Abandon)		0		0	No Standard Cost	0	0	0
FM	OT_F106.02	RET_OT_015	2028	New Gravity	0	0.0	45.7	9.2			0	0	160	95 000		0	54 000	149 000
FM	OT_F106.03	RET_OT_015	2028	New Gravity	0	0.0	18.7	9.2	Rail road crossing		0	0	160	116 000		0	54 000	170 000
FM	OT_F106.04	RET_OT_015	2028	New Gravity	0	0.0	300.3	9.2			0	0	160	620 000		0	54 000	674 000
FM	OT_F106.05	RET_OT_015	2028	New Gravity	0	0.0	368.0	9.9			0	0	160	760 000		0	54 000	814 000
FM	OT_F106.06	RET_OT_015	2028	New Gravity	0	0.0	108.1	10.6			0	0	160	224 000		0	54 000	278 000
FM	OT_F101.01	RET_OT_017	2038	New Flow Diversion				37.3	Abandoned PS	Future Tamsui PS (Abandon)		0		0	No Standard Cost	0	0	0
FM	OT_F101.02	RET_OT_017	2038	New Gravity	0	0.0	544.6	37.3			0	0	315	1 918 000		0	62 000	1 979 000
FM	OT_F101.03	RET_OT_017	2038	New Gravity	0	0.0	96.5	37.3	Road crossing (major)		0	0	315	1 020 000		0	62 000	1 081 000
FM	OT_F101.04	RET_OT_017	2038	New Gravity	0	0.0	234.7	37.4			0	0	315	827 000		0	62 000	888 000
FM	OT_F101.06	RET_OT_018	2038	New Gravity	0	0.0	330.5	43.2			0	0	315	1 164 000		0	62 000	1 225 000
FM	OT_F102.01	RET_OT_018	2038	New Flow Diversion				6.3	Abandoned PS	Future Rosedale PS 2 (Abandon)		0		0	No Standard Cost	0	0	0
FM	OT_F102.02	RET_OT_018	2038	New Gravity	0	0.1	46.3	6.3			0	0	160	96 000		0	54 000	150 000
FM	OT_F101.07	RET_OT_019	2038	New Gravity	0	0.0	745.1	47.9			0	0	315	2 624 000		0	62 000	2 685 000
FM	OT_F101.08	RET_OT_019	2038	New Gravity	0	0.0	8.5	50.5			0	0	315	31 000		0	62 000	92 000
FM	OT_F18.01	RET_OT_020	2033	New Pump Station				70.7	New pump station	Pacaltsdorp Ext.3A PS		0		0	Pump Station	6 854 000	0	6 854 000
FM	OT_F18.02	RET_OT_020	2038	New Rising	0		276.2	70.7		Pacaltsdorp Ext.3A PS	0	0	250	660 000		0	44 000	704 000
MPa	OT_46.01	RET_OT_021	2023	Abandon existing Pump Station				0.0	Abandon existing pump station (Investigate flow)	Tamsui PS		0		0	Abandon	287 000	0	287 000
MPa	OT_46.02	RET_OT_021	2023	Abandon existing Rising	199		451.1	0.0	Abandoned - Investigate (locality)	Tamsui PS	0	0	250	0	Abandon	30 000	0	30 000
MPa	OT_46.04	RET_OT_021	2038	Abandon existing Gravity	250	0.0	436.5	0.1	Abandoned		0	0	315	0	Abandon	98 000	0	98 000
MPa	OT_43.01	RET_OT_022	2033	Abandon existing Pump Station				0.0	Abandon existing pump station	Rosedale PS 2		0		0	Abandon	287 000	0	287 000
MPa	OT_43.02	RET_OT_022	2038	Abandon existing Rising	110		162.7	0.0	Abandoned	Rosedale PS 2	0	0	110	0	Abandon	10 000	0	10 000
MPa	OT_43.03	RET_OT_022	2038	Abandon existing Gravity	149	0.0	27.2	0.0	Abandoned - Investigate (locality)		0	0	160	0	Abandon	10 000	0	10 000
MPa	OT_43.04	RET_OT_022	2038	Abandon existing Gravity	200	0.0	32.1	0.0	Abandoned		0	0	200	0	Abandon	30 000	0	30 000
MPa	OT_43.05	RET_OT_022	2033	Abandon existing Conservancy Tank				-60.0	Abandon existing storage dam	Rosedale PS 2 CT		0		0	Abandon	0	0	0
FM	OT_F16.01	RET_OT_023	2023	New Gravity	0	0.0	123.2	2.5			0	0	160	255 000		0	54 000	309 000
MPa	OT_F65.01	RET_OT_023	2023	Abandon existing Flow Diversion				1.8	Abandoned PS	Future Rosedale PS 1 (Abandon)		0		0	No Standard Cost	0	0	0
FM	OT_F65.02	RET_OT_023	2023	New Gravity	0	0.0	153.2	1.8	Alternative		0	0	160	317 000		0	54 000	371 000
FM	OT_F103.01	RET_OT_024	2038	New Gravity	0	0.0	129.4	2.5			0	0	160	268 000		0	54 000	322 000
MPa	OT_52.01	RET_OT_026	2023	Abandon existing Pump Station				0.0	Abandon existing pump station	Rosedale PS 1		0		0	Abandon	287 000	0	287 000
MPa	OT_52.02	RET_OT_026	2023	Abandon existing Rising	110		742.4	0.0	Abandoned	Rosedale PS 1	0	0	110	0	Abandon	10 000	0	10 000
MPa	OT_52.03	RET_OT_026	2023	Abandon existing Gravity	200	0.3	5.0	0.0	Abandoned		0	0	200	0	Abandon	10 000	0	10 000
FM	OT_F93.01	RET_OT_028	2028	New Flow Diversion				1.5	Abandoned PS	Future Parkdene PS 3 (Abandon)		0		0	No Standard Cost	0	0	0
FM	OT_F93.02a	RET_OT_028	2028	New Gravity	0	0.0	55.3	1.5			0	0	160	115 000		0	54 000	169 000

FM	OT_F93.02b	RET_OT_028	2028	New Gravity	0	0.0	88.9	1.5	Road crossing (major)		0	0	160	551 000		0	54 000	605 000
MPa	OT_51.01	RET_OT_029	2028	Abandon existing Pump Station				0.0	Abandon existing pump station	Parkdene PS 3		0		0	Abandon	287 000	0	287 000
MPa	OT_51.02	RET_OT_029	2028	Abandon existing Rising	150		150.5	0.0	Abandoned	Parkdene PS 3	0	0	200	0	Abandon	10 000	0	10 000
MPa	OT_51.03	RET_OT_029	2028	Abandon existing Gravity	150	0.0	11.7	0.0	Abandoned		0	0	160	0	Abandon	10 000	0	10 000
FM	OT_F92.01	RET_OT_030	2028	New Flow Diversion				1.5	Abandoned PS	Future Parkdene PS 2 (Abandon)		0		0	No Standard Cost	0	0	0
FM	OT_F92.02a	RET_OT_030	2028	New Gravity	0	0.1	35.1	1.5			0	0	160	73 000		0	54 000	127 000
FM	OT_F92.02b	RET_OT_030	2028	New Gravity	0	0.1	95.0	1.5	Road crossing (major)		0	0	160	588 000		0	54 000	642 000
FM	OT_F92.03	RET_OT_030	2028	New Gravity	0	0.1	156.4	2.5			0	0	160	323 000		0	54 000	377 000
MPa	OT_50.01	RET_OT_031	2028	Abandon existing Pump Station				0.0	Abandon existing pump station	Parkdene PS 2		0		0	Abandon	287 000	0	287 000
MPa	OT_50.02	RET_OT_031	2028	Abandon existing Rising	150		226.5	0.0	Abandoned	Parkdene PS 2	0	0	200	0	Abandon	10 000	0	10 000
MPa	OT_50.03	RET_OT_031	2028	Abandon existing Gravity	150	0.0	11.4	0.0	Abandoned		0	0	160	0	Abandon	10 000	0	10 000
MPi	OT_57.01a	RET_OT_032	2028	Upgrade existing Gravity (Investigate first)	150	0.0	33.5	15.1	Investigate (full flow velocity)		160	86 000	200	98 000	Investigate	0	115 000	213 000
MP	OT_57.01b	RET_OT_032	2028	Upgrade existing Gravity	150	0.0	46.6	15.1	Investigate (full flow velocity)		0	0	160	120 000		0	108 000	228 000
MPi	OT_58.02	RET_OT_032	2023	Upgrade existing Gravity (Investigate first)	200	0.0	46.6	22.9	Investigate (full flow velocity)		450	307 000	450	307 000	Investigate	0	151 000	458 000
MP	OT_58.03	RET_OT_032	2023	Upgrade existing Gravity	200	0.0	79.1	26.8			250	274 000	315	339 000		0	123 000	462 000
FM	OT_F91.01	RET_OT_034	2028	New Flow Diversion				2.8	Abandoned PS	Future Parkdene PS 1 (Abandon)		0		0	No Standard Cost	0	0	0
FM	OT_F91.02a	RET_OT_034	2028	New Gravity	0	0.0	108.9	2.8			0	0	160	225 000		0	54 000	279 000
FM	OT_F91.02b	RET_OT_034	2028	New Gravity	0	0.0	79.3	2.8	Road crossing (major)		0	0	160	492 000		0	54 000	546 000
FM	OT_F91.03	RET_OT_034	2028	New Gravity	0	0.0	963.3	3.9			0	0	160	1 989 000		0	54 000	2 043 000
MPa	OT_49.01	RET_OT_035	2028	Abandon existing Pump Station				0.0	Abandon existing pump station	Parkdene PS 1		0		0	Abandon	287 000	0	287 000
MPa	OT_49.02	RET_OT_035	2028	Abandon existing Rising	150		175.2	0.0	Abandoned	Parkdene PS 1	0	0	200	0	Abandon	10 000	0	10 000
MPa	OT_49.03	RET_OT_035	2028	Abandon existing Gravity	150	0.0	8.8	0.0	Abandoned		0	0	160	0	Abandon	10 000	0	10 000
MPa	OT_F94.01	RET_OT_036	2028	Abandon existing Flow Diversion				35.6	Abandoned PS	Future Thembalethu PS 1 (Abandon)		0		0	No Standard Cost	0	0	0
FM	OT_F94.02	RET_OT_036	2028	New Gravity	0	0.0	513.0	35.6			0	0	200	1 209 000		0	56 000	1 265 000
FM	OT_F94.03	RET_OT_037	2028	New Gravity	0	0.0	514.9	35.9			0	0	250	1 453 000		0	59 000	1 512 000
FM	OT_F95.01	RET_OT_037	2028	Upgrade Manhole				0.0				0		0	Manhole	0	0	0
FM	OT_F95.02	RET_OT_037	2028	New Gravity	0	0.1	8.2	0.1			0	0	160	18 000		0	54 000	72 000
FM	OT_F94.04	RET_OT_038	2028	New Gravity	0	0.0	210.8	36.2			0	0	250	595 000		0	59 000	654 000
FM	OT_F96.01	RET_OT_038	2028	Upgrade Manhole				0.0				0		0	Manhole	0	0	0
FM	OT_F96.02	RET_OT_038	2028	New Gravity	0	0.2	23.2	0.1			0	0	160	48 000		0	54 000	102 000
FM	OT_F94.05	RET_OT_039	2028	New Gravity	0	0.0	1 630.2	52.8			0	0	315	5 740 000		0	62 000	5 801 000
FM	OT_F97.01	RET_OT_039	2028	Upgrade Manhole				0.0				0		0	Manhole	0	0	0
FM	OT_F97.02	RET_OT_039	2028	New Gravity	0	0.3	24.2	16.2			0	0	160	50 000		0	54 000	104 000

MPa	OT_27.01	RET_OT_040	2028	Abandon existing Pump Station				0.0	Abandon existing pump station (Investigate flow)	Thembalethu PS 1		0		0	Abandon	287 000	0	287 000
MPa	OT_27.02	RET_OT_040	2028	Abandon existing Rising	200		866.9	0.0	Abandoned	Thembalethu PS 1	0	0	250	0	Abandon	10 000	0	10 000
MPa	OT_27.03	RET_OT_040	2028	Abandon existing Gravity	200	0.0	17.3	0.0	Abandoned		0	0	250	0	Abandon	10 000	0	10 000
MPa	OT_39.01	RET_OT_041	2028	Abandon existing Pump Station				0.0	Abandon existing pump station (Investigate flow)	Thembalethu PS A		0		0	Abandon	287 000	0	287 000
MPa	OT_39.02	RET_OT_041	2028	Abandon existing Rising	79		90.0	0.0	Abandoned - Investigate (locality)	Thembalethu PS A	0	0	90	0	Abandon	10 000	0	10 000
MPa	OT_39.03	RET_OT_041	2028	Abandon existing Gravity	99	0.0	16.4	0.0	Abandoned - Investigate (locality)		0	0	110	0	No Standard Cost	0	0	0
MPi	OT_39.04	RET_OT_042	2023	Upgrade existing Gravity (Investigate first)	99	0.0	76.7	0.0	Investigate (locality)		0	0	110	0	No Standard Cost	0	0	0
MPi	OT_39.05	RET_OT_042	2023	Upgrade existing Gravity (Investigate first)	99	0.0	84.9	0.1	Investigate (locality)		0	0	110	0	No Standard Cost	0	0	0
MPa	OT_38.01	RET_OT_043	2028	Abandon existing Pump Station				0.0	Abandon existing pump station (Investigate flow)	Thembalethu PS B		0		0	Abandon	287 000	0	287 000
MPa	OT_38.02	RET_OT_043	2028	Abandon existing Rising	79		98.1	0.0	Abandoned - Investigate (locality)	Thembalethu PS B	0	0	90	0	Abandon	10 000	0	10 000
MPa	OT_38.03	RET_OT_043	2028	Abandon existing Gravity	99	0.0	13.3	0.0	Abandoned - Investigate (locality)		0	0	110	0	No Standard Cost	0	0	0
MPi	OT_38.04	RET_OT_044	2023	Upgrade existing Gravity (Investigate first)	99	0.0	94.4	0.1	Investigate (locality)		0	0	110	0	No Standard Cost	0	0	0
MPi	OT_38.05	RET_OT_044	2023	Upgrade existing Gravity (Investigate first)	99	0.0	73.9	0.1	Investigate (locality)		0	0	110	0	No Standard Cost	0	0	0
MPa	OT_07.01	RET_OT_045	2028	Abandon existing Pump Station				0.0	Abandon existing pump station	Thembalethu PS 2		0		0	Abandon	287 000	0	287 000
MPa	OT_07.02	RET_OT_045	2028	Abandon existing Rising	150		84.0	0.0	Abandoned	Thembalethu PS 2	0	0	200	0	Abandon	10 000	0	10 000
MPa	OT_F97.03	RET_OT_045	2028	Abandon existing Gravity	250	0.0	9.4	0.0	Abandoned		0	0	250	0	Abandon	10 000	0	10 000
MPi	OT_12.01	RET_OT_047	2023	Upgrade existing Gravity (Investigate first)	100	0.0	43.6	2.6	Investigate (full flow velocity)		600	388 000	600	388 000	Investigate	0	181 000	568 000
MPi	OT_12.03	RET_OT_047	2023	Upgrade existing Gravity (Investigate first)	100	0.0	86.0	4.4	Investigate (full flow velocity)		0	0	110	187 000	Investigate	0	109 000	296 000
MPi	OT_30.01	RET_OT_048	2023	Upgrade existing Gravity (Investigate first)	160	0.0	157.9	0.1	Investigate (AB status)		0	0	160	0	No Standard Cost	0	0	0
MPi	OT_30.02	RET_OT_048	2023	Upgrade existing Gravity (Investigate first)	160	0.0	310.4	0.2	Investigate (AB status)		0	0	160	0	No Standard Cost	0	0	0
MPi	OT_30.03	RET_OT_048	2023	Upgrade existing Gravity (Investigate first)	160	0.0	222.7	0.0	Investigate (AB status)		0	0	160	0	No Standard Cost	0	0	0
MPi	OT_30.04	RET_OT_048	2023	Upgrade existing Gravity (Investigate first)	160	0.0	187.9	0.1	Investigate (AB status)		0	0	160	0	No Standard Cost	0	0	0
MPi	OT_30.05	RET_OT_048	2023	Upgrade existing Gravity (Investigate first)	160	0.0	37.3	0.0	Investigate (AB status)		0	0	160	0	No Standard Cost	0	0	0
MPi	OT_30.06	RET_OT_048	2023	Upgrade existing Gravity (Investigate first)	160	0.0	90.2	0.0	Investigate (AB status)		0	0	160	0	No Standard Cost	0	0	0
MPi	OT_30.07	RET_OT_048	2023	Upgrade existing Gravity (Investigate first)	160	0.0	135.1	0.0	Investigate (AB status)		0	0	160	0	No Standard Cost	0	0	0
MPi	OT_30.08	RET_OT_048	2023	Upgrade existing Gravity (Investigate first)	160	0.0	266.1	0.0	Investigate (AB status)		0	0	160	0	No Standard Cost	0	0	0
MPi	OT_30.09	RET_OT_048	2023	Upgrade existing Gravity (Investigate first)	160	0.0	56.4	0.0	Investigate (AB status)		0	0	160	0	No Standard Cost	0	0	0

MPi	OT_30.10	RET_OT_048	2023	Upgrade existing Gravity (Investigate first)	160	0.0	14.3	0.1	Investigate (AB status)		0	0	160	0	No Standard Cost	0	0	0
MPi	OT_30.11	RET_OT_048	2023	Upgrade existing Gravity (Investigate first)	160	0.0	370.6	0.2	Investigate (AB status)		0	0	160	0	No Standard Cost	0	0	0
MPi	OT_30.12	RET_OT_048	2023	Upgrade existing Gravity (Investigate first)	110	0.0	3.7	0.0	Investigate (AB status)		0	0	110	0	No Standard Cost	0	0	0
MPi	OT_30.13	RET_OT_048	2023	Upgrade existing Gravity (Investigate first)	110	0.0	1.9	0.0	Investigate (AB status)		0	0	110	0	No Standard Cost	0	0	0
MPi	OT_30.14	RET_OT_048	2023	Upgrade existing Gravity (Investigate first)	110	0.0	3.2	0.0	Investigate (AB status)		0	0	110	0	No Standard Cost	0	0	0
MPi	OT_30.15	RET_OT_048	2023	Upgrade existing Gravity (Investigate first)	110	0.0	3.3	0.0	Investigate (AB status)		0	0	110	0	No Standard Cost	0	0	0
MPi	OT_30.16	RET_OT_048	2023	Upgrade existing Gravity (Investigate first)	110	0.0	5.2	0.0	Investigate (AB status)		0	0	110	0	No Standard Cost	0	0	0
MPi	OT_30.17	RET_OT_048	2023	Upgrade existing Gravity (Investigate first)	110	0.0	3.4	0.0	Investigate (AB status)		0	0	110	0	No Standard Cost	0	0	0
MPi	OT_57.00	RET_OT_049	2023	Upgrade existing Gravity (Investigate first)	110	0.1	101.6	0.4	Investigate (locality)		0	0	110	0	No Standard Cost	0	0	0
MPi	OT_44.00	RET_OT_054	2023	Upgrade existing Gravity (Investigate first)	149	0.0	5.0	0.0	Investigate (locality)		0	0	160	0	No Standard Cost	0	0	0
FM	OT_F79.01	RET_OT_055	2023	New Flow Diversion				0.0	Abandoned PS	Future Pacaltsdorp PS 6 (Abandon)		0		0	No Standard Cost	0	0	0
FM	OT_F79.02	RET_OT_055	2023	New Gravity	0	0.0	210.9	0.0			0	0	160	436 000		0	54 000	490 000
MPa	OT_15.01	RET_OT_056	2023	Abandon existing Pump Station				0.0	Abandon existing pump station (Investigate flow)	Pacaltsdorp PS 6		0		0	Abandon	287 000	0	287 000
MPa	OT_15.02	RET_OT_056	2023	Abandon existing Rising	99		25.7	0.0	Abandoned	Pacaltsdorp PS 6	0	0	110	0	Abandon	10 000	0	10 000
MPa	OT_25.00	RET_OT_056	2023	Abandon existing Gravity	149	0.0	5.0	0.0	Abandoned - Investigate (locality)		0	0	160	0	Abandon	10 000	0	10 000
FM	OT_F55.01	RET_OT_057	2023	New Pump Station				37.3	New pumps	Le Grand PS		0		0	Pump(s) only	2 011 000	0	2 011 000
FM	OT_F55.02	RET_OT_057	2023	New Rising	0		2 282.6	37.3		Le Grand PS	0	0	200	4 749 000		0	29 000	4 778 000
FM	OT_F58.01	RET_OT_058	2023	New Gravity	0	0.1	288.0	53.1			0	0	200	679 000		0	56 000	735 000
FM	OT_F58.03	RET_OT_058	2023	New Gravity	0	0.0	213.6	22.9			0	0	250	603 000		0	59 000	662 000
FM	OT_F58.04	RET_OT_058	2023	New Gravity	0	0.0	228.5	28.2			0	0	250	645 000		0	59 000	704 000
MPi	OT_33.00	RET_OT_059	2023	Upgrade existing Gravity (Investigate first)	99	0.0	9.7	11.2			160	25 000	160	25 000	Investigate	0	112 000	137 000
FM	OT_F81.00	RET_OT_060	2023	New Gravity	0	0.0	356.2	1.4			0	0	160	736 000		0	54 000	790 000
FM	OT_F82.00	RET_OT_060	2023	New Gravity	0	0.2	107.2	1.3			0	0	160	222 000		0	54 000	276 000
FM	OT_F99.02	RET_OT_060	2023	New Gravity	0	0.0	611.3	5.4			0	0	160	1 262 000		0	54 000	1 316 000
FM	OT_F99.03	RET_OT_060	2023	New Gravity	0	0.0	266.2	6.8			0	0	160	550 000		0	54 000	604 000
FM	OT_F99.04	RET_OT_060	2023	New Gravity	0	0.1	185.1	8.8			0	0	160	383 000		0	54 000	437 000
FM	OT_F99.01	RET_OT_061	2033	New Gravity	0	0.0	578.6	2.0			0	0	160	1 195 000		0	54 000	1 249 000
MPa	OT_69.01	RET_OT_066	2023	Abandon existing Gravity	149	0.0	46.5	0.0	Abandoned		0	0	160	0	Abandon	10 000	0	10 000
MPa	OT_69.02a	RET_OT_066	2023	Abandon existing Gravity	150	0.0	49.1	0.0	Abandoned		0	0	160	0	Abandon	10 000	0	10 000
MPa	OT_69.02b	RET_OT_066	2023	Abandon existing Gravity	200	0.0	52.3	0.0	Abandoned		0	0	250	0	Abandon	10 000	0	10 000
MPa	OT_69.02c	RET_OT_066	2023	Abandon existing Gravity	200	0.0	51.6	0.0	Abandoned		0	0	250	0	Abandon	10 000	0	10 000
MPa	OT_69.02d	RET_OT_066	2023	Abandon existing Gravity	200	0.0	30.1	0.0	Abandoned		0	0	250	0	Abandon	10 000	0	10 000
FM	OT_F104.01a	RET_OT_066	2023	New Flow Diversion				1.1		Future Ikozi St (Abandon)		0		0	No Standard Cost	0	0	0
FM	OT_F104.01b	RET_OT_066	2023	New Flow Diversion				0.9		Future Kahle St (Abandon)		0		0	No Standard Cost	0	0	0
FM	OT_F104.01c	RET_OT_066	2023	New Flow Diversion				0.2		Future Siyabulela St (Abandon)		0		0	No Standard Cost	0	0	0

FM	OT_F104.01d	RET_OT_066	2023	New Flow Diversion				0.2		Future Eluxolweni St (Abandon)		0		0	No Standard Cost	0	0	0
FM	OT_F104.03a	RET_OT_066	2023	New Gravity	0	0.0	52.9	1.1			0	0	160	110 000		0	54 000	164 000
FM	OT_F104.03b	RET_OT_066	2023	New Gravity	0	0.0	24.1	2.1			0	0	160	50 000		0	54 000	104 000
FM	OT_F104.03d	RET_OT_066	2023	New Gravity	0	0.0	12.1	0.9			0	0	160	26 000		0	54 000	80 000
FM	OT_F104.03e	RET_OT_066	2023	New Gravity	0	0.0	32.9	0.2			0	0	160	68 000		0	54 000	122 000
FM	OT_F104.03f	RET_OT_066	2023	New Gravity	0	0.0	26.7	0.2			0	0	160	56 000		0	54 000	110 000
FM	OT_F104.03g	RET_OT_066	2023	New Gravity	0	0.0	74.1	0.0			0	0	160	153 000		0	54 000	207 000
FM	OT_F104.03h	RET_OT_066	2023	New Gravity	0	0.0	22.2	0.1			0	0	160	46 000		0	54 000	100 000
FM	OT_F87.01	RET_OT_067	2023	New Gravity	0	0.1	41.6	2.2			0	0	160	86 000		0	54 000	140 000
MPi	SV_08.01	RET_OT_068	2023	Upgrade existing Pump Station (Investigate first)				5.0	Investigate existing pump flow	Saasveld PS 3		0		0	Pump investigation only	0	30 000	30 000
MPi	SV_02.01	RET_OT_069	2023	Upgrade existing Pump Station (Investigate first)				5.2	Upgrade existing pump flow (Investigate flow)	Saasveld PS 4		0		0	Pump(s) only Investigate	1 238 000	30 000	1 268 000
MPi	SV_07.01	RET_OT_070	2023	Upgrade existing Pump Station (Investigate first)				5.0	Investigate existing pump flow	Saasveld PS 2		0		0	Pump investigation only	0	30 000	30 000
MPi	SV_06.01	RET_OT_071	2023	Upgrade existing Pump Station (Investigate first)				5.0	Investigate existing pump flow	Saasveld PS 1		0		0	Pump investigation only	0	30 000	30 000
MPi	SV_09.00	RET_OT_072	2023	Upgrade existing Gravity (Investigate first)	200	0.0	10.5	23.3			200	31 000	250	37 000	Investigate	0	121 000	157 000
MPi	OT_44.01	RET_OT_073	2023	Upgrade existing Gravity (Investigate first)	149	0.0	46.8	0.0	Investigate (locality)		0	0	160	0	No Standard Cost	0	0	0
MPi	OT_44.02	RET_OT_073	2023	Upgrade existing Gravity (Investigate first)	149	0.0	118.0	0.0	Investigate (locality)		0	0	160	0	No Standard Cost	0	0	0
MPi	OT_45.00	RET_OT_074	2023	Upgrade existing Gravity (Investigate first)	149	0.0	22.8	1.3	Investigate (locality)		0	0	160	0	No Standard Cost	0	0	0
FM	OT_F29.01	RET_OT_075	2028	New Pump Station				19.6	New pumps	Victoria Bay PS 2		0		0	Pump(s) only	1 587 000	0	1 587 000
FM	OT_F29.02a	RET_OT_075	2028	New Rising	0		680.2	19.6		Victoria Bay PS 2	0	0	140	967 000		0	17 000	983 000
FM	OT_F29.02b	RET_OT_075	2028	New Rising	0		21.3	19.6	Rail road crossing	Victoria Bay PS 2	0	0	140	91 000		0	17 000	108 000
FM	OT_F29.02c	RET_OT_075	2028	New Rising	0		724.0	19.6		Victoria Bay PS 2	0	0	140	1 029 000		0	17 000	1 045 000
MPs	OT_V01.01	RET_OT_076	2023	Investigate existing Gravity	110	0.0	11.6	0.3	Investigate (full flow velocity)		315	0	315	0	Investigate	0	4 000	4 000
MPs	OT_V01.02	RET_OT_076	2023	Investigate existing Gravity	150	0.0	9.5	0.3	Investigate (full flow velocity)		200	0	200	0	Investigate	0	4 000	4 000
MPs	OT_V01.03	RET_OT_076	2023	Investigate existing Gravity	150	0.0	64.4	0.1	Investigate (full flow velocity)		1 000	0	1 000	0	Investigate	0	4 000	4 000
MPs	OT_V01.04	RET_OT_076	2023	Investigate existing Gravity	150	0.0	31.7	0.1	Investigate (full flow velocity)		250	0	250	0	Investigate	0	4 000	4 000
MPs	OT_V01.05	RET_OT_076	2023	Investigate existing Gravity	150	0.0	41.2	0.1	Investigate (full flow velocity)		1 000	0	1 000	0	Investigate	0	4 000	4 000
MPs	OT_V01.06	RET_OT_076	2023	Investigate existing Gravity	150	0.0	33.7	0.6	Investigate (full flow velocity)		525	0	525	0	Investigate	0	4 000	4 000
MPs	OT_V01.07	RET_OT_076	2023	Investigate existing Gravity	150	0.0	44.4	0.1	Investigate (full flow velocity)		400	0	400	0	Investigate	0	4 000	4 000
MPs	OT_V01.08	RET_OT_076	2023	Investigate existing Gravity	150	0.0	19.2	0.1	Investigate (full flow velocity)		315	0	315	0	Investigate	0	4 000	4 000

MPs	OT_V01.09	RET_OT_076	2023	Investigate existing Gravity	150	0.0	58.1	0.2	Investigate (full flow velocity)		250	0	250	0	Investigate	0	4 000	4 000
MPs	OT_V01.10	RET_OT_076	2023	Investigate existing Gravity	150	0.0	44.8	1.6	Investigate (full flow velocity)		525	0	525	0	Investigate	0	4 000	4 000
MPs	OT_V02.01	RET_OT_076	2023	Investigate existing Gravity	200	0.0	58.6	3.9	Investigate (full flow velocity)		315	0	315	0	Investigate	0	4 000	4 000
MPs	OT_V02.02	RET_OT_076	2023	Investigate existing Gravity	250	0.0	40.7	7.2	Investigate (full flow velocity)		355	0	355	0	Investigate	0	4 000	4 000
MPs	OT_V02.03	RET_OT_076	2023	Investigate existing Gravity	150	0.0	76.5	0.2	Investigate (full flow velocity)		200	0	200	0	Investigate	0	4 000	4 000
MPs	OT_V03.01	RET_OT_076	2023	Investigate existing Gravity	300	0.0	63.6	11.9	Investigate (full flow velocity)		400	0	400	0	Investigate	0	4 000	4 000
MPs	OT_V03.02	RET_OT_076	2023	Investigate existing Gravity	300	0.0	41.7	12.9	Investigate (full flow velocity)		675	0	675	0	Investigate	0	4 000	4 000
MPs	OT_V04.01	RET_OT_076	2023	Investigate existing Gravity	150	0.0	18.6	0.2	Investigate (full flow velocity)		200	0	200	0	Investigate	0	4 000	4 000
MPs	OT_V04.02	RET_OT_076	2023	Investigate existing Gravity	150	0.0	103.9	0.1	Investigate (full flow velocity)		250	0	250	0	Investigate	0	4 000	4 000
MPs	OT_V04.03	RET_OT_076	2023	Investigate existing Gravity	150	0.0	79.6	2.5	Investigate (full flow velocity)		200	0	200	0	Investigate	0	4 000	4 000
MPs	OT_V05.01	RET_OT_076	2023	Investigate existing Gravity	150	0.0	14.9	0.1	Investigate (full flow velocity)		200	0	200	0	Investigate	0	4 000	4 000
MPs	OT_V05.02	RET_OT_076	2023	Investigate existing Gravity	150	0.0	6.3	0.0	Investigate (full flow velocity)		200	0	200	0	Investigate	0	4 000	4 000
MPs	OT_V05.03	RET_OT_076	2023	Investigate existing Gravity	150	0.0	7.5	0.5	Investigate (full flow velocity)		200	0	200	0	Investigate	0	4 000	4 000
MPs	OT_V05.04	RET_OT_076	2023	Investigate existing Gravity	150	0.0	37.5	2.5	Investigate (full flow velocity)		250	0	250	0	Investigate	0	4 000	4 000
MPs	OT_V05.05	RET_OT_076	2023	Investigate existing Gravity	150	0.0	26.7	1.5	Investigate (full flow velocity)		200	0	200	0	Investigate	0	4 000	4 000
MPs	OT_V06.01	RET_OT_076	2023	Investigate existing Gravity	110	0.0	22.0	0.6	Investigate (full flow velocity)		160	0	160	0	Investigate	0	4 000	4 000
MPs	OT_V06.02	RET_OT_076	2023	Investigate existing Gravity	160	0.0	3.0	0.0	Investigate (full flow velocity)		200	0	200	0	Investigate	0	4 000	4 000
MPs	OT_V06.03	RET_OT_076	2023	Investigate existing Gravity	160	0.0	42.9	3.1	Investigate (full flow velocity)		200	0	200	0	Investigate	0	4 000	4 000
MPs	OT_V06.04	RET_OT_076	2023	Investigate existing Gravity	160	0.0	2.7	0.3	Investigate (full flow velocity)		200	0	200	0	Investigate	0	4 000	4 000
MPs	OT_V06.05	RET_OT_076	2023	Investigate existing Gravity	160	0.0	16.6	8.5	Investigate (full flow velocity)		0	0	160	0	Investigate	0	4 000	4 000
MPs	OT_V07.01	RET_OT_076	2023	Investigate existing Gravity	315	0.0	29.4	7.9	Investigate (full flow velocity)		400	0	400	0	Investigate	0	4 000	4 000
MPs	OT_V07.02	RET_OT_076	2023	Investigate existing Gravity	315	0.0	25.1	16.8	Investigate (full flow velocity)		355	0	355	0	Investigate	0	4 000	4 000
MPs	OT_V07.03	RET_OT_076	2023	Investigate existing Gravity	315	0.0	51.2	17.0	Investigate (full flow velocity)		355	0	355	0	Investigate	0	4 000	4 000

MPs	OT_V07.04	RET_OT_076	2023	Investigate existing Gravity	160	0.0	166.5	7.1	Investigate (full flow velocity)		315	0	315	0	Investigate	0	4 000	4 000
MPs	OT_V07.05	RET_OT_076	2023	Investigate existing Gravity	200	0.0	22.8	5.9	Investigate (full flow velocity)		675	0	675	0	Investigate	0	4 000	4 000
MPs	OT_V08.00	RET_OT_076	2023	Investigate existing Gravity	160	0.0	44.1	1.0	Investigate (full flow velocity)		200	0	200	0	Investigate	0	4 000	4 000
MPs	OT_V16.01	RET_OT_076	2023	Investigate existing Gravity	300	0.0	15.1	2.1	Investigate (full flow velocity)		400	0	400	0	Investigate	0	4 000	4 000
MPs	OT_V16.02	RET_OT_076	2023	Investigate existing Gravity	160	0.0	48.2	0.1	Investigate (full flow velocity)		200	0	200	0	Investigate	0	4 000	4 000
MPs	OT_V16.03	RET_OT_076	2023	Investigate existing Gravity	300	0.0	13.9	4.0	Investigate (full flow velocity)		450	0	450	0	Investigate	0	4 000	4 000
MPs	OT_V16.04	RET_OT_076	2023	Investigate existing Gravity	150	0.0	8.1	5.8	Investigate (full flow velocity)		200	0	200	0	Investigate	0	4 000	4 000
MPs	OT_V16.05	RET_OT_076	2023	Investigate existing Gravity	150	0.0	99.1	1.8	Investigate (full flow velocity)		200	0	200	0	Investigate	0	4 000	4 000
MPs	OT_V22.01	RET_OT_076	2023	Investigate existing Gravity	150	0.0	29.2	0.2	Investigate (full flow velocity)		200	0	200	0	Investigate	0	4 000	4 000
MPs	OT_V09.01	RET_OT_077	2023	Investigate existing Gravity	150	0.0	34.1	1.8	Investigate (full flow velocity)		200	0	200	0	Investigate	0	4 000	4 000
MPs	OT_V09.05	RET_OT_077	2023	Investigate existing Gravity	200	0.0	25.0	0.8	Investigate (full flow velocity)		355	0	355	0	Investigate	0	4 000	4 000
MPs	OT_V09.06	RET_OT_077	2023	Investigate existing Gravity	200	0.0	29.7	1.2	Investigate (full flow velocity)		450	0	450	0	Investigate	0	4 000	4 000
MPs	OT_V10.03	RET_OT_077	2023	Investigate existing Gravity	200	0.0	20.5	12.5	Investigate (full flow velocity)		250	0	250	0	Investigate	0	4 000	4 000
MPs	OT_V10.04	RET_OT_077	2023	Investigate existing Gravity	200	0.0	25.2	13.3	Investigate (full flow velocity)		250	0	250	0	Investigate	0	4 000	4 000
MPs	OT_V10.05	RET_OT_077	2023	Investigate existing Gravity	110	0.0	107.2	0.1	Investigate (full flow velocity)		315	0	315	0	Investigate	0	4 000	4 000
MPs	OT_V10.06	RET_OT_077	2023	Investigate existing Gravity	110	0.0	60.3	0.5	Investigate (full flow velocity)		250	0	250	0	Investigate	0	4 000	4 000
MPs	OT_V10.07	RET_OT_077	2023	Investigate existing Gravity	100	0.0	60.8	0.3	Investigate (full flow velocity)		200	0	200	0	Investigate	0	4 000	4 000
MPs	OT_V10.08	RET_OT_077	2023	Investigate existing Gravity	100	0.0	72.6	0.2	Investigate (full flow velocity)		600	0	600	0	Investigate	0	4 000	4 000
MPs	OT_V10.09	RET_OT_077	2023	Investigate existing Gravity	150	0.0	69.7	9.1	Investigate (full flow velocity)		200	0	200	0	Investigate	0	4 000	4 000
MPs	OT_V10.10	RET_OT_077	2023	Investigate existing Gravity	200	0.0	69.8	9.1	Investigate (full flow velocity)		450	0	450	0	Investigate	0	4 000	4 000
MPs	OT_V10.12	RET_OT_077	2023	Investigate existing Gravity	100	0.0	99.0	0.1	Investigate (full flow velocity)		450	0	450	0	Investigate	0	4 000	4 000
MPs	OT_V10.13	RET_OT_077	2023	Investigate existing Gravity	100	0.0	50.0	0.2	Investigate (full flow velocity)		160	0	160	0	Investigate	0	4 000	4 000
MPs	OT_V10.15	RET_OT_077	2023	Investigate existing Gravity	100	0.0	207.1	0.1	Investigate (full flow velocity)		250	0	250	0	Investigate	0	4 000	4 000

MPs	OT_V10.28	RET_OT_077	2023	Investigate existing Gravity	100	0.0	160.1	0.2	Investigate (full flow velocity)		315	0	315	0	Investigate	0	4 000	4 000
MPs	OT_V10.29	RET_OT_077	2023	Investigate existing Gravity	100	0.0	69.1	0.0	Investigate (full flow velocity)		200	0	200	0	Investigate	0	4 000	4 000
MPs	OT_V10.30	RET_OT_077	2023	Investigate existing Gravity	100	0.0	66.0	0.3	Investigate (full flow velocity)		160	0	160	0	Investigate	0	4 000	4 000
MPs	OT_V10.31	RET_OT_077	2023	Investigate existing Gravity	100	0.0	136.0	4.1	Investigate (full flow velocity)		160	0	160	0	Investigate	0	4 000	4 000
MPs	OT_V10.32	RET_OT_077	2023	Investigate existing Gravity	100	0.0	13.3	3.0	Investigate (full flow velocity)		160	0	160	0	Investigate	0	4 000	4 000
MPs	OT_V11.01	RET_OT_077	2023	Investigate existing Gravity	160	0.0	39.0	0.4	Investigate (full flow velocity)		250	0	250	0	Investigate	0	4 000	4 000
MPs	OT_V11.02	RET_OT_077	2023	Investigate existing Gravity	160	0.0	77.4	0.8	Investigate (full flow velocity)		315	0	315	0	Investigate	0	4 000	4 000
MPs	OT_V13.01	RET_OT_077	2023	Investigate existing Gravity	350	0.0	80.4	0.3	Investigate (full flow velocity)		1 400	0	1 400	0	Investigate	0	4 000	4 000
MPs	OT_V13.02	RET_OT_077	2023	Investigate existing Gravity	150	0.0	65.4	2.7	Investigate (full flow velocity)		355	0	355	0	Investigate	0	4 000	4 000
MPs	OT_V13.03	RET_OT_077	2023	Investigate existing Gravity	150	0.0	60.8	0.3	Investigate (full flow velocity)		1 800	0	1 800	0	Investigate	0	4 000	4 000
MPs	OT_V13.04	RET_OT_077	2023	Investigate existing Gravity	150	0.0	58.9	0.1	Investigate (full flow velocity)		1 000	0	1 000	0	Investigate	0	4 000	4 000
MPs	OT_V13.05	RET_OT_077	2023	Investigate existing Gravity	150	0.0	33.3	0.3	Investigate (full flow velocity)		250	0	250	0	Investigate	0	4 000	4 000
MPs	OT_V13.06	RET_OT_077	2023	Investigate existing Gravity	150	0.0	46.8	7.4	Investigate (full flow velocity)		200	0	200	0	Investigate	0	4 000	4 000
MPs	OT_V13.07	RET_OT_077	2023	Investigate existing Gravity	150	0.0	88.5	7.9	Investigate (full flow velocity)		200	0	200	0	Investigate	0	4 000	4 000
MPs	OT_V13.08	RET_OT_077	2023	Investigate existing Gravity	149	0.0	27.9	0.0	Investigate (full flow velocity)		200	0	200	0	Investigate	0	4 000	4 000
MPs	OT_V14.01	RET_OT_077	2023	Investigate existing Gravity	150	0.0	30.4	0.1	Investigate (full flow velocity)		250	0	250	0	Investigate	0	4 000	4 000
MPs	OT_V14.02	RET_OT_077	2023	Investigate existing Gravity	150	0.0	34.3	0.3	Investigate (full flow velocity)		250	0	250	0	Investigate	0	4 000	4 000
MPs	OT_V14.03	RET_OT_077	2023	Investigate existing Gravity	100	0.0	49.0	0.0	Investigate (full flow velocity)		160	0	160	0	Investigate	0	4 000	4 000
MPs	OT_V15.01	RET_OT_077	2023	Investigate existing Gravity	110	0.0	71.7	0.2	Investigate (full flow velocity)		160	0	160	0	Investigate	0	4 000	4 000
MPs	OT_V15.02	RET_OT_077	2023	Investigate existing Gravity	110	0.0	13.7	0.0	Investigate (full flow velocity)		200	0	200	0	Investigate	0	4 000	4 000
MPs	OT_V15.03	RET_OT_077	2023	Investigate existing Gravity	110	0.0	71.0	0.3	Investigate (full flow velocity)		160	0	160	0	Investigate	0	4 000	4 000
MPs	OT_V15.04	RET_OT_077	2023	Investigate existing Gravity	110	0.0	14.7	0.4	Investigate (full flow velocity)		160	0	160	0	Investigate	0	4 000	4 000
MPs	OT_V15.06	RET_OT_077	2023	Investigate existing Gravity	110	0.0	35.9	0.0	Investigate (full flow velocity)		525	0	525	0	Investigate	0	4 000	4 000

MPs	OT_V15.07	RET_OT_077	2023	Investigate existing Gravity	110	0.0	70.6	0.9	Investigate (full flow velocity)		160	0	160	0	Investigate	0	4 000	4 000
MPs	OT_V15.08	RET_OT_077	2023	Investigate existing Gravity	110	0.0	15.4	1.2	Investigate (full flow velocity)		160	0	160	0	Investigate	0	4 000	4 000
MPs	OT_V15.09	RET_OT_077	2023	Investigate existing Gravity	110	0.0	43.1	0.0	Investigate (full flow velocity)		0	0	110	0	Investigate	0	4 000	4 000
MPs	OT_V17.01	RET_OT_077	2023	Investigate existing Gravity	160	0.0	42.5	0.1	Investigate (full flow velocity)		525	0	525	0	Investigate	0	4 000	4 000
MPs	OT_V17.02	RET_OT_077	2023	Investigate existing Gravity	160	0.0	55.8	0.4	Investigate (full flow velocity)		315	0	315	0	Investigate	0	4 000	4 000
MPs	OT_V17.03	RET_OT_077	2023	Investigate existing Gravity	160	0.0	13.0	0.3	Investigate (full flow velocity)		200	0	200	0	Investigate	0	4 000	4 000
MPs	OT_V17.04	RET_OT_077	2023	Investigate existing Gravity	160	0.0	7.8	0.3	Investigate (full flow velocity)		200	0	200	0	Investigate	0	4 000	4 000
MPs	OT_V17.05	RET_OT_077	2023	Investigate existing Gravity	160	0.0	21.1	0.3	Investigate (full flow velocity)		0	0	160	0	Investigate	0	4 000	4 000
MPs	OT_V18.01	RET_OT_077	2023	Investigate existing Gravity	160	0.0	31.8	0.1	Investigate (full flow velocity)		250	0	250	0	Investigate	0	4 000	4 000
MPs	OT_V20.01	RET_OT_077	2023	Investigate existing Gravity	160	0.0	24.3	0.0	Investigate (full flow velocity)		200	0	200	0	Investigate	0	4 000	4 000
MPs	OT_V20.02	RET_OT_077	2023	Investigate existing Gravity	160	0.0	60.1	5.2	Investigate (full flow velocity)		200	0	200	0	Investigate	0	4 000	4 000
MPs	OT_V21.01	RET_OT_077	2023	Investigate existing Gravity	160	0.0	54.5	0.4	Investigate (full flow velocity)		315	0	315	0	Investigate	0	4 000	4 000
MPi	SV_01.01	RET_OT_078	2023	Upgrade existing Gravity (Investigate first)	110	0.0	46.4	5.3	Investigate (full flow velocity)		160	119 000	160	119 000	Investigate	0	112 000	231 000
MPs	SV_V01.01	RET_OT_078	2023	Investigate existing Gravity	110	0.0	53.0	0.1	Investigate (full flow velocity)		160	0	160	0	Investigate	0	4 000	4 000
MPs	SV_V01.02	RET_OT_078	2023	Investigate existing Gravity	160	0.0	36.2	6.0	Investigate (full flow velocity)		400	0	400	0	Investigate	0	4 000	4 000
FM	OT_F02.01	RET_OT_082	2028	New Gravity	0	0.0	38.7	1.0			0	0	160	80 000		0	54 000	134 000
FM	OT_F02.02	RET_OT_082	2028	New Gravity	0	0.0	310.9	2.2			0	0	160	642 000		0	54 000	696 000
FM	OT_F02.03	RET_OT_082	2028	New Gravity	0	0.0	321.8	5.5			0	0	160	665 000		0	54 000	719 000
FM	OT_F02.04	RET_OT_082	2028	New Gravity	0	0.0	22.2	5.5	Road crossing (minor)		0	0	160	92 000		0	54 000	146 000
FM	OT_F02.05	RET_OT_082	2028	New Gravity	0	0.0	424.6	5.5			0	0	160	877 000		0	54 000	931 000
FM	OT_F02.06	RET_OT_082	2028	New Gravity	0	0.0	35.4	5.5	River crossing (minor))		0	0	160	147 000		0	54 000	201 000
FM	OT_F86.00	RET_OT_083	2038	New Gravity	0	0.0	77.2	1.0			0	0	160	160 000		0	54 000	214 000
FM	OT_F09.01	RET_OT_084	2033	New Gravity	0	0.0	194.0	2.0			0	0	160	401 000		0	54 000	455 000
FM	OT_F68.01	RET_OT_086	2033	New Gravity	0	0.1	345.7	0.7			0	0	160	714 000		0	54 000	768 000
FM	OT_F68.02	RET_OT_086	2033	New Gravity	0	0.1	290.1	1.4			0	0	160	599 000		0	54 000	653 000
FM	OT_F04.02	RET_OT_087	2028	New Gravity	0	0.0	680.0	5.2			0	0	160	1 404 000		0	54 000	1 458 000
FM	OT_F04.03	RET_OT_087	2033	New Gravity	0	0.0	408.6	7.6			0	0	160	844 000		0	54 000	898 000
FM	OT_F04.04	RET_OT_087	2033	New Gravity	0	0.0	39.2	21.8			0	0	160	81 000		0	54 000	135 000

FA	OT_F04.05	RET_OT_087	2028	New Rising (Alternative)	0		209.5	7.3	Interim pump station for Aan de Meulen and Kraaibosch Ridge, if developed prior to the construction of Kraaibosch 3 PS	Kraaibosch Ridge PS 4	0	0	110	0	No Standard Cost	0	0	0
FA	OT_F04.06	RET_OT_087	2028	New Pump Station (Alternative)				7.3	Interim pump station for Aan de Meulen and Kraaibosch Ridge, if developed prior to the construction of Kraaibosch 3 PS	Kraaibosch Ridge PS 4		0		0	No Standard Cost	0	0	0
FA	OT_F05.03	RET_OT_087	2028	New Rising (Alternative)	0		185.9	3.0	Interim pump station for Aan de Meulen and Kraaibosch Ridge, if developed prior to the construction of Kraaibosch 3 PS	Kraaibosch Ridge PS 2	0	0	90	0	No Standard Cost	0	0	0
FA	OT_F05.04	RET_OT_087	2028	New Pump Station (Alternative)				3.0	Interim pump station for Aan de Meulen and Kraaibosch Ridge, if developed prior to the construction of Kraaibosch 3 PS	Kraaibosch Ridge PS 2		0		0	No Standard Cost	0	0	0
FA	OT_F07.03	RET_OT_087	2028	New Pump Station (Alternative)				17.0	Interim pump station for Aan de Meulen and Kraaibosch Ridge, if developed prior to the construction of Kraaibosch 3 PS	Kraaibosch Ridge PS 3		0		0	No Standard Cost	0	0	0
FM	OT_F07.04	RET_OT_087	2028	New Gravity	0	0.0	742.7	9.6			0	0	160	1 533 000		0	54 000	1 587 000
FM	OT_F07.05	RET_OT_087	2028	New Gravity	0	0.0	170.3	0.8			0	0	160	352 000		0	54 000	406 000
FM	OT_F07.06	RET_OT_087	2028	New Gravity	0	0.0	225.2	3.2			0	0	160	465 000		0	54 000	519 000
FM	OT_F07.07	RET_OT_087	2028	New Rising	0		659.2	3.0		Kraaibosch Ridge PS 1	0	0	90	705 000		0	12 000	717 000
FM	OT_F07.08	RET_OT_087	2028	New Pump Station				3.0	New pump station	Kraaibosch Ridge PS 1		0		0	Pump Station	1 863 000	0	1 863 000
FM	OT_F10.01	RET_OT_087	2033	New Gravity	0	0.1	135.0	0.5			0	0	160	279 000		0	54 000	333 000
FM	OT_F10.02	RET_OT_087	2033	New Gravity	0	0.1	99.8	2.8			0	0	160	206 000		0	54 000	260 000
FM	OT_F07.02	RET_OT_088	2033	New Gravity	0	0.0	234.2	13.5			0	0	160	484 000		0	54 000	538 000
FM	OT_F08.00	RET_OT_089	2033	New Gravity	0	0.1	195.7	0.3			0	0	160	404 000		0	54 000	458 000
FM	OT_F05.01	RET_OT_090	2033	New Gravity	0	0.0	314.3	0.6			0	0	160	649 000		0	54 000	703 000
FM	OT_F05.02	RET_OT_090	2033	New Gravity	0	0.0	337.5	0.9			0	0	160	697 000		0	54 000	751 000
FM	OT_F06.01	RET_OT_091	2033	New Pump Station				26.3	New pump station	Kraaibosch3 PS		0		0	Pump Station	5 452 000	0	5 452 000
FM	OT_F06.02a	RET_OT_091	2033	New Rising	0		654.6	26.3		Kraaibosch3 PS	0	0	160	1 058 000		0	20 000	1 077 000

FM	OT_F06.02b	RET_OT_091	2033	New Rising	0		38.3	26.3	Road crossing (major)	Kraaibosch3 PS	0	0	160	186 000		0	20 000	206 000
FM	OT_F06.02c	RET_OT_091	2033	New Rising	0		308.5	26.3		Kraaibosch3 PS	0	0	160	499 000		0	20 000	518 000
FA	OT_F06.02d	RET_OT_092	2033	New Rising (Alternative)	0		275.3	26.3	New Interim pump station (Design Flow = 17 L/s)	Kraaibosch3 PS	0	0	160	0	No Standard Cost	0	0	0
FA	OT_F06.02e	RET_OT_092	2028	New Rising (Alternative)	0		1 521.5	26.3	New Interim pump station (Design Flow = 17 L/s)	Kraaibosch3 PS	0	0	160	0	No Standard Cost	0	0	0
FM	OT_F33.02	RET_OT_093	2028	New Gravity	0	0.0	164.1	14.0			0	0	160	339 000		0	54 000	393 000
FM	OT_F33.03	RET_OT_093	2028	New Gravity	0	0.0	279.9	15.2			0	0	160	578 000		0	54 000	632 000
FM	OT_F33.04	RET_OT_093	2028	New Gravity	0	0.0	278.6	20.8			0	0	160	576 000		0	54 000	630 000
FM	OT_F33.05	RET_OT_093	2028	New Gravity	0	0.0	1 609.1	43.0			0	0	200	3 792 000		0	56 000	3 848 000
FM	OT_F33.06	RET_OT_093	2028	New Gravity	0	0.0	363.5	45.1			0	0	200	857 000		0	56 000	913 000
FM	OT_F70.02	RET_OT_094	2058	New Gravity	0	0.0	1 777.5	15.0			0	0	160	3 669 000		0	54 000	3 723 000
FM	OT_F70.03	RET_OT_094	2033	New Gravity	0	0.9	37.7	20.0			0	0	160	78 000		0	54 000	132 000
FM	OT_F31.01	RET_OT_095	2033	New Pump Station				26.0	New pump station, else siphon	Thembalethu Ext.10 PS		0		0	Pump Station	4 272 000	0	4 272 000
FM	OT_F31.02	RET_OT_095	2033	New Rising	0		199.4	26.0	River Rail road crossing	Thembalethu Ext.10 PS	0	0	160	967 000		0	20 000	986 000
FM	OT_F34.00	RET_OT_096	2033	New Gravity	0	0.0	572.2	29.2			0	0	200	1 349 000		0	56 000	1 404 000
FM	OT_F117.00	RET_OT_096	2048	New Gravity	0	0.1	606.6	3.1			0	0	160	1 253 000		0	54 000	1 307 000
FM	OT_F30.01	RET_OT_097	2033	New Pump Station				5.0	New pump station	Ballots Bay PS		0		0	Pump Station	3 024 000	0	3 024 000
FM	OT_F30.02	RET_OT_097	2033	New Rising	0		1 265.9	5.0		Ballots Bay PS	0	0	110	1 474 000		0	14 000	1 487 000
FM	OT_F38.02	RET_OT_098	2058	New Gravity	0	0.0	389.0	36.2			0	0	200	917 000		0	56 000	973 000
FM	OT_F38.03	RET_OT_098	2058	New Gravity	0	0.1	39.5	48.4			0	0	160	82 000		0	54 000	136 000
FM	OT_F39.01	RET_OT_098	2058	New Gravity	0	0.1	511.8	13.8			0	0	160	1 057 000		0	54 000	1 111 000
FM	OT_F39.02	RET_OT_098	2058	New Gravity	0	0.1	244.1	21.2			0	0	160	504 000		0	54 000	558 000
FM	OT_F38.01	RET_OT_099	2063	New Gravity	0	0.1	445.5	15.0			0	0	160	920 000		0	54 000	974 000
FM	OT_F40.01	RET_OT_100	2058	New Gravity	0	0.0	1 369.2	9.0			0	0	160	2 827 000		0	54 000	2 881 000
FM	OT_F40.02	RET_OT_100	2058	New Gravity	0	0.1	596.8	12.7			0	0	160	1 232 000		0	54 000	1 286 000
FM	OT_F41.01	RET_OT_101	2058	New Pump Station				67.8	New pump station	Thembalethu Ext.12A PS		0		0	Pump Station	6 690 000	0	6 690 000
FM	OT_F41.02	RET_OT_101	2058	New Rising	0		708.2	67.8		Thembalethu Ext.12A PS	0	0	250	1 693 000		0	44 000	1 736 000
FM	OT_F42.01	RET_OT_102	2058	New Gravity	0	0.1	238.6	67.8			0	0	200	563 000		0	56 000	618 000
FM	OT_F42.02	RET_OT_102	2058	New Gravity	0	0.1	341.7	67.9			0	0	200	806 000		0	56 000	861 000
FM	OT_F42.03	RET_OT_102	2058	New Gravity	0	0.1	27.9	71.0			0	0	200	66 000		0	56 000	122 000
FM	OT_F43.00	RET_OT_103	2068	New Gravity	0	0.1	384.1	3.1			0	0	160	793 000		0	54 000	847 000
FM	OT_F44.01	RET_OT_104	2058	New Pump Station				72.2	New pump station	Thembalethu Ext.11B PS		0		0	Pump Station	6 941 000	0	6 941 000
FM	OT_F44.02	RET_OT_104	2058	New Rising	0		834.4	72.2		Thembalethu Ext.11B PS	0	0	250	1 994 000		0	44 000	2 038 000
FM	OT_F46.00	RET_OT_105	2058	New Gravity	0	0.2	290.2	72.3			0	0	160	599 000		0	54 000	653 000
FM	OT_F69.01	RET_OT_106	2033	New Gravity	0	0.0	696.3	4.6			0	0	160	1 438 000		0	54 000	1 492 000
FM	OT_F69.02	RET_OT_106	2033	New Gravity	0	0.0	244.4	6.1			0	0	160	505 000		0	54 000	559 000
FM	OT_F69.03a	RET_OT_106	2033	New Gravity	0	0.0	95.9	6.3			0	0	160	198 000		0	54 000	252 000
FM	OT_F69.03b	RET_OT_106	2033	New Gravity	0	0.0	63.8	6.4	Road crossing (major)		0	0	160	395 000		0	54 000	449 000
FM	OT_F69.03c	RET_OT_106	2033	New Gravity	0	0.0	376.2	6.4			0	0	160	777 000		0	54 000	831 000
FM	OT_F26.01	RET_OT_107	2033	New Gravity	0	0.0	211.8	0.5			0	0	160	438 000		0	54 000	492 000

FM	OT_F26.02	RET_OT_107	2033	New Gravity	0	0.0	214.3	2.8			0	0	160	443 000		0	54 000	497 000
FM	OT_F26.03	RET_OT_107	2033	New Gravity	0	0.0	540.7	61.6			0	0	315	1 904 000		0	62 000	1 965 000
FM	OT_F26.04	RET_OT_107	2033	New Gravity	0	0.3	33.9	63.3			0	0	160	71 000		0	54 000	125 000
FM	OT_F27.01	RET_OT_108	2033	New Pump Station				66.9	New pump station	Kraaibosch5 PS		0		0	Pump Station	6 636 000	0	6 636 000
FM	OT_F27.02	RET_OT_108	2033	New Rising	0		1 716.6	66.9		Kraaibosch5 PS	0	0	250	4 102 000		0	44 000	4 146 000
FM	OT_F89.01	RET_OT_109	2068	New Gravity	0	0.0	354.3	24.6			0	0	250	1 000 000		0	59 000	1 059 000
FM	OT_F89.02	RET_OT_109	2068	New Gravity	0	0.0	374.2	25.6			0	0	250	1 056 000		0	59 000	1 115 000
MPa	OT_F90.01	RET_OT_109	2068	Abandon existing Flow Diversion				23.5	Abandoned PS	Future Saasveld PS 6 (Abandon)		0		0	No Standard Cost	0	0	0
FM	OT_F90.02	RET_OT_109	2068	New Gravity	0	0.0	621.5	23.5			0	0	250	1 754 000		0	59 000	1 813 000
FM	OT_F22.01	RET_OT_110	2068	New Pump Station				29.8	New pump station	Woodifields PS F3		0		0	Pump Station	4 497 000	0	4 497 000
FM	OT_F22.02	RET_OT_110	2068	New Rising	0		194.6	29.8		Woodifields PS F3	0	0	200	405 000		0	29 000	434 000
FM	OT_F24.01	RET_OT_111	2068	New Gravity	0	0.1	228.2	29.9			0	0	160	472 000		0	54 000	526 000
FM	OT_F24.02	RET_OT_111	2068	New Gravity	0	0.0	517.0	31.1			0	0	200	1 219 000		0	56 000	1 274 000
FM	OT_F24.03	RET_OT_111	2068	New Gravity	0	0.0	368.6	32.4			0	0	250	1 040 000		0	59 000	1 099 000
FM	OT_F23.03	RET_OT_112	2068	New Gravity	0	0.1	556.5	45.7			0	0	200	1 312 000		0	56 000	1 367 000
FM	OT_F23.04	RET_OT_112	2068	New Gravity	0	0.1	184.5	50.7			0	0	200	435 000		0	56 000	491 000
FM	OT_F23.05	RET_OT_112	2068	New Gravity	0	0.2	42.8	50.7			0	0	160	89 000		0	54 000	143 000
FM	OT_F25.01	RET_OT_113	2068	New Pump Station				54.3	New pump station	Woodifields PS F4		0		0	Pump Station	5 917 000	0	5 917 000
FM	OT_F25.02a	RET_OT_113	2068	New Rising	0		614.0	54.3		Woodifields PS F4	0	0	250	1 468 000		0	44 000	1 511 000
FM	OT_F25.02b	RET_OT_113	2068	New Rising	0		102.3	54.3	River Road crossing	Woodifields PS F4	0	0	250	734 000		0	44 000	778 000
FM	OT_F25.02c	RET_OT_113	2068	New Rising	0		332.7	54.3		Woodifields PS F4	0	0	250	795 000		0	44 000	839 000
MPa	SV_10.01	RET_OT_114	2068	Abandon existing Pump Station				0.0	Abandon existing pump station	Saasveld PS 6		0		0	Abandon	287 000	0	287 000
MPa	SV_10.02	RET_OT_114	2068	Abandon existing Rising	160		322.0	0.0	Abandoned	Saasveld PS 6	0	0	160	0	Abandon	30 000	0	30 000
MPa	SV_10.03	RET_OT_114	2068	Abandon existing Gravity	200	0.0	640.3	0.1	Abandoned		0	0	200	0	Abandon	195 000	0	195 000
FM	OT_F19.01	RET_OT_115	2068	New Pump Station				5.0	New pump station	Woodifields PS F1		0		0	Pump Station	3 024 000	0	3 024 000
FM	OT_F19.02	RET_OT_115	2068	New Rising	0		564.6	5.0		Woodifields PS F1	0	0	110	658 000		0	14 000	671 000
FM	OT_F20.01	RET_OT_116	2068	New Gravity	0	0.0	615.4	6.3			0	0	160	1 271 000		0	54 000	1 325 000
FM	OT_F20.02	RET_OT_116	2068	New Gravity	0	0.0	486.4	7.5			0	0	160	1 004 000		0	54 000	1 058 000
FM	OT_F20.03	RET_OT_116	2068	New Gravity	0	0.0	671.8	7.6			0	0	160	1 387 000		0	54 000	1 441 000
FM	OT_F20.04	RET_OT_116	2068	New Gravity	0	0.2	59.6	10.0			0	0	160	124 000		0	54 000	178 000
FM	OT_F21.01	RET_OT_117	2068	New Pump Station				12.0	New pump station	Woodifields PS F2		0		0	Pump Station	3 442 000	0	3 442 000
FM	OT_F21.02	RET_OT_117	2068	New Rising	0		222.6	12.0		Woodifields PS F2	0	0	110	260 000		0	14 000	273 000
FM	OT_F23.01	RET_OT_118	2068	New Gravity	0	0.2	191.0	12.0			0	0	160	395 000		0	54 000	449 000
FM	OT_F23.02	RET_OT_118	2068	New Gravity	0	0.1	186.8	13.2			0	0	160	386 000		0	54 000	440 000
MPa	OT_F94.06	RET_OT_119	2028	Abandon existing Flow Diversion				56.6	Abandoned PS	Future Thembalethu PS 7 (Abandon)		0		0	No Standard Cost	0	0	0
FM	OT_F94.07	RET_OT_119	2028	New Gravity	0	0.0	321.3	56.6			0	0	315	1 132 000		0	62 000	1 193 000
MPa	OT_62.01	RET_OT_120	2028	Abandon existing Pump Station				0.0	Abandon existing pump station (Investigate flow)	Thembalethu PS 7		0		0	Abandon	287 000	0	287 000

MPa	OT_62.02	RET_OT_120	2028	Abandon existing Rising	200		1 170.0	0.0	Abandoned	Thembalethu PS 7	0	0	200	0	Abandon	10 000	0	10 000
MPa	OT_62.03	RET_OT_120	2028	Abandon existing Gravity	999	0.1	44.7	0.0	Abandoned		0	0	1 000	0	Abandon	69 000	0	69 000
MPa	OT_62.04	RET_OT_120	2028	Abandon existing Flow Diversion				0.0	Abandoned PS	Thembalethu PS 7 Inlet		0		0	No Standard Cost	0	0	0
FM	OT_F88.01	RET_OT_121	2043	New Gravity	0	0.0	221.6	7.3			0	0	160	458 000		0	54 000	512 000
FM	OT_F88.02	RET_OT_121	2028	New Gravity	0	0.0	163.5	10.1			0	0	160	338 000		0	54 000	392 000
FM	OT_F88.03	RET_OT_121	2028	New Gravity	0	0.0	270.8	11.6			0	0	160	559 000		0	54 000	613 000
FM	OT_F88.04	RET_OT_121	2043	New Gravity	0	0.0	749.5	14.8			0	0	200	1 767 000		0	56 000	1 822 000
FM	OT_F48.01	RET_OT_122	2033	New Gravity	0	0.0	1 078.1	7.0			0	0	160	2 226 000		0	54 000	2 280 000
FM	OT_F48.02	RET_OT_122	2033	New Gravity	0	0.0	25.3	8.8			0	0	160	53 000		0	54 000	107 000
FM	OT_F49.01	RET_OT_123	2033	New Pump Station				12.3	New pump station	Le Grand2 PS F2		0		0	Pump Station	3 460 000	0	3 460 000
FM	OT_F49.02	RET_OT_123	2033	New Rising	0		587.2	12.3		Le Grand2 PS F2	0	0	110	684 000		0	14 000	697 000
FM	OT_F52.01	RET_OT_124	2033	New Gravity	0	0.2	34.8	1.9			0	0	160	72 000		0	54 000	126 000
FM	OT_F53.01	RET_OT_124	2033	New Pump Station				5.0	New pump station	Le Grand2 PS F1		0		0	Pump Station	3 024 000	0	3 024 000
FM	OT_F53.02	RET_OT_124	2033	New Rising	0		812.4	5.0		Le Grand2 PS F1	0	0	110	946 000		0	14 000	960 000
FM	OT_F50.01	RET_OT_125	2058	New Gravity	0	0.1	441.5	1.4			0	0	160	912 000		0	54 000	966 000
FM	OT_F50.02	RET_OT_125	2058	New Gravity	0	0.1	19.6	2.8			0	0	160	41 000		0	54 000	95 000
FM	OT_F51.01	RET_OT_126	2058	New Pump Station				5.0	New pump station	Le Grand1 PS		0		0	Pump Station	3 024 000	0	3 024 000
FM	OT_F51.02	RET_OT_126	2058	New Rising	0		759.7	5.0		Le Grand1 PS	0	0	110	885 000		0	14 000	898 000
FM	OT_F56.01	RET_OT_127	2053	New Gravity	0	0.1	434.0	2.1			0	0	160	896 000		0	54 000	950 000
FM	OT_F56.02	RET_OT_127	2053	New Gravity	0	0.0	489.1	3.6			0	0	160	1 010 000		0	54 000	1 064 000
FM	OT_F56.03	RET_OT_127	2048	New Gravity	0	0.1	77.6	11.2			0	0	160	161 000		0	54 000	215 000
FM	OT_F57.01	RET_OT_128	2048	New Pump Station				15.7	New pump station	Hansmoeskraal 4 PS		0		0	Pump Station	3 660 000	0	3 660 000
FM	OT_F57.02	RET_OT_128	2048	New Rising	0		855.1	15.7		Hansmoeskraal 4 PS	0	0	125	1 100 000		0	15 000	1 115 000
FM	OT_F76.00	RET_OT_129	2048	New Gravity	0	0.1	80.4	4.7			0	0	160	167 000		0	54 000	221 000
FM	OT_F75.00	RET_OT_130	2048	New Gravity	0	0.0	986.7	2.8			0	0	160	2 037 000		0	54 000	2 091 000
FM	OT_F71.02	RET_OT_131	2063	New Gravity	0	0.0	923.0	1.8			0	0	160	1 905 000		0	54 000	1 959 000
FM	OT_F77.01	RET_OT_131	2028	New Gravity	0	0.0	260.4	1.3			0	0	160	538 000		0	54 000	592 000
FM	OT_F77.02	RET_OT_131	2028	New Gravity	0	0.0	1 245.9	1.9			0	0	160	2 572 000		0	54 000	2 626 000
FM	OT_F77.03	RET_OT_131	2028	New Gravity	0	0.0	31.0	6.3			0	0	160	65 000		0	54 000	119 000
FM	OT_F59.01	RET_OT_132	2028	New Pump Station				8.9	New pump station	Hansmoeskraal 5 PS 1		0		0	Pump Station	3 254 000	0	3 254 000
FM	OT_F59.02	RET_OT_132	2028	New Rising	0		1 531.4	8.9		Hansmoeskraal 5 PS 1	0	0	110	1 783 000		0	14 000	1 797 000
FM	OT_F61.01	RET_OT_133	2028	New Gravity	0	0.0	670.0	25.9			0	0	200	1 579 000		0	56 000	1 635 000
FM	OT_F61.02	RET_OT_133	2028	New Gravity	0	0.3	32.6	76.9			0	0	160	68 000		0	54 000	122 000
FM	OT_F62.01	RET_OT_134	2028	New Pump Station				86.8	New pump station	Hansmoeskraal 2 PS		0		0	Pump Station	7 758 000	0	7 758 000
FM	OT_F62.02	RET_OT_134	2028	New Rising	0		221.9	86.8		Hansmoeskraal 2 PS	0	0	315	881 000		0	69 000	950 000
FM	OT_F60.01	RET_OT_135	2048	New Pump Station				11.5	New pump station	Hansmoeskraal 5 PS 2		0		0	Pump Station	3 411 000	0	3 411 000
FM	OT_F60.02	RET_OT_135	2048	New Rising	0		872.1	11.5		Hansmoeskraal 5 PS 2	0	0	110	1 016 000		0	14 000	1 029 000
FM	OT_F58.02	RET_OT_136	2043	New Flow Diversion				57.2	Additional Outfall	Future Hansmoeskraal 2 PS		0		0	Diversion: (Max. Size: 235mm)	293 000	0	293 000
FM	OT_F78.01	RET_OT_136	2043	New Gravity	0	0.0	282.4	34.3			0	0	200	666 000		0	56 000	721 000
FM	OT_F78.02	RET_OT_136	2043	New Gravity	0	0.0	733.2	51.0			0	0	200	1 728 000		0	56 000	1 784 000

FM	OT_F78.03	RET_OT_136	2043	New Gravity	0	0.0	539.1	51.0			0	0	200	1 271 000		0	56 000	1 326 000
MPi	OT_68.00	RET_OT_137	2023	Upgrade existing Sub-Catchment (Investigate first)				0.0	WTP Sludge (20 L/s New WTP 100 L/s Old WTP)	George WTP Sludge		0		0	No Standard Cost	0	0	0
MPi	OT_70.01a	RET_OT_139	2028	Upgrade existing Gravity (Investigate first)	200	0.0	83.6	6.7	Maintenance upgrade		0	0	200	244 000	Investigate	0	115 000	359 000
MPi	OT_70.01b	RET_OT_139	2028	Upgrade existing Flow Diversion (Investigate first)				6.9	Maintenance upgrade			0		0	No Standard Cost	0	0	0
MPi	OT_70.01c	RET_OT_139	2028	Upgrade existing Gravity (Investigate first)	200	0.0	269.5	7.0	Maintenance upgrade		0	0	200	785 000	Investigate	0	115 000	900 000
MPi	OT_70.01d	RET_OT_139	2028	Upgrade existing Flow Diversion (Investigate first)				7.4	Maintenance upgrade			0		0	No Standard Cost	0	0	0
MPi	OT_70.01e	RET_OT_139	2028	Upgrade existing Gravity (Investigate first)	200	0.0	184.2	7.4	Maintenance upgrade		0	0	200	537 000	Investigate	0	115 000	652 000
MPi	OT_70.01f	RET_OT_139	2028	Upgrade existing Flow Diversion (Investigate first)				8.0	Maintenance upgrade			0		0	No Standard Cost	0	0	0
MPi	OT_70.01g	RET_OT_139	2028	Upgrade existing Gravity (Investigate first)	200	0.0	136.7	8.9	Maintenance upgrade		0	0	200	399 000	Investigate	0	115 000	513 000
MPi	OT_70.01h	RET_OT_139	2028	Upgrade existing Flow Diversion (Investigate first)				8.9	Maintenance upgrade			0		0	No Standard Cost	0	0	0
MPi	OT_70.01i	RET_OT_139	2028	Upgrade existing Gravity (Investigate first)	200	0.0	184.1	10.3	Maintenance upgrade		0	0	200	537 000	Investigate	0	115 000	651 000
FM	OT_F110.01	RET_OT_140	2033	New Pump Station				55.3	New pump station	George Erf 464 PS F1		0		0	Pump Station	5 978 000	0	5 978 000
FM	OT_F110.02	RET_OT_140	2033	New Rising	0		693.2	55.3		George Erf 464 PS F1	0	0	250	1 657 000		0	44 000	1 700 000
FM	OT_F111.01	RET_OT_141	2033	New Pump Station				21.5	New pump station	George Erf 464 PS F2		0		0	Pump Station	4 005 000	0	4 005 000
FM	OT_F111.02	RET_OT_141	2033	New Rising	0		461.5	21.5		George Erf 464 PS F2	0	0	140	656 000		0	17 000	673 000
FM	OT_F109.01	RET_OT_142	2033	New Gravity	0	0.0	384.2	39.5			0	0	200	906 000		0	56 000	961 000
FM	OT_F112.01	RET_OT_142	2033	New Gravity	0	0.1	178.0	58.6			0	0	200	420 000		0	56 000	476 000
FM	OT_F112.02	RET_OT_142	2033	New Gravity	0	0.0	380.4	95.3			0	0	315	1 340 000		0	62 000	1 401 000
FM	OT_F113.01	RET_OT_142	2033	New Gravity	0	0.0	379.4	28.9			0	0	160	784 000		0	54 000	838 000
FM	OT_F113.02	RET_OT_142	2033	New Gravity	0	0.0	84.7	36.6			0	0	250	239 000		0	59 000	298 000
FM	OT_F114.00	RET_OT_142	2033	New Gravity	0	0.0	72.2	1.2			0	0	160	149 000		0	54 000	203 000
FM	OT_F115.00	RET_OT_142	2033	New Gravity	0	0.0	178.3	0.6			0	0	160	368 000		0	54 000	422 000
MP	OT_72.00	RET_OT_143	2033	Upgrade existing Gravity	500	0.0	45.8	268.0			355	286 000	600	489 000		0	177 000	666 000
MP	SV_11.01	RET_OT_145	2033	Upgrade existing Gravity	160	0.0	73.9	22.1			110	161 000	200	216 000		0	111 000	327 000
MP	SV_11.02	RET_OT_145	2033	Upgrade existing Gravity	200	0.0	118.1	22.6			160	303 000	250	409 000		0	117 000	526 000
MP	SV_11.03	RET_OT_145	2033	Upgrade existing Gravity	200	0.0	61.9	23.2			160	159 000	250	215 000		0	117 000	332 000
MP	SV_11.04	RET_OT_145	2033	Upgrade existing Gravity	200	0.0	333.1	23.2			160	854 000	250	1 153 000		0	117 000	1 270 000
MP	SV_11.05	RET_OT_145	2033	Upgrade existing Gravity	200	0.0	28.9	23.3			160	75 000	250	100 000		0	117 000	217 000
FM	OT_F80.00	RET_OT_146	2043	New Gravity	0	0.0	290.8	4.0			0	0	160	601 000		0	54 000	655 000
FM	OT_F119.01	RET_OT_147	2043	New Flow Diversion				13.2	New interim pump station (Design Flow = 15 L/s)	Hansmoeskraal 1 PS (Interim)		0		0	No Standard Cost	0	0	0
FA	OT_F119.02	RET_OT_147	2028	New Gravity (Alternative)	0	0.0	5.1	0.0	New interim pump station (Design Flow = 15 L/s)		0	0	160	0	No Standard Cost	0	0	0
FA	OT_F120.01	RET_OT_147	2028	New Pump Station (Alternative)				15.0	New interim pump station (Design Flow = 15 L/s)	Hansmoeskraal 1 PS		0		0	No Standard Cost	0	0	0
FA	OT_F120.02	RET_OT_147	2023	New Rising (Alternative)	0		84.2	0.0	New interim pump station (Design Flow = 15 L/s)	Hansmoeskraal 1 PS	0	0	160	0	No Standard Cost	0	0	0
FM	OT_F107.00	RET_OT_148	2033	New Gravity	0	0.0	336.0	4.2			0	0	160	694 000		0	54 000	748 000

MPi	OT_73.01	RET_OT_149	2023	Upgrade existing Gravity (Investigate first)	160	0.0	26.1	5.5	Investigate (full flow velocity)		900	434 000	900	434 000	Investigate	0	283 000	717 000
MPi	OT_73.02	RET_OT_149	2023	Upgrade existing Gravity (Investigate first)	160	0.0	79.4	6.1	Investigate (full flow velocity)		3 500	49 337 000	3 500	49 337 000	Investigate	0	7 096 000	56 432 000
MP	OT_74.01	RET_OT_149	2023	Upgrade existing Gravity	150	0.0	157.0	7.0	Transfer ownership		0	0	160	0	No Standard Cost	0	0	0
FM	OT_F121.01	RET_OT_149	2028	New Pump Station				4.0	New pump station	George Erf 195/325 PS		0		0	Pump Station	2 420 000	0	2 420 000
FM	OT_F121.02	RET_OT_149	2028	New Rising	0		198.3	4.0		George Erf 195/325 PS	0	0	90	213 000		0	12 000	225 000
FA	OT_F121.03a	RET_OT_149	2028	New Rising (Alternative)	0		147.8	0.0	Alternative	George Erf 195/325 PS	0	0	90	0	No Standard Cost	0	0	0
FA	OT_F121.03b	RET_OT_149	2028	New Rising (Alternative)	0		62.2	0.0	Alternative, Road crossing (major)	George Erf 195/325 PS	0	0	90	0	No Standard Cost	0	0	0
FA	OT_F121.03c	RET_OT_149	2028	New Rising (Alternative)	0		59.3	0.0	Alternative	George Erf 195/325 PS	0	0	90	0	No Standard Cost	0	0	0
FA	OT_F121.04	RET_OT_149	2028	New Rising (Alternative)	0		886.1	0.0	Alternative	George Erf 195/325 PS	0	0	90	0	No Standard Cost	0	0	0
FM	OT_F71.01	RET_OT_150	2063	New Gravity	0	0.2	50.1	0.5			0	0	160	104 000		0	54 000	158 000
FA	OT_F72.01	RET_OT_150	2063	New Sump (Alternative)				50.0				0		0	No Standard Cost	0	0	0
MPi	OT_75.01	RET_OT_152	2023	Upgrade existing Gravity (Investigate first)	199	0.0	35.3	13.3	Investigate (AB status)		0	0	250	0	No Standard Cost	0	0	0
MPi	OT_75.02	RET_OT_152	2023	Upgrade existing Gravity (Investigate first)	299	0.0	28.5	26.5	Investigate (AB status)		0	0	355	0	No Standard Cost	0	0	0
MPi	OT_75.03	RET_OT_152	2023	Upgrade existing Gravity (Investigate first)	149	0.0	3.3	13.2	Investigate (AB status)		160	9 000	200	10 000	Investigate	0	115 000	125 000
FM	OT_F123.01	RET_OT_153	2033	New Gravity	0	0.0	144.1	1.0			0	0	160	298 000		0	54 000	352 000
FM	OT_F123.02	RET_OT_153	2033	New Gravity	0	0.0	43.7	1.0			0	0	160	91 000		0	54 000	145 000
FM	OT_F123.03	RET_OT_153	2033	New Gravity	0	0.0	437.3	2.0			0	0	160	903 000		0	54 000	957 000
FM	OT_F123.04	RET_OT_153	2033	New Gravity	0	0.0	485.6	2.9			0	0	160	1 003 000		0	54 000	1 057 000
FM	OT_F123.05	RET_OT_153	2033	New Gravity	0	0.0	57.5	3.8			0	0	160	119 000		0	54 000	173 000
FM	OT_F123.06	RET_OT_153	2033	New Gravity	0	0.0	331.8	4.4			0	0	160	685 000		0	54 000	739 000
FM	OT_F123.07	RET_OT_153	2033	New Gravity	0	0.0	413.5	5.0			0	0	160	854 000		0	54 000	908 000
FM	OT_F123.08	RET_OT_153	2033	New Gravity	0	0.1	112.8	5.6			0	0	160	233 000		0	54 000	287 000
FM	OT_F124.01	RET_OT_154	2033	New Pump Station				7.8	New pump station	Kraaibosch 195/62 PS F1		0		0	Pump Station	3 194 000	0	3 194 000
FM	OT_F124.02	RET_OT_154	2033	New Rising	0		403.2	7.8		Kraaibosch 195/62 PS F1	0	0	110	470 000		0	14 000	483 000
FM	OT_F125.01	RET_OT_155	2033	New Gravity	0	0.0	463.9	8.5			0	0	160	958 000		0	54 000	1 012 000
FM	OT_F125.02	RET_OT_155	2033	New Gravity	0	0.3	63.4	14.1			0	0	160	131 000		0	54 000	185 000
FM	OT_F125.03	RET_OT_155	2033	New Gravity	0	0.0	111.1	16.3	River crossing (minor)		0	0	200	524 000		0	56 000	580 000
FM	OT_F126.01	RET_OT_156	2033	New Gravity	0	0.0	42.0	1.2			0	0	160	87 000		0	54 000	141 000
FM	OT_F126.02	RET_OT_156	2033	New Gravity	0	0.0	241.0	1.7			0	0	160	498 000		0	54 000	552 000
FM	OT_F126.03	RET_OT_156	2033	New Gravity	0	0.1	26.7	2.2			0	0	160	56 000		0	54 000	110 000
FM	OT_F126.04	RET_OT_156	2033	New Gravity	0	0.0	503.2	4.0			0	0	160	1 039 000		0	54 000	1 093 000
FM	OT_F126.05	RET_OT_156	2033	New Gravity	0	0.0	237.2	4.5			0	0	160	490 000		0	54 000	544 000
FM	OT_F126.06	RET_OT_156	2033	New Gravity	0	0.0	85.2	4.6			0	0	160	176 000		0	54 000	230 000
FM	OT_F126.07	RET_OT_156	2033	New Gravity	0	0.1	115.6	5.6			0	0	160	239 000		0	54 000	293 000
FM	OT_F127.01	RET_OT_157	2033	New Gravity	0	0.1	163.5	1.8			0	0	160	338 000		0	54 000	392 000
FM	OT_F127.02	RET_OT_157	2033	New Gravity	0	0.0	112.9	1.8			0	0	160	234 000		0	54 000	288 000
FM	OT_F127.03	RET_OT_157	2033	New Gravity	0	0.0	133.0	2.0			0	0	160	275 000		0	54 000	329 000
FM	OT_F127.04	RET_OT_157	2033	New Gravity	0	0.0	138.0	2.1			0	0	160	285 000		0	54 000	339 000

FM	OT_F03.01	RET_OT_158	2033	New Gravity	0	0.0	322.4	2.1			0	0	160	666 000		0	54 000	720 000
FM	OT_F128.01	RET_OT_158	2033	New Gravity	0	0.0	114.4	0.5			0	0	160	237 000		0	54 000	291 000
FM	OT_F128.02	RET_OT_158	2033	New Gravity	0	0.0	29.7	1.0			0	0	160	62 000		0	54 000	116 000
FM	OT_F129.01	RET_OT_159	2033	New Gravity	0	0.0	121.9	0.5			0	0	160	252 000		0	54 000	306 000
FM	OT_F129.02	RET_OT_159	2033	New Gravity	0	0.0	25.9	1.0			0	0	160	54 000		0	54 000	108 000
FA	OT_F130.01	RET_OT_160	2033	New Flow Diversion (Alternative)				2.2	Interim PS	Future Kraaibosch 195/21 PS F1 (Interim)		0		0	No Standard Cost	0	0	0
FA	OT_F130.02	RET_OT_160	2033	New Gravity (Alternative)	0	0.1	5.0	0.0	Interim (Design Flow = 1 L/s)		0	0	160	0	No Standard Cost	0	0	0
FA	OT_F131.01	RET_OT_160	2033	New Pump Station (Alternative)				4.0	New interim pump station (Design Flow = 4 L/s)	Kraaibosch 195/21 PS F1		0		0	No Standard Cost	0	0	0
FA	OT_F131.02	RET_OT_160	2033	New Rising (Alternative)	0		332.6	0.0	New interim pump station (Design Flow = 4 L/s)	Kraaibosch 195/21 PS F1	0	0	90	0	No Standard Cost	0	0	0
FM	OT_F33.01	RET_OT_161	2028	New Gravity	160	0.0	307.6	4.1			0	0	160	635 000		0	54 000	689 000
FA	OT_F132.01	RET_OT_161	2033	New Flow Diversion (Alternative)				1.0	Interim PS	Future Kraaibosch 195/21 PS F2 (Interim)		0		0	No Standard Cost	0	0	0
FA	OT_F132.02	RET_OT_161	2033	New Gravity (Alternative)	0	0.2	5.0	0.0	Interim (Design Flow = 1 L/s)		0	0	160	0	No Standard Cost	0	0	0
FA	OT_F133.01	RET_OT_161	2033	New Pump Station (Alternative)				4.0	New interim pump station (Design Flow = 4 L/s)	Kraaibosch 195/21 PS F2		0		0	No Standard Cost	0	0	0
FA	OT_F133.02	RET_OT_161	2033	New Rising (Alternative)	0		129.3	0.0	New interim pump station (Design Flow = 4 L/s)	Kraaibosch 195/21 PS F2	0	0	90	0	No Standard Cost	0	0	0
FM	OT_F134.01	RET_OT_161	2028	New Gravity	160	0.1	181.7	1.4			0	0	160	376 000		0	54 000	430 000
FM	OT_F135.01	RET_OT_161	2028	New Gravity	160	0.0	92.7	0.6			0	0	160	192 000		0	54 000	246 000
FM	OT_F135.02	RET_OT_161	2028	New Gravity	160	0.0	434.3	2.6			0	0	160	897 000		0	54 000	951 000
FM	OT_F135.03	RET_OT_161	2028	New Gravity	160	0.0	330.4	4.9			0	0	160	682 000		0	54 000	736 000
FM	OT_F136.01	RET_OT_161	2028	New Gravity	160	0.1	121.7	0.7			0	0	160	252 000		0	54 000	306 000
FM	OT_F137.01	RET_OT_161	2028	New Gravity	160	0.0	351.4	1.3			0	0	160	726 000		0	54 000	780 000
FM	OT_F137.02	RET_OT_161	2028	New Gravity	160	0.0	439.7	1.9			0	0	160	908 000		0	54 000	962 000
FM	OT_F137.03	RET_OT_161	2028	New Gravity	160	0.0	231.1	3.2			0	0	160	477 000		0	54 000	531 000
FM	OT_F137.04	RET_OT_161	2028	New Gravity	160	0.0	289.5	6.3			0	0	160	598 000		0	54 000	652 000
FM	OT_F138.01	RET_OT_161	2028	New Gravity	160	0.2	69.8	0.6			0	0	160	145 000		0	54 000	199 000
FM	OT_F139.01	RET_OT_161	2028	New Gravity	160	0.1	49.1	1.2			0	0	160	102 000		0	54 000	156 000
FM	OT_F140.01	RET_OT_161	2028	New Gravity	160	0.1	49.7	0.3			0	0	160	103 000		0	54 000	157 000
FM	OT_F140.02	RET_OT_161	2028	New Gravity	160	0.0	632.9	1.1			0	0	160	1 307 000		0	54 000	1 361 000
FM	OT_F140.03	RET_OT_161	2028	New Gravity	160	0.1	200.1	2.0			0	0	160	413 000		0	54 000	467 000
FM	OT_F140.04	RET_OT_161	2028	New Gravity	160	0.1	35.7	2.5			0	0	160	74 000		0	54 000	128 000
FM	OT_F141.01	RET_OT_161	2028	New Gravity	160	0.1	81.7	0.9			0	0	160	169 000		0	54 000	223 000
FM	OT_F142.01	RET_OT_161	2028	New Gravity	160	0.1	171.6	0.5			0	0	160	355 000		0	54 000	409 000
FM	OT_F143.01	RET_OT_162	2028	New Gravity	160	0.1	187.5	2.1			0	0	160	387 000		0	54 000	441 000
FM	OT_F143.02	RET_OT_162	2028	New Gravity	160	0.0	281.6	4.3			0	0	160	582 000		0	54 000	636 000
FM	OT_F143.03	RET_OT_162	2028	New Gravity	160	0.0	312.0	8.5			0	0	160	645 000		0	54 000	699 000
FM	OT_F143.04	RET_OT_162	2028	New Gravity	160	0.0	278.5	10.6			0	0	160	575 000		0	54 000	629 000
FM	OT_F143.05	RET_OT_162	2028	New Gravity	160	0.0	482.0	18.0			0	0	200	1 136 000		0	56 000	1 192 000
FM	OT_F143.06	RET_OT_162	2028	New Gravity	160	0.0	599.2	20.6			0	0	200	1 413 000		0	56 000	1 468 000

FM	OT_F143.07	RET_OT_162	2028	New Gravity	160	0.0	484.8	23.5			0	0	250	1 368 000		0	59 000	1 427 000
FM	OT_F143.08	RET_OT_162	2028	New Gravity	160	0.0	449.7	26.2			0	0	250	1 269 000		0	59 000	1 328 000
FM	OT_F143.09	RET_OT_162	2028	New Gravity	160	0.0	975.2	29.0			0	0	250	2 752 000		0	59 000	2 810 000
FM	OT_F143.10	RET_OT_162	2028	New Gravity	160	0.0	225.7	32.1			0	0	250	637 000		0	59 000	696 000
FM	OT_F144.01	RET_OT_162	2028	New Gravity	160	0.1	97.2	2.1			0	0	160	201 000		0	54 000	255 000
FM	OT_F144.02	RET_OT_162	2028	New Gravity	160	0.1	127.6	5.2			0	0	160	264 000		0	54 000	318 000
FM	OT_F145.01	RET_OT_162	2028	New Gravity	160	0.1	89.8	1.0			0	0	160	186 000		0	54 000	240 000
FM	OT_F146.01	RET_OT_162	2028	New Gravity	160	0.1	191.0	0.4			0	0	160	395 000		0	54 000	449 000
FM	OT_F146.02	RET_OT_162	2028	New Gravity	160	0.2	91.3	0.7			0	0	160	189 000		0	54 000	243 000
FM	OT_F147.01	RET_OT_162	2028	New Gravity	160	0.2	78.4	0.3			0	0	160	162 000		0	54 000	216 000
FM	OT_F147.02	RET_OT_162	2028	New Gravity	160	0.1	98.7	1.0			0	0	160	204 000		0	54 000	258 000
FM	OT_F148.01	RET_OT_162	2028	New Gravity	160	0.1	126.8	0.7			0	0	160	262 000		0	54 000	316 000
FM	OT_F148.02	RET_OT_162	2028	New Gravity	160	0.2	110.4	1.6			0	0	160	228 000		0	54 000	282 000
FM	OT_F149.01	RET_OT_162	2028	New Gravity	160	0.1	204.3	0.5			0	0	160	422 000		0	54 000	476 000
FM	OT_F149.02	RET_OT_162	2028	New Gravity	160	0.2	115.1	1.4			0	0	160	238 000		0	54 000	292 000
FM	OT_F150.01	RET_OT_162	2028	New Gravity	160	0.0	139.6	0.5			0	0	160	289 000		0	54 000	343 000
FM	OT_F150.02	RET_OT_162	2028	New Gravity	160	0.1	196.2	3.7			0	0	160	405 000		0	54 000	459 000
FA	OT_F151.01	RET_OT_163	2028	New Flow Diversion (Alternative)				34.0	New interim pump station (Design Flow = 50 L/s)	Future Garden Route City PS (interim)		0		0	No Standard Cost	0	0	0
FA	OT_F151.02	RET_OT_163	2028	New Gravity (Alternative)	0	0.1	10.0	0.0	Interim (Design Flow = 50 L/s)		0	0	200	0	No Standard Cost	0	0	0
FA	OT_F152.01	RET_OT_163	2028	New Pump Station (Alternative)				50.0	New interim pump station (Design Flow = 50 L/s)	Garden Route City PS		0		0	No Standard Cost	0	0	0
FA	OT_F152.02	RET_OT_163	2028	New Rising (Alternative)	0		1 149.9	0.0	New interim pump station (Design Flow = 50 L/s)	Garden Route City PS	0	0	250	0	No Standard Cost	0	0	0
FA	OT_F153.01	RET_OT_164	2028	New Flow Diversion (Alternative)				257.8	New interim package plant (Design Flow = 90 L/s)	Future Garden Route City WWTP (interim)		0		0	No Standard Cost	0	0	0
FA	OT_F153.02	RET_OT_164	2028	New Gravity (Alternative)	0	0.2	20.0	0.0	New interim package plant (Design Flow = 90 L/s)		0	0	315	0	No Standard Cost	0	0	0
FA	OT_F154.01	RET_OT_164	2028	New Treatment Works (Alternative)				3 200.0	New interim package plant (Design Flow = 90 L/s)	Garden Route City WWTP		0		0	No Standard Cost	0	0	0
FA	OT_F155.01	RET_OT_165	2028	New Flow Diversion (Alternative)				1.7				0		0	No Standard Cost	0	0	0
FM	OT_F155.02	RET_OT_165	2028	New Gravity	0	0.0	175.6	1.7			0	0	160	363 000		0	54 000	417 000
FA	OT_F155.03	RET_OT_165	2028	New Gravity (Alternative)	0	0.0	32.0	0.0			0	0	160	0	No Standard Cost	0	0	0
MPi	SV_12.01	RET_OT_166	2023	Upgrade existing Gravity (Investigate first)	110	0.0	38.9	5.1			110	85 000	160	100 000	Investigate	0	112 000	212 000
FM	OT_F156.01	RET_OT_167	2038	New Gravity	0	0.0	189.3	4.6			0	0	160	391 000		0	54 000	445 000
FM	OT_F156.02	RET_OT_167	2038	New Gravity	0	0.0	246.6	2.5			0	0	160	509 000		0	54 000	563 000
FM	OT_F156.03	RET_OT_167	2038	New Gravity	0	0.0	369.5	2.1			0	0	160	763 000		0	54 000	817 000
FM	OT_F157.01	RET_OT_168	2028	New Gravity	0	0.0	253.6	1.6			0	0	160	524 000		0	54 000	578 000
FM	OT_F157.02	RET_OT_168	2028	New Gravity	0	0.0	234.3	1.8			0	0	160	484 000		0	54 000	538 000
FM	OT_F158.01	RET_OT_169	2028	New Gravity	0	0.0	299.0	1.6			0	0	160	618 000		0	54 000	672 000
FM	OT_F158.02	RET_OT_169	2028	New Gravity	0	0.0	262.8	11.1			0	0	160	543 000		0	54 000	597 000

FM	OT_F158.03	RET_OT_169	2028	New Gravity	0	0.1	179.6	11.1			0	0	160	371 000		0	54 000	425 000
Total																678 008 000	39 008 000	1 083 332 000

Master Plan Projects

Note: Costs include P&G's, Contingencies & Fees exclude EIA studies, registration of servitudes and/or land acquisition, protection, monitoring and VAT.

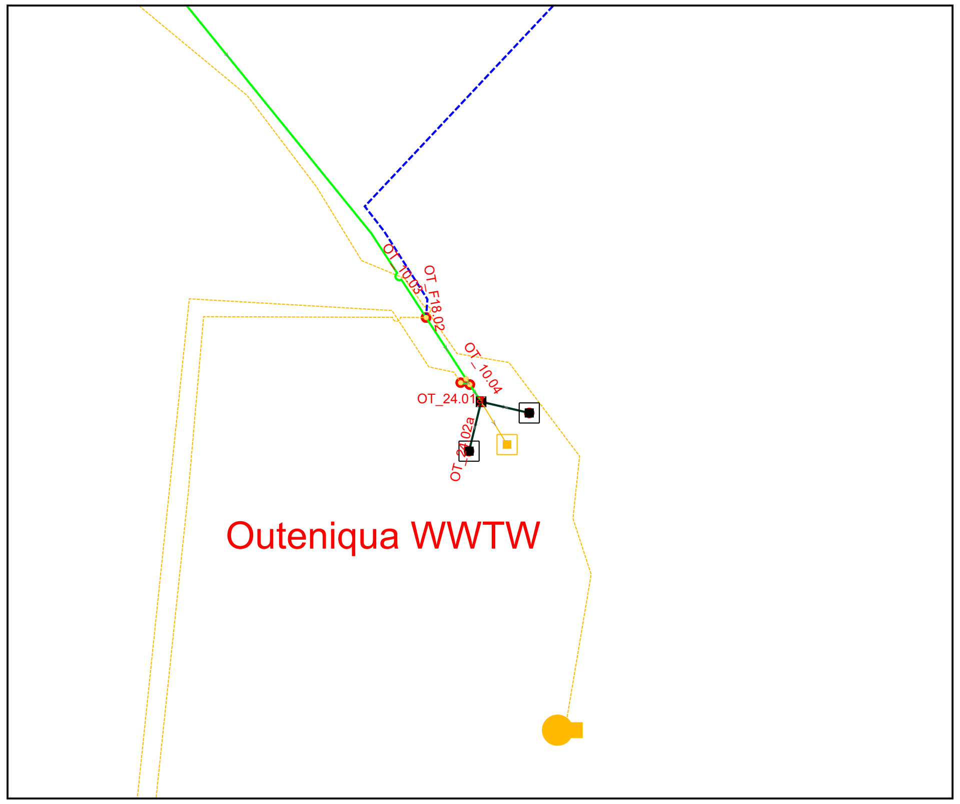
Project No.	Description	Beg Impl. Yr	End Impl. Yr	Par Pipe Cost Inc. (R)	New Pipe Cost Inc. (R)	Other Cost Inc. (R)	Extra Cost Inc. (R)	Total Cost Inc. (R)	Invest. Cost Inc. (R)
BLK_OT_001	New 10000 kL/d Outeniqua WWTW (Phase 2 of 3)	2038	2038	0	0	232 325 000	0	232 325 000	0
BLK_OT_002	New 10000 kL/d Outeniqua WWTW (Phase 3 of 3)	2038	2053	0	298 000	231 500 000	162 000	231 960 000	0
BLK_OT_005	Upgrade Meul PS and inspect rising main velocity	2023	2023	3 775 000	7 437 000	9 640 000	904 000	17 981 000	3 600
BLK_OT_006	Upgrade Schaapkop bulk outfall sewer 1 of 2	2023	2033	2 871 000	5 334 000	0	912 000	6 245 000	10 800
BLK_OT_007	Upgrade Schaapkop bulk outfall sewer 2 of 2	2023	2023	207 000	270 000	0	283 000	553 000	3 600
BLK_OT_008	Upgrade Schaapkop PS and rising main	2023	2023	2 321 000	3 556 000	11 055 000	900 000	15 511 000	0
BLK_OT_009	Investigate Outeniqua WWTW slope/locality	2023	2023	0	0	0	0	0	0
BLK_OT_010	Upgrade Sandkraal 197 outfall sewer	2028	2028	21 626 000	21 633 000	0	757 000	22 388 000	14 400
BLK_OT_011	Upgrade Sandkraal 197 outfall sewer	2028	2028	9 322 000	10 921 000	20 543 000	2 742 000	34 205 000	40 800
BLK_OT_012	Upgrade Pacaltsdorp Rural outfall sewer	2068	2068	1 571 000	2 418 000	0	945 000	3 363 000	0
BLK_OT_013	Upgrade Pacaltsdorp PS 1 and rising main	2063	2068	271 000	384 000	14 740 000	3 510 000	18 634 000	0
BLK_OT_014	Upgrade Pacaltsdorp Rural outfall sewer	2028	2028	526 000	775 000	0	202 000	976 000	3 600
BLK_OT_015	Upgrade Pacaltsdorp PS 3 and rising main	2028	2028	10 709 000	14 293 000	6 646 000	474 000	21 413 000	0
BLK_OT_016	Upgrade Pacaltsdorp Rural outfall sewer	2023	2043	2 856 000	6 433 000	0	589 000	7 021 000	3 600
BLK_OT_017	Construct Kraaibosch (4) outfall sewer	2033	2033	0	2 713 000	0	118 000	2 830 000	0
BLK_OT_018	Construct Kraaibosch (4) outfall sewer	2028	2028	0	1 377 000	0	124 000	1 500 000	0
BLK_OT_019	Construct Kraaibosch4 PS and rising main	2028	2028	0	12 394 000	14 168 000	237 000	26 799 000	0
BLK_OT_020	Construct Kraaibosch4 PS and rising main	2028	2028	0	5 760 000	0	205 000	5 965 000	0
BLK_OT_021	Construct Destiny Africa PS and rising main	2028	2028	0	12 769 000	18 685 000	333 000	31 787 000	0
RET_GW_063	Abandon Pacaltsdorp PS 2 and construct alternative outfall sewer	2043	2043	0	0	307 000	0	307 000	0
RET_GW_071	Abandon Pacaltsdorp PS 4 and construct alternative outfall sewer	2028	2028	0	0	307 000	0	307 000	0
RET_GW_107	Construct interim Schaapkop PS (int) and outfall sewer	2028	2028	0	0	0	0	0	0
RET_GW_111	Divert existing Eden George PS outfall sewer	2023	2033	0	521 000	59 000	74 000	654 000	0
RET_OT_001	Upgrade Glenwood PS	2033	2033	3 234 000	7 435 000	4 086 000	473 000	11 993 000	37 200
RET_OT_002	Construct Denver alternative sewer	2023	2023	0	0	0	0	0	0
RET_OT_003	Construct Panorama alternative sewer	2023	2023	0	0	0	0	0	0
RET_OT_004	Investigate Urbansville slope/locality	2023	2023	0	0	0	0	0	0
RET_OT_005	Investigate Central Business District slope/locality	2028	2028	0	0	0	0	0	0
RET_OT_006	Investigate George South slope/locality	2023	2023	3 002 000	4 810 000	0	375 000	5 183 000	10 800
RET_OT_007	Upgrade Kraaibosch outfall sewer	2033	2033	632 000	751 000	0	121 000	872 000	3 600
RET_OT_008	Upgrade Welgelegen PS and rising main	2023	2023	0	0	0	0	0	0
RET_OT_009	Investigate Welgelegen slope/locality	2023	2033	1 447 000	1 722 000	0	608 000	2 328 000	7 200
RET_OT_010	Upgrade Kraaibosch PS (Alternative)	2038	2038	0	0	0	0	0	0
RET_OT_011	Construct Blue Mountain PS 1 rising main alternative	2023	2023	0	0	1 300 000	0	1 300 000	0
RET_OT_012	Upgrade Blue Mountain PS 2	2023	2023	0	0	1 305 000	0	1 305 000	0
RET_OT_014	Upgrade Tamsui outfall sewer	2028	2028	255 000	342 000	0	222 000	564 000	0
RET_OT_015	Abandon Bos-en-Dal PS and construct new outfall sewer	2028	2028	0	1 815 000	0	270 000	2 085 000	0
RET_OT_017	Abandon Tamsui PS and construct new outfall sewer	2038	2038	0	3 765 000	0	186 000	3 948 000	0
RET_OT_018	Abandon Rosedale PS 2 and construct new outfall sewer	2038	2038	0	1 260 000	0	116 000	1 375 000	0
RET_OT_019	Construct Pacaltsdorp Ext.3A PS and outfall sewer	2038	2038	0	2 655 000	0	124 000	2 777 000	0
RET_OT_020	Construct Pacaltsdorp Ext.3A PS and outfall sewer	2033	2038	0	660 000	6 854 000	44 000	7 558 000	0
RET_OT_021	Abandon Tamsui PS and construct new outfall sewer	2023	2038	0	0	425 000	0	425 000	0

RET_OT_022	Abandon Rosedale PS 2 and construct new outfall sewer	2033	2038	0	0	337 000	0	337 000	0
RET_OT_023	Abandon Rosedale PS 1 and construct new outfall sewer	2023	2023	0	572 000	0	108 000	680 000	0
RET_OT_024	Construct Pacaltsdorp Ext.3B outfall sewer	2038	2038	0	268 000	0	54 000	322 000	0
RET_OT_026	Abandon Rosedale PS 1 and construct new outfall sewer	2023	2023	0	0	307 000	0	307 000	0
RET_OT_028	Abandon Parkdene PS 3 and construct new outfall sewer	2028	2028	0	666 000	0	108 000	774 000	0
RET_OT_029	Abandon Parkdene PS 3 and construct new outfall sewer	2028	2028	0	0	307 000	0	307 000	0
RET_OT_030	Abandon Parkdene PS 2 and construct new outfall sewer	2028	2028	0	984 000	0	162 000	1 146 000	0
RET_OT_031	Abandon Parkdene PS 2 and construct new outfall sewer	2028	2028	0	0	307 000	0	307 000	0
RET_OT_032	Upgrade Thembalethu Zone 1 outfall sewer	2023	2028	667 000	864 000	0	497 000	1 361 000	7 200
RET_OT_034	Abandon Parkdene PS 1 and construct new outfall sewer	2028	2028	0	2 706 000	0	162 000	2 868 000	0
RET_OT_035	Abandon Parkdene PS 1 and construct new outfall sewer	2028	2028	0	0	307 000	0	307 000	0
RET_OT_036	Abandon Thembalethu PS 1 and construct new outfall sewer	2028	2028	0	1 209 000	0	56 000	1 265 000	0
RET_OT_037	Abandon Thembalethu PS A and construct new outfall sewer	2028	2028	0	1 471 000	0	113 000	1 584 000	0
RET_OT_038	Abandon Thembalethu PS B and construct new outfall sewer	2028	2028	0	643 000	0	113 000	756 000	0
RET_OT_039	Abandon Thembalethu PS 2 and construct new outfall sewer	2028	2028	0	5 790 000	0	116 000	5 905 000	0
RET_OT_040	Abandon Thembalethu PS 1 and construct new outfall sewer	2028	2028	0	0	307 000	0	307 000	0
RET_OT_041	Abandon Thembalethu PS A and construct new outfall sewer	2028	2028	0	0	297 000	0	297 000	0
RET_OT_042	Investigate Thembalethu Zone 3 slope/locality	2023	2023	0	0	0	0	0	0
RET_OT_043	Abandon Thembalethu PS B and construct new outfall sewer	2028	2028	0	0	297 000	0	297 000	0
RET_OT_044	Investigate Thembalethu Zone 3 slope/locality	2023	2023	0	0	0	0	0	0
RET_OT_045	Abandon Thembalethu PS 2 and construct new outfall sewer	2028	2028	0	0	307 000	0	307 000	0
RET_OT_047	Investigate Thembalethu Zone 6 slope/locality	2023	2023	388 000	575 000	0	290 000	864 000	7 200
RET_OT_048	Investigate Thembalethu Zone 6 slope/locality	2023	2023	0	0	0	0	0	0
RET_OT_049	Investigate Thembalethu Zone 6 slope/locality	2023	2023	0	0	0	0	0	0
RET_OT_054	Investigate Seaview slope/locality	2023	2023	0	0	0	0	0	0
RET_OT_055	Abandon Pacaltsdorp PS 6 and construct new outfall sewer	2023	2023	0	436 000	0	54 000	490 000	0
RET_OT_056	Abandon Pacaltsdorp PS 6 and construct new outfall sewer	2023	2023	0	0	307 000	0	307 000	0
RET_OT_057	Construct Le Grand PS and outfall sewer	2023	2023	0	4 749 000	2 011 000	29 000	6 789 000	0
RET_OT_058	Construct Le Grand PS and outfall sewer	2023	2023	0	1 927 000	0	174 000	2 101 000	0
RET_OT_059	Investigate Le Grand slope/locality	2023	2023	25 000	25 000	0	112 000	137 000	3 600
RET_OT_060	Construct Thembalethu (2) outfall sewer	2023	2023	0	3 153 000	0	270 000	3 423 000	0
RET_OT_061	Construct Old Brick Area outfall sewer	2033	2033	0	1 195 000	0	54 000	1 249 000	0
RET_OT_066	Construct Thembalethu Area 3 outfall sewer	2023	2023	0	509 000	50 000	378 000	937 000	0
RET_OT_067	Construct Thembalethu Ext.11A outfall sewer	2023	2023	0	86 000	0	54 000	140 000	0
RET_OT_068	Investigate Saasveld PS 3 capacity	2023	2023	0	0	0	30 000	30 000	30 000
RET_OT_069	Investigate Saasveld PS 4 capacity	2023	2023	0	0	1 238 000	30 000	1 268 000	30 000
RET_OT_070	Investigate Saasveld PS 2 capacity	2023	2023	0	0	0	30 000	30 000	30 000
RET_OT_071	Investigate Saasveld PS 1 capacity	2023	2023	0	0	0	30 000	30 000	30 000
RET_OT_072	Investigate Saasveld slope/locality	2023	2023	31 000	37 000	0	121 000	157 000	3 600
RET_OT_073	Investigate Victoria Bay slope/locality	2023	2023	0	0	0	0	0	0
RET_OT_074	Investigate Victoria Bay slope/locality	2023	2023	0	0	0	0	0	0
RET_OT_075	Construct Victoria Bay PS 2 and rising main	2028	2028	0	2 087 000	1 587 000	51 000	3 723 000	0
RET_OT_076	Investigate Outeniqua WWTW north sewer AB Info	2023	2023	0	0	0	160 000	160 000	144 000
RET_OT_077	Investigate Outeniqua WWTW south sewer AB info	2023	2023	0	0	0	200 000	200 000	180 000
RET_OT_078	Investigate Saasveld sewer AB info	2023	2023	119 000	119 000	0	120 000	239 000	10 800
RET_OT_082	Construct Kraaibosch outfall sewer	2028	2028	0	2 503 000	0	324 000	2 827 000	0
RET_OT_083	Construct Glenwood Erf R/8259 outfall sewer	2038	2038	0	160 000	0	54 000	214 000	0
RET_OT_084	Construct Glenwood Ext. (1) outfall sewer	2033	2033	0	401 000	0	54 000	455 000	0
RET_OT_086	Construct Kraaibosch 195/5 outfall sewer	2033	2033	0	1 313 000	0	108 000	1 421 000	0

RET_OT_087	Construct Sawmill outfall sewer	2028	2033	0	5 869 000	1 863 000	444 000	8 176 000	0
RET_OT_088	Construct Sawmill outfall sewer	2033	2033	0	484 000	0	54 000	538 000	0
RET_OT_089	Construct Kraaibosch (2) outfall sewer	2033	2033	0	404 000	0	54 000	458 000	0
RET_OT_090	Construct Kraaibosch AH PS and outfall sewer	2033	2033	0	1 346 000	0	108 000	1 454 000	0
RET_OT_091	Construct Kraaibosch AH PS and outfall sewer	2033	2033	0	1 743 000	5 452 000	60 000	7 253 000	0
RET_OT_092	Construct Kraaibosch (3) PS interim rising main	2028	2033	0	0	0	0	0	0
RET_OT_093	Construct Sallywood City outfall sewer	2028	2028	0	6 142 000	0	274 000	6 416 000	0
RET_OT_094	Construct Thembalethu Ext.10B outfall sewer	2033	2058	0	3 747 000	0	108 000	3 855 000	0
RET_OT_095	Construct Ballots Bay PSs and rising mains	2033	2033	0	967 000	4 272 000	20 000	5 258 000	0
RET_OT_096	Construct Sallywood City outfall sewer	2033	2048	0	2 602 000	0	110 000	2 711 000	0
RET_OT_097	Construct Ballots Bay PSs and rising mains	2033	2033	0	1 474 000	3 024 000	14 000	4 511 000	0
RET_OT_098	Construct Thembalethu Ext.12A PS and outfall sewer	2058	2058	0	2 560 000	0	218 000	2 778 000	0
RET_OT_099	Construct Thembalethu Ext.12A PS and outfall sewer	2063	2063	0	920 000	0	54 000	974 000	0
RET_OT_100	Construct Thembalethu Ext.12A PS and outfall sewer	2058	2058	0	4 059 000	0	108 000	4 167 000	0
RET_OT_101	Construct Thembalethu Ext.12A PS and outfall sewer	2058	2058	0	1 693 000	6 690 000	44 000	8 426 000	0
RET_OT_102	Construct Thembalethu Ext.12A PS and outfall sewer	2058	2058	0	1 435 000	0	168 000	1 601 000	0
RET_OT_103	Construct Thembalethu Ext.11B PS and outfall sewer	2068	2068	0	793 000	0	54 000	847 000	0
RET_OT_104	Construct Thembalethu Ext.11B PS and outfall sewer	2058	2058	0	1 994 000	6 941 000	44 000	8 979 000	0
RET_OT_105	Construct Thembalethu Ext.11B PS and outfall sewer	2058	2058	0	599 000	0	54 000	653 000	0
RET_OT_106	Construct Far Hills Hotel outfall sewer	2033	2033	0	3 313 000	0	270 000	3 583 000	0
RET_OT_107	Construct Far Hills Hotel outfall sewer	2033	2033	0	2 856 000	0	224 000	3 079 000	0
RET_OT_108	Construct Far Hills Hotel outfall sewer	2033	2033	0	4 102 000	6 636 000	44 000	10 782 000	0
RET_OT_109	Abandon Saasveld outfall sewer and PS 6 and construct new outfall sewer	2068	2068	0	3 810 000	0	177 000	3 987 000	0
RET_OT_110	Construct Woodifields PSs and outfall sewer	2068	2068	0	405 000	4 497 000	29 000	4 931 000	0
RET_OT_111	Construct Woodifields PSs and outfall sewer	2068	2068	0	2 731 000	0	169 000	2 899 000	0
RET_OT_112	Construct Woodifields PSs and outfall sewer	2068	2068	0	1 836 000	0	166 000	2 001 000	0
RET_OT_113	Construct Woodifields PSs and outfall sewer	2068	2068	0	2 997 000	5 917 000	132 000	9 045 000	0
RET_OT_114	Abandon Saasveld outfall sewer and PS 6 and construct new outfall sewer	2068	2068	0	0	512 000	0	512 000	0
RET_OT_115	Construct Woodifields PSs and outfall sewer	2068	2068	0	658 000	3 024 000	14 000	3 695 000	0
RET_OT_116	Construct Woodifields PSs and outfall sewer	2068	2068	0	3 786 000	0	216 000	4 002 000	0
RET_OT_117	Construct Woodifields PSs and outfall sewer	2068	2068	0	260 000	3 442 000	14 000	3 715 000	0
RET_OT_118	Construct Woodifields PSs and outfall sewer	2068	2068	0	781 000	0	108 000	889 000	0
RET_OT_119	Abandon Thembalethu PS 7 and construct new outfall sewer	2028	2028	0	1 132 000	0	62 000	1 193 000	0
RET_OT_120	Abandon Thembalethu PS 7 and construct new outfall sewer	2028	2028	0	0	366 000	0	366 000	0
RET_OT_121	Construct Hansmoeskraal 202/58-59-61 outfall sewer	2028	2043	0	3 122 000	0	218 000	3 339 000	0
RET_OT_122	Construct Le Grand PSs and outfall sewer	2033	2033	0	2 279 000	0	108 000	2 387 000	0
RET_OT_123	Construct Le Grand PSs and outfall sewer	2033	2033	0	684 000	3 460 000	14 000	4 157 000	0
RET_OT_124	Construct Le Grand PSs and outfall sewer	2033	2033	0	1 018 000	3 024 000	68 000	4 110 000	0
RET_OT_125	Construct Hansmoeskraal (4) PS and outfall sewer	2058	2058	0	953 000	0	108 000	1 061 000	0
RET_OT_126	Construct Hansmoeskraal (4) PS and outfall sewer	2058	2058	0	885 000	3 024 000	14 000	3 922 000	0
RET_OT_127	Construct Hansmoeskraal (4) PS and outfall sewer	2048	2053	0	2 067 000	0	162 000	2 229 000	0
RET_OT_128	Construct Hansmoeskraal 202/41 PS and outfall sewer	2048	2048	0	1 100 000	3 660 000	15 000	4 775 000	0
RET_OT_129	Construct Hansmoeskraal 202/41 PS and outfall sewer	2048	2048	0	167 000	0	54 000	221 000	0
RET_OT_130	Construct Hansmoeskraal 202/41 PS and outfall sewer	2048	2048	0	2 037 000	0	54 000	2 091 000	0
RET_OT_131	Construct Hansmoeskraal (5) PSs and outfall sewer	2028	2063	0	5 080 000	0	216 000	5 296 000	0
RET_OT_132	Construct Hansmoeskraal (5) PSs and outfall sewer	2028	2028	0	1 783 000	3 254 000	14 000	5 051 000	0
RET_OT_133	Comnstruct Hansmoeskraal (2) PS and outfall sewer	2028	2028	0	1 647 000	0	110 000	1 757 000	0
RET_OT_134	Comnstruct Hansmoeskraal (2) PS and outfall sewer	2028	2028	0	881 000	7 758 000	69 000	8 708 000	0
RET_OT_135	Construct Hansmoeskraal (5) PSs and outfall sewer	2048	2048	0	1 016 000	3 411 000	14 000	4 440 000	0

RET_OT_136	Construct Hansmoeskraal 202/58-59-61 outfall sewer	2043	2043	0	3 665 000	293 000	168 000	4 124 000	0
RET_OT_137	George WTP sludge connection	2023	2023	0	0	0	0	0	0
RET_OT_139	Upgrade Thembalethu PS 5 outfall sewer	2028	2028	0	2 502 000	0	575 000	3 075 000	18 000
RET_OT_140	Construct George Erf 464 PS F1 pump station and rising main	2033	2033	0	1 657 000	5 978 000	44 000	7 678 000	0
RET_OT_141	Construct George Erf 464 PS F2 pump station and rising main	2033	2033	0	656 000	4 005 000	17 000	4 678 000	0
RET_OT_142	Construct George Erf 464 (University) outfall sewers	2033	2033	0	4 206 000	0	395 000	4 599 000	0
RET_OT_143	Upgrade Urbansville outfall sewer	2033	2033	286 000	489 000	0	177 000	666 000	0
RET_OT_145	Upgrade Saasveld outfall sewer	2033	2033	1 552 000	2 093 000	0	579 000	2 672 000	0
RET_OT_146	Construct Hansmoeskraal 202/58-59-61 outfall sewer	2043	2043	0	601 000	0	54 000	655 000	0
RET_OT_147	Construct interim Hansmoeskraal1 PS and rising main	2023	2043	0	0	0	0	0	0
RET_OT_148	Construct Correctional Services Erf 3284 outfall sewer	2033	2033	0	694 000	0	54 000	748 000	0
RET_OT_149	Construct George Erf 195/325 PS rising main	2023	2028	49 771 000	49 984 000	2 420 000	7 391 000	59 794 000	7 200
RET_OT_150	Construct Hansmoeskraal 202-46 and outfall sewer	2063	2063	0	104 000	0	54 000	158 000	0
RET_OT_152	Investigate Thembalethu PS 3 outfall sewer	2023	2023	9 000	10 000	0	115 000	125 000	3 600
RET_OT_153	Construct Kraaibosch 195/62 PS F1 outfall sewer	2033	2033	0	4 186 000	0	432 000	4 618 000	0
RET_OT_154	Construct Kraaibosch 195/62 PS F1 rising main	2033	2033	0	470 000	3 194 000	14 000	3 677 000	0
RET_OT_155	Construct Kraaibosch 195/3 PS F1 outfall sewer	2033	2033	0	1 613 000	0	164 000	1 777 000	0
RET_OT_156	Construct Kraaibosch 195/21 outfall sewer	2033	2033	0	2 585 000	0	378 000	2 963 000	0
RET_OT_157	Construct Kraaibosch 195/3 outfall sewer	2033	2033	0	1 132 000	0	216 000	1 348 000	0
RET_OT_158	Construct Kraaibosch 195/21 PS F1 outfall sewer	2033	2033	0	965 000	0	162 000	1 127 000	0
RET_OT_159	Construct Kraaibosch 195/21 PS F2 outfall sewer	2033	2033	0	306 000	0	108 000	414 000	0
RET_OT_160	Construct interim Kraaibosch 195/21 PS F1 and rising main	2033	2033	0	0	0	0	0	0
RET_OT_161	Construct Garden Route City outfall sewer	2028	2033	0	8 411 000	0	972 000	9 383 000	0
RET_OT_162	Construct Garden Route City outfall sewer	2028	2028	0	14 209 000	0	1 266 000	15 473 000	0
RET_OT_163	Construct interim Garden Route City PS and rising main	2028	2028	0	0	0	0	0	0
RET_OT_164	Construct interim Garden Route City WWTP	2028	2028	0	0	0	0	0	0
RET_OT_165	Construct Crocodile Farm outfall sewer	2028	2028	0	363 000	0	54 000	417 000	0
RET_OT_166	Upgrade Saasveld PS 3 outfall sewer	2023	2023	85 000	100 000	0	112 000	212 000	3 600
RET_OT_167	Construct Pacaltsdorp Ext.3A outfall sewers	2038	2038	0	1 663 000	0	162 000	1 825 000	0
RET_OT_168	Construct Hansmoeskraal (1a) outfall sewer	2028	2028	0	1 008 000	0	108 000	1 116 000	0
RET_OT_169	Construct Hansmoeskraal (1a) outfall sewer	2028	2028	0	1 532 000	0	162 000	1 694 000	0
Total				117 558 000	366 370 000	678 028 000	39 012 000	1 083 356 000	648 000


Saasveld PS 1
Eden George PS
George Erf 464 PS F2
George Erf 25091 PS
Saasveld PS 2
Saasveld PS 4
Saasveld PS 3
George Erf 464 PS F1
Glenwood PS
Kingswood PS
Rooirivier PS
Kingswood PS F1
Woodifields PS F1
Saasveld PS 6
Woodifields PS F3
Woodifields PS F2
Welgelegen PS
Kingswood PS 1
Kingswood PS 2
Bos-en-Dal PS
Kraaibosch PS
Kraaibosch Ridge PS 1
George Erf 195/325 PS
Kraaibosch Ridge PS 2
Woodifields PS F4
Blue Mountain PS 2
Meul PS
Blue Mountain PS 1
Kraaibosch Ridge PS 3
Kraaibosch3 PS
Kraaibosch5 PS
Kraaibosch Ridge PS 4
Schaapkop PS
Tamsui PS
Stludge Outlet
Pacaltsdorp PS 5
Parkdene PS 1
Parkdene PS 2
Parkdene PS 3
Rosedale PS 2
Thembalethu PS 1
Thembalethu PS A
Pacaltsdorp PS 7
Thembalethu PS B
Pacaltsdorp PS 2
Rosedale PS 1
Pacaltsdorp Ext.3A PS
Thembalethu PS 2
Victoria Bay PS 2
(Victoria Bay CT)
Outeniqua WWTW
Victoria Bay PS
Thembalethu PS 5
Sludge PS
Thembalethu PS 7
195/95 PS
195/152 PS
195/232 PS
195/153 PS
195/88 PS
195/97 PS
Destiny Africa PS
Kraaibosch4 PS
Pacaltsdorp West PS
Pacaltsdorp PS 1
Thembalethu Ext.10 PS
Ballots Bay PS
Thembalethu PS 6
Pacaltsdorp PS 4
Thembalethu Ext.11B PS
Thembalethu Ext.12A PS
Pacaltsdorp PS 6
Pacaltsdorp PS 3
Hansmoeskraal2 PS
Hansmoeskraal1 PS
Hansmoeskraal5 PS 2
Hansmoeskraal7 PS
Hansmoeskraal5 PS 1
Hansmoeskraal4 PS
Le Grand2 PS F2
Le Grand PS
(Le Grand CT)
Oubaai PS 4
Le Grand2 PS F1
Oubaai PS 1
Le Grand PS 1
Le Grand PS 2
Le Grand1 PS
GLS
Scale 1:15000
LEGEND
Model Data Date:
Mar 2024
Swift Data Date:
Mar 2024
GEORGE



Scale 1:3000 Detail 1

GLS Infrastructure planning

Scale 1:1500
0 12 24 36 48 60 m

LEGEND

Gravity Pipes:
- Existing Gravity System
- Existing Private System
- Abandoned Gravity System
- Existing Schematic System
- Upgrade Gravity Main
- Investigate Gravity Main
- Investigate Pipe slope
- Future Gravity Main
- Future Schematic pipes
- Future Alternative GM

Rising Mains:
- Existing Rising Main
- Existing Private RM
- Abandoned RM
- Existing Schematic RM
- Upgrade Rising Main
- Investigate Rising Main
- Future Rising Main
- Future Alternative RM

Symbols:
- Encased
- Bridge
- Culvert/Sleeve
- Siphon
- Tunnel

Pump Stations:
- Existing Pump Station
- Upgrade Existing Pumps
- Investigate Existing Pumps
- Eliminate Pump Station
- Future Pump Station
- Private Pump Station

Waste Water Treatment Plants:
- Existing WWTP
- Upgrade Existing WWTP
- Eliminate Existing WWTP
- Proposed WWTP
- Private WWTP

Areas:
- Future Drainage
- Future Pump Stations

Developments:
- Existing Areas (new sewers)
- Future Areas (new sewers)
- Future Areas (no sewers)
- Informal Areas

Model Data Date:
Mar 2024

Swift Data Date:
Mar 2024

GEORGE
THE CITY FOR ALL REASONS

Scale 1:40000

George
Current System

Model Data Date:
Dec 2021

Swift Data Date:
Dec 2021

George
Future System

Model Data Date:
Dec 2021

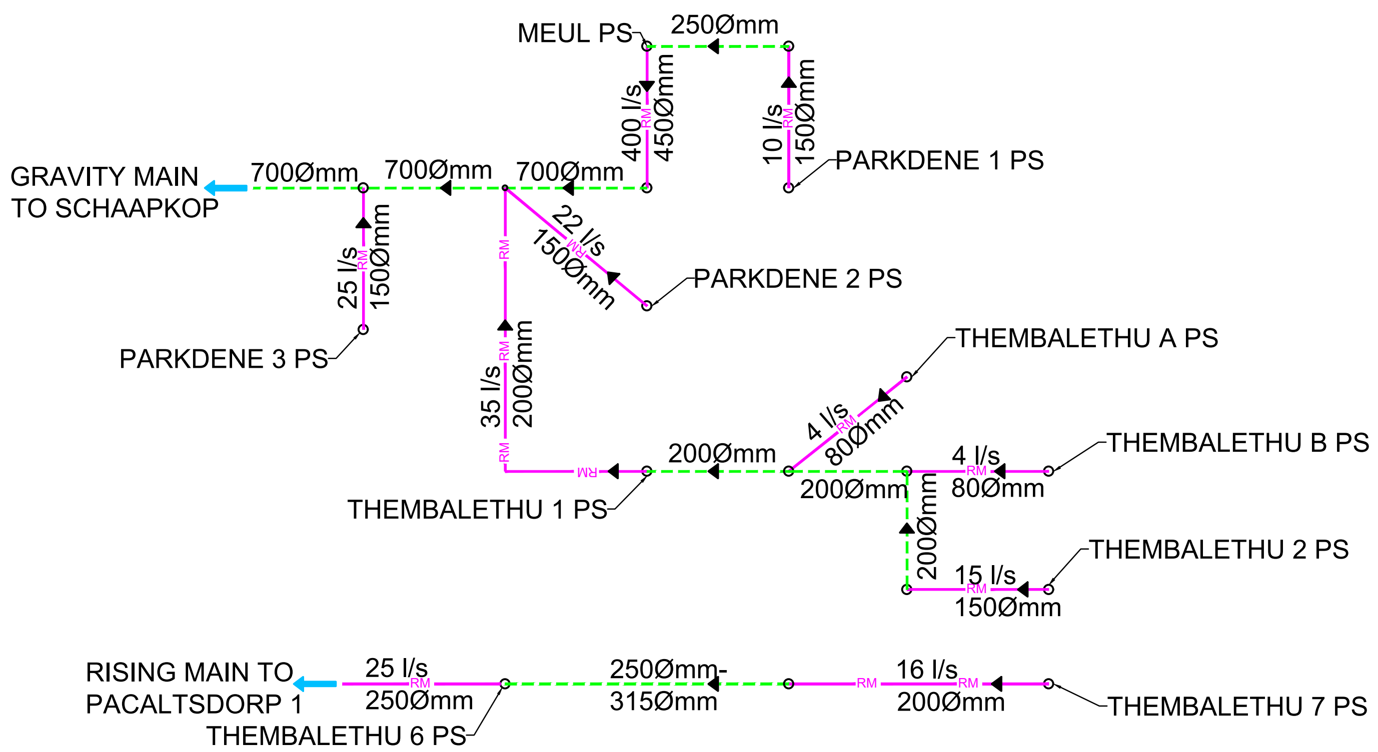
Swift Data Date:
Dec 2021

ANNEXURE B :

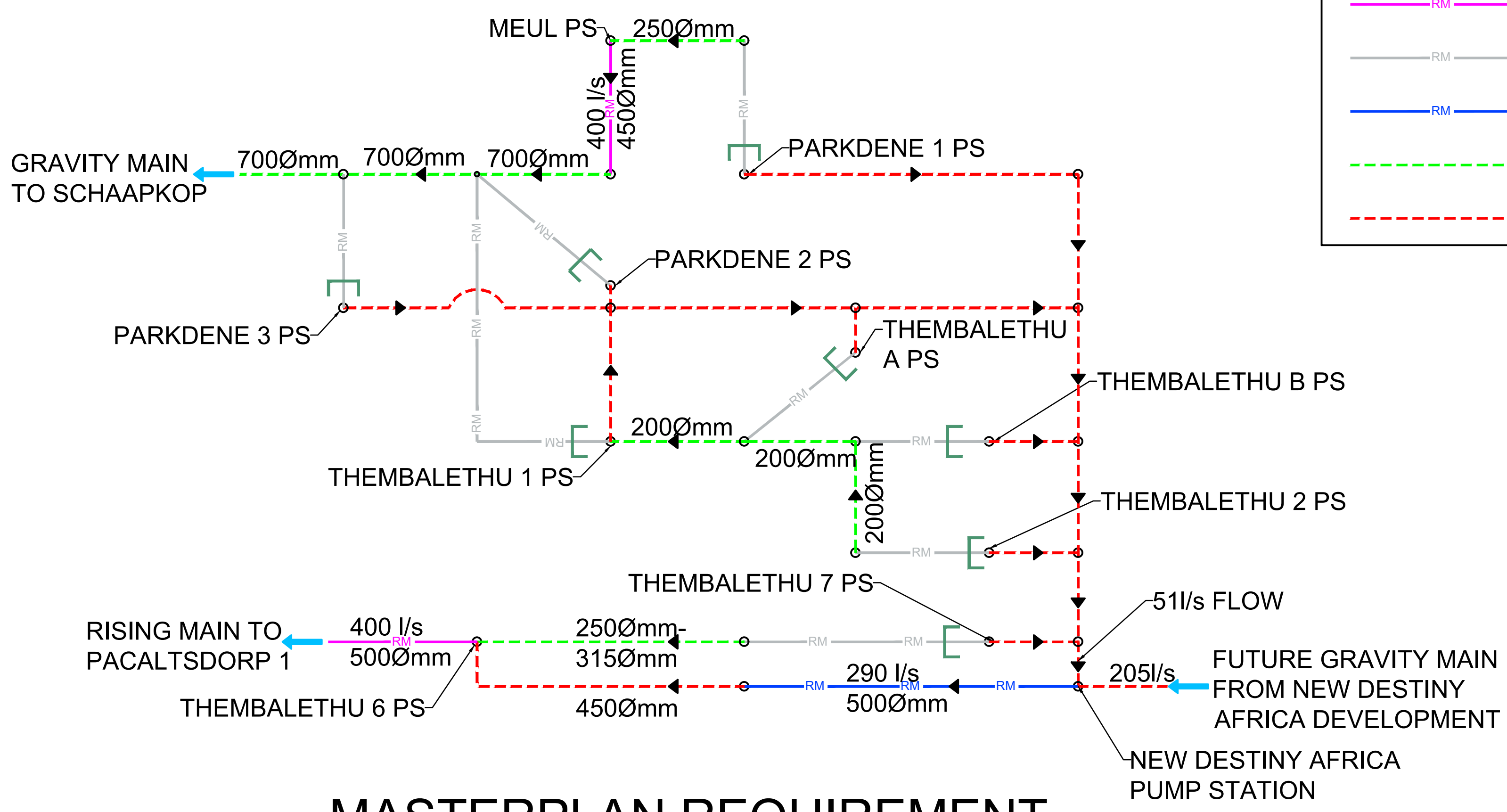
Schematic for Optioneering Conceptualisation

LEGEND

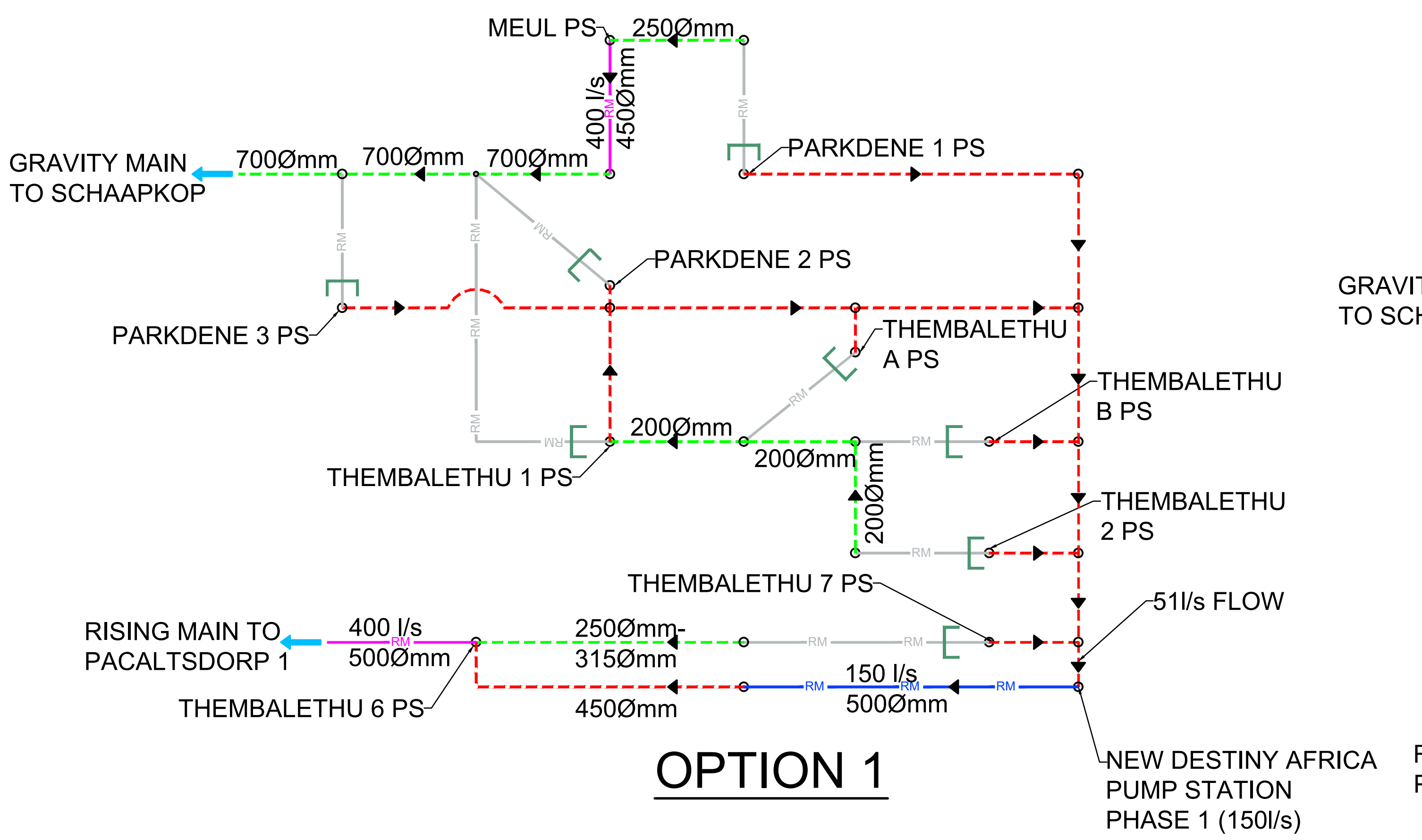
- RM — EXISTING RISING MAIN
- RM — EXISTING RISING MAIN TO BE DISCONTINUED
- RM — NEW RISING MAIN
- EXITING GRAVITY MAIN
- NEW GRAVITY MAIN



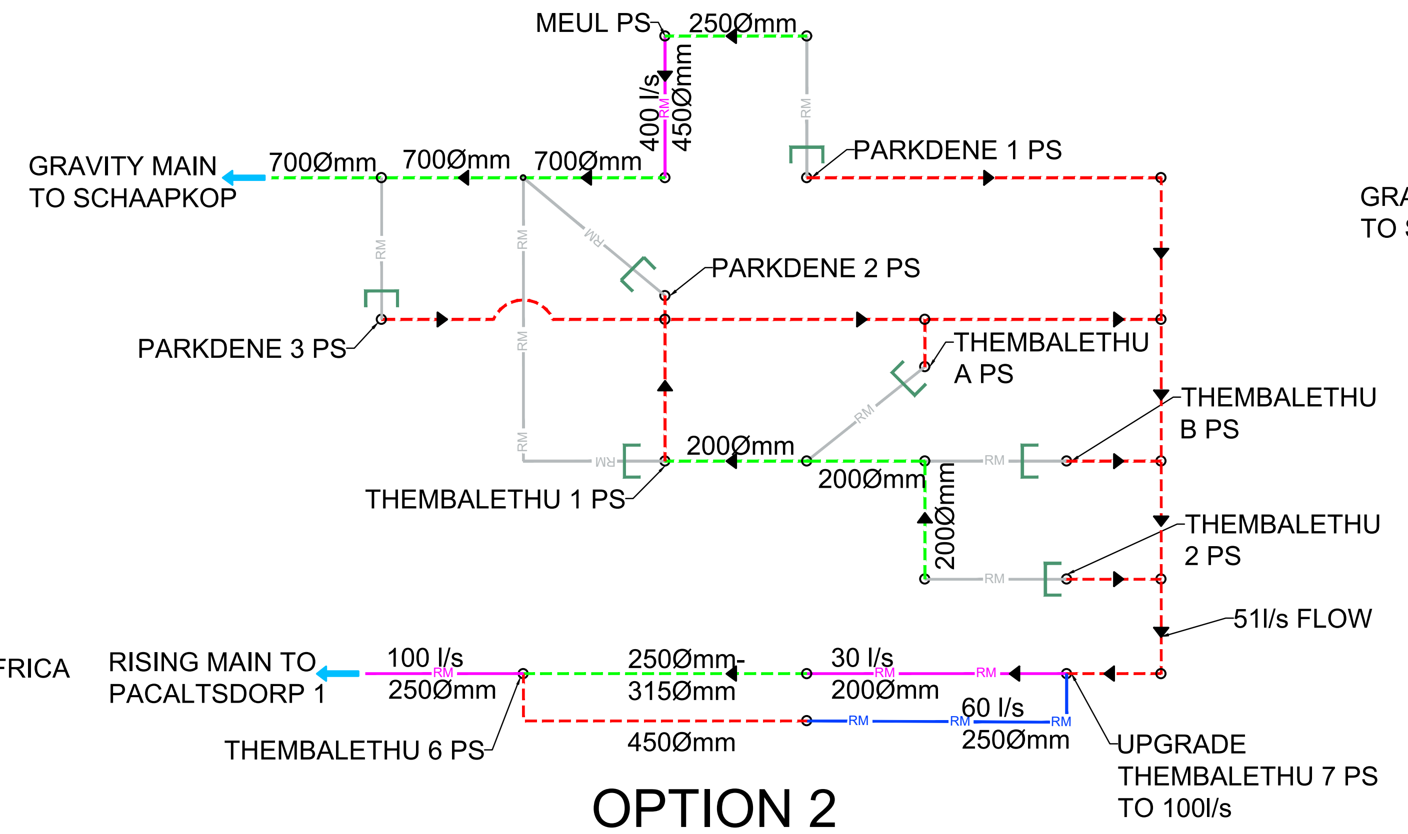
EXISTING NETWORK



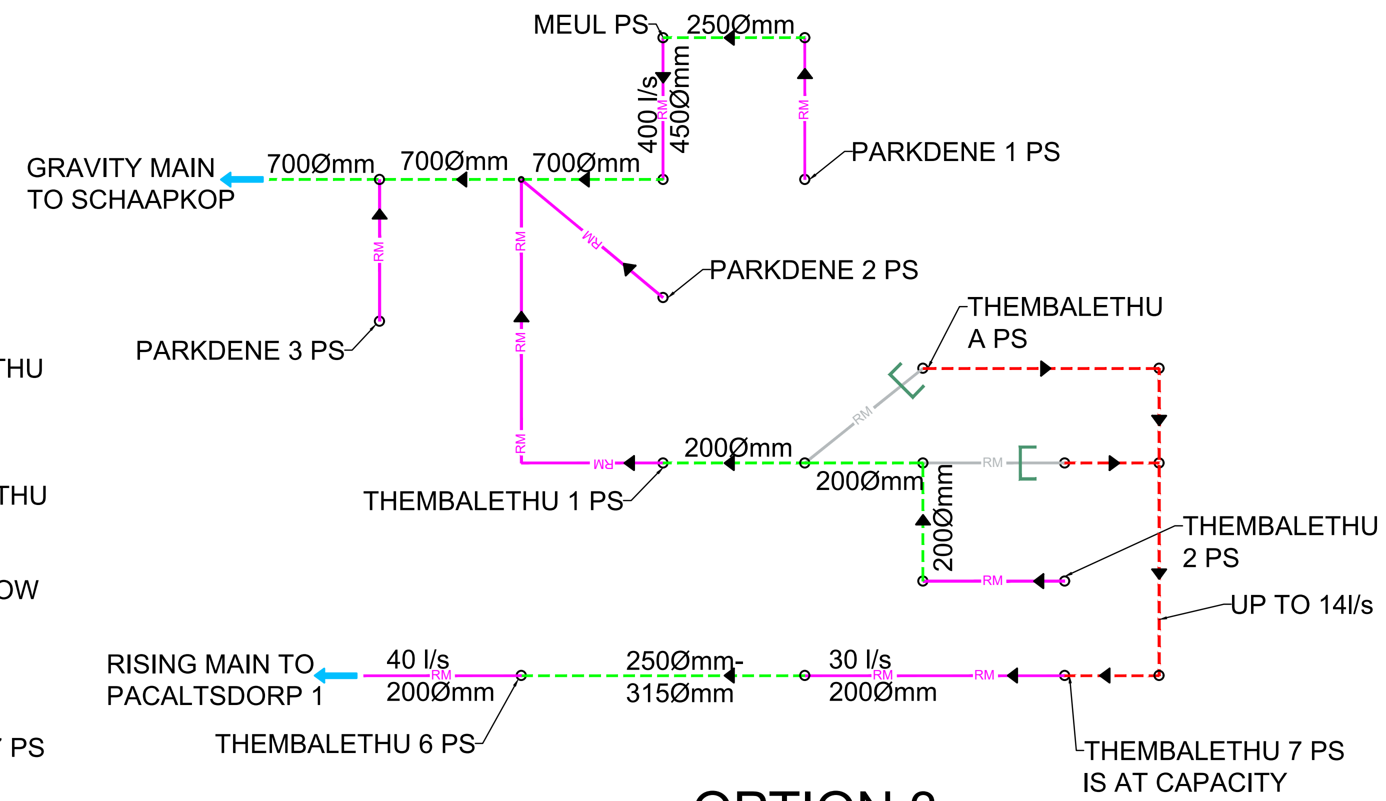
MASTERPLAN REQUIREMENT



OPTION 1



OPTION 2



OPTION 3

SCALEBAR

N.T.S

All dimensions must be verified on site before the works commence. Refer any discrepancies to the Engineer.

The reference made to Engineer will also refer to Employer's Agent for GCC 2015 Contracts

REV	DESCRIPTION	DATE	REV BY	CHKD
A	ISSUED FOR INFORMATION	'23-07-05	AL	CD

REVISIONS

DESIGNED	AL
DRAWN	AL
CHECKED	CD

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APPROVED
ENGINEERS:
DATE: 2024-05-08

CLIENT
GEORGE
THE CITY FOR ALL REASONS

APPROVED
CLIENT:
DATE:

PROJECT
THEMBALETHU EASTERN BULK
GRAVITY SEWER UPGRADE

TITLE
DESTINY AFRICA PUMP STATION RISING
MAIN & GRAVITY MAIN CONSTRUCTION
PROPOSED ALTERNATIVES

SCALE on A2	SHEET
N.T.S	1 OF 1
CONTRACT No.	PROJECT No.
N/A	C23176

DRAWING No. C23176-C-Figure1 REV A

COORDINATE SYSTEM: N/A

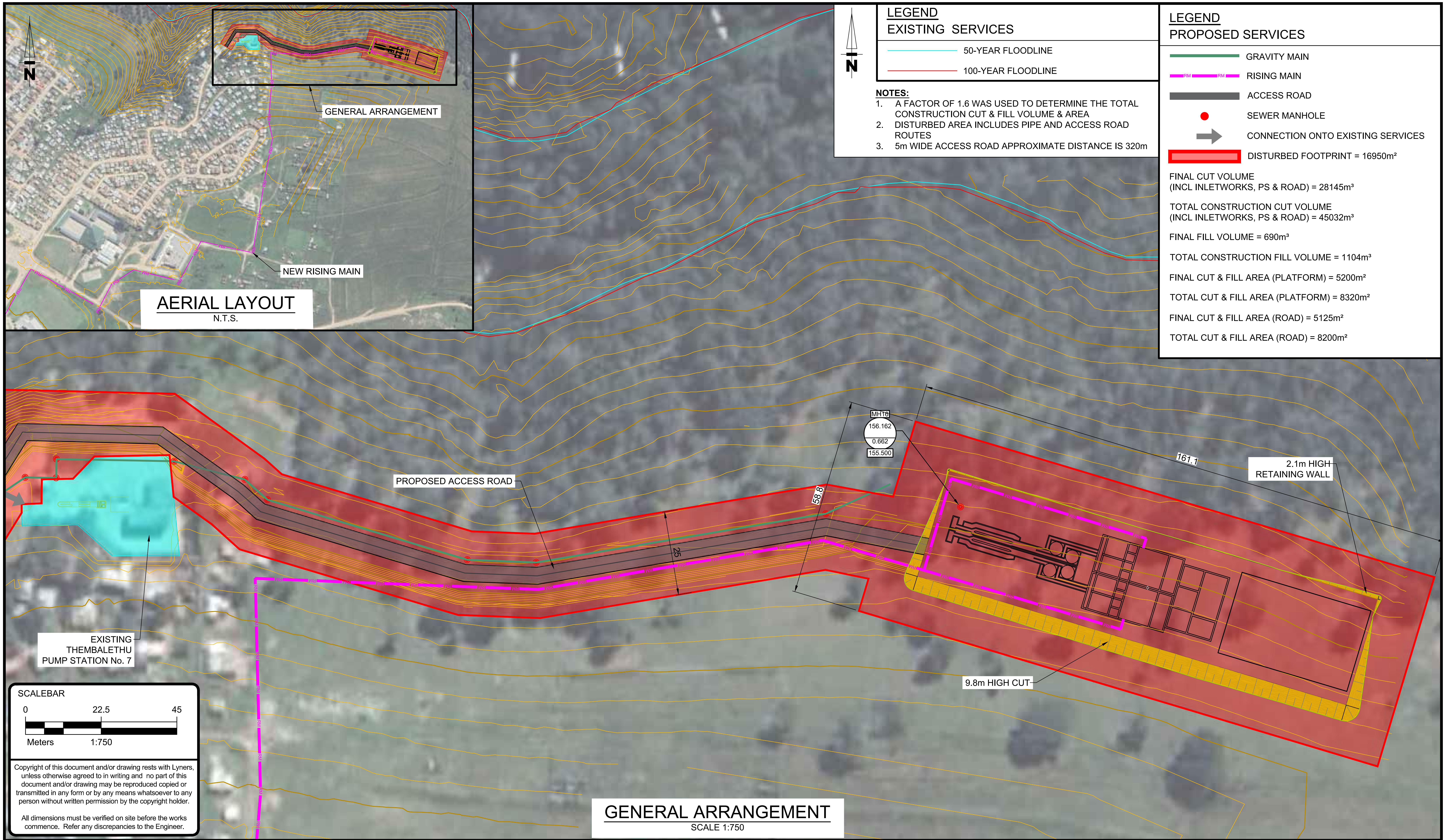
Date: Checked: 2024-05-08 Auditing: Arnold Louw

iso full bleed a2 (420.00 x 594.00 mm) Lyners_AutoCAD.ctb 2024-05-08

U:\WERKE\2300\23176 CG - THEMBALETHU EASTERN BULK GRAVITY SEWER UPGRADE\DRAWINGS\1.2 ACTIVE\C23176 - C - FIGURE1 (DESTINY AFRICA PUMP STATION RISING MAIN & GRAVITY MAIN CONSTRUCTION PROPOSED ALTERNATIVES).DWG

ANNEXURE C :

Drawings of Pump Station Layout Options



All dimensions must be verified on site before the works commence. Refer any discrepancies to the Engineer.

REV	DESCRIPTION	DATE	REV BY	CHKD
E	MINOR AMENDMENTS	'25-08-07	AL	CD
D	RISING MAIN & IMAGE AMENDED	'25-07-01	AL	CD
C	DRAWING TITLE BLOCK AMENDED	'25-05-16	JP	CD
B	INLET & PS LAYOUT AMENDED	'24-10-30	AL	CD
A	ISSUED FOR INFORMATION	'24-10-16	ES	CD

REVISIONS

DESIGNED	AL
DRAWN	ES
CHECKED	CD

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APPROVED
ENGINEERS:
DATE: 2025-10-07

CLIENT
GEORGE
THE CITY FOR ALL REASONS

APPROVED
CLIENT:
DATE:

PROJECT
UPGRADING OF THEMBALETHU PUMP STATION 7 AND CONSTRUCTION OF THE NEW THEMBALETHU REGIONAL PUMP STATION: PORTION 2: CIVIL, STRUCTURAL, MECHANICAL & ELECTRICAL WORKS

TITLE
PROPOSED INLETWORKS & PUMP STATION CONCEPT LAYOUT: OPTION 1

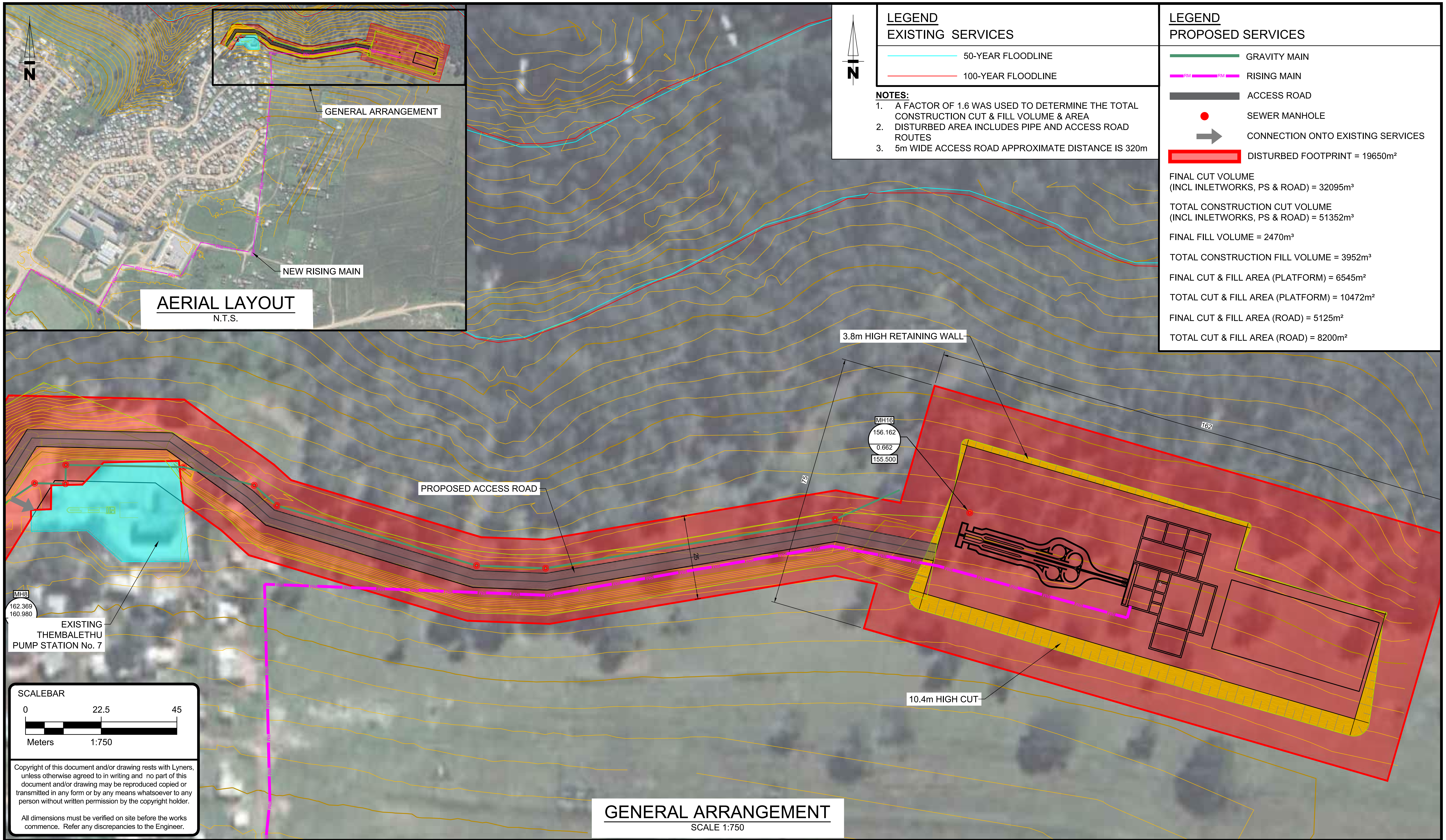
SCALE on A2	SHEET
AS SHOWN	1 OF 4
CONTRACT No.	PROJECT No.
CE	23176CG

DRAWING No. 23176-CG-FIG1
REV E
COORDINATE SYSTEM: WGS84 / Lo23°

Auditing: Jesse-James Pleiss 2025-10-07 Checked: Date:

iso full bleed a2 (420.00 x 594.00 mm) Lyners_AutoCAD.ctb 2025-10-07

U:\WERKE\2300\23176 CG - THEMBALETHU EASTERN BULK GRAVITY SEWER UPGRADE\DRAWINGS\1.2 ACTIVE\REPORT FIGURES\C23176-CG-FIG1_REV 1 (PROPOSED INLETWORKS AND PS OPTION 1).DWG



LEGEND
EXISTING SERVICES

- 50-YEAR FLOODLINE
- 100-YEAR FLOODLINE

NOTES:

1. A FACTOR OF 1.6 WAS USED TO DETERMINE THE TOTAL CONSTRUCTION CUT & FILL VOLUME & AREA
2. DISTURBED AREA INCLUDES PIPE AND ACCESS ROAD ROUTES
3. 5m WIDE ACCESS ROAD APPROXIMATE DISTANCE IS 320m

LEGEND
PROPOSED SERVICES

- GRAVITY MAIN
- RISING MAIN
- ACCESS ROAD
- SEWER MANHOLE
- CONNECTION ONTO EXISTING SERVICES
- DISTURBED FOOTPRINT = 19650m²

FINAL CUT VOLUME
(INCL INLETWORKS, PS & ROAD) = 32095m³

TOTAL CONSTRUCTION CUT VOLUME
(INCL INLETWORKS, PS & ROAD) = 51352m³

FINAL FILL VOLUME = 2470m³

TOTAL CONSTRUCTION FILL VOLUME = 3952m³

FINAL CUT & FILL AREA (PLATFORM) = 6545m²

TOTAL CUT & FILL AREA (PLATFORM) = 10472m²

FINAL CUT & FILL AREA (ROAD) = 5125m²

TOTAL CUT & FILL AREA (ROAD) = 8200m²

SCALEBAR

0 22.5 45

Meters 1:750

All dimensions must be verified on site before the works commence. Refer any discrepancies to the Engineer.

GENERAL ARRANGEMENT
SCALE 1:750

REV	DESCRIPTION	DATE	REV BY	CHKD
E	MINOR AMENDMENTS	'25-08-07	AL	CD
D	RISING MAIN & IMAGE AMENDED	'25-07-01	AL	CD
C	DRAWING TITLE BLOCK AMENDED	'25-05-16	JP	CD
B	INLET & PS LAYOUT AMENDED	'24-10-30	AL	CD
A	ISSUED FOR INFORMATION	'24-10-16	AL	CD

REVISIONS

DESIGNED	AL
DRAWN	ES
CHECKED	CD

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APPROVED
ENGINEERS:
DATE: 2025-10-07

CLIENT

GEORGE
THE CITY FOR ALL REASONS

APPROVED
CLIENT:
DATE:

PROJECT

UPGRADING OF THEMBALETHU PUMP STATION 7 AND CONSTRUCTION OF THE NEW THEMBALETHU REGIONAL PUMP STATION: PORTION 2: CIVIL, STRUCTURAL, MECHANICAL & ELECTRICAL WORKS

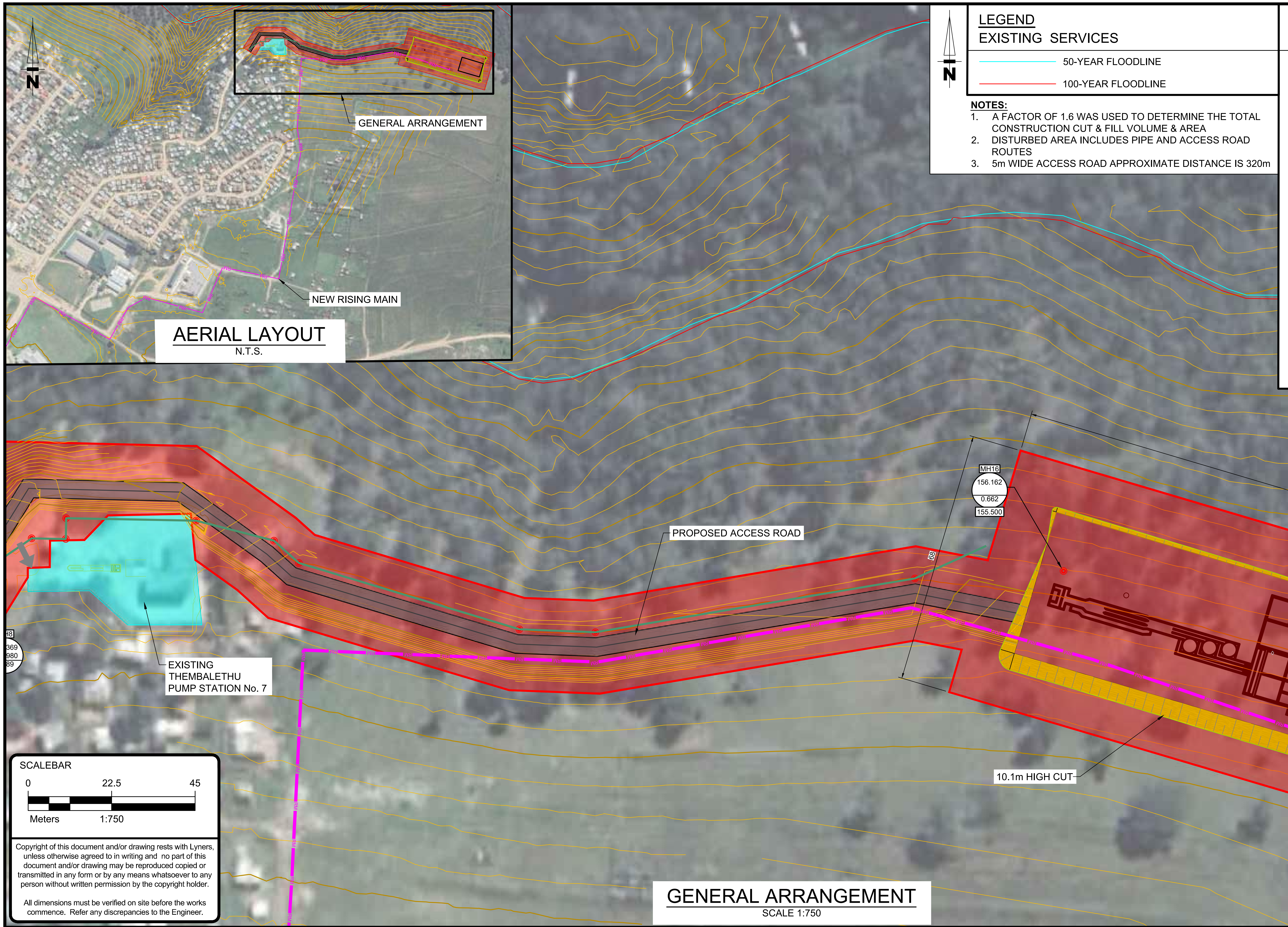
TITLE

PROPOSED INLETWORKS & PUMP STATION CONCEPT LAYOUT: OPTION 2

SCALE on A2: AS SHOWN	SHEET: 2 OF 4
CONTRACT No.: CE	PROJECT No.: 23176CG
DRAWING No.: 23176-CG-FIG2	REV: E

COORDINATE SYSTEM: WGS84 / Lo23°

Auditing: Jesse-James Plessis 2025-10-07 Checked: Date:



LEGEND
EXISTING SERVICES

- 50-YEAR FLOODLINE
- 100-YEAR FLOODLINE

NOTES:
1. A FACTOR OF 1.6 WAS USED TO DETERMINE THE TOTAL CONSTRUCTION CUT & FILL VOLUME & AREA
2. DISTURBED AREA INCLUDES PIPE AND ACCESS ROAD ROUTES
3. 5m WIDE ACCESS ROAD APPROXIMATE DISTANCE IS 320m

LEGEND
PROPOSED SERVICES

- GRAVITY MAIN
- RISING MAIN
- ACCESS ROAD
- SEWER MANHOLE
- CONNECTION ONTO EXISTING SERVICES
- DISTURBED FOOTPRINT = 18425m²

FINAL CUT VOLUME (INCL INLETWORKS, PS & ROAD) = 29975m³

TOTAL CONSTRUCTION CUT VOLUME (INCL INLETWORKS, PS & ROAD) = 47960m³

FINAL FILL VOLUME = 1925m³

TOTAL CONSTRUCTION FILL VOLUME = 3080m³

FINAL CUT & FILL AREA (PLATFORM) = 6300m²

TOTAL CUT & FILL AREA (PLATFORM) = 10080m²

FINAL CUT & FILL AREA (ROAD) = 5125m²

TOTAL CUT & FILL AREA (ROAD) = 8200m²

SCALEBAR

0 22.5 45

Meters 1:750

All dimensions must be verified on site before the works commence. Refer any discrepancies to the Engineer.

REV	DESCRIPTION	DATE	REV BY	CHKD
E	MINOR MAMENDMENTS	'25-08-07	AL	CD
D	RISING MAIN & IMAGE AMENDED	'25-07-01	AL	CD
C	DRAWING TITLE BLOCK AMENDED	'25-05-16	JP	CD
B	INLET & PS LAYOUT AMENDED	'24-10-30	AL	CD
A	ISSUED FOR INFORMATION	'24-10-16	ES	CD

REVISIONS

DESIGNED	AL
DRAWN	ES
CHECKED	CD

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APPROVED
ENGINEERS:
DATE: 2025-10-07

CLIENT
GEORGE
THE CITY FOR ALL REASONS

APPROVED
CLIENT:
DATE:

PROJECT
UPGRADING OF THEMBALETHU PUMP STATION 7 AND CONSTRUCTION OF THE NEW THEMBALETHU REGIONAL PUMP STATION: PORTION 2: CIVIL, STRUCTURAL, MECHANICAL & ELECTRICAL WORKS

TITLE
PROPOSED INLETWORKS & PUMP STATION CONCEPT LAYOUT: OPTION 3

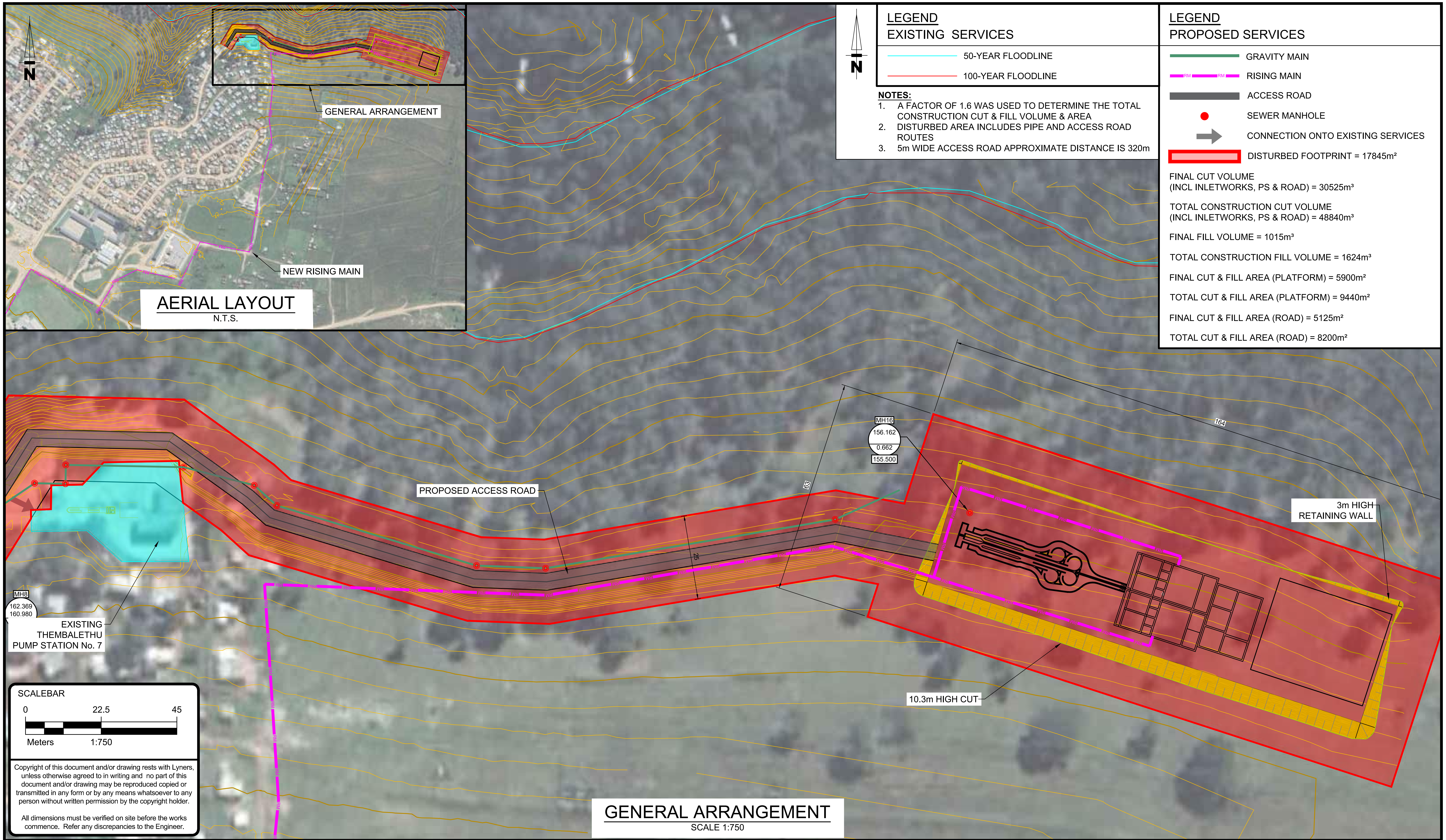
SCALE on A2: AS SHOWN	SHEET: 3 OF 4
CONTRACT No.: CE	PROJECT No.: 23176CG
DRAWING No.: 23176-CG-FIG3	REV: E

COORDINATE SYSTEM: WGS84 / Lo23°

Auditing: Jesse-James Pleass 2025-10-07 Checked: Date:

iso full bleed a2 (420.00 x 594.00 mm) Lyners_AutoCAD.ctb 2025-10-07

U:\WERKE\2300\23176 CG - THEMBALETHU EASTERN BULK GRAVITY SEWER UPGRADE\DRAWINGS\1.2 ACTIVE\REPORT FIGURES\C23176-CG-FIG3_REV 1 (PROPOSED INLETWORKS AND PS OPTION 3).DWG



GENERAL ARRANGEMENT
SCALE 1:750

LEGEND
EXISTING SERVICES

- 50-YEAR FLOODLINE
- 100-YEAR FLOODLINE

NOTES:
1. A FACTOR OF 1.6 WAS USED TO DETERMINE THE TOTAL CONSTRUCTION CUT & FILL VOLUME & AREA
2. DISTURBED AREA INCLUDES PIPE AND ACCESS ROAD ROUTES
3. 5m WIDE ACCESS ROAD APPROXIMATE DISTANCE IS 320m

LEGEND
PROPOSED SERVICES

- GRAVITY MAIN
- RISING MAIN
- ACCESS ROAD
- SEWER MANHOLE
- CONNECTION ONTO EXISTING SERVICES
- DISTURBED FOOTPRINT = 17845m²

FINAL CUT VOLUME (INCL INLETWORKS, PS & ROAD) = 30525m³

TOTAL CONSTRUCTION CUT VOLUME (INCL INLETWORKS, PS & ROAD) = 48840m³

FINAL FILL VOLUME = 1015m³

TOTAL CONSTRUCTION FILL VOLUME = 1624m³

FINAL CUT & FILL AREA (PLATFORM) = 5900m²

TOTAL CUT & FILL AREA (PLATFORM) = 9440m²

FINAL CUT & FILL AREA (ROAD) = 5125m²

TOTAL CUT & FILL AREA (ROAD) = 8200m²

SCALEBAR
0 22.5 45
Meters 1:750

REV	DESCRIPTION	DATE	REV BY	CHKD
C	RISING MAIN & IMAGE AMENDED	'25-06-03	ES	CD
B	DRAWING TITLE BLOCK AMENDED	'25-05-14	JP	CD
A	ISSUED FOR INFORMATION	'24-10-30	AL	CD

REVISIONS

DESIGNED	AL
DRAWN	ES
CHECKED	CD

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APPROVED
ENGINEERS:
DATE: 2025-10-07

CLIENT
GEORGE
THE CITY FOR ALL REASONS

APPROVED
CLIENT:
DATE:

PROJECT
UPGRADING OF THEMBALETHU PUMP STATION 7 AND CONSTRUCTION OF THE NEW THEMBALETHU REGIONAL PUMP STATION: PORTION 2: CIVIL, STRUCTURAL, MECHANICAL & ELECTRICAL WORKS

TITLE
PROPOSED INLETWORKS & PUMP STATION CONCEPT LAYOUT: OPTION 4

SCALE on A2	SHEET
AS SHOWN	4 OF 4
CONTRACT No. CE	PROJECT No. 23176CG

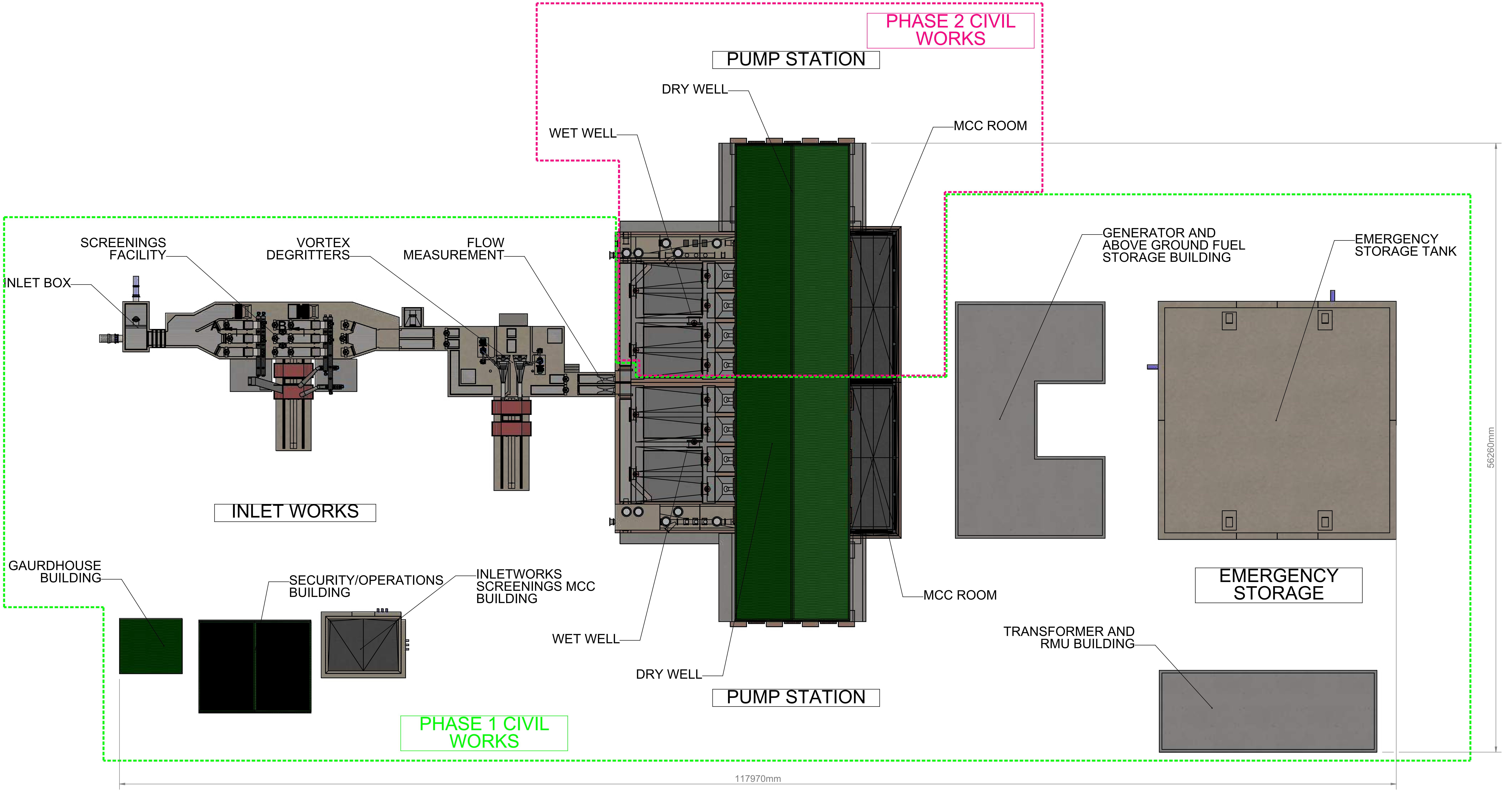
DRAWING No. 23176-CG-FIG4 REV C

COORDINATE SYSTEM: WGS84 / Lo23°

Auditing: Jesse-James Plessis 2025-10-07 Checked: Date:

ANNEXURE D :

Drawings of 3D Concept Model of Pump Station Based on Layout Option 3



ULTIMATE CAPACITY: PLAN VIEW OF THE NEW THEMBALETHU EAST PUMP STATION

SCALE 1:250

REV	DESCRIPTION	DATE	REV BY	CHKD
C	CLIENT COMMENTS ADDED	26-02-15	JP	CD
B	LAYOUT UPDATE TO OPTION 3	25-10-07	AL	CD
A	FOR PDR INFORMATION ONLY	23-03-01	AL	CD

REVISIONS

DESIGNED	JP
DRAWN	AL
CHECKED	CD

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APPROVED
ENGINEERS: N/A
DATE: 2026-02-15

CLIENT

GEORGE THE CITY FOR ALL REASONS

APPROVED
CLIENT: N/A
DATE: 2026-02-15

PROJECT

UPGRADING OF THEMBALETHU PUMP STATION 7 AND CONSTRUCTION OF THE NEW THEMBALETHU EAST PUMP STATION

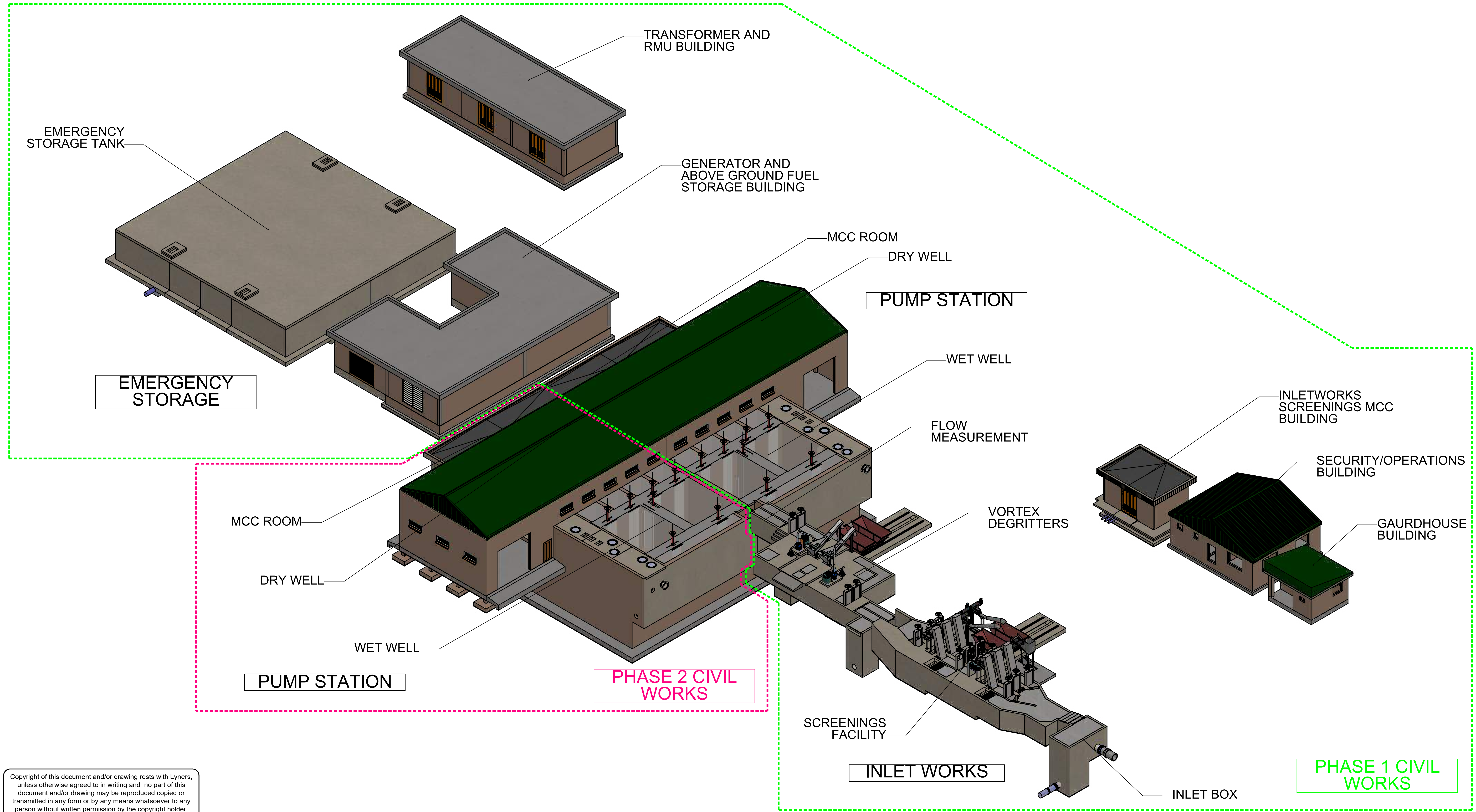
TITLE

ULTIMATE CAPACITY: TYPICAL PLAN AND ISOMETRIC CONCEPT LAYOUTS AND VIEWS

SCALE on A2	SHEET
AS SHOWN	1 OF 2
CONTRACT No.	PROJECT No.
20(W.P 8)	C23176

DRAWING No. 23176-C-PDR1 REV C

COORDINATE SYSTEM: N/A



ULTIMATE CAPACITY: ISOMETRIC VIEW OF THE NEW THEMBALETHU EAST PUMP STATION

NOT TO SCALE

REV	DESCRIPTION	DATE	REV BY	CHKD
C	CLIENT COMMENTS ADDED	26-02-15	JP	CD
B	LAYOUT UPDATE TO OPTION 3	25-10-07	AL	CD
A	FOR PDR INFORMATION ONLY	24-03-01	AL	CD

REVISIONS

DESIGNED	JP	
DRAWN	AL	
CHECKED	CD	

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APPROVED
ENGINEERS: N/A
DATE: 2026-02-15

CLIENT

GEORGE
THE CITY FOR ALL REASONS

APPROVED
CLIENT: N/A
DATE: 2026-02-15

PROJECT

UPGRADING OF THEMBALETHU PUMP STATION 7 AND CONSTRUCTION OF THE NEW THEMBALETHU EAST PUMP STATION

TITLE

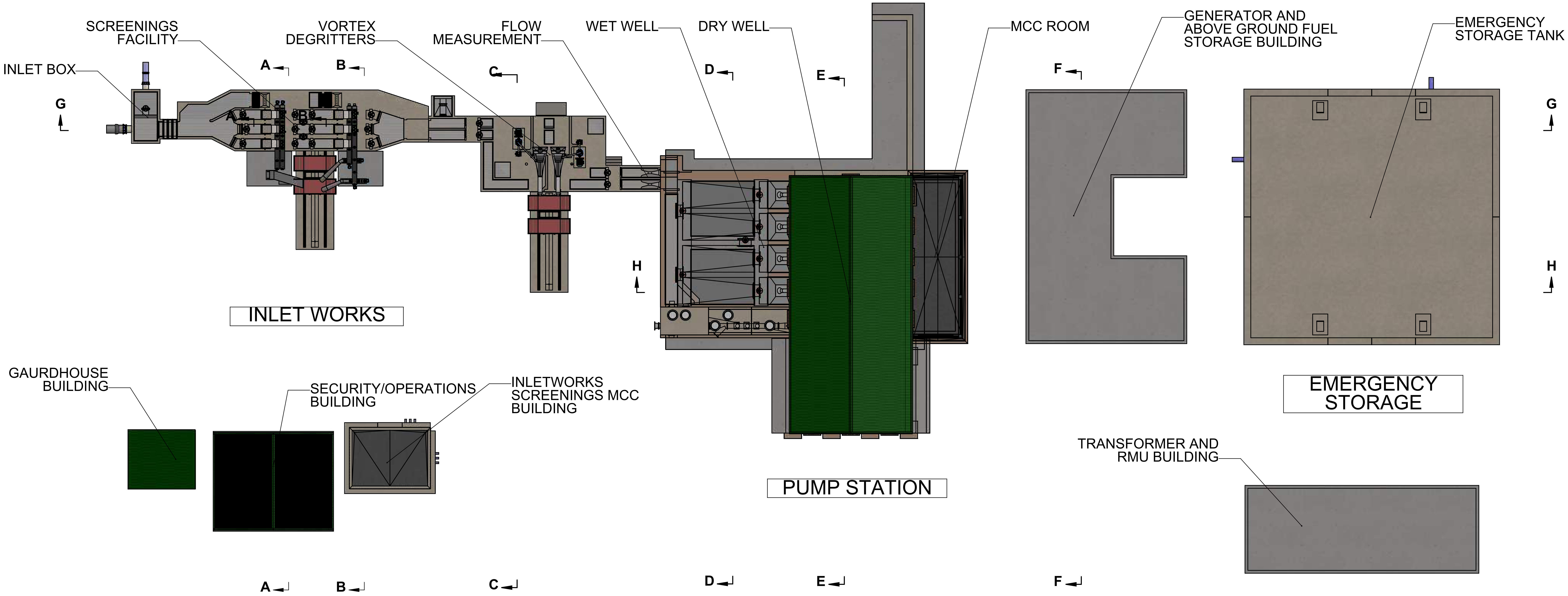
ULTIMATE CAPACITY: TYPICAL PLAN AND ISOMETRIC CONCEPT LAYOUTS AND VIEWS

SCALE on A2	SHEET
AS SHOWN	2 OF 2
PROJECT No.	PROJECT No.
20(W.P 8)	C23176

DRAWING No. 23176-C-PDR2 REV C

COORDINATE SYSTEM: N/A

iso a2 (420,00 x 594,00 mm) Lyners_SolidWorks.template



PHASE 1: PLAN VIEW OF THE NEW THEMBALETHU EAST PUMP STATION

SCALE 1:250

All dimensions must be verified on site before the works commence. Refer any discrepancies to the Engineer.

REV	DESCRIPTION	DATE	REV BY	CHKD
C	CLIENT COMMENTS ADDED	26-02-15	JP	CD
B	LAYOUT UPDATE TO OPTION 3	25-10-07	AL	CD
A	FOR PDR INFORMATION ONLY	23-03-01	AL	CD

REVISIONS

DESIGNED	JP
DRAWN	AL
CHECKED	CD

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APPROVED
ENGINEERS: N/A
DATE: 2026-02-15

CLIENT

GEORGE THE CITY FOR ALL REASONS

APPROVED
CLIENT: N/A
DATE: 2026-02-15

PROJECT

UPGRADING OF THEMBALETHU PUMP STATION 7 AND CONSTRUCTION OF THE NEW THEMBALETHU EAST PUMP STATION

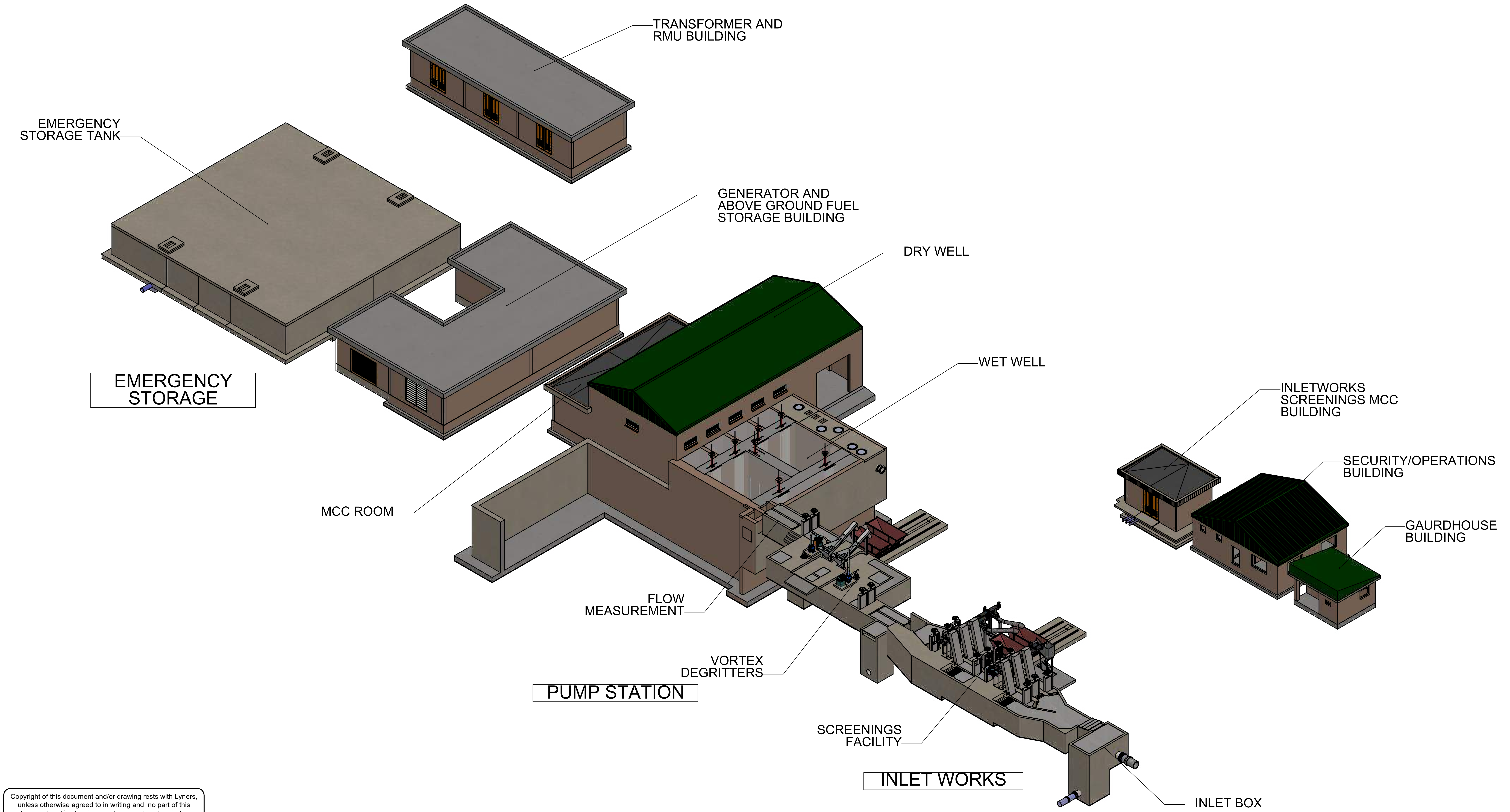
TITLE

PHASE 1: TYPICAL PLAN AND ISOMETRIC CONCEPT LAYOUTS AND VIEWS

SCALE on A2	SHEET
AS SHOWN	1 OF 8
CONTRACT No.	PROJECT No.
20(W.P 8)	C23176

DRAWING No. 23176-C-PDR3
REV C

COORDINATE SYSTEM: N/A



PHASE 1: ISOMETRIC VIEW OF THE NEW THEMBALETHU EAST PUMP STATION

NOT TO SCALE

REV	DESCRIPTION	DATE	REV BY	CHKD
C	CLIENT COMMENTS ADDED	26-02-15	JP	CD
B	LAYOUT UPDATE TO OPTION 3	25-10-07	AL	CD
A	FOR PDR INFORMATION ONLY	24-03-01	AL	CD

REVISIONS

DESIGNED	JP
DRAWN	AL
CHECKED	CD

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APPROVED
ENGINEERS: N/A
DATE: 2026-02-15

CLIENT

GEORGE
THE CITY FOR ALL REASONS

APPROVED
CLIENT: N/A
DATE: 2026-02-15

PROJECT

UPGRADING OF THEMBALETHU PUMP STATION 7 AND
CONSTRUCTION OF THE NEW THEMBALETHU EAST PUMP STATION

TITLE

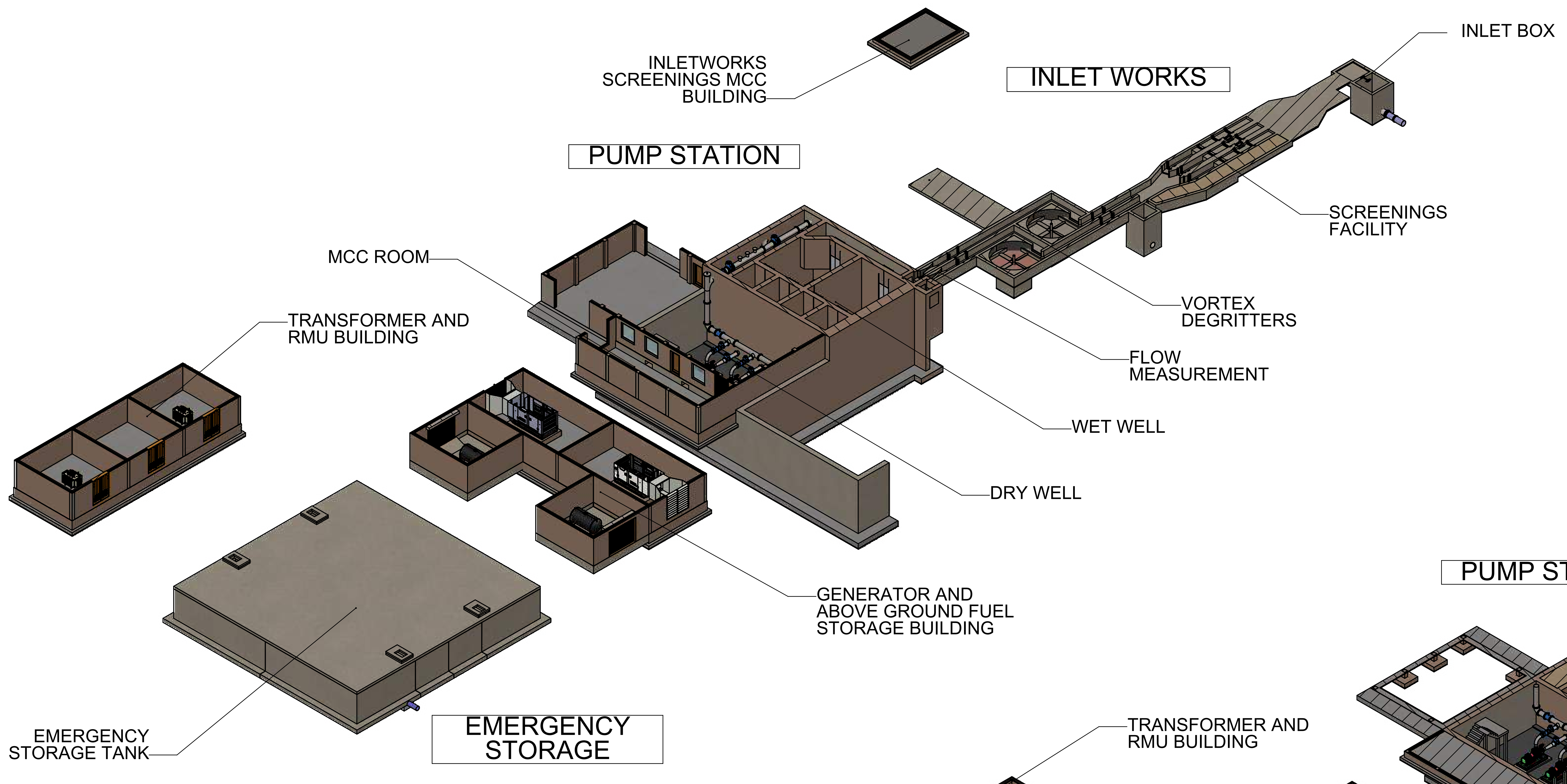
PHASE 1: TYPICAL PLAN AND ISOMETRIC
CONCEPT LAYOUTS AND VIEWS

SCALE on A2	SHEET
AS SHOWN	2 OF 8
PROJECT No.	PROJECT No.
20(W.P 8)	C23176

DRAWING No.: 23176-C-PDR4
REV: C

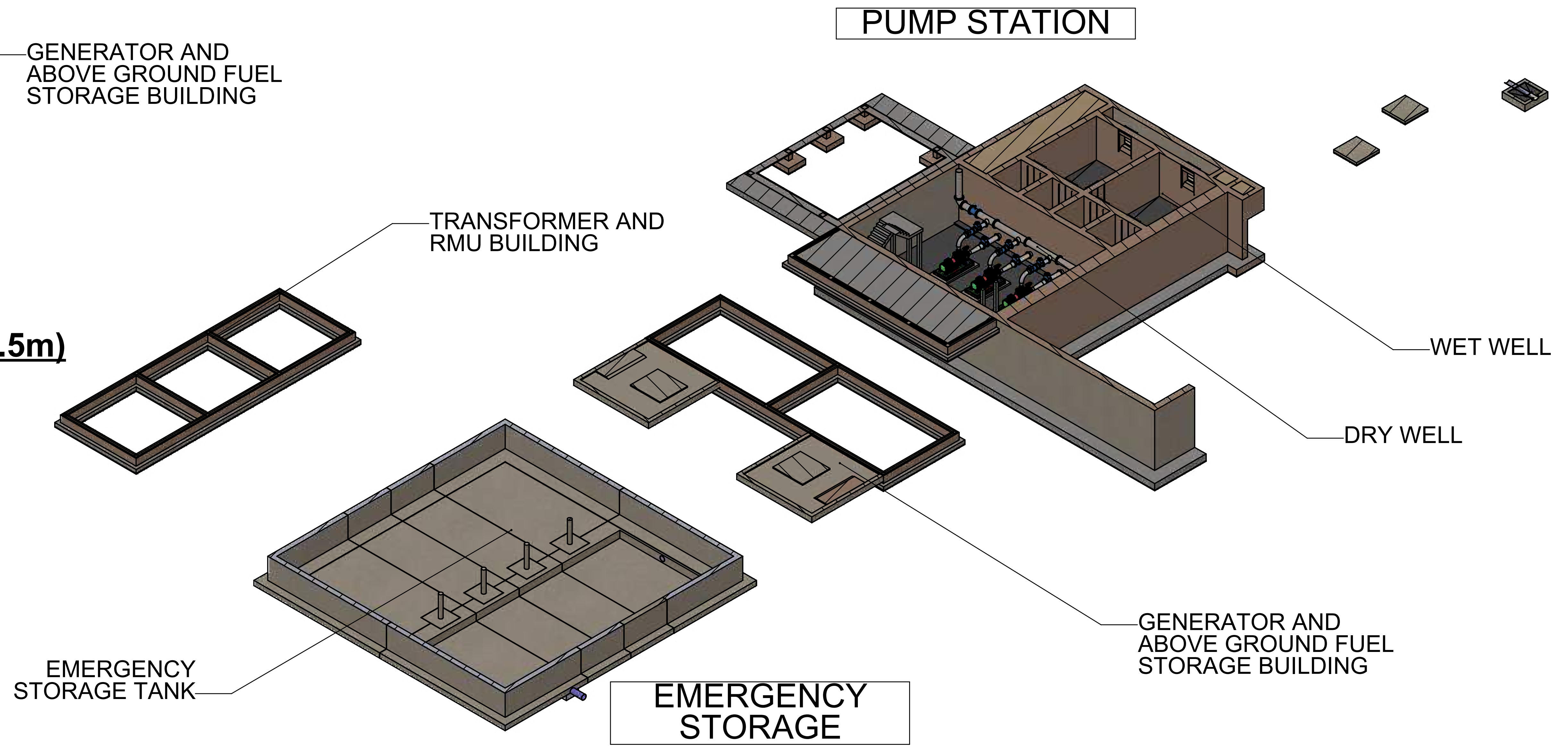
COORDINATE SYSTEM: N/A

iso a2 (420,00 x 594,00 mm) Lyners_SolidWorks.template



PHASE 1: ISOMETRIC SECTIONAL PLAN (F.G.L +2.5m)

NOT TO SCALE



PHASE 1: ISOMETRIC SECTIONAL PLAN (F.G.L -0.5m)

NOT TO SCALE

REV	DESCRIPTION	DATE	REV BY	CHKD
C	CLIENT COMMENTS ADDED	26-02-15	JP	CD
B	LAYOUT UPDATE TO OPTION 3	25-10-07	AL	CD
A	FOR PDR INFORMATION ONLY	24-03-01	AL	CD

REVISIONS

DESIGNED	JP	
DRAWN	AL	
CHECKED	CD	

CONSULTING ENGINEERS

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APPROVED
ENGINEERS: N/A
DATE: 2026-02-15

CLIENT

GEORGE
THE CITY FOR ALL REASONS

APPROVED
CLIENT: N/A
DATE: 2026-02-15

PROJECT

UPGRADING OF THEMBALETHU PUMP STATION 7 AND
CONSTRUCTION OF THE NEW THEMBALETHU EAST PUMP STATION

TITLE

PHASE 1: TYPICAL PLAN AND ISOMETRIC
CONCEPT LAYOUTS AND VIEWS

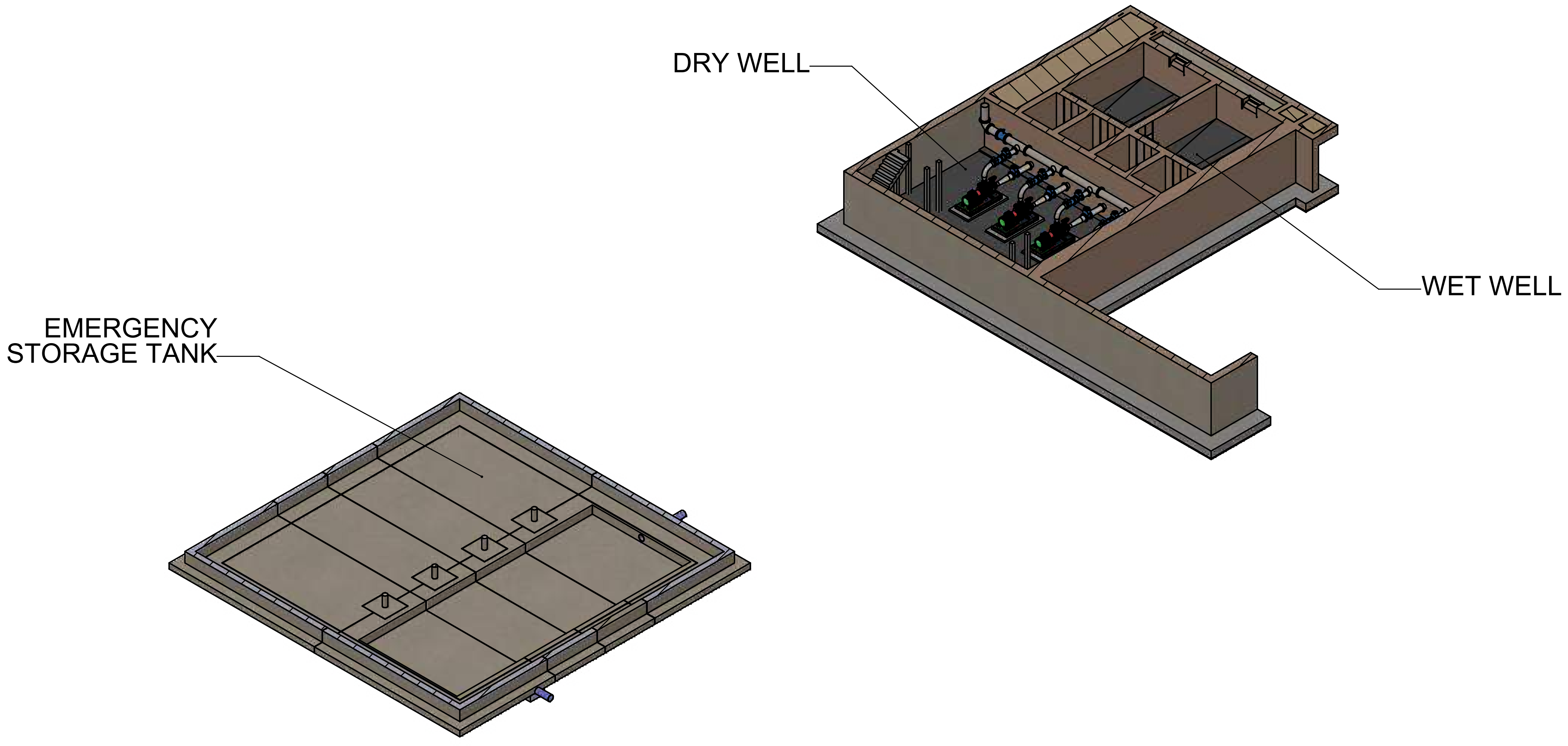
SCALE on A2	SHEET
AS SHOWN	3 OF 8
PROJECT No.	PROJECT No.
20(W.P 8)	C23176

DRAWING No. 23176-C-PDR5

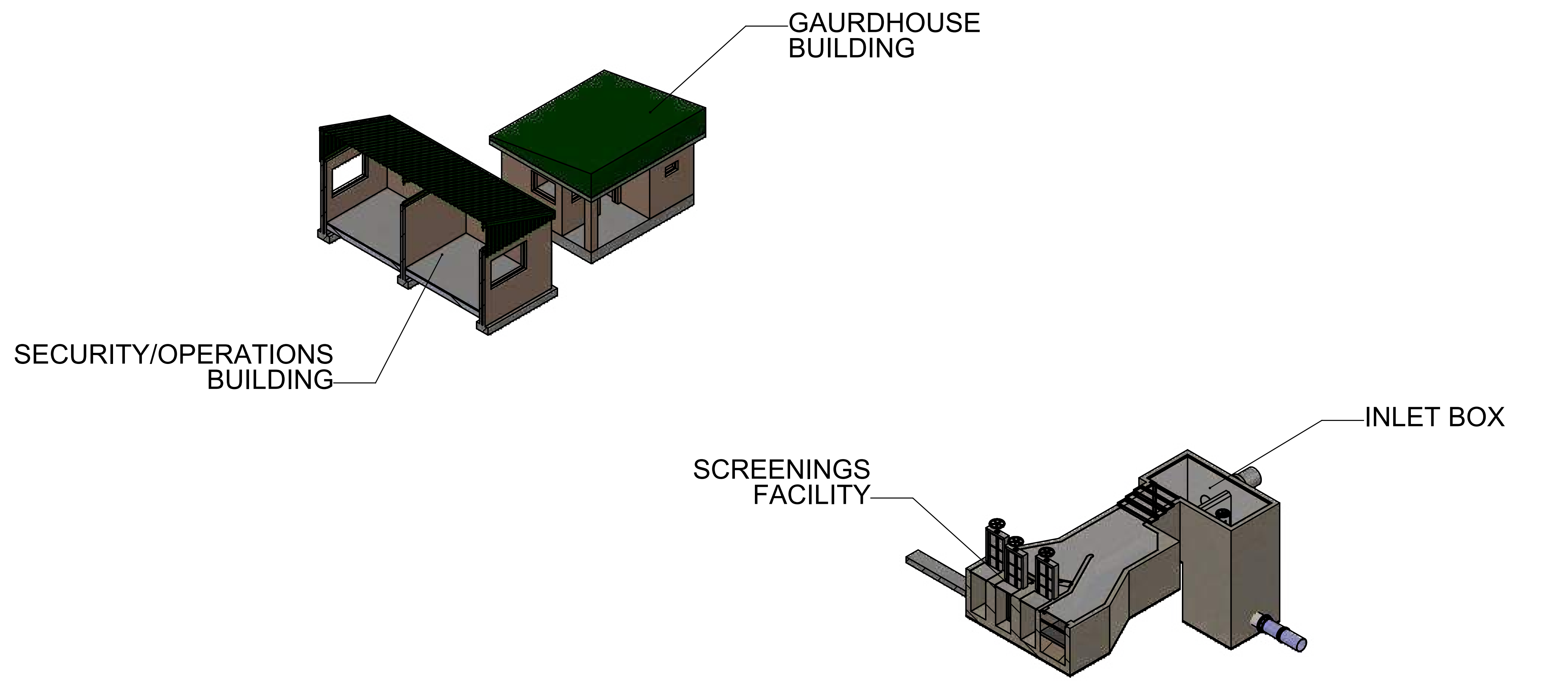
REV C

COORDINATE SYSTEM: N/A

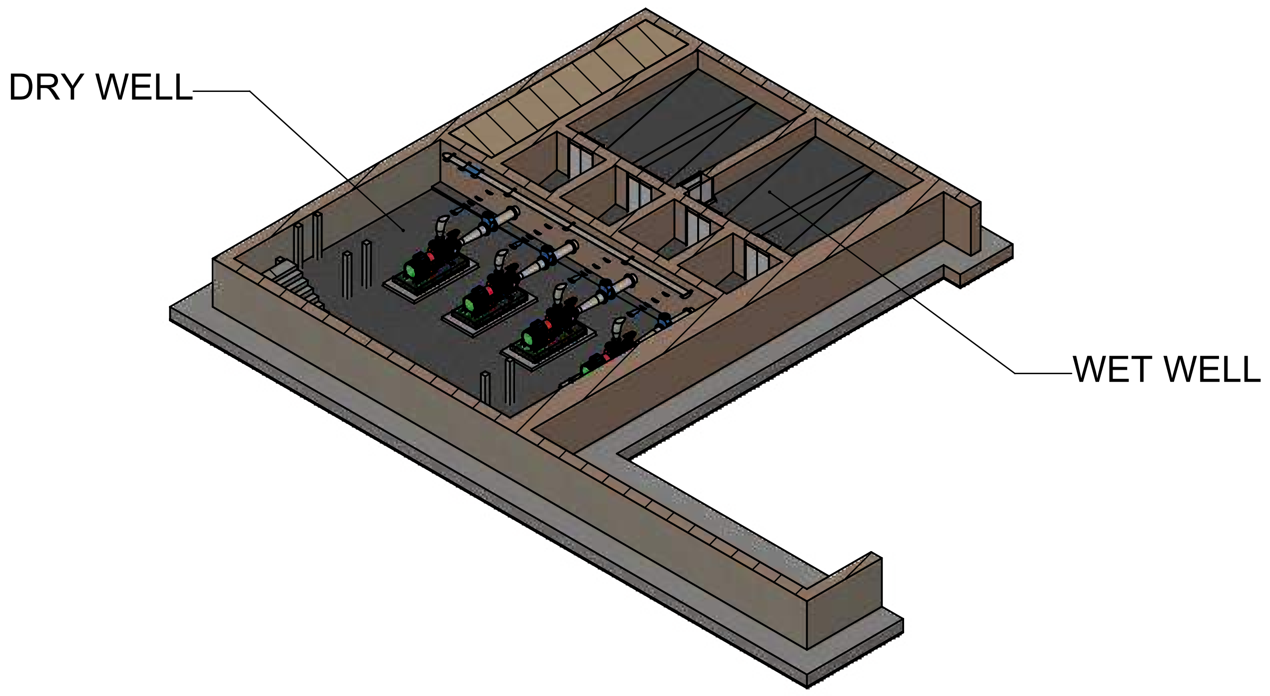
iso a2 (420,00 x 594,00 mm) Lyners_SolidWorks.template



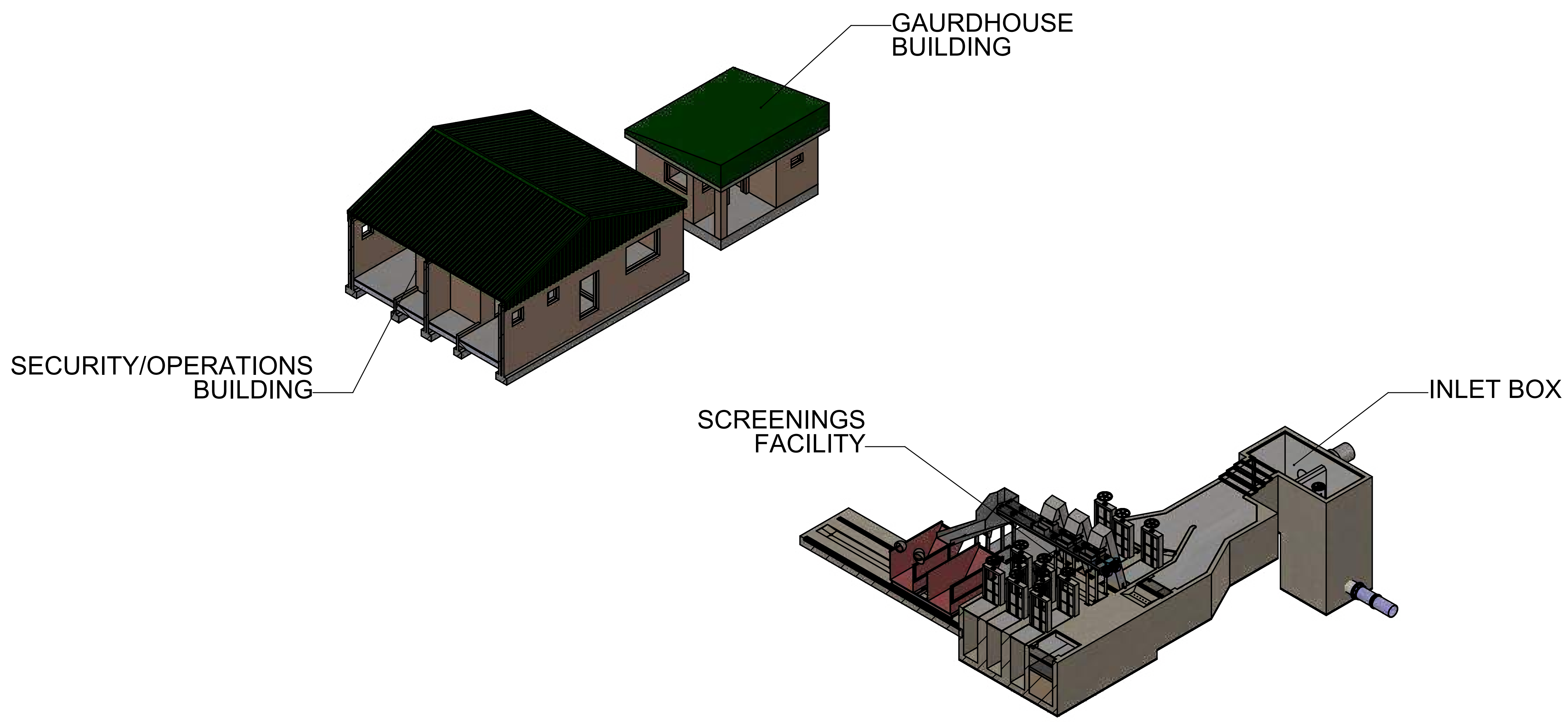
PHASE 1: ISOMETRIC SECTIONAL PLAN (N.G.L -1.5m)
NOT TO SCALE



PHASE 1: ISOMETRIC SECTION A-A
NOT TO SCALE



PHASE 1: ISOMETRIC SECTIONAL PLAN (N.G.L -3.0m)
NOT TO SCALE



PHASE 1: ISOMETRIC SECTION B-B
NOT TO SCALE

REV	DESCRIPTION	DATE	REV BY	CHKD
C	CLIENT COMMENTS ADDED	26-02-15	JP	CD
B	LAYOUT UPDATE TO OPTION 3	25-10-07	AL	CD
A	FOR PDR INFORMATION ONLY	24-03-01	AL	CD

REVISIONS

DESIGNED	JP
DRAWN	AL
CHECKED	CD

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APPROVED
ENGINEERS: N/A
DATE: 2026-02-15

CLIENT
GEORGE
THE CITY FOR ALL REASONS

APPROVED
CLIENT: N/A
DATE: 2026-02-15

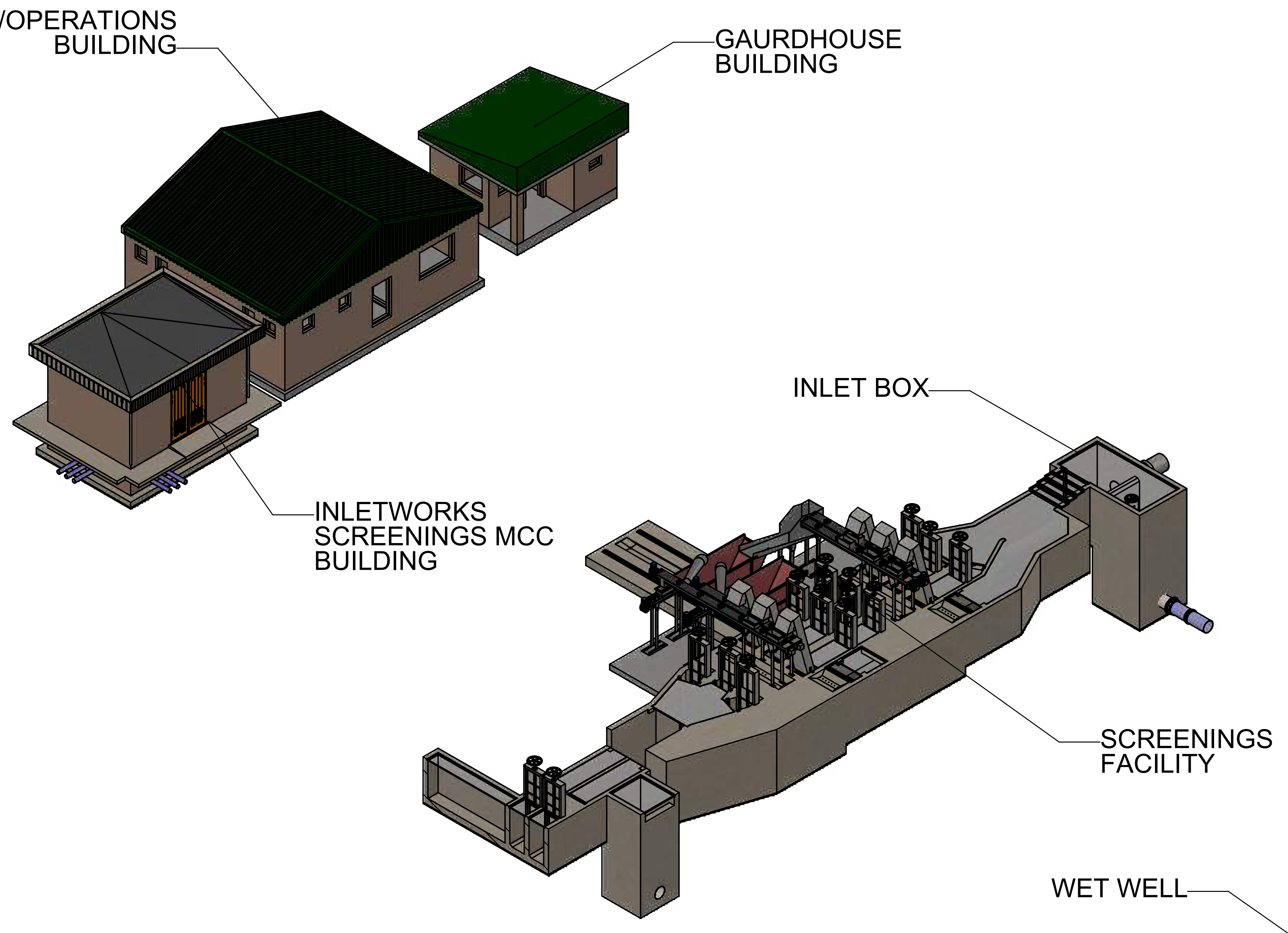
PROJECT
UPGRADING OF THEMBALETHU PUMP STATION 7 AND CONSTRUCTION OF THE NEW THEMBALETHU EAST PUMP STATION

TITLE
PHASE 1: TYPICAL PLAN AND ISOMETRIC CONCEPT LAYOUTS AND VIEWS

SCALE on A2	SHEET
AS SHOWN	4 OF 8
PROJECT No.	PROJECT No.
20(W.P 8)	C23176

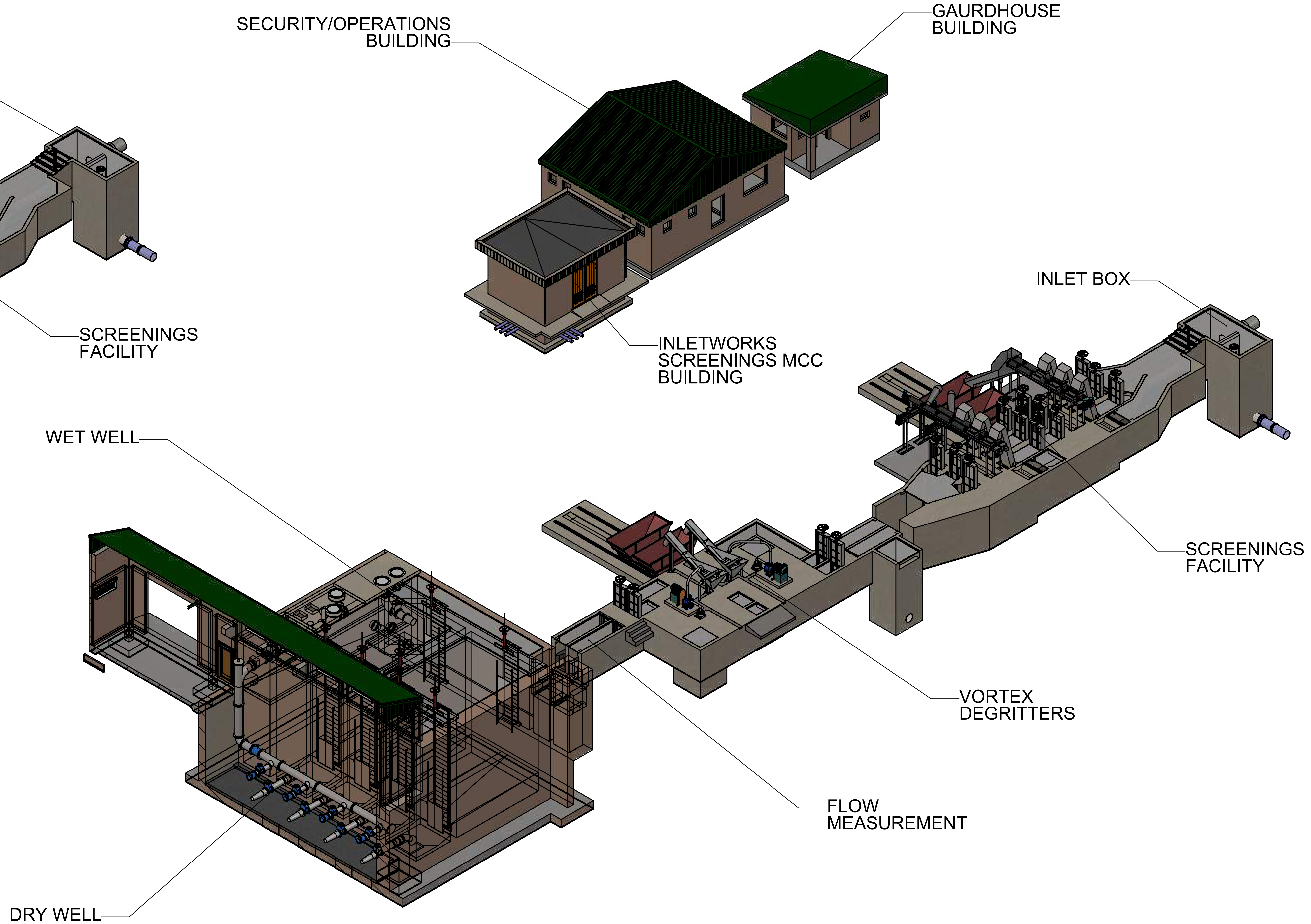
DRAWING No. 23176-C-PDR6 REV C
COORDINATE SYSTEM: N/A

iso a2 (420,00 x 594,00 mm) Lyners_SolidWorks.template



PHASE 1: ISOMETRIC SECTION C-C

NOT TO SCALE



PHASE 1: ISOMETRIC SECTION D-D

NOT TO SCALE

REV	DESCRIPTION	DATE	REV BY	CHKD
C	CLIENT COMMENTS ADDED	26-02-15	JP	CD
B	LAYOUT UPDATE TO OPTION 3	25-10-07	AL	CD
A	FOR PDR INFORMATION ONLY	24-03-01	AL	CD

REVISIONS

DESIGNED	JP
DRAWN	AL
CHECKED	CD

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APPROVED
ENGINEERS: N/A
DATE: 2026-02-15

CLIENT

GEORGE THE CITY FOR ALL REASONS

APPROVED
CLIENT: N/A
DATE: 2026-02-15

PROJECT

UPGRADING OF THEMBALETHU PUMP STATION 7 AND CONSTRUCTION OF THE NEW THEMBALETHU EAST PUMP STATION

TITLE

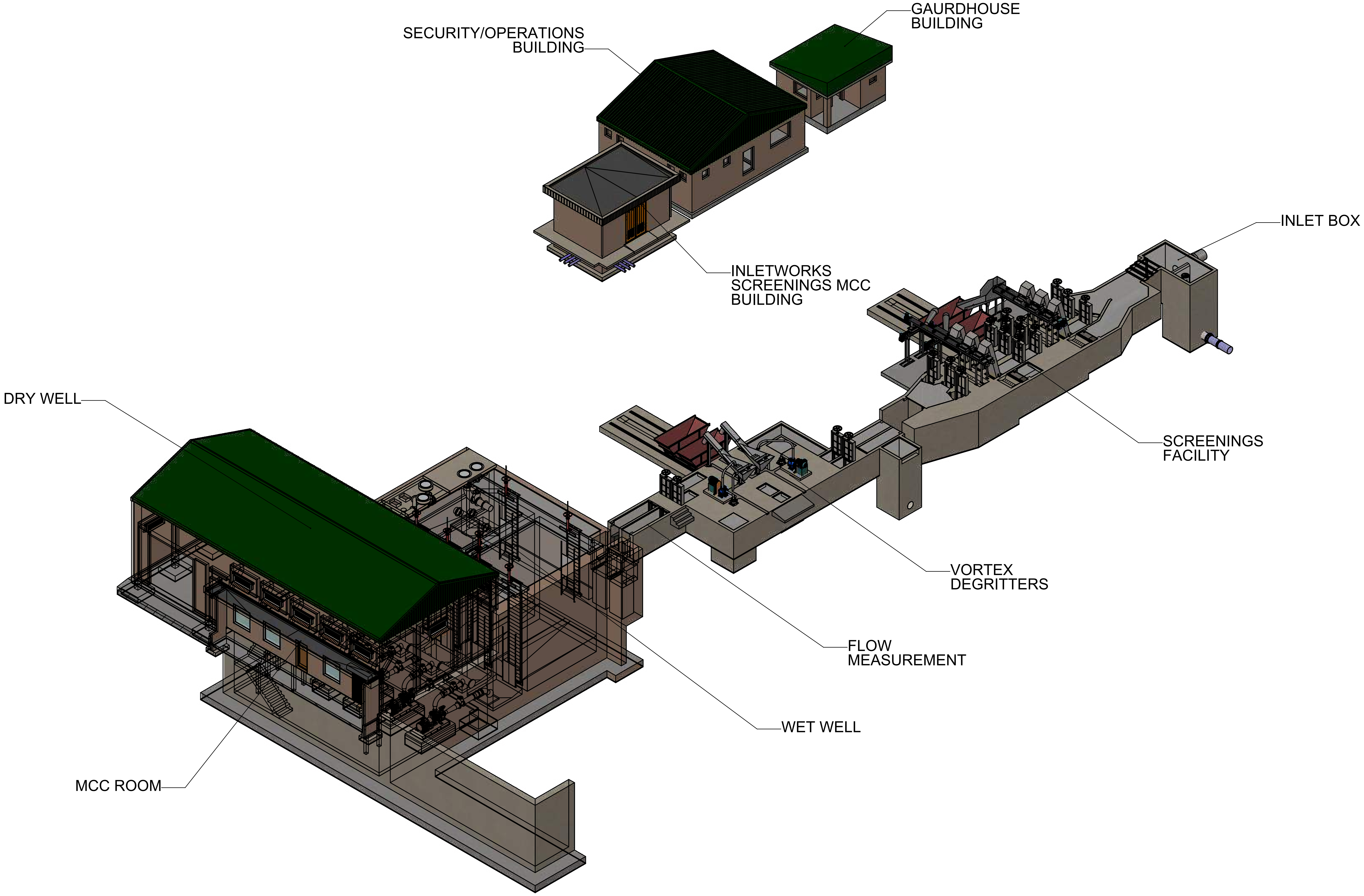
PHASE 1: TYPICAL PLAN AND ISOMETRIC CONCEPT LAYOUTS AND VIEWS

SCALE on A2	SHEET
AS SHOWN	5 OF 8
PROJECT No.	PROJECT No.
20(W.P 8)	C23176

DRAWING No. 23176-C-PDR7 REV C

COORDINATE SYSTEM: N/A

iso a2 (420,00 x 594,00 mm) Lyners_SolidWorks.template



All dimensions must be verified on site before the works commence. Refer any discrepancies to the Engineer.

PHASE 1: ISOMETRIC SECTION E-E

NOT TO SCALE

REV	DESCRIPTION	DATE	REV BY	CHKD
C	CLIENT COMMENTS ADDED	26-02-15	JP	CD
B	LAYOUT UPDATE TO OPTION 3	25-10-07	AL	CD
A	FOR PDR INFORMATION ONLY	24-03-01	AL	CD

REVISIONS

DESIGNED	JP
DRAWN	AL
CHECKED	CD

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APPROVED
ENGINEERS: N/A
DATE: 2026-02-15

CLIENT

GEORGE THE CITY FOR ALL REASONS

APPROVED
CLIENT: N/A
DATE: 2026-02-15

PROJECT

UPGRADING OF THEMBALETHU PUMP STATION 7 AND
CONSTRUCTION OF THE NEW THEMBALETHU EAST PUMP STATION

TITLE

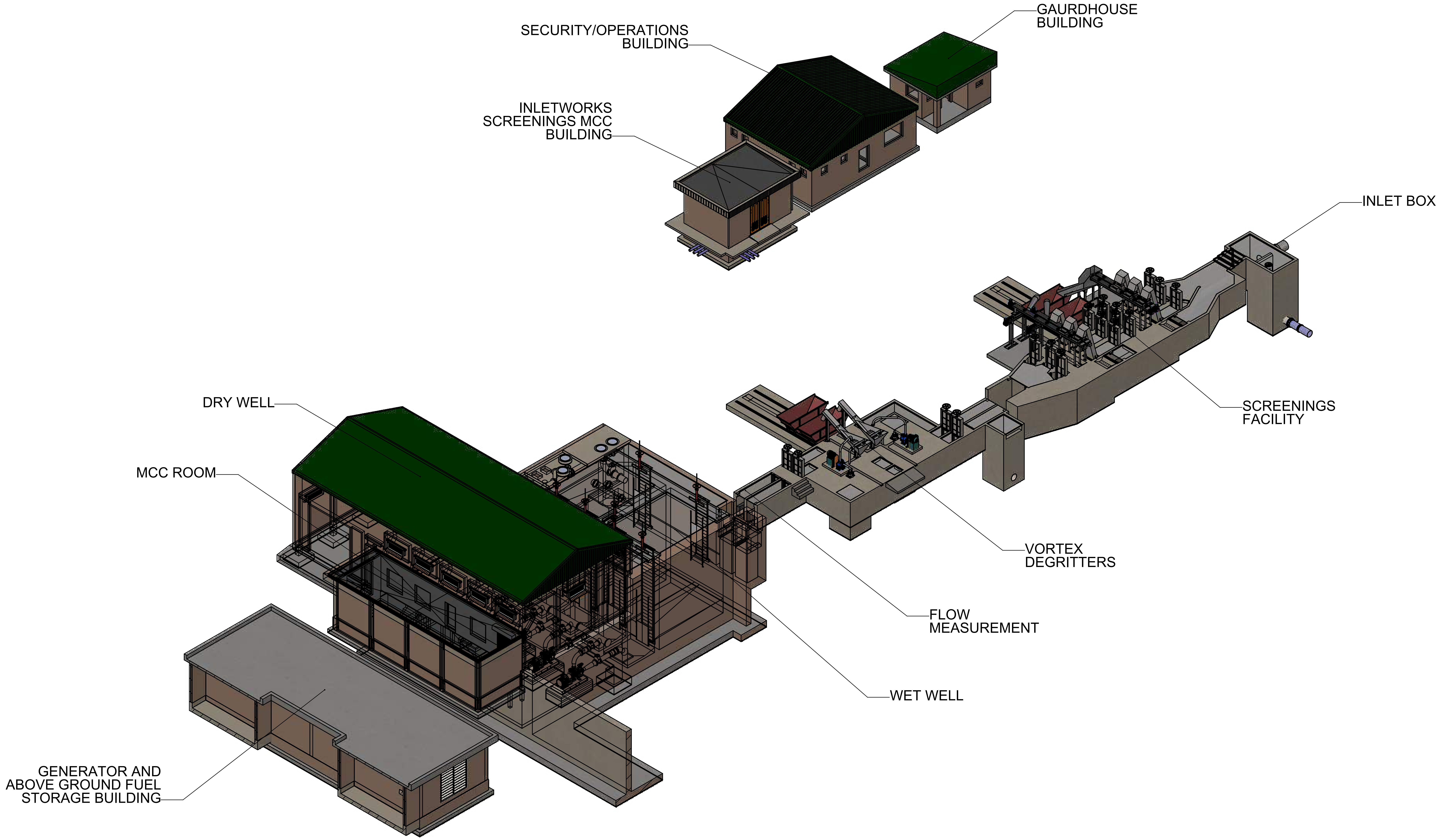
PHASE 1: TYPICAL PLAN AND ISOMETRIC
CONCEPT LAYOUTS AND VIEWS

SCALE on A2	SHEET
AS SHOWN	6 OF 8
PROJECT No. 20(W.P 8)	PROJECT No. C23176

DRAWING No. 23176-C-PDR8 REV C

COORDINATE SYSTEM: N/A

iso a2 (420,00 x 594,00 mm) Lyners_SolidWorks.template



PHASE 1: ISOMETRIC SECTION F-F

NOT TO SCALE

REV	DESCRIPTION	DATE	REV BY	CHKD
C	CLIENT COMMENTS ADDED	26-02-15	JP	CD
B	LAYOUT UPDATE TO OPTION 3	25-10-07	AL	CD
A	FOR PDR INFORMATION ONLY	24-03-01	AL	CD

REVISIONS

DESIGNED	JP
DRAWN	AL
CHECKED	CD

CONSULTING ENGINEERS

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APPROVED
ENGINEERS: N/A
DATE: 2026-02-15

CLIENT

GEORGE
THE CITY FOR ALL REASONS

APPROVED
CLIENT: N/A
DATE: 2026-02-15

PROJECT

UPGRADING OF THEMBALETHU PUMP STATION 7 AND CONSTRUCTION OF THE NEW THEMBALETHU EAST PUMP STATION

TITLE

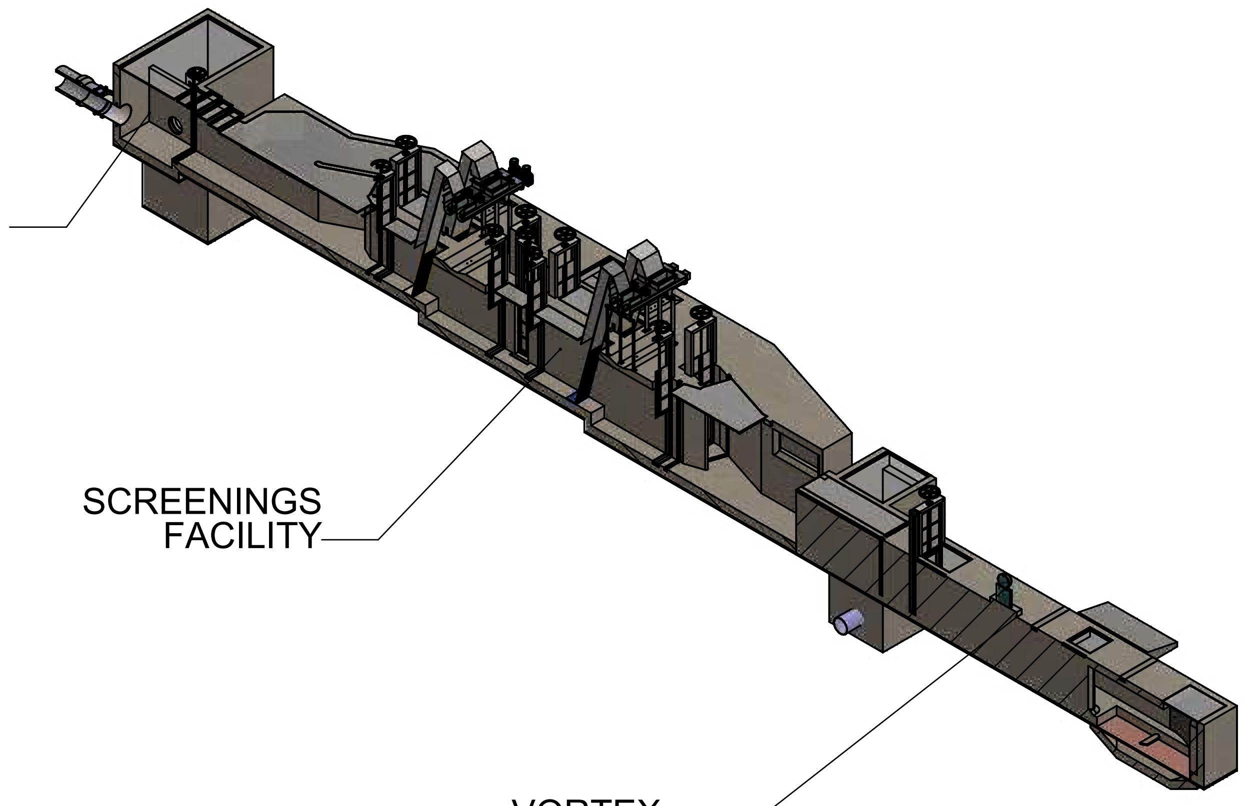
PHASE 1: TYPICAL PLAN AND ISOMETRIC CONCEPT LAYOUTS AND VIEWS

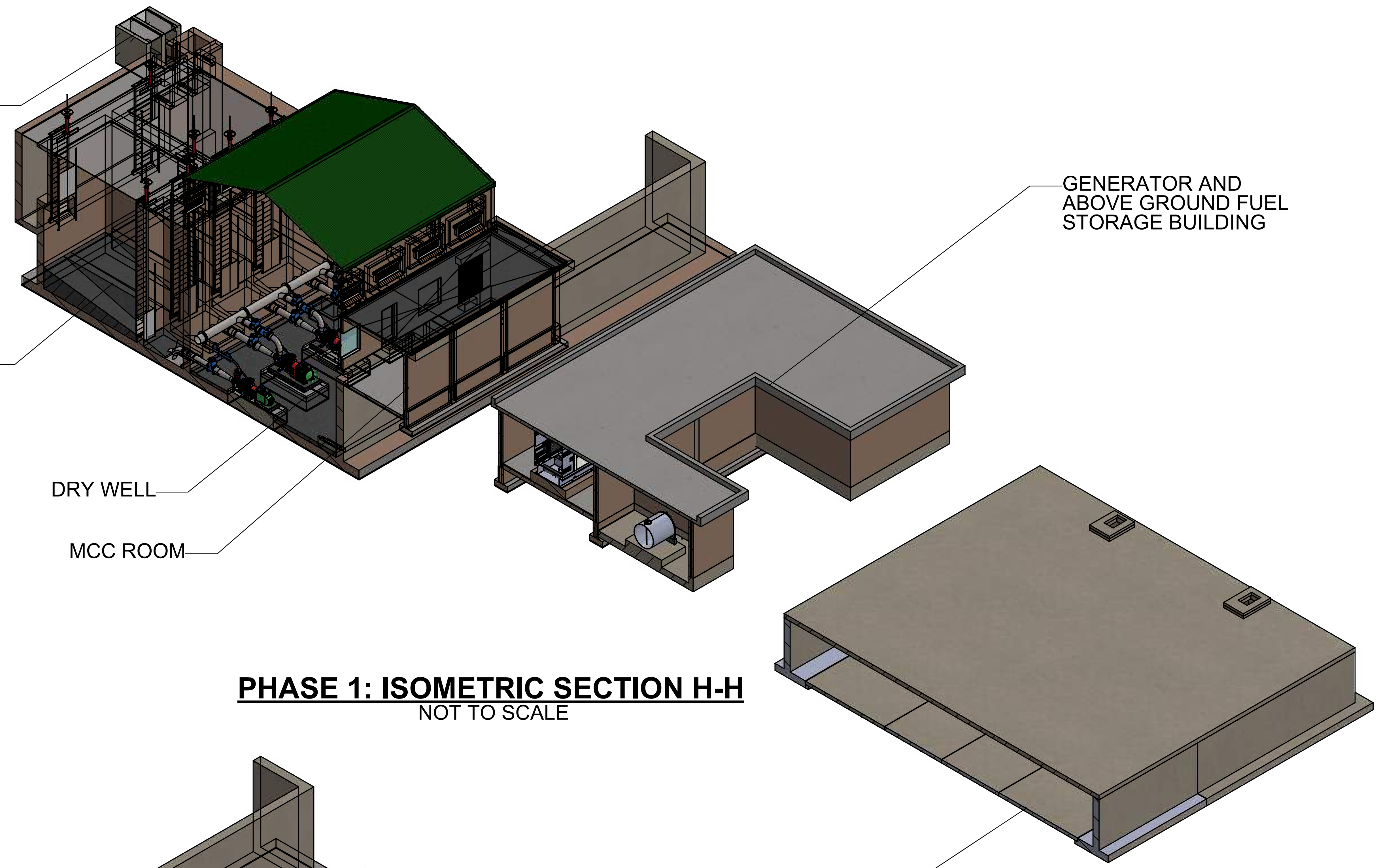
SCALE on A2	SHEET
AS SHOWN	7 OF 8
PROJECT No.	PROJECT No.
20(W.P 8)	C23176

DRAWING No. 23176-C-PDR9 REV C

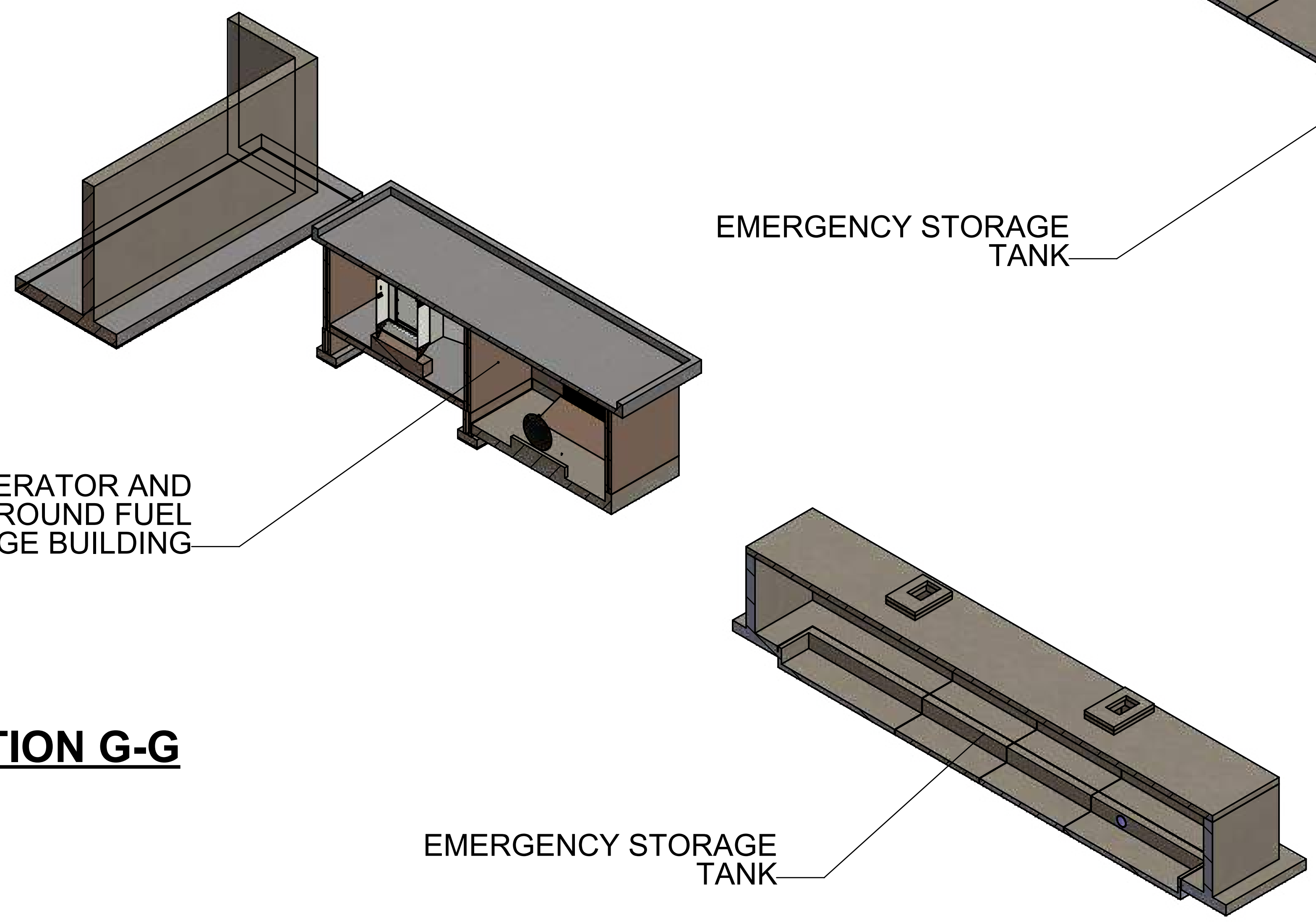
COORDINATE SYSTEM: N/A

iso a2 (420,00 x 594,00 mm) Lyners_SolidWorks.template





PHASE 1: ISOMETRIC SECTION H-H
NOT TO SCALE



PHASE 1: ISOMETRIC SECTION G-G
NOT TO SCALE

All dimensions must be verified on site before the works commence. Refer any discrepancies to the Engineer.

REV	DESCRIPTION	DATE	REV BY	CHKD
C	CLIENT COMMENTS ADDED	26-02-15	JP	CD
B	LAYOUT UPDATE TO OPTION 3	25-10-07	AL	CD
A	FOR PDR INFORMATION ONLY	24-03-01	AL	CD

REVISIONS

DESIGNED	JP
DRAWN	AL
CHECKED	CD

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APPROVED
ENGINEERS: N/A
DATE: 2026-02-15

CLIENT

GEORGE
THE CITY FOR ALL REASONS

APPROVED
CLIENT: N/A
DATE: 2026-02-15

PROJECT

UPGRADING OF THEMBALETHU PUMP STATION 7 AND CONSTRUCTION OF THE NEW THEMBALETHU EAST PUMP STATION

TITLE

PHASE 1: TYPICAL PLAN AND ISOMETRIC CONCEPT LAYOUTS AND VIEWS

SCALE on A2	SHEET
AS SHOWN	8 OF 8
PROJECT No.	PROJECT No.
20(W.P 8)	C23176

DRAWING No. 23176-C-PDR10
REV C

COORDINATE SYSTEM: N/A

iso a2 (420,00 x 594,00 mm) Lyners_SolidWorks.template

ANNEXURE E :

GLS Potable Water Supply Confirmation Correspondence

Jesse-James Pleass

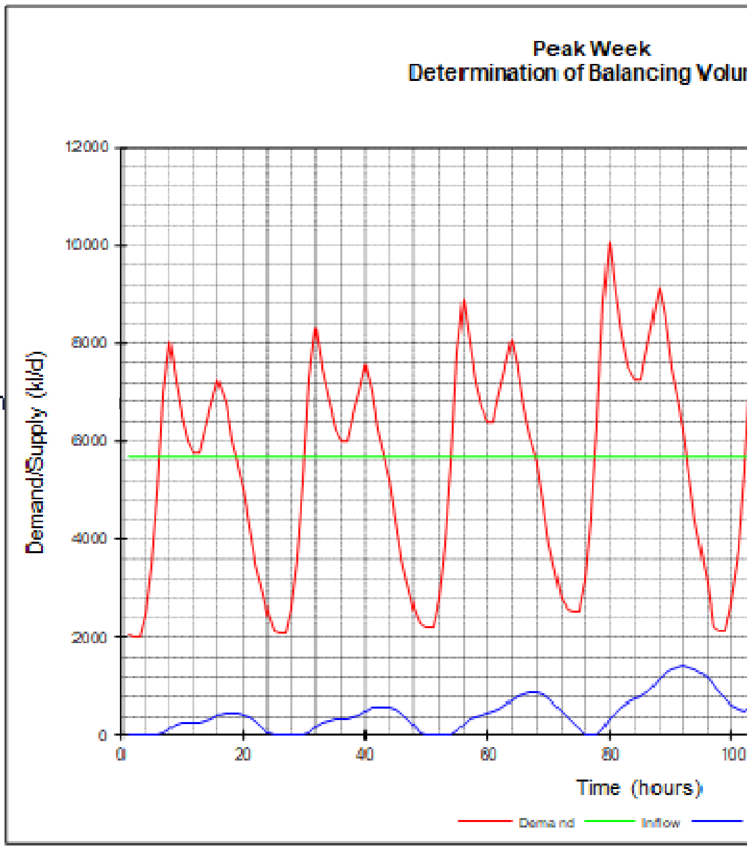
From:	Johann Rudolph <johann.rudolph@gls.co.za>
Sent:	Thursday, 28 May 2026 08:02
To:	Jesse-James Pleass
Cc:	Carel Davids; Francois van Eck; Pierre Joubert; Martyn le Roux; Melanie Geyer; Vuyolwethu Sotenjwa; Flip du Plessis; Melanie Geyer; ddejager
Subject:	RE: 23176BC-New Thembalethu East Raw Sewage Pumpstation in George - Bulk Water Supply and Connection Enquiry [Filed 28 May 2026 11:56]
Attachments:	Water System Type-2026-5-28.pdf; Sewer System Type-2026-5-28.pdf
Categories:	Filed by Mail Manager

Good morning Jesse-James,

The closes link would be the existing 50 mm Ø HDPE-10/PE80 supply pipeline to Thembalethu PS 7, however this pipeline would need to be replaced with at least a 75 mm Ø (but preferably a 90 mm Ø) and extended to the new Thembalethu East PS site along the route of the new rising main.
The existing supply 50 mm Ø pipeline is preferred as it is separate from the adjacent reticulation network.

The existing pipeline forms part of the Thembalethu West tower zone, but will in future be supplied by the Thembalethu East tower.
The Thembalethu West reservoir doesn't have sufficient capacity to accommodate the additional demand required.

Type in values in shaded cells				**Thembalethu Res**
Full zone	3 152	kl/d		
Direct zone	3 152	kl/d		
AADD	**3 152**	kl/d		
PDF	**2.00**	* AADD		
PWF	**1.70**	* AADD		
P3DF	1.84	* AADD		
Supply	**1.80**	* AADD	By Hand	
=	5 674	kl/d		
=	66	l/s	Pipe @ 1.8m/s	
			216 mm	
Bal.Vol.	1 429	kl		
=	10.9	h*AADD		



			%
Pattern 1	Large zone	Large	**100.0%**
Pattern 2	Small zone	Medium	**0.0%**
Pattern 3	LC Housing	Small	**0.0%**
Pattern 4			**0.0%**
Pattern 5			**0.0%**
Pattern 6			**0.0%**
Pattern 7	Even	To a res.	**0.0%**
Must add up to 100 --> check			100.0%

VOLUME ANALYSIS (applies only to area directly supplied, I.e. not to the Pattern 7 supply)

Capacity	**3 000**	kl	=	22.8	h x AADD
Required balancing	1 429	kl	=	10.9	h x AADD
Available volume	1 571	kl	=	12.0	h x AADD
Required emergency	3 152	kl	=	**24.00**	h x AADD
Spare capacity	-1 581	kl	=	-12.0	h x AADD

However, the first of two Thembalethu East reservoirs and the Thembalethu East tower (top water level ± 235 m a.s.l.) should be nearing commissioning. The surrounding network, including the Thembalethu PS 7 pipeline is to be moved to the new tower zone.

The switch of supply source will provide ample capacity to meet the demand requirements.

At the Thembalethu East PS site, the head is estimated as follows for the minimum pipe diameter and preferred pipe diameter (based on the tower EGL at 235 m a.s.l. and pipe length ± 900 m):

Connection Point	Static		Residual		Ground Level
	EGL (m a.s.l.)	Head (m)	EGL (m a.s.l.)	Head (m)	(m a.s.l.)
75 mm Ø HDPE-12.5/PE100	235.0	68.3	196.7	30.0	166.7
90 mm Ø HDPE-12.5/PE100	235.0	68.3	216.2	49.5	166.7

Kind regards

Johann Rudolph *BTech Civil Eng*
Civil Engineering Technologist II

GLS
Infrastructure planning

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www.gls.co.za
Stellenbosch - Pretoria

From: Jesse-James Pleass <jesse@lyners.co.za>
Sent: Thursday, May 28, 2026 1:04 AM
To: Johann Rudolph <johann.rudolph@gls.co.za>
Cc: Carel Davids <carel@lyners.co.za>; Francois van Eck <francois@lyners.co.za>; Pierre Joubert <pierre@mne-oak.co.za>; Martyn le Roux <martyn@lyners.co.za>; Melanie Geyer <mgeyer@george.gov.za>; Vuyolwethu Sotenjwa <vsotenjwa@george.gov.za>; Flip du Plessis <flip@gls.co.za>
Subject: 23176BC-New Thembalethu East Raw Sewage Pumpstation in George - Bulk Water Supply and Connection Enquiry
Importance: High

Hello Johan,

I hope all is well your side.

We are currently busy with the design of the new Thembalethu East Raw Sewage Pumpstation which will be situated to the east of the existing Thembalethu Pumpstation 7. See attached *.kmz for the approximate proposed pumpstation position and tie in points for sewer and rising main for reference.

The new pump station site will require a potable bulk water supply for washwater, day to day operations, odour control, domestic use, etc as per the table below:

ESTIMATED POTABLE WATER DEMAND SOURCES AND REQUIRED HOURLY FLOW				**ESTIM**
Description	**Flow required**	**Estimated Frequency**	**Flow [m³/h]**	**Duration /60 min**
Sparge water for grit chamber	9 m³/h (2.5 L/s)	As / When required for cleaning	9.0000	0.25
Washer compactor	3.6 m³/h (1 L/s)	10 min at 20 intervals	3.6000	0.17
WAP	0.9 m³/h (0.25 L/s)	0.5hrs daily cleaning	0.9000	0.5
Odour control unit	0.1625 m³/h (0.05L/s)	Semi-constant to constant draw	0.1625	1
Guard House, Security and Ablution	0.0051 m³/h (0.0035L/s)	As / When required	0.0051	8
		Estimate at Peak Flow	***13.6676***	-
		Estimate at Peak Flow (Rounded-up)	**13.67**	-

Considering the above, would you please be able to assist me with the following information:

- The closest feasible connection point which we could connect to the existing potable water network near the existing Thembalethu PS 7.
  Note: The ideal situation would be if this could run in close proximity to either the sewer tie-in or rising main pipeline corridors.

- Confirmation that there is adequate capacity and pressure in the bulk water network to provide the potable water demand as required at the Estimate at Peak Flows as indicated in the table above for the new Thembalethu East Raw Sewage Pumpstation.

Regards,

Jesse-james Pleass PrTechEng, C.CPM, MWISA | Civil Technologist | TYGERVALLEY | T +27 (0)21 914 0300 | M +27 (0)82 571 4430 | jesse@lyners.co.za

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Water: System Type

2026-05-28 07:17

0 100m
Scale 1:3300

ANNEXURE F :

Potential High-Level Construction Cost Estimate Pump Station Layouts Options

ITEM	DESCRIPTION	Option 1		Option 2		Option 3		Option 4	
		AMOUNT (ZAR) - 2024/12		AMOUNT (ZAR) - 2024/12		AMOUNT (ZAR) - 2024/12		AMOUNT (ZAR) - 2024/12	
		Civil	Mechanical/Electrical	Civil	Mechanical/Electrical	Civil	Mechanical/Electrical	Civil	Mechanical/Electrical
A	PRELIMINARY AND GENERAL	R 16 906 000.00	R 9 347 292.22	R 17 010 000.00	R 9 347 292.22	R 15 732 500.00	R 9 347 292.22	R 16 724 500.00	R 9 347 292.22
A.1	(i.e. Civil at 25%, Mechanical / Electrical at 20%)	R 16 856 000.00	R 9 247 292.22	R 16 960 000.00	R 9 247 292.22	R 15 682 500.00	R 9 247 292.22	R 16 674 500.00	R 9 247 292.22
A.2	Dealing with Sewage (Temp. Diverstions, Temp. Screenings, etc.)	R 50 000.00	R 100 000.00	R 50 000.00	R 100 000.00	R 50 000.00	R 100 000.00	R 50 000.00	R 100 000.00
B	SITE WORKS	R 30 029 000.00	R -	R 27 825 000.00	R -	R 28 821 000.00	R -	R 28 705 000.00	R -
B.1	Site Clearance	R 970 000.00	R -	R 821 000.00	R -	R 942 000.00	R -	R 871 000.00	R -
B.2	Demolishment of existing structures	R 1 212 000.00	R -	R 1 212 000.00	R -	R 1 212 000.00	R -	R 1 212 000.00	R -
B.3	Interconnecting pipework	R 6 740 000.00	R -	R 7 025 000.00	R -	R 6 695 000.00	R -	R 6 955 000.00	R -
B.4	Bulk Earthworks, Terracing and Shaping	R 10 264 000.00	R -	R 8 663 000.00	R -	R 9 515 000.00	R -	R 9 455 000.00	R -
B.5	Retaining Walls	R 10 843 000.00	R -	R 10 104 000.00	R -	R 10 457 000.00	R -	R 10 212 000.00	R -
C	RISING MAIN	R 850 000.00	R -	R 850 000.00	R -	R 850 000.00	R -	R 850 000.00	R -
C.1	New rising main	R 850 000.00	R -	R 850 000.00	R -	R 850 000.00	R -	R 850 000.00	R -
D	INLETWORKS	R 13 612 000.00	R 16 106 000.00	R 11 952 000.00	R 16 106 000.00	R 10 126 000.00	R 16 106 000.00	R 12 284 000.00	R 16 106 000.00
D.1	Inletworks Structure including Screens channels & degritters structures	R 13 612 000.00	R -	R 11 952 000.00	R -	R 10 126 000.00	R -	R 12 284 000.00	R -
D.2	Screening								
D.2.1	Mechanical Screens - coarse	R -	R 1 510 000.00	R -	R 1 510 000.00	R -	R 1 510 000.00	R -	R 1 510 000.00
D.2.2	Mechanical Screens - medium	R -	R 1 610 000.00	R -	R 1 610 000.00	R -	R 1 610 000.00	R -	R 1 610 000.00
D.2.3	Screening basket - coarse	R -	R 55 000.00	R -	R 55 000.00	R -	R 55 000.00	R -	R 55 000.00
D.2.4	Hand rake screen - medium	R -	R 85 000.00	R -	R 85 000.00	R -	R 85 000.00	R -	R 85 000.00
D.2.5	Hand rake screen -fine	R -	R 125 000.00	R -	R 125 000.00	R -	R 125 000.00	R -	R 125 000.00
D.2.6	Screw Conveyors and chutes	R -	R 2 083 500.00	R -	R 2 083 500.00	R -	R 2 083 500.00	R -	R 2 083 500.00
D.2.7	Washer Compactors	R -	R 1 584 000.00	R -	R 1 584 000.00	R -	R 1 584 000.00	R -	R 1 584 000.00
D.3	Grit Handling								
D.3.1	Paddle system	R -	R 530 000.00	R -	R 530 000.00	R -	R 530 000.00	R -	R 530 000.00
D.3.2	Pump system and pipework	R -	R 620 000.00	R -	R 620 000.00	R -	R 620 000.00	R -	R 620 000.00
D.3.3	Grit classifier	R -	R 1 924 000.00	R -	R 1 924 000.00	R -	R 1 924 000.00	R -	R 1 924 000.00
D.4	Skip System								
D.4.1	Skip Dolley	R -	R 776 500.00	R -	R 776 500.00	R -	R 776 500.00	R -	R 776 500.00
D.4.2	Skips	R -	R 106 500.00	R -	R 106 500.00	R -	R 106 500.00	R -	R 106 500.00
D.5	Miscellaneous Items								
D.5.1	Penstocks, Stop Logs and other isolating equipment	R -	R 3 578 500.00	R -	R 3 578 500.00	R -	R 3 578 500.00	R -	R 3 578 500.00
D.5.2	Ancillary Equipment	R -	R 1 203 000.00	R -	R 1 203 000.00	R -	R 1 203 000.00	R -	R 1 203 000.00
D.5.3	Spares	R -	R 315 000.00	R -	R 315 000.00	R -	R 315 000.00	R -	R 315 000.00
E	PUMP STATION	R 12 483 000.00	R 11 361 200.00	R 16 763 000.00	R 11 361 200.00	R 12 483 000.00	R 11 361 200.00	R 14 409 000.00	R 11 361 200.00
E.1	Pump Station and Wetwell	R 8 132 000.00	R -	R 12 412 000.00	R -	R 8 132 000.00	R -	R 10 058 000.00	R -
E.2	Electrical Building	R 4 351 000.00	R -	R 4 351 000.00	R -	R 4 351 000.00	R -	R 4 351 000.00	R -
E.3	Pumps and Motors								
E.3.1	Pump sets	R -	R 1 849 500.00	R -	R 1 849 500.00	R -	R 1 849 500.00	R -	R 1 849 500.00
E.3.2	SS pipework	R -	R 2 260 500.00	R -	R 2 260 500.00	R -	R 2 260 500.00	R -	R 2 260 500.00
E.3.3	Valves	R -	R 812 000.00	R -	R 812 000.00	R -	R 812 000.00	R -	R 812 000.00
E.4	Pump Station Ancillaries								
E.4.1	Penstocks, Stop Logs and other isolating equipment	R -	R 1 442 500.00	R -	R 1 442 500.00	R -	R 1 442 500.00	R -	R 1 442 500.00
E.4.2	Ancillaries	R -	R 1 962 700.00	R -	R 1 962 700.00	R -	R 1 962 700.00	R -	R 1 962 700.00
E.4.3	Minor Civil Works required by Mechanical Contractor	R -	R 154 000.00	R -	R 154 000.00	R -	R 154 000.00	R -	R 154 000.00
E.4.4	Miscellaneous compliance expenses	R -	R 300 000.00	R -	R 300 000.00	R -	R 300 000.00	R -	R 300 000.00
E.5	New Overpumping Pump and Trailer	R -	R 2 580 000.00	R -	R 2 580 000.00	R -	R 2 580 000.00	R -	R 2 580 000.00
F	EMERGENCY STORAGE	R 10 400 000.00	R -	R 10 400 000.00	R -	R 10 400 000.00	R -	R 10 400 000.00	R -
G	ELECTRICAL	R -	R 18 669 261.08	R -	R 18 669 261.08	R -	R 18 669 261.08	R -	R 18 669 261.08
G.1	Electrical Medium Voltage Work								
G.1.1	Construction of new 11kV extension	R -	R 536 272.00	R -	R 536 272.00	R -	R 536 272.00	R -	R 536 272.00
G.1.2	New Indoor Transformer	R -	R 768 240.00	R -	R 768 240.00	R -	R 768 240.00	R -	R 768 240.00
G.1.3	Existing Pole-Mounted Transformer	R -	R 35 100.00	R -	R 35 100.00	R -	R 35 100.00	R -	R 35 100.00
G.1.4	Removal of Old 11kV Line	R -	R 21 000.00	R -	R 21 000.00	R -	R 21 000.00	R -	R 21 000.00
G.1.5	Supply authority coordination for shutdowns and connections	R -	R 1 100.00	R -	R 1 100.00	R -	R 1 100.00	R -	R 1 100.00
G.1.6	Site testing and equipment verification and commissioning	R -	R 3 300.00	R -	R 3 300.00	R -	R 3 300.00	R -	R 3 300.00
G.1.7	Taking-over	R -	R 1 100.00	R -	R 1 100.00	R -	R 1 100.00	R -	R 1 100.00
G.1.8	Miscellaneous compliance expenses	R -	R -	R -	R -	R -	R -	R -	R -
G.2	Electrical Low Voltage Work								
G.2.1	Motor Control Centres (MCCs)	R -	R 2 476 573.00	R -	R 2 476 573.00	R -	R 2 476 573.00	R -	R 2 476 573.00
G.2.2	Instrumentation	R -	R 1 327 216.00	R -	R 1 327 216.00	R -	R 1 327 216.00	R -	R 1 327 216.00
G.2.3	Cables	R -	R 1 050 735.00	R -	R 1 050 735.00	R -	R 1 050 735.00	R -	R 1 050 735.00
G.2.4	Connections	R -	R 123 363.78	R -	R 123 363.78	R -	R 123 363.78	R -	R 123 363.78
G.2.5	Cable tray and Ancillaries	R -	R 182 054.00	R -	R 182 054.00	R -	R 182 054.00	R -	R 182 054.00
G.2.6	General Electrical Installation	R -	R 780 838.00	R -	R 780 838.00	R -	R 780 838.00	R -	R 780 838.00
G.2.7	Earthing	R -	R 80 792.00	R -	R 80 792.00	R -	R 80 792.00	R -	R 80 792.00
G.2.8	Excavations	R -	R 127 435.00	R -	R 127 435.00	R -	R 127 435.00	R -	R 127 435.00
G.2.9	Building Lighting and Power	R -	R 1 452 273.30	R -	R 1 452 273.30	R -	R 1 452 273.30	R -	R 1 452 273.30
G.2.10	Testing, Commissioning and Optimisation	R -	R 55 000.00	R -	R 55 000.00	R -	R 55 000.00	R -	R 55 000.00
G.2.11	CCTV and fibre system	R -	R 2 500 000.00	R -	R 2 500 000.00	R -	R 2 500 000.00	R -	R 2 500 000.00
G.2.12	Taking-over	R -	R 32 000.00	R -	R 32 000.00	R -	R 32 000.00	R -	R 32 000.00
G.3	Telemetry and Outstation	R -	R 214 869.00	R -	R 214 869.00	R -	R 214 869.00	R -	R 214 869.00
G.4	Generator	R -	R 1 900 000.00	R -	R 1 900 000.00	R -	R 1 900 000.00	R -	R 1 900 000.00
G.5	Bulk Electrical Work Allowance	R -	R 5 000 000.00	R -	R 5 000 000.00	R -	R 5 000 000.00	R -	R 5 000 000.00
#	SUBTOTAL A	R 84 280 000.00	R 55 483 753.30	R 84 800 000.00	R 55 483 753.30	R 78 412 500.00	R 55 483 753.30	R 83 372 500.00	R 55 483 753.30
	Add 10% Contingencies on Sub-total A	R 8 428 000.00	R 5 548 375.33	R 8 480 000.00	R 5 548 375.33	R 7 841 250.00	R 5 548 375.33	R 8 337 250.00	R 5 548 375.33
#	SUBTOTAL B	R 92 708 000.00	R 61 032 128.63	R 93 280 000.00	R 61 032 128.63	R 86 253 750.00	R 61 032 128.63	R 91 709 750.00	R 61 032 128.63
	Add Contract Price Adjustment (CPA) for 1 year at 8% on Sub-total B for Civil	R 15 426 611.20	-	R 15 521 792.00	-	R 14 352 624.00	-	R 15 260 502.40	-
	Add Contract Price Adjustment (CPA) for 1 year at 16% on Sub-total B for Mechancial/Electrical	-	R 21 092 703.65	-	R 21 092 703.65	-	R 21 092 703.65	-	R 21 092 703.65
1	POTENTIAL HIGH-LEVEL CONSTRUCTION TOTAL CONSTRUCTION TOTAL	R	190 259 443.48	R	190 926 624.28	R	182 731 206.28	R	189 095 084.68

Notes:
1) High-Level Cost Estimates for Each Option was completed in December 2024 and escalation has been allowed for two years.
2) This table is only to be used to gauge an order of magnitude cost for strategic planning and Lyners shall outright not be held accountable for a degree of accuracy of the estimate nor be bound to the estimate. The estimate shall furthermore be re-calibrated and realigned as design development progress, however actual cost can only be confirmed if George Municipality ventures to sought prices from the market.