ANNEXURE I:

Detailed Design Report for Thembalethu No. 6 Sewer Pump Station

Member of the Surbana Jurong Group

SMEC INTERNAL REF. C1924

Draft Design Report

Upgrading of Thembalethu No.6 Sewer Pump Station

Client Reference No. Tender T/ING/010/2020

Prepared for George Municipality

27 October 2023

Document Control

Document	Design Report
File Location	P:\C1924_Thembalethu Pumpstation\3_Working\Reports
Project Name	Thembalethu Pumpstation
Project Number	C1924
Revision Number	Revision 0

Revision History

Revision No.	Date	Prepared By	Reviewed By	Approved for Issue By
0	27/10/2023	G Whalley J Fourie B van Niekerk R Pieters T Brink	G Whalley T Kleynhans T Cronje	W Annadale

Issue Register

Distribution List	Date Issued	Number of Copies
George Municipality	20/10/2023	1

SMEC Company Details

Approved by	W Annadale		
Address	13 Progress Street, Dormehlsdrift, George, 6529		
	Western Cape	South Africa	6529
Telephone	+27 44 873 5029	**Website**	www.smec.com
Email	willem.annadale@smec.com		
Signature			

George Municipality

Approved by	M Geyer		
Address	94 York Street		
	Central		
	George	South Africa	6529
Telephone	+27 44 801 9268		
Email	mgeyer@george.gov.za		
Signature			

The information within this document is and shall remain the property of: SMEC South Africa (Pty) Ltd - George

Important Notice

This report is confidential and is provided solely for the purposes of a Design Report for the abovementioned project for George Municipality. This report is provided pursuant to a Consultancy Agreement between SMEC South Africa (Pty) Ltd ("SMEC") and George Municipality, under which SMEC undertook to perform a specific and limited task for George Municipality. This report is strictly limited to the matters stated in it and subject to the various assumptions, qualifications, and limitations in it and does not apply by implication to other matters. SMEC makes no representation that the scope, assumptions, qualifications, and exclusions set out in this report will be suitable or sufficient for other purposes nor that the content of the report covers all matters which you may regard as material for your purposes.

This report must be read as a whole. The executive summary is not a substitute for this. Any subsequent report must be read in conjunction with this report.

The report supersedes all previous draft or interim reports, whether written or presented orally, before the date of this report. This report has not and will not be updated for events or transactions occurring after the date of the report or any other matters which might have a material effect on its contents, or which come to light after the date of the report. SMEC is not obliged to inform you of any such event, transaction or matter nor to update the report for anything that occurs, or of which SMEC becomes aware, after the date of this report.

Unless expressly agreed otherwise in writing, SMEC does not accept a duty of care or any other legal responsibility whatsoever in relation to this report, or any related enquiries, advice or other work, nor does SMEC make any representation in connection with this report, to any person other than George Municipality. Any other person who receives a draft or a copy of this report (or any part of it) or discusses it (or any part of it) or any related matter with SMEC, does so on the basis that he or she acknowledges and accepts that he or she may not rely on this report nor on any related information or advice given by SMEC for any purpose whatsoever.

Table of Contents

1 Introduction 1
Terms of Reference 1
1.1 Problem Identification 1
1.2 Objectives of this report 2
2 Objectives and scope of the project 3
2.1 Employer's Objectives 3
2.2 Scope of Works 3
2.2.1 Scope of Professional Services 4
2.2.2 Additional Services 4
2.3 Wayleaves 5
3 Existing System 6
3.1 Earthworks 7
3.2 Inlet works 9
3.3 Pump Station 11
3.4 Electrical Infrastructure 12
3.4.1 Medium Voltage Reticulation 12
3.4.2 Equipment Room Layouts 12
3.4.3 Medium Voltage Switchgear 13
3.4.4 Medium Voltage Power Cable 14
3.4.5 Power Transformer 14
3.4.6 Motor Control Centre 15
3.4.7 Low Voltage Motors 15
3.4.8 Standby Diesel Generator 16
3.4.9 Telemetry & SCADA 17
3.5 Existing rising main 17
4 Detailed Design 21
4.1 Inlet works 21
4.1.1 Flow Measurement & Sump 21
4.1.2 Grit Removal 22
4.1.3 Screening 23
4.1.4 Inlet 28
4.2 Pumping Station 28
4.2.1 System characteristics 28
4.2.2 Pump Selection 29
4.2.3 Pipework Optimisation 32
4.2.4 Pump Station Design 32
4.2.5 Control Philosophy 33
4.2.6 Structures 34
4.3 Electrical Load Requirements 35
4.3.1 Background 35
4.3.2 Phase 1 (Capacity: 238 l/s) 36

4.3.3 Phase 2 (Capacity: 400 l/s) 36
4.4 Proposed Equipment 37
4.4.1 Medium Voltage Reticulation 37
4.4.2 Equipment Room Layouts 37
4.4.3 Medium Voltage Switchgear 37
4.4.4 Power Transformers 37
4.4.5 Medium Voltage Power Cables 38
4.4.6 Low Voltage Switchgear 39
4.4.7 Standby Diesel Generator 41
4.4.8 Telemetry & SCADA 42
4.4.9 Earthing and Bonding 43
4.4.10 Building Small Power & Lighting 43
4.5 Rising Main 44
4.5.1 Horizontal Alignment 44
4.5.2 Vertical Profile 44
4.5.3 Pipeline Material Selection 44
4.5.4 Water Hammer Analysis 46
4.6 Design Specifications 89
4.6.1 Pipework and fittings 89
4.6.2 Associated Infrastructure 90
1.1.1. Stormwater 91
4.6.3 Valves, Fittings and Specials 91
4.6.4 Control Assembly 93
4.6.5 Corrosion Protection 94
5 Operation and Maintenance 95
5.1 Operational and Maintenance Requirements 95
5.2 Institutional Training Requirements 95
5.3 Cost Recovery Plan 95
6 Capital Cost Estimate 96
7 Conclusion and Recommendations 97

Appendices

Annexure A Pump Station Drawings
Annexure B Mechanical Drawings
Annexure C Structural Drawings
Annexure D Rising Main Drawings
Annexure E Architectural Finishing Schedule
Annexure F Architectural Ironmongery Schedule
Annexure G Architectural Sanitary Schedule

List of Figures

Figure 1-1 Extent of project ... 2
Figure 3-1: Existing sewer network ... 6
Figure 3-2: Existing terrace section ... 7
Figure 3-3: Existing layout ... 7
Figure 3-4: Photo of existing ground slope and gabions ... 8
Figure 3-5: Existing mechanical screens ... 9
Figure 3-6: Existing hand rake screens ... 9
Figure 3-7: Existing ultrasonic flow measurement ... 10
Figure 3-8: Existing pump station electrical rooms ... 11
Figure 3-9: Existing pumps ... 11
Figure 3-10: Existing Single Line Diagram ... 12
Figure 3-11: Existing Equipment Room Layout ... 13
Figure 3-12: Existing Medium Voltage Ring Main Unit ... 13
Figure 3-13: Existing Medium Voltage Metering Unit ... 14
Figure 3-14: Existing Power Transformer No.1 (315kVA) ... 14
Figure 3-15: Existing LV Motor Control Centre ... 15
Figure 3-16: Existing LV Motors ... 16
Figure 3-17: Existing Standby Diesel Generator, ACO Panel & Day Tank ... 16
Figure 3-18: Existing Telemetry & Control Panel ... 17
Figure 3-19: Existing pipe corridor ... 18
Figure 3-20: Existing pipe bridge ... 18
Figure 3-21: Vandalised bridge ... 19
Figure 3-22: Stormwater erosion ... 19
Figure 3-23: Stormwater damage ... 20
Figure 3-24: Existing infrastructure on pipe route ... 20
Figure 4-1: Backwater calculation sections ... 21
Figure 4-2: Section of Parshall Flume ... 22
Figure 4-3: Discharge Characteristics of Parshall Flumes ... 22
Figure 4-4: Grit channel design criteria ... 23
Figure 4-5: Typical screening loading rates on screens (Metcalf and Eddy Inc., 2003) ... 25
Figure 4-6: Pump Station System Curve ... 29
Figure 4-7: Phase 1 Pump Curve with Duty Point 1 ... 31
Figure 4-8: Phase 1 Pump Curve with Duty Point 2 ... 31
Figure 4-9: Phase 2 Pump Curve with Duty Point 3 ... 32
Figure 4-10: Pump and Pipework layout ... 34
Figure 4-11: Typical Dry-type Transformer (credit: Toshiba) ... 38
Figure 4-12: Proposed Main LV Incoming Section ... 39
Figure 4-13: Typical MCC Arrangement (credit: Tricom Africa) ... 40
Figure 4-14: Typical 800kVA Generator General Arrangement (credit: Himoinsa) ... 42
Figure 4-15: Pipe fixture on bridge structure ... 45
Figure 4-16: Isometric View of the Pump Stationwith Pipe Diameters ... 47
Figure 4-17: Pump Characteristic Curves ... 48
Figure 4-18: Scenario 1.1 – Maximum Water Hammer Pressure Values ... 50

Figure 4-19: Scenario 1.1 – Minimum Water Hammer Pressure Values 51
Figure 4-20: Scenario 1.1 – Maximum and Minimum Water Hammer Grade Line Envelopes 52
Figure 4-21: Scenario 1.1 – Maximum and Minimum Water Hammer Pressures Along Pipeline 53
Figure 4-22: Scenario 1.1 – Air Volume Inside a Strategically Positioned Air Valve 54
Figure 4-23: Scenario 1.1 – Pressure and Flow Directly Downstream of the Pump Station 55
Figure 4-24: Scenario 1.2 – Maximum Water Hammer Pressure Values 56
Figure 4-25: Scenario 1.2 – Minimum Water Hammer Pressure Values 57
Figure 4-26: Scenario 1.2 – Maximum and Minimum Water Hammer Grade Line Envelopes 58
Figure 4-27: Scenario 1.2 – Maximum and Minimum Water Hammer Pressures Along Pipeline 59
Figure 4-28: Scenario 1.2 – Pressure and Flow Directly Downstream of the Pump Station 60
Figure 4-29: Scenario 2.1 – Maximum Water Hammer Pressure Values 61
Figure 4-30: Scenario 2.1 – Minimum Water Hammer Pressure Values 62
Figure 4-31: Scenario 2.1 – Maximum and Minimum Water Hammer Grade Line Envelopes Along the New Pipeline 63
Figure 4-32: Scenario 2.1 – Maximum and Minimum Water Hammer Pressures Along the New Pipeline 64
Figure 4-33: Scenario 2.1 – Maximum and Minimum Water Hammer Pressures Along the Future Pipeline 65
Figure 4-34: Scenario 2.1 – Air Volume Inside a Strategically Positioned Air Valve Along the New Pipeline 66
Figure 4-35: Scenario 2.1 – Pressure and Flow Directly Downstream of the Pump Station 67
Figure 4-36: Scenario 2.2 – Maximum Water Hammer Pressure Values 68
Figure 4-37: Scenario 2.2 – Minimum Water Hammer Pressure Values 69
Figure 4-38: Scenario 2.2 – Maximum and Minimum Water Hammer Grade Line Envelopes Along the New Pipeline 70
Figure 4-39: Scenario 2.2 – Maximum and Minimum Water Hammer Pressures Along the New Pipeline 71
Figure 4-40: Scenario 2.2 – Pressure and Flow Directly Downstream of the Pump Station 72
Figure 4-41: Scenario 3.1 – Maximum Water Hammer Pressure Values 73
Figure 4-42: Scenario 3.1 – Minimum Water Hammer Pressure Values 74
Figure 4-43: Scenario 3.1 – Maximum and Minimum Water Hammer Grade Line Envelopes Along the New Pipeline 75
Figure 4-44: Scenario 3.1 – Maximum and Minimum Water Hammer Pressures Along the New Pipeline 76
Figure 4-45: Scenario 3.1 – Maximum and Minimum Water Hammer Grade Line Envelopes Along the Future Pipeline 77
Figure 4-46: Scenario 3.1 – Maximum and Minimum Water Hammer Pressures Along the Future Pipeline 78
Figure 4-47: Scenario 3.1 – Air Volume Inside a Strategically Positioned Air Valve Along the New Pipeline 79
Figure 4-48: Scenario 3.1 – Air Volume Inside a Strategically Positioned Air Valve Along the Future Pipeline 80
Figure 4-49: Scenario 3.1 – Pressure and Flow Directly Downstream of the Pump Station 81
Figure 4-50: Scenario 3.2 – Maximum Water Hammer Pressure Values 82
Figure 4-51: Scenario 3.2 – Minimum Water Hammer Pressure Values 83
Figure 4-52: Scenario 3.2 – Maximum and Minimum Water Hammer Grade Line Envelopes Along the New Pipeline 84
Figure 4-53: Scenario 3.2 – Maximum and Minimum Water Hammer Pressures Along the New Pipeline 85
Figure 4-54: Scenario 3.2 – Maximum and Minimum Water Hammer Grade Line Envelopes Along the Future Pipeline 86
Figure 4-55: Scenario 3.2 – Maximum and Minimum Water Hammer Pressures Along the Future Pipeline 87
Figure 4-56: Scenario 3.2 – Pressure and Flow Directly Downstream of the Pump Station 88
Figure 4-57: Scour assembly 92
Figure 4-58: Airvalve assembly 92
Figure 4-59: Control assembly section 93
Figure 4-60: Control assembly 94

List of Tables

Table 4-1: Grit channel design values....23
Table 4-2: Grit channel design values....27
Table 4-3: Pump System Characteristics....28
Table 4-4: Operational Points Characteristics....30
Table 4-5: Operational Points Characteristics....30
Table 4-6: Grit channel design values....32
Table 4-7: Electrical Load Summary (Capacity 180l/s)....36
Table 4-8: Electrical Load Summary (Capacity 400l/s)....36
Table 4-9: Standard for Earth Rod Dimensions....43
Table 4-10: Standard for Earth Electrode Dimensions....43
Table 4-11: Pump Station Pipe Work Hydraulic Data....46
Table 4-12: Force Main Hydraulic Data....49
Table 4-13:Summary of design standards for access roads....90

1 Introduction

Terms of Reference

SMEC South Africa was appointed for a Multi-Year Professional Services Contract (Tender No. TING/010/2020), which includes the upgrade of Municipal Infrastructure by the George Municipality.

The scope of work described in this document is the Design and Implementation of Project 20 (Work Package 1) for the Upgrading of Thembalethu Sewer Pump Station no.6 and the associated rising main.

1.1 Problem Identification

The George Municipality needs to upgrade the existing Thembalethu sewer pumpstation No. 6 and its rising main due to it being hydraulically overloaded. The current capacity of the pumpstation is 60 ℓ/s and needs to be upgraded. The pumpstation will be upgraded to cater for the projected 20-year flow of 238 ℓ/s.

In terms of the sanitation Master Plan of the George Municipality, further upgrades to the pumpstation will be required to cater for the ultimate capacity of 400 ℓ/s as per the George Municipality Sewer Masterplan (GMSMP).

Thembalethu Area 8A & B (Erf 4056 & 4055) is an existing informal community with limited services. The UISP project aims to improve living conditions, reduce the health risk to the residents and the surrounding areas, and allow continued improvement of the surrounding environment via proper management of waste, sewage and stormwater.

The project aims to upgrade / formalise the insitu / existing informal settlement area, as well as provide the necessary internal and bulk services required for the ongoing formalisation of erven through Thembalethu.

The existing Thembalethu bulk sewer system is under stress, with frequent blockages, spillages and leaks resulting in pollution of the Schaapkop River. In addition, the lack of proper sewerage reticulation in the new and proposed formal extensions of Thembalethu UISP (over 4 939 erven) and the proposed Syferfontein Housing Project (7700 erven) will aggravate the situation, and significantly compound the environmental and health problems.

The proposed Thembalethu bulk sewerage infrastructure has been designed to address several of the constraints/problems experienced by the current system and provide the necessary capacity to handle the additional sewage from new and proposed housing developments planned for the area.

The scope of works also includes a new Ø400mm rising main, to be installed parallel to the existing Ø250mm rising main for approximately 700m. The new Ø400mm rising main will be used to convey the future flow of up to 200l/s, with an additional Ø400mm rising main being installed at a later stage to accommodate the ultimate flow requirement of the pump station. The layout of the pump station, therefore, needs to be carefully considered to be compatible with both the current upgrades, as well as future planned upgrades.

Representatives of SMEC and the George Municipality Civil Engineering Services Directorate represented by both Planning, Project Management and Operational personnel walked the site on 08 June 2022 and discussed operational issues currently being experienced.

Figure 1-1 below provides an image from Google Earth which indicates the access road, route of the rising main, pipe bridge, and sewer pumpstation that form part of this project.

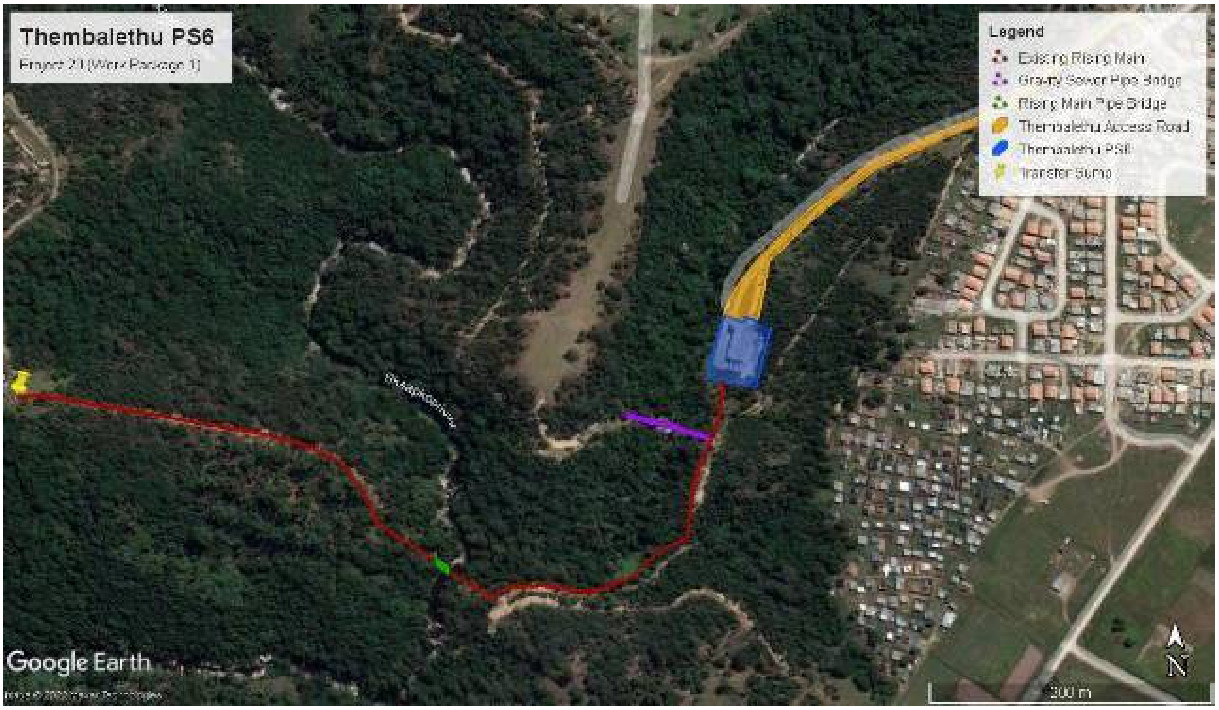


Figure 1-1 Extent of project

1.2 Objectives of this report

The objective of this Design Report is to advise the George Municipality of the Design and Detailed cost estimates of this project. This report is based on the conclusions and recommendations from previous planning reports, outcomes of various meetings and discussions with the client, detailed site investigations and visual inspections that were undertaken.

2 Objectives and scope of the project

2.1 Employer's Objectives

The George Municipality has the following objectives:

- Appoint a professional engineering service provider for the upgrade of the existing sewer pumpstation and associated rising main to comply with the current demand and forecasted future demand as set out by the municipal sewer master plan.
- To provide professional engineering services for the upgrade of the existing Thembalethu sewer pumpstation No. 6 and associated rising main ;
- To address all the required planning aspects needed for the project outcomes, including Environmental Authorization, WULA, Survey, Material investigations, and approval from relevant authorities by application of Wayleaves;
- To deliver public services infrastructure using labour-intensive construction methods wherever technically feasible and economically viable;
- To comply with the requirements of the statutory, legislative, and regulatory framework governing local government infrastructure provision; and
- To comply with all funding conditions.

2.2 Scope of Works

The total scope of work for this work package as recommended in the Concept and Viability Report, is outlined below.

<u>Pump station</u>

- Upgrade existing pump station capacity from 60 ℓ/s to 238 ℓ/s (Phase 1)
- Construct two new wet well modules (adjacent to the existing)
- Install three new 134 *ℓ/s* pump sets in the wet wells. One duty, one assist and one standby pump, rotational basis. (Phase 1)
- Construct a new pump station building to house the three new pumps including an additional for future upgrade of 400 *ℓ/s* (Phase 2)

<u>Electrical and Electronic</u>

- Install a new 630kVA transformer and upgrade existing 315kVA to a 630kVA, totalling 1.260 kVA
- Replace the existing 350kVA generator with a new 600kVA generator
- Pumps to be equipped with variable-speed drives

<u>Inlet works</u>

- Construct new high-flow inlet works with a capacity of 300 ℓ/s
- Install automated mechanical front rake screens

<u>Rising main</u>

Construct a 700m long, 400mm nominal diameter rising main parallel to the existing rising main (a portion of the pipeline will cross over the existing Schaapkop river pipe bridge which spans 30m in length).

<u>Civil works</u>

- Bulk earthwork and construct a new platform
- Extend the existing gabion retaining wall.
- Construct new concrete retaining walls,
- Extend fencing
- New buildings including guard house, store room, office, and ablution facilities
- Stormwater management at the pump station needs to be linked to that of the access road

2.2.1 Scope of Professional Services

The Scope of Services entails the full scope of services as detailed in ECSA's Guideline for Services and Processes for Estimating Fees for Persons Registered in terms of the Engineering Profession Act, 2000 (Act No. 46 of 2000), and includes the following:

Stage 1: Inception

Stage 2: Concept and Viability

Stage 3: Design Development

Stage 4: Contract Documentation and Procurement

Stage 5: Contract Administration

Stage 6: Close-out

2.2.2 Additional Services

(a) Environmental Considerations

A project of this nature requires an Environmental Impact Assessment (EIA) process to be followed in terms of the National Environmental Management Act (NEMA).

SMEC's appointment includes the design and implementation of a rising main parallel to the existing rising main and the upgrade and improvement to the sewer pumpstation. The flow through the pumpstation and pipeline, liquid (raw sewage) and locality of the infrastructure (construction within 3m of water course and wetland) trigger environmental studies.

The Environmental Impact Assessment (EIA) and Water Use License Application (WULA) were concluded in 2014 and the environmental authorisation is still valid and encompasses all the activities triggered. SMEC will incorporate the terms and conditions of the authorization in the design of the project.

Should the need for an environmental process still be required later during the project, an Environmental Practitioner will be appointed by SMEC using a transparent procurement process consisting of requesting quotations from a minimum of three service providers. Quotations received with recommendations will be presented to the Municipality for acceptance.

(b) Occupational Health and Safety Considerations

The Municipality has appointed a panel of OH&S Representatives. The representative will be included in the design process. The OH&S representative will carry out and build on the Baseline Risk Assessment for the Contract and include monthly audits for the duration of the project. This will be done by analysing the site-specific risks, as well as the proposed design, and being in line with the latest Construction Regulations.

(c) Topographical Survey

Existing survey data is available. Baseline maps of the project area and surrounds showing the location's property boundaries, existing structures, and connections, have been prepared at the onset of the project.

All as-built information available on existing infrastructure pertaining to the site, buildings, inlet works, sumps and associated pumps and pipework including the rising main have been obtained from the Client. This establishes the service interfaces and highlights areas of potential service conflicts. These comprehensive infrastructure service maps will be used throughout the project for the verification of service positions and alignments.

(d) Material Investigation

Previous studies have been undertaken for the initial construction of the pump station. The report will be studied by SMEC.

The available data showed that

- rock refusal has been experienced at depths of 2.5m to 3.7m at the various test pit locations.
- The pipe covers of the new sewer rising main pipe follow the existing rising main profile with varied cover depths of approximately 1 m to 2.5 m below the ground surface. The top layers are a very dense weathered granite which is not suitable for bedding material and allowance from commercial sources has been made in the pricing schedule. Allowance has been made for hard rock excavation for isolated rock outcrops that can be experienced.

2.3 Wayleaves

SMEC has received existing service layouts from service providers and local authority departments. The provided information does not provide the exact locations of the services, but merely a confirmation of their presence.

Before commencing with the works, the Contractor is responsible for obtaining final approval from the local authorities and service providers.

It is anticipated that approval will be required from the following authorities:

- George Municipality
- Sewer infrastructure
- Electrical infrastructure

3 Existing System

The pump station was constructed in 2014 with a capacity of 60ℓ/s. The pumpstation will now be upgraded to handle an interim design flow of 238 ℓ/s, with an ultimate capacity of 400 ℓ/s (GMSMP).

An existing 250mm ND PVC-u Class 16 pipeline accommodates the existing flow from the 60 ℓ/s pump set. The pumpstation is serviced by an existing 315kVA transformer and has a 350kVA generator to supply backup power. The low-flow inlet works are equipped with automated mechanical front rake screens.

The Thembalethu pump station receives sewage from the north by a 315mm diameter HDPE pipe and from the south by a 600mm diameter GRP pipe. Both these currently feed into the existing inlet works.

Flow enters the pumpstation and is divided into two streams, both equipped with mechanical screens and emergency overflow manual screens. The screened sewage passes through grit channels, before passing through a measurement flume and into the wet well of the pumpstation. The pumpstation does not have a balancing dam or emergency storage. The components are discussed in greater detail below.

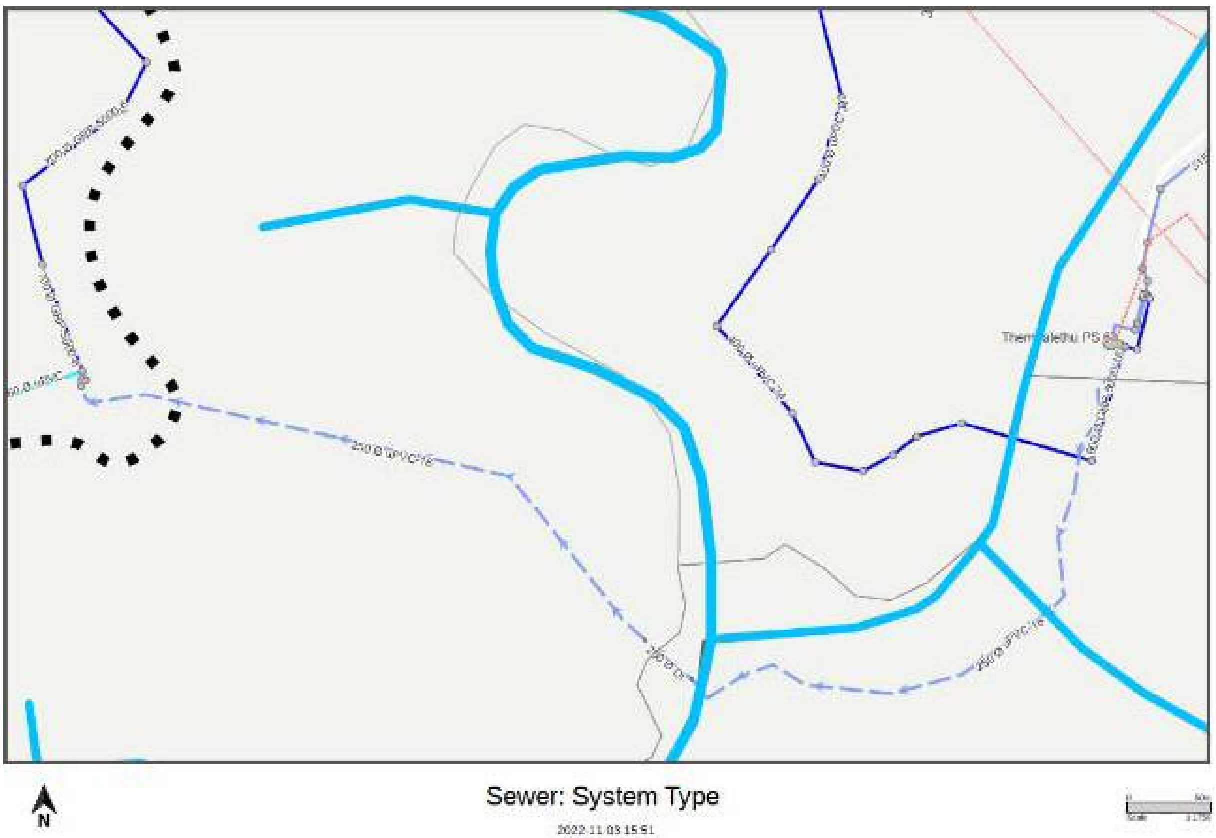


Figure 3-1: Existing sewer network

3.1 Earthworks

The pump station is constructed on two terraces, cut into the slope. The cut slope is stabilised with a gabion wall structure. The inlet works is positioned on the upper level, from where it drains to the wet well structure. The drywall is positioned on the lower level as can be seen in Figure 3-2. The lower level provides vehicle access to the main structure which houses the electrical infrastructure and equipment.

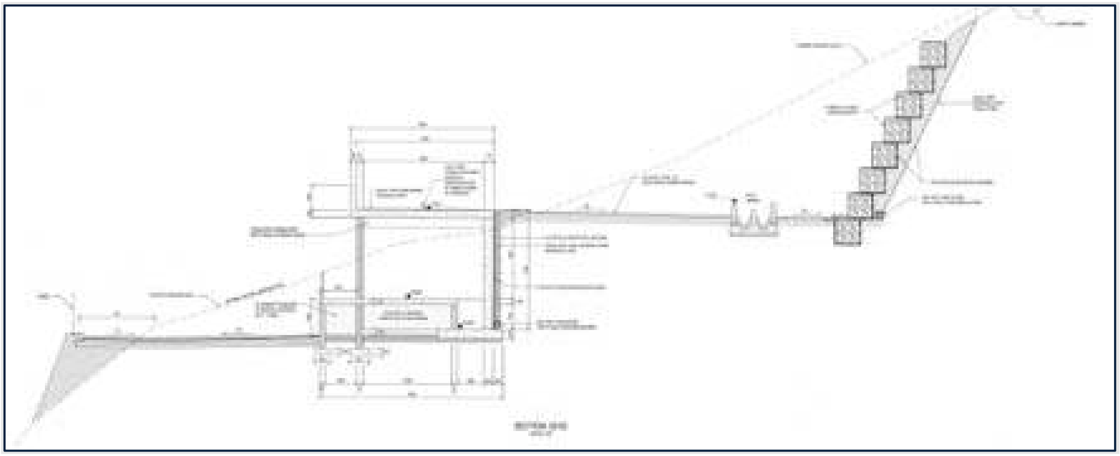


Figure 3-2: Existing terrace section

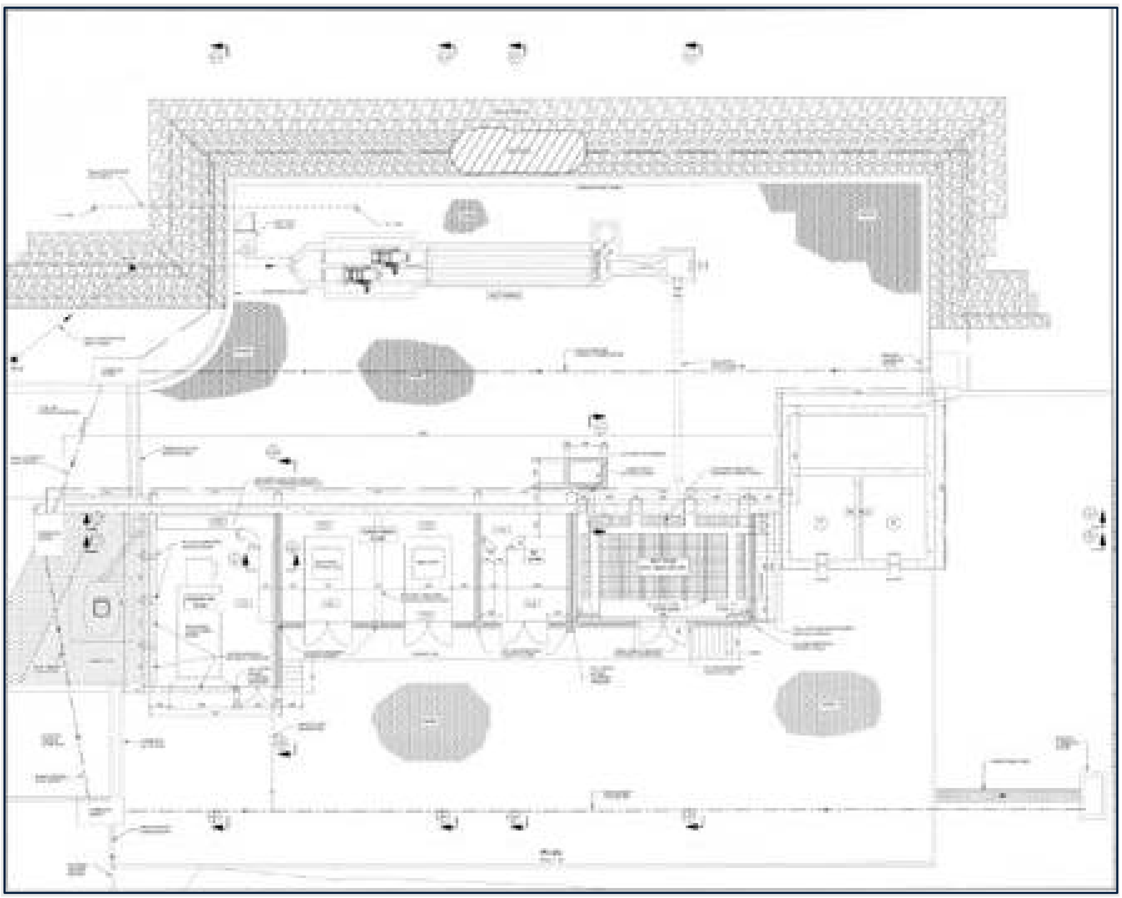


Figure 3-3: Existing layout

Figure 3-4: Photo of existing ground slope and gabions

3.2 Inlet works

The existing inlet works have a designed capacity of 100 ℓ/s.

The screening collection system has been removed from the mechanical screens. The team on site informed us that this decision was taken due to them breaking down when the waste collected on them dried and solidified, making it difficult to move and ultimately shearing off the conveyor shaft.

An alternative has been adopted on-site with a perforated dustbin being used to collect the trash directly from the screen. This is an inefficient system with much of the screenings spilling onto the grating and re-entering the liquid stream below, negating the purpose of the screening infrastructure

Figure 3-5: Existing mechanical screens

It was observed on-site that hand-rake screens and additional hanging bars were installed in the grit channels to catch rags and floating materials. This confirms the conclusion about the ineffectual handling of the screenings above or is indicative of the mechanical screens being bypassed or not operating as intended.

Figure 3-6: Existing hand rake screens

The Parshall flume at the end of the inlet works appears to be working correctly with ultrasonic level measurement. Ultrasonic level sensing is taken before and after the mechanical screens to operate the screens.

Figure 3-7: Existing ultrasonic flow measurement

3.3 Pump Station

The previous design made provision for expansion and allowance was made in the electrical buildings for additional equipment. Accordingly, the MCC room, MV room, transformer room, and generator room have all already been provided.

Figure 3-8: Existing pump station electrical rooms

The installed pumps are Gorman Rupp self-priming pumps and are situated above the existing wet well. These pumps are to remain in operation until the new pumps have been installed and commissioned.

Figure 3-9: Existing pumps

3.4 Electrical Infrastructure

3.4.1 Medium Voltage Reticulation

The existing bulk electrical supply to the Thembalethu Pump Station No.6 is reticulated via the George Municipality's medium voltage network, from SS Balottsbaai via the "Pro-Ball Lyn Oos" 11kV overhead line infrastructure as indicated in Figure 3-10 below.

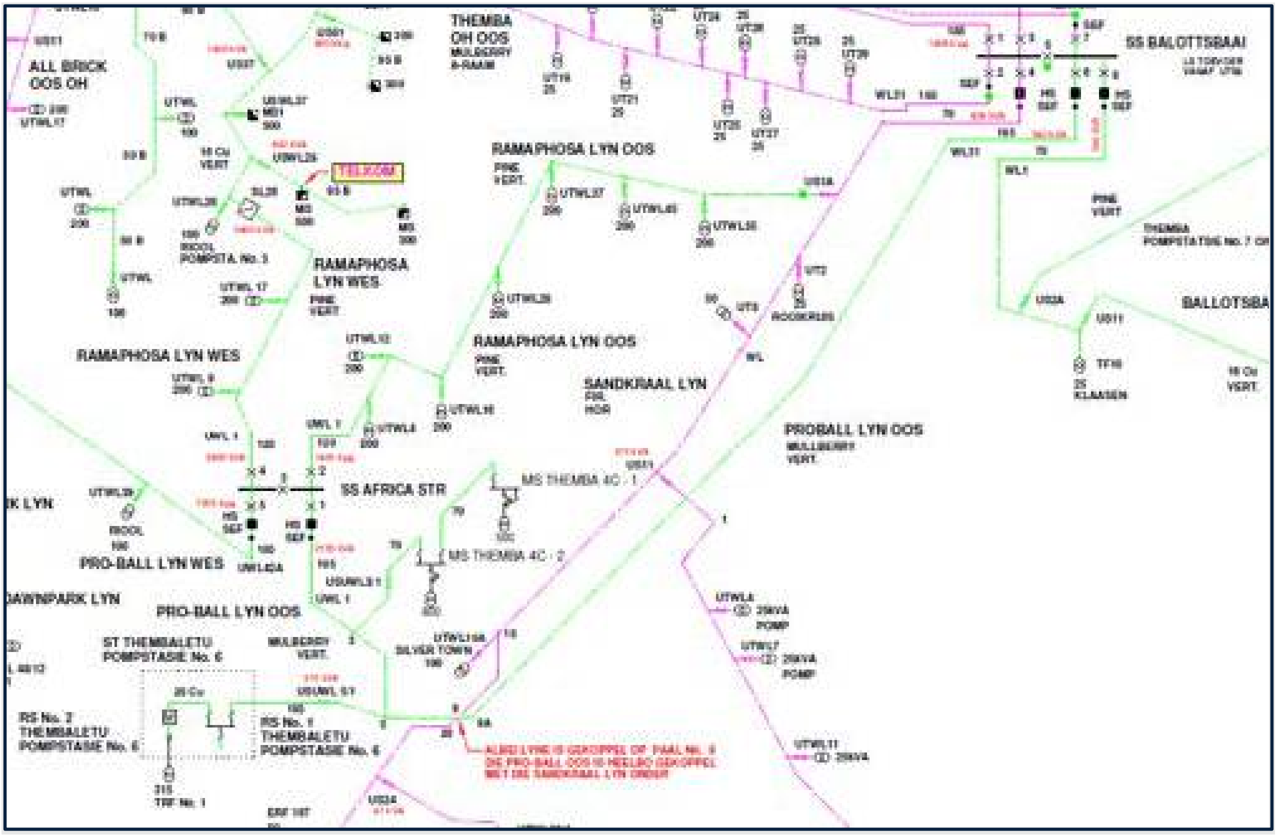


Figure 3-10: Existing Single Line Diagram

The supply to the Pump Station is via an 11kV overhead line with an AAAC Mulberry conductor (rated 420A, 8MVA @11kV), which terminates onto a 185mm^2, Aluminium power cable (rated 265A, 5MVA @11kV) at the pump station. The supply to the pump station is currently a radial supply.

3.4.2 Equipment Room Layouts

Figure 3-12 below shows the existing electrical equipment room layouts at Thembalethu Pump Station No.6. As can be seen from this figure, the equipment rooms have been sized with future expansions in mind. All rooms are very spacious and well-equipped with cable trenches, between the different rooms. This ensures easy installation of electrical equipment and linking of electrical cables between the different equipment.

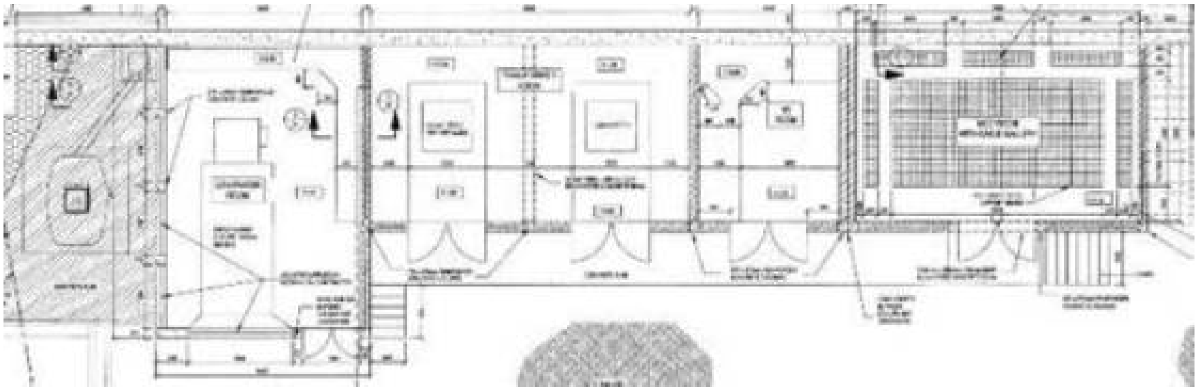


Figure 3-11: Existing Equipment Room Layout

3.4.3 Medium Voltage Switchgear

Figure 3-12 below shows the existing medium voltage switchgear that is housed in the pump station's MV Room. accommodate MV Switchgear consists of a 3-way Ring Main Unit (CCC-configuration). Each of the contactor circuits is rated at 17.5kV, 630A. The 11kV, 185mm², Aluminium power cable from SS Ballotsbaai terminates onto Incoming Contactor No.1. Contactor No. 2 is supplying the MV Metering Unit. Contactor No.3 is currently not connected. This means that an alternative 11kV source could be connected to this spare feeder to provide a more secure ring feed to the pump station, instead of the current radial supply.

Figure 3-12: Existing Medium Voltage Ring Main Unit

Figure 3-13 below shows the Medium Voltage Metering Unit, which is housed in the same MV Room as the 3-way RMU. As can be seen from the images, the metering unit consists of an incoming cable compartment (from RMU), the main metering compartment (housing the 11kV CTs and VTs) and a circuit breaker compartment, from where the main power transformer for the pump station is being supplied. The circuit breaker compartment is rated 17.5kV, 200A. It is important to note that there is currently only one (1) transformer feeder, supplying the existing 315kVA transformer. There is, however, sufficient space next to the existing transformer feeder to add an additional feeder to supply a second transformer.

Figure 3-13: Existing Medium Voltage Metering Unit

3.4.4 Medium Voltage Power Cable

Although it could not physically be confirmed on site, it can be seen from the existing single line diagram (Figure 3-10), that an 11kV, 25mm^2, Copper power cable is used between the MV Metering Unit and the main power transformer. This cable is rated 115A, 2.2MVA @11kV when installed in ducts/trenches.

3.4.5 Power Transformer

The existing power transformer is shown in the figure below. As can be seen from these images, this transformer is housed in the dedicated transformer room. This transformer room is big enough to accommodate a second transformer in the future (if required).

Figure 3-14: Existing Power Transformer No.1 (315kVA)

From the transformer nameplate data, the following could be established:

Output kVA:	315kVA
Ratio:	11000/400 V
Cooling:	ONAN
Vector Group:	Dyn11
Year of Manufacture:	2012

3.4.6 Motor Control Centre

Figure 3-15 below shows the existing LV Motor Control Centre. This MCC is positioned against the northern wall of the existing MCC Room at the pump station. The MCC was manufactured in 2012 and has a busbar rating of 400A @ 400V (276kVA), with a fault withstand capability of 30kA for 1 second.

Figure 3-15: Existing LV Motor Control Centre

The current MCC layout makes provision for the following functional units:

1. Main incoming
2. Local distribution
3. Control section: mechanical screen 1
4. Control section: mechanical screen 2
5. Control section: screw conveyor 1
6. Control section: screw conveyor 2
7. Control section: sewage pump 1
8. Control section: sewage pump 2
9. Local control section
10. Wireways & distribution terminals

The screw conveyor and mechanical screens have been equipped with WEG CFW-11 variable frequency drives, whilst the two (2) sewage pumps are started via WEG SSW-06 soft starters.

All power and control cables are bottom entry via cable trenches and neatly managed between the MCC and the motors using heavy-duty cable racks, mounted against the walls.

3.4.7 Low Voltage Motors

The existing sewage pump motors are shown in Figure 3-16 below. These motors are both rated 75kW @400V, with a power factor of 0.87. The motors are currently operated in a 1x duty, 1x standby configuration.

Figure 3-16: Existing LV Motors

3.4.8 Standby Diesel Generator

The images below provide an overview of the existing standby diesel generator installation for the pump station.

Figure 3-17: Existing Standby Diesel Generator, ACO Panel & Day Tank

From the generator nameplate data, the following could be established:

- Output kVA (continuous): 403kVA

- Output Voltage: 400 V
- Power Factor: 0.8
- Insulation: Class H
- Speed: 1500 rpm

The generator is housed in a dedicated generator room (also indicated in Figure 3-11). The room is well-ventilated with louvered wall sheets, with a dedicated air inlet in front of the machine. The generator is supplied from an external (underground) bulk fuel tank of which the capacity could not be determined from the site or existing drawings. The diesel is then pumped into a day-tank, which is installed inside the generator room (refer to Figure 3-17 above).

The standby diesel generator is also equipped with an Automatic Change-over (ACO) Panel system, which senses the loss of the Mains Supply, automatically starts the diesel engine and transfers the load to standby power. The same sequence is also reversed when the normal power is restored. The existing contactors on the ACO panel are rated 500A and 400V, which means that they are only sized for the current generator capacity.

3.4.9 Telemetry & SCADA

The images below provide an overview of the existing telemetry and SCADA control equipment installed for the pump station. As can be seen from these images, the existing MCC has a control panel, which houses a Spectrum Teleflex 5, that acts as both controller and Telemetry RTU and has an HMI display on the door of the panel.

There is also communication equipment installed, which interfaces with the municipality's master SCADA system for remote monitoring and control functionality.

Figure 3-18: Existing Telemetry & Control Panel

3.5 Existing rising main

The existing rising main is indicated to be a 250mm diameter U_PVC of class 16 which accommodates the existing flow of 60 ℓ/s. The pipe route follows the service corridor which has been prepared to accommodate the pipe route. The existing 250mm diameter pipe with associated infrastructure is located within the service corridor. The pipeline crosses over the Schaapkop river with a steel structure pipe bridge. Figure 3-19 shows the corridor with stormwater infrastructure in the background.

Figure 3-19: Existing pipe corridor

The pipe route follows the corridor up the crossing of the river, where a street carrier bridge was constructed. The bridge structure is crossed with a ductile iron pipe. The image below shows the bridge structure. It was noted that some vandalism has occurred and that remedial actions will be required.

Figure 3-20: Existing pipe bridge

Figure 3-21: Vandalised bridge

The existing pipe route shows some signs of erosion which may pose a risk to the pipe construction if left unprotected.

Figure 3-22: Stormwater erosion

Figure 3-23: Stormwater damage

Existing chambers along the existing pipe route what seems to be a scour valve seem to be still in tack and structurally sound as seen in Figure 3-24 below.

Figure 3-24: Existing infrastructure on pipe route

4 Detailed Design

During the design phase, careful consideration was given to safety, leak and damage prevention, government regulations and environmental concerns. As far as reasonably practicable, interruption to the operations of the existing works will be avoided with minimal downtime for cross-connection of the existing and new works.

4.1 Inlet works

The new inlet structure will consist of flow division into 2 streams, manual coarse screening, mechanical screening with emergency screen bypass, grit channels, and flume measurement.

The hydraulic design calculations of the inlet works were done by means of hydraulically calculating the backwater curve to determine the flow depth and velocity throughout the inlet works; as such, the first section calculated was the end of the inlet works and then moving upstream.

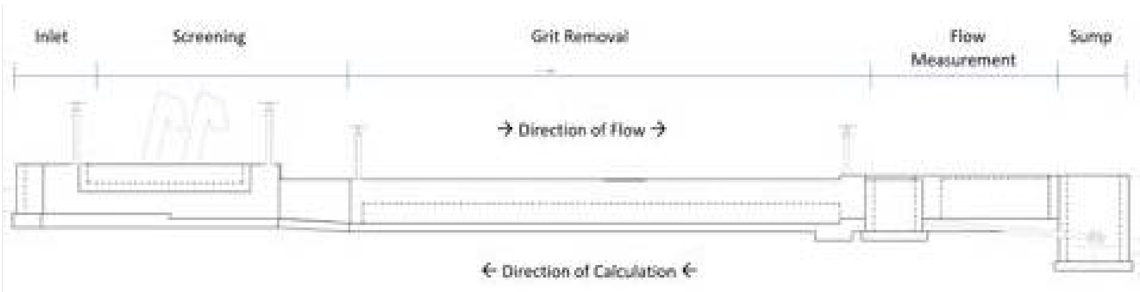


Figure 4-1: Backwater calculation sections

The new inlet works will be sized to handle the anticipated flows for the initial period after the upgrade. Thus, the refurbishment of the existing inlet works can be performed. Both inlet works (new and refurbished) will be required to accommodate the ultimate design flows.

4.1.1 Flow Measurement & Sump

The Parshall flume size was selected as a 1-foot flume. This was done for a number of reasons.

- The flow depth can accommodate the largest range of flows
- The discharge rate that can be accommodated encompasses all flows that would be expected
- The correction factor for submerged conditions is 1 which does not alter the flow calculations in the event that the flume is flooded

Flows from the existing inlet works will discharge into a combined sump with the flows from the new inlet works (each having been measured through their respective flumes), from where it will discharge via a DN500 pipeline equipped with an isolation valve. The depth of the sump is such that the Parshall flume can have a free-flow discharge and not cause any backwater pressure which would affect the measurement readings.

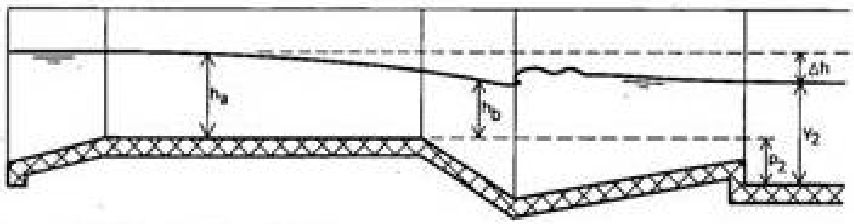


Figure 7.18 Section of Parshall flume

Figure 4-2: Section of Parshall Flume

Table 7.4 Discharge characteristics of Parshall flumes

Throat width b_c in feet or inches	Discharge range in $m^3/s \times 10^{-3}$ minimum	Discharge range in $m^3/s \times 10^{-3}$ maximum	Equation $Q = K h_a^u$ (Q in m^3/s)	Head range in metres minimum	Head range in metres maximum	Modular limit h_b/h_a
1″	0.09	5.4	$0.0604\ h_a^{1.55}$	0.015	0.21	0.50
2″	0.18	13.2	$0.1207\ h_a^{1.55}$	0.015	0.24	0.50
3″	0.77	32.1	$0.1771\ h_a^{1.55}$	0.03	0.33	0.50
6″	1.50	111	$0.3812\ h_a^{1.58}$	0.03	0.45	0.60
9″	2.50	251	$0.5354\ h_a^{1.53}$	0.03	0.61	0.60
1′	3.32	457	$0.6909\ h_a^{1.522}$	0.03	0.76	0.70
1′6″	4.80	695	$1.056\ h_a^{1.538}$	0.03	0.76	0.70
2′	12.1	937	$1.428\ h_a^{1.550}$	0.046	0.76	0.70
3′	17.6	1427	$2.184\ h_a^{1.566}$	0.046	0.76	0.70
4′	35.8	1923	$2.953\ h_a^{1.578}$	0.06	0.76	0.70
5′	44.1	2424	$3.732\ h_a^{1.587}$	0.06	0.76	0.70
6′	74.1	2929	$4.519\ h_a^{1.595}$	0.076	0.76	0.70
7′	85.8	3438	$5.312\ h_a^{1.601}$	0.076	0.76	0.70
8′	97.2	3949	$6.112\ h_a^{1.607}$	0.076	0.76	0.70

Figure 4-3: Discharge Characteristics of Parshall Flumes

4.1.2 Grit Removal

For grit removal, the determining factors are the settling velocity and retention time. The table below gives guidelines on the design of the grit channels.

TABLE 3.3.1: Horizontal flow grit chamber design criteria

Design Criteria	Range	Typical
Detention time	40 – 90 s	60 s
Horizontal velocity	0.24 – 0.4 m/s	0.3 m/s
Settling velocity		
50-mesh	2.8 – 3.1 m/min	2.9 m/min
100-mesh	0.6 –0.9 m/min	0.8 m/min
Headloss (% of channel depth)	30 – 40%	36%
Inlet and outlet length allowance	25 – 50%	30%

If the specific gravity of the grit is significantly less than 2.65, lower velocities should be used.

Figure 4-4: Grit channel design criteria

A robust approach was opted for in order to be able to meet the worst possible conditions experienced in the grit channels. Table 4-1 below provides the design values used to determine the sizing of the grit channels. With 2 channels operational and one on standby, there is redundancy that allows for cleaning the channel that is not in use to ensure full capacity is available at all times. A side chamber is provided to assist with flushing the channel, not in operation. This is done by closing the gates at either end of the channel and opening the drainage valve to the side chamber so that all the liquid dissipates from the channel – the channel can then be cleaned with a spade to remove all the solid material left behind. The bottom width of the channel was sized to be able to accommodate a spade for ease of cleaning.

Table 4-1: Grit channel design values

Criteria	Units	Value
Flow	m^3/s	0.3
# of channels operational	-	2
Width of channel	m	1
Depth of channel	m	0.9
Area of water	m2	1.53
Horizontal velocity	m/s	0.196
Vertical velocity (settlement)	m/s	0.016
Time for the particle to settle	seconds	56.25
Horizontal distance travelled	m	11.03

With a channel length of 11m, at maximum flow, the retention time in the channels will be just less than 1 minute which is typical despite the horizontal velocity being lower than the typical range.

4.1.3 Screening

There will be two screening trains, each with an automated mechanical bar screen, a coarse manual bar rake screen upstream of the automated screen, and a fine manual bar rake screen downstream of the automated screen.

Each screen will have a bypass channel in the event of a screen being blocked, allowing sewage to bypass the specific screen and re-enter the screening channel directly downstream of the blocked screen.

Each screening train shall be designed to handle the full design flow rate and solids loads.

The channels for screening were designed to be the same as the existing inlet works. The advantages of using the same screens will reduce the number of spare parts to be kept as all screens will be the same.

New automated mechanical screens, hand rake screens, screw conveyors and washer compactors will be installed in the new screening channels.

The sizing of the screening channels was done such that the velocity did not drop below 0.6m/s which would allow for settlement and thus self-cleaning can be maintained by the flow through the screen channels.

Sluice gates are provided upstream and downstream of the screens as well as upstream and downstream of the grit channels to allow for the selection of any of the channels to be used or isolated in the operation while allowing enough transition space for the water to flow and not become stagnant. The screens have been sized with the following sizes:

- 50mm hand rake screen (protection of the mechanical screen from large objects)
- 10mm mechanical screen (intended to remove the majority of the solids in suspension)
- 6mm hand rake screen (catchment for any finer particles and a failsafe in the event of the mechanical screen not being operational)

(a) Screening Equipment

Manual Hand Rake Bar Screens:

The screens shall be the flat bar type bar screens. The hand-rake screens in the main channels prior to the automated mechanical screen shall be sized to catch large objects that pose a risk of damage to the automated screens, therefore a bar spacing of 50 mm is used. The hand-rake screens in the main channels after the automated mechanical screen shall be sized to catch finer particles and will have a 6mm bar spacing. The angle of the bars shall be 60 °to the channel floor and the minimum bar thickness would be 10 mm. The screens shall span over the entire width of the respective channels.

All screens shall be completely manufactured from 316-grade Stainless Steel to ensure the longevity of the equipment. Specifically sized hand rakes to suit the bar spacing of the types of screens shall be provided. Each screen shall have a removable drainage platform onto which the debris can be raked to drain excess liquid before the debris is transferred to the waste skip by means of a shovel. The drainage platform shall be removable to allow access to the channel for maintenance work.

The George Municipality accepted the associated labour-intensive operation to clean the screens and transfer the debris to the skips in meetings held during the design stage.

Automated Mechanical Bar Front-Rake Screen

The automated screens will be of the front rake type and each screen train shall be sized to handle the full design flow. Due to the high number of rags in the sewage, medium screens with 10 mm bar spacing are proposed.

The automated 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 and have full access to the bypass channel (should it be needed). Sufficient space has also been allowed between the units for day-to-day operational access and maintenance.

The automated mechanical screens are estimated to handle an average solid loading of ± 0.098 m^3/h (based on an assumed 50 L screenings removed from 1000 m^3 sewage with a 10 mm screen opening and 35 % excess over the maximum expected solids loading of the sewage as per Figure 4-5) under peak conditions.

Table 5-2
Typical information on the characteristics and quantities of screenings removed from wastewater with coarse screens

Size of opening between bars, mm	Moisture content, %	Specific weight, kg/m³	Volume of screenings: ft³/Mgal Range	Volume of screenings: ft³/Mgal Typical	Volume of screenings: L/1000 m³ Range	Volume of screenings: L/1000 m³ Typical
6.0*	60-90	700-1100	7-13.5	9.5	51-100	67
12.5	60-90	700-1100	5-10	7.0	37-74	50
25.0	50-80	600-1000	2-5	3.0	15-37	22
37.5	50-80	600-1000	1-2	1.5	7-15	11
50.0	50-80	600-1000	0.5-1.5	0.8	4-11	6

*Information on fine screen added for the purpose of comparison.

Note: mm × 0.3937 = in.
kg/m³ × 8.3492 = lb/1000 gal

Figure 4-5: Typical screening loading rates on screens (Metcalf and Eddy Inc., 2003)

The above typical information is not based on the South Africa environment and therefore, as a minimum, the equipment should be sized to handle at least 4 m^3/h to ensure the longevity of equipment and be in line with the expected loading as discussed in section 2.3. Each screen shall at least have 8 rakes to lower the volume of debris handled per rake. The material of construction shall be selected for highly corrosive environments and South African sewage characteristics, therefore as a minimum grade 316 Stainless Steel shall be used on all components, including the chains and sprockets.

The mechanical screen frame sizes shall be designed to reach the screw conveyor situated at roughly 1.5-2.0 m above ground level, with a specially manufactured diversion chute between the screen discharge point and the screw conveyor hopper.

General maintenance is required on the mechanical screens and components based on the OEM’s requirements, therefore items such as the gearboxes, motors, drive shafts, bearings and 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 space available between the channels is an issue, only a wall thickness of 200 mm is available. This does not allow for sufficient space to work on the screens during maintenance or repairs. It will also mean that the mechanical screens placed adjacent to one another will have to be configured with the drive unit on opposite sides to enable - the unit to be installed in adjacent channels.

(b) Waste Removal Equipment

For the proposed layout, screened debris from the manual hand rake screens would be removed by the operator and transported to the skip adjacent to the screening facility. The operator would rake the debris caught by the manual hand rake screens on to the respective drainage platforms where the excess liquid can drain from the debris. Large objects can be transported to the waste skip by hand or by means of a shovel. Smaller objects can be transported to and deposit into the screw conveyor (servicing the automated mechanical screens) through the hatch provided that will transfer the debris to the washer compactor unit to clean and compact it.

Sufficient working space is provided for the operator to do the daily duties of cleaning the screens.

Two trains of waste removal equipment will be installed, each with a screw conveyor and washer compactor. Screened debris from the automated mechanical screens is deposited into a specially manufactured chute per screen which will direct screenings into either the screw conveyors, from where two screw conveyors then transport the debris to a washer-compactor unit where the matter is cleaned, dried, and compacted for removal. The specially manufactured chute is to ensure redundancy in case one of the conveyors or washer compactors is out of order. Once this wash and dry process is complete, the washer compactors deposit the materials into a skip, mounted on a dolly system.

<u>Screw Conveyor</u>

The screw conveyor for the automated mechanical screens shall be of the centreless screw type, driven by a geared electrical motor. The conveyor shall be sized to handle at least 3.5 m^3/h to ensure the longevity and robustness of the unit. The resulting minimum screw size is DN300 and is driven by a 4kW motor.

Each automated mechanical screen shall have a specially manufactured chute that will be able to divert screenings from each screen to either of the two screw conveyors. The chute shall be operated manually by means of a lever.

Each screw conveyor unit shall have three inline hoppers, two hoppers to receive the debris from the two automated screens and one hopper with a hatch that is used for the debris deposited by the operator that was removed from the manual hand rake screen. The conveyor will be supported by legs to handle all static and dynamic forces.

The complete unit, including the screw shall be manufactured from 316-grade Stainless Steel and the through will have a double colour UHMWPE liner.

General maintenance is required on the equipment and components based on the OEM's guidelines, therefore items such as the gearboxes, motors, drive shafts and bearings must be easily accessible for maintenance and the relevant equipment put in place to remove components when required. The conveyor's inherent design allows for access to wear or serviceable parts for general maintenance to be completed, without the need to remove the entire unit/s.

Washer Compactor

The washer compactor shall be of the shafted intensive type with a forced washing mechanism by means of an impeller. The unit shall have a washing compartment that fills with water and the debris and water are agitated by means of a motor-driven impeller to separate the organic particles from the debris. Once the washing cycle is complete, the compartment will be drained via the drain valve and drain pipework back to the screening channels. The washed debris will be compacted by a screw to reduce the liquid content and reduce the volume and conveyed to the discharge chute. The compacted debris will be deposited into a waste skip positioned adjacent to the screening channels.

The unit shall be sized to handle a minimum of 3.5 m^3/h debris (batch processing) and the complete unit, including the compacting screw, shall be manufactured from 316-grade Stainless Steel.

The unit shall be equipped with a suitable solenoid discharge valve to drain the water after the washing cycle and during the compacting cycle. The drainage pipework would be suitably sized DN100 pipework (according to SANS 62) and flanged according to SANS 1123. The pipe work shall be manufactured from 316-grade Stainless Steel and shall be properly supported by means of clamps.

The unit requires a wash water connection for the filling of the wash compartment. Due to no available treated effluent available on the site, potable water is proposed from the Municipal network. The wash water supply of 1.2 L/s at 2-3 bar is required for intermittent operation. The associated supply pipework from an onsite point to the washer compactor will be installed as part of the project.

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

Skip Dolly System

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 chute, to be removed from the site with a truck. A minimum skip size of 6 m^3 is recommended to prevent a high turn around frequency. The layout allows for a dolly system that would allow for two skips to be placed on two dollies, linked together operating. The supply of skips would not be part of the project, however, the Municipality shall make use of existing service level agreements to provide and service the skips.

The skips would work on a one-duty and one-standby configuration. The dolly could be moved closer to the common channel while still receiving debris from the washer-compactor should a crane truck need to access the area for maintenance.

The dolly rails would be recessed into the concrete slab on request of George Municipality to enable vehicles to pass over it with ease. The dolly rails shall be a standard rail profile of a minimum of 22 kg/m and shall be used to suit the weight of the dolly system. The dolly shall be manufactured from hot dipped galvanised and coated mild steel and driven by an electrical geared motor. It must be noted that dolly rails and channels must be kept clean and dried to prevent premature corrosion and ensure maximum longevity.

(c) Ancillary Equipment

Penstocks

Four penstocks will be installed in the screening channels and will be equipped with suitable-sized multi-turn electrical actuators for open/close function for ease of operation. Actuators such a Auma / Rotork rated at ±5.5 kW would be considered with the suitable network communication to the MCC. The penstocks upstream of the screening channels have a width and height of 600 mm and 1100mm respectively. The penstocks downstream of the screening channels have a width and height of 600 mm and 1250mm respectively.

Six penstocks will be installed in the degritting channels and will be equipped with suitably sized multi-turn electrical actuators for open/close function for ease of operation. Actuators such a Auma / Rotork rated at ±5.5 kW would be considered with the suitable network communication to the MCC. The penstocks have a width and height of 1000 mm and 1000mm respectively.

Wash Water Requirements

Suitable wash water would be required for the operation of the washer compactor. As stated previously, treated effluent is not available on-site and therefore potable water from the Municipal network would be used for the above operation and general wash-down actions by the operators.

A mobile, high-pressure washing system is recommended so that the area can routinely and easily be cleaned and washed down, of which the run-off is contained and diverted back into the sewage canals. The washer would be connected to the water network and rated for at least 840 l/min at 130 bars.

A suitable connection to the onsite potable water network would be made and distributed to the respective areas where it is required. In Table 2 below, an estimate is made on the amount of water to be used by the respective processes:

Table 4-2: Grit channel design values

Process	Flow Required	Estimated Frequency	Estimated Total per Month (30 days)
Washer compactor	4.2 m^3/h (1.2 L/s)	10 min at 2-hour intervals	252 m^3
Manual cleaning operations (high-pressure washer)	0.9 m^3/h (0.25 L/s	8 hours per week	31 m^3
		Estimated Total	283 m^3

Note that the frequency of use is estimated and would depend on the frequency of the automated screen cleaning cycles and the frequency/duration of operator cleaning operations.

4.1.4 Inlet

Similar to the existing inlet works, the inlet acts as a collection sump and splitter before the screening channels. The question was asked whether a macerator would be beneficial at this location. Upon review, it is the opinion of the design team that a macerator would not be suitable for this application; the macerator is used to reduce the particle size, however, this only serves to make the screening more difficult as the screens are required to capture smaller object sizes and they are more likely to not be captured before pumping, and will increase the volume of sludge generated and requiring handling is at the waste water treatment plant. As this site is primarily for pumping of the wastewater, and treatment of the wastewater will take place at another location, the use of a macerator is not suggested and thus has not been included in this design

4.2 Pumping Station

SMEC completed the sewer pump station building and pipework design, which was based on the various investigations, the site visual assessment, provided pipe diameters and flows by GLS, EIA and WULA requirements and the connectivity to the existing sewerage system.

The design takes into consideration the previously proposed pump station design with provision being made for the proposed expansion of the pump station capacity at a later stage.

Pumps and piping:

The pump and pipe sizing have been designed with the information including projected future flows obtained from the approved GLS report. The static head, friction losses and transient event pressures were considered in the pump sizing.

Building Infrastructure:

The design has been based on best practices, taking into consideration the current infrastructure and proposed pump station layout and requirements, making provision for the further expansion of the pump station at a later stage. The building size is based on the pumps and mechanical arrangements required to fit within the building for the final capacity, along with the generators and transformers chosen for the final approved design. The layout of the building allows sufficient space and specific connection points to accommodate future expansion in this design. Additional components such as washrooms, ablutions, a control room, and a guardhouse have also been considered to ensure a holistic design of the pump station.

4.2.1 System characteristics

The design of the pumping system is dependent on the system characteristics and the connections to the existing infrastructure. The existing sump will be used (and duplicated with the same dimensions and levels) and the discharge point will remain the same which determines the static head required. The pipeline will follow the same route as the existing pipeline; thus, the pipe length is already known. The pipeline diameter is selected to be able to meet the current and future demands and from this determination the friction losses are determined, giving the total required head. The pump is then selected based on the flow and head requirements, which then determines the required impeller diameter and pump motor sizes.

The table below summarizes the key system characteristics:

Table 4-3: Pump System Characteristics

Description	Data
Maximum Water Level in Sump	116.1 m
Minimum Water Level in Sump	114.0 m
Discharge Level	165.2 m
Minimum Static Head	49.1 m
Maximum Static Head	51.2 m
Pipe Length	710 m

Suction Pipe Size and Type	450 mm Ø Steel Grade 316
Delivery Pipe Size and Type	350 mm Ø Steel Grade 316
Delivery Pipe Size and Type	400 mm Ø OPVC

The system curve is shown in the below figure:

Figure 4-6: Pump Station System Curve

4.2.2 Pump Selection

The proposed pumps of Thembalethu 6 pump station are selected in line with the information obtained from the GLS report.

The current capacity of the pump station is to be upgraded to accommodate the next estimated flow for the next 20 years of 238 ℓ/s. In terms of the sanitation master plan of the George Municipality, further upgrades to the pump station will need to be carried out in the future to cater for the ultimate capacity of 400 ℓ/s.

Mechanical equipment has an acceptable lifespan of 15 - 20 years thus it is recommended that the initial pump station capacity should allow for 238 l/s until the 20-year sanitation master plan horizon, at which time the pump station's capacity can be upgraded in conjunction with refurbishment/replacement of the existing mechanical equipment.

It is recommended that the capacity upgrade is achieved by adding an additional pump set, that is equivalent/identical to the initial pump set installed, with the addition of a self-priming system being installed on the pumps, and the start level of the pumps lowered to ensure the maximum number of pumps starts per hour is not met.

A minimum flow rate of 90 l/s and 180 l/s is recommended to ensure self-cleansing velocities are achieved in the rising main for a single and a double DN400mm rising main(s) respectively. It is recommended that a variable speed drive is installed to operate the pumps to allow the pumps' speed to be reduced to meet the lower duty points.

To ensure adequate redundancy in the pumping system, it is recommended that there be at least one standby pump provided at any point to achieve the required flow rate.

A number of reputable dry-installed sewage pump suppliers were requested to provide their proposed pump configurations and selections to achieve the different system flow rates. Different configurations were evaluated, ranging from a single-duty pump to achieve the ultimate flow rate of 400 l/s, to three identical pumps in parallel able to meet the 400 l/s in parallel. The three-duty pump configuration has been selected as it offers the widest flow ranges able to be met in the current phase, with the option of adding an additional pump in the future to meet the ultimate flow requirement. All the suppliers recommended end-suction centrifugal pumps. Three pumps will be installed during the initial phase, as a duty-assist-standby configuration.

Phase 1 (238 l/s):

To minimise the complexity of the pumping system, it is not recommended to PID on the level in the wet well, but rather to start the pumps sequentially depending on the level in the wet well. There will thus be two start levels in the wet well, with one pump operating at a set speed and flow on the first start level, and two pumps operating at a set speed and flow on the second start level. The levels in the wet well are set such that the effective pumping volume is sufficient to ensure the pumps do not operate more than six (6) cycles per hour and allow enough volume for pumps to speed up to meet their operational set point prior to reaching any other level set points in the sump such as the next start level or high level.

To ensure sufficient effective pumping volume in the wet well for the ultimate pumping capacity of 400 l/s, the pumps installed under the first phase shall be capable of being adapted to be a self-priming pump, with the self-priming system being installed under the second phase of the project when refurbishment/replacement of the mechanical equipment is required.

On the first start level, one pump shall operate at the manufacturer's minimum recommended flow rate, which in this case is 125 l/s. On the second start level, two pumps in parallel shall operate at a combined flow of 238 l/s.

The table below summarizes the key operational points of the pumps:

Table 4-4: Operational Points Characteristics

Duty Point	Description	Data
1	1 x Duty Pumping Flow Rate	125 l/s
	1 x Duty Pumping Head	53.0 m
	1 x Duty Operating Speed	1427 RPM
2	2 x Duty Pumping Flow Rate	119 l/s
	2 x Duty Pumping Flow Rate (Combined)	238 l/s
	2 x Duty Pumping Head	59.0 m
	2 x Duty Operating Speed	1476 RPM

<u>Phase 2 (400 l/s):</u>

A self-priming system will be required at the upgrade of the pump station to the ultimate capacity to allow for sufficient effective pumping volume. The start level shall be set to the minimum draw-down level based on the pump NPSH and minimum submergence of the suction pipe, which is below the pump's suction port. In line with this, the pumps shall be configured to operate as 3 x duty, with an additional pump being installed as a standby.

The table below summarizes the key operational points of the pumps:

Table 4-5: Operational Points Characteristics

Duty Point	Description	Data
3	3 x Duty Pumping Flow Rate	134 l/s
	3 x Duty Pumping Flow Rate (Combined)	400 l/s
	3 x Duty Pumping Head	55.0 m
	3 x Duty Operating Speed	1464 RPM

The pump curves with the respective operational points are shown in the below figures:

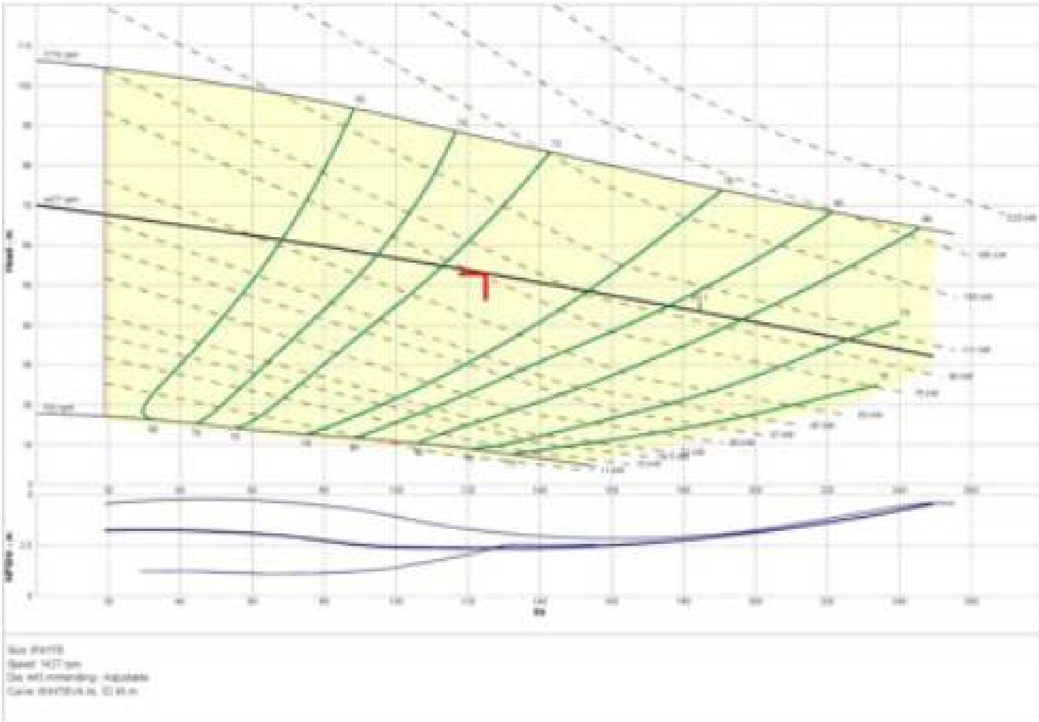


Figure 4-7: Phase 1 Pump Curve with Duty Point 1

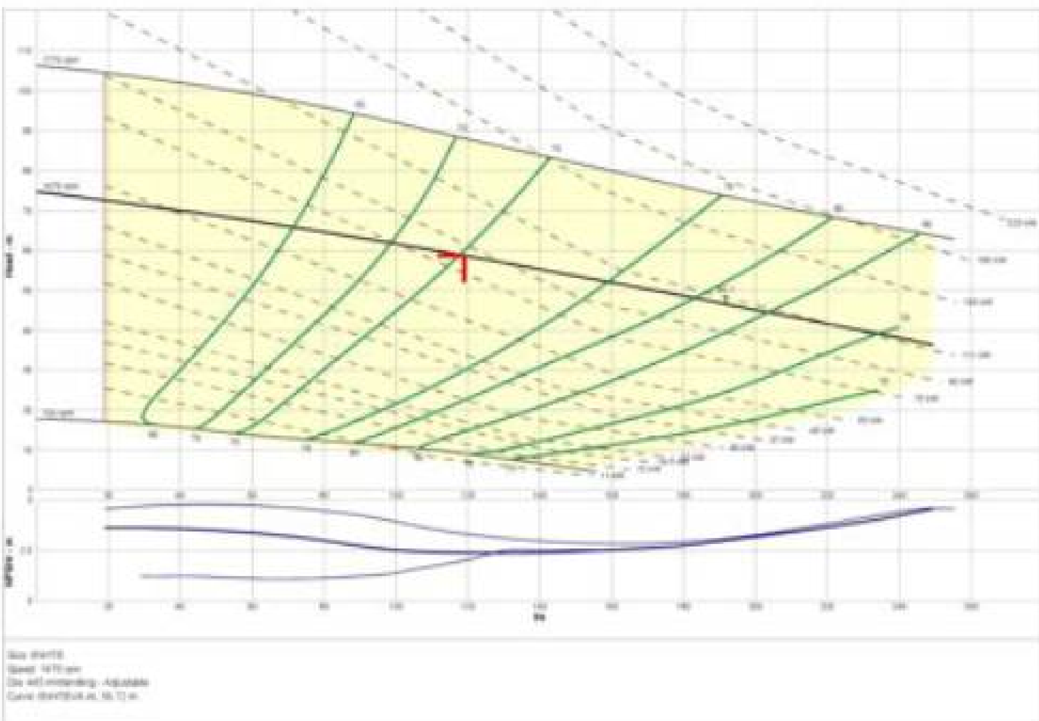


Figure 4-8: Phase 1 Pump Curve with Duty Point 2

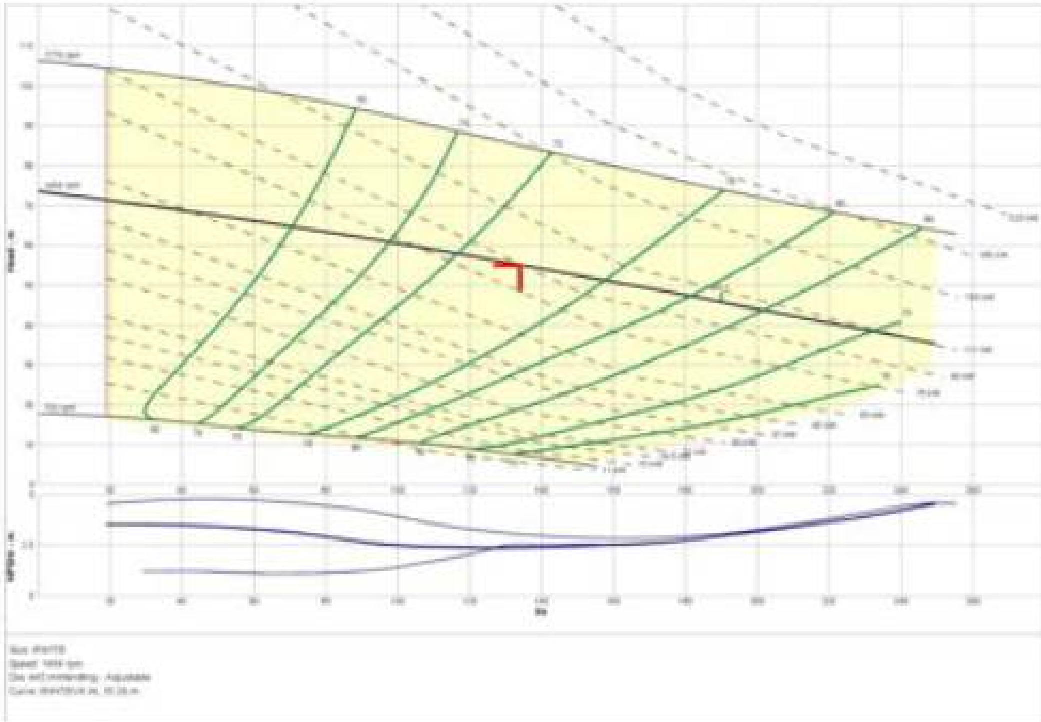


Figure 4-9: Phase 2 Pump Curve with Duty Point 3

4.2.3 Pipework Optimisation

The selection of pipe sizes in the pumping station is done to ensure the pump station is effectively and efficiently able to convey sewage throughout the required flow ranges. The suction and delivery pipework sizes are selected to convey the current and ultimate flow rates between 125 l/s and 400 l/s.

Incoming sewage into the wet well has been screened and the remaining larger solids settled out in the grit settling channels, thus only organic material is expected in the wet well. The minimum recommended suction pipe velocity for sewage with organic matter is 0.6 m/s, with the maximum being 1.5 m/s. The maximum recommended velocity in the inlet bell of the suction pipework is 1 m/s. The maximum recommended velocity in delivery pipework is 2.5 m/s.

Table 4-6: Grit channel design values

Description	Pipe Diameter	Minimum Flow Velocity	Maximum Flow Velocity
Suction Bell	500 mm	0.61 m/s	1.02 m/s
Suction Pipework	450 mm	0.75 m/s	1.26 m/s
Delivery Pipework	350 mm	1.24 m/s	1.39 m/s
Delivery Manifold 1	350 mm	1.24 m/s	1.39 m/s
Delivery Manifold 2	450 mm	0.75 m/s	1.69 m/s
Delivery Manifold 3	500 mm	0.61 m/s	2.04 m/s

4.2.4 Pump Station Design

The pump station building design requires consideration of several factors – these have been incorporated in the design of the pump station:

- Suction and discharge mechanical arrangements
- Local start/stop and pressure sensors for each pump
- Sufficient space surrounding pumps for operators to move and work
- Valve handles at easy-to-operate heights
- Trenches sloping towards the sump to drain and spills or excess water
- Sump pump to return water to collection sump and be pumped
- Safety shower for operators to use if necessary and provide washing area
- Overhead crane for maintenance and replacement of pumps and mechanical equipment
- Flow meter at sufficient distances from upstream/downstream fittings for accurate readings
- Ablution facility (toilet, basin, shower), Control room, MCC room, LV/MV room, Transformer room, Generator room
- Control room to be separate from the pump well to reduce noise for operators, however still in sight for operators to see if there are issues with pumps – can also have remote control of the pumps from the control room
- Emergency access – 2 per level at a minimum – doors opening outward for emergencies
- Lighting & ventilation – as much natural light as possible to reduce the electrical load for air conditioning
- Vehicle access into the pump area for the loading & offloading of equipment directly with the overhead crane.
- Over-pumping connection to rising main for bypass of the pump station.

The pump station was designed with the space allowance for three (3) pumps to be installed initially to meet the initial requirements; as well as allow sufficient space to install 1 additional pump in the future to meet the final demand of 400 ℓ/s as per the (GMSMP). This configuration will ensure that there is always standby availability for the pumps if any of the pumps have failed or need maintenance.

4.2.5 Control Philosophy

(a) Pumps

The pumps will be operated with VSDs to control the speed at which the pumps operate to meet a specific flow requirement in line with the start signal received from the wet well. The number of pumps operating is dependent on the level reached in the wet well. One pump will operate with flows up to 125 ℓ/s, with an assist pump operating in parallel will operate with flows between 125 l/s and 238 l/s. The pumps will operate at a set speed dependent on the pumping configuration to ensure the required flow rate is met. The pumps will be rotated as to which of them is running so that wear and tear are evenly distributed, and maintenance can be properly planned and carried out (avoidance of one pump accumulating hours and the remaining not operating).

(b) Sumps

An ultrasonic level sensor will be placed in the collection wet well, with a high-level and low-level float installed in each separate extraction wet well. These sensors and switches will control the start of the pumps. The suction pipework for the pumps has been designed in such a way that each wet well can be emptied by 2 different pumps. Similar to the pumps, the wet wells will be able to be isolated and any combination of the wet wells used so that regular maintenance can be performed. In the event of a failure, the operational wet wells can be utilized while the faulty one is out of service.

(c) Pipework

Isolating valves will be placed on each of the suction pipes from the wet wells, as well as each of the pumps to determine which wet wells and pumps are operational at any time. There is also an isolation valve between the two to allow for complete switching or separation between sumps and pump sets.

Figure 4-10 below gives a layout of the sumps, pumps, and interconnecting pipework in the pump station. The blue pipelines indicate suction pipework, with blue valves on the sump pipes and orange valves on the pump suction lines. The green pipelines indicate discharge pipework from the pumps with yellow valves on the discharge pipework; the valves interconnecting the pump suction pipes between the wet wells are shown in green.

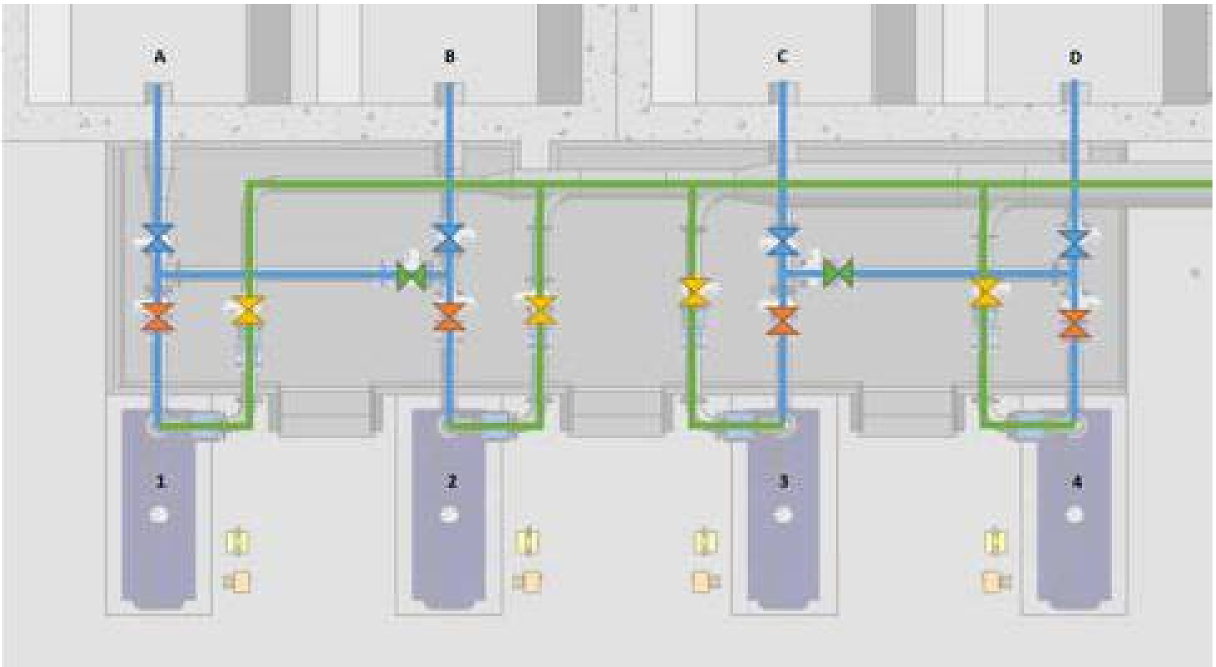


Figure 4-10: Pump and Pipework layout

(d) Electronic metering

A single flow meter is located adjacent to the pump station that reads the collective flow from the pump station to the discharge point. The readings from this meter will be compared with the meters located at the head of the inlet works and in between to ensure all flows are accounted for.

4.2.6 Structures

The design of the structures is based on the guidelines and standards set out below.

(a) Guidelines

- Pipework in the control room building will be installed above the lower terrace level.
- The control room building has been sized to allow a minimum free passage for operational activities, cleaning and maintenance of equipment.
- The building will be a reinforced concrete frame structure complete with brick infill panels. The concrete columns will be founded on reinforced concrete pad footings, with the brick infill panels founded on reinforced concrete strip footings.
- All floors are to be 150mm thick reinforced concrete floors, with integrated plinths.
- Apron slabs around the building to be 100mm thick by 1,000 mm wide concrete slabs sloping away from the building.
- The roof structure connects to the top ringbeam. The pitched roof will consist of dual-pitch steel trusses, bracing and steel purlins with 0.53mm thick IBR sheeting placed on top.
- No allowance has been made for ceilings, insolation (thermal or sound), or solar panels.
- All doors will be double-leaf steel doors with a locking mechanism.

The following standards were used in the design of buildings and chambers:

- Construction of all buildings to conform to the requirements stipulated in SANS 10400:2010: The application of the National Building Regulations.

- The structural systems of all the buildings are designed to resist the permanent and superimposed loads specified in SANS 10160:2011: Basis of structural design and actions for buildings and industrial structures.
- All hot-rolled structural steelwork shall conform to the requirements of SANS 10162-1:2011: Part 1: The Limit-states Design of Hot-rolled Structural Steelwork.
- All cold-formed steel work shall conform to the requirements of SANS 10162-2:2011 Part 2: Cold-formed steel structures.
- All concrete foundations and other concrete elements conform to SANS 10100-1:2000: The Structural use of Concrete Part 1: Design.
- All brick walls shall be constructed to SANS 10164:1980 Part 1: The Structural use of Masonry Part 1: Unreinforced Masonry walling.

(b) Structural Materials

1. Concrete

The sumps (wet wells) will be constructed using reinforced concrete.

Concrete elements were designed to have the following minimum 28-day compressive strengths:

- Blinding: 15MPa
- Water retaining structures: 25MPa watertight concrete to BS8007, complete with an approved waterproofing admixture (such as Penetron),
- All other concrete: 25MPa

2. Reinforcement

Concrete elements are detailed with the following rebar sizes (complying with SABS 920):

- Mild steel (250MPa): R8, R10 and R12
- High yield steel (450MPa): Y10, Y12, Y16, Y20 and Y25

For corrosion protection of reinforcement, liquid retaining structures are specified to have a minimum concrete cover of 50mm and be cast complete with Penetron waterproofing admixture (or equivalent).

Concrete cast directly against soil, the cover will be 75mm.

3. Structural Steel

All steelwork located within the inside of liquid retaining structures is specified as stainless steel to avoid corrosion damage. External steelwork is specified as hot-dip galvanised. The structural steel grade is to be S355JR, steel plate grade to be 300WA and cold-formed steel to be commercial quality.

4.3 Electrical Load Requirements

4.3.1 Background

As discussed in detail in other sections of this report, the upgrading/modifications to the existing Thembalethu Pump Station No.6 will be done in phases.

The first stage will increase the capacity from the current 60 ℓ/s to 238 ℓ/s. This will require the replacement of the existing pumps and associated 75kW motors with new pump sets with the new pump sets and motor rated 132kW (PF=0.86). The motors will operate on one(1) duty and one(1) assist. This means that under peak flow conditions, a maximum of two (2) 132kW motors (two pumps in parallel) could be in operation at the same time.

The second stage of the upgrade will increase the capacity from 238 ℓ/s to 400 ℓ/s. This will require an additional two (2) new pumps and motors. The pump sets will operate two (2) duty, one (1) assist, and one (1) standby. This means that a total of four (4) motors will be installed and in peak flow conditions, a maximum of 3x 132kW motors could be in operation.

The expected load requirements for the different stages, which form the basis for the electrical equipment design and specifications, are calculated and summarised in the paragraphs below.

4.3.2 Phase 1 (Capacity: 238 l/s)

Table 4-7 below provides a summary of the expected maximum electrical demand associated with this phase of the project.

Table 4-7: Electrical Load Summary (Capacity 180l/s)

Description	Comment	Duty	Assist	Stand-by	Rating (kW)	Total Power (kW)	Power Factor	Total Power (kVA)
Inlet Works: Screens	2x Existing Huber mechanical screens can be re-used	1	0	1	1.5	1.5	0.85	1.75
Inlet Works: Conveyors	2x Existing conveyors can be re-used	1	0	1	1.5	1.5	0.85	1.75
Sewerage Pumps	3x New Pumps & Motors	1	1	0	132	264	0.86	307
Small Power & Lighting	Building & Security Lights	1	0	0	1.5	1.5	1.0	1.5
					TOTAL (Expected Maximum Demand)	**136.5**		**312**

The maximum expected electrical demand for this stage of the pump station capacity upgrade is calculated to be **312 kVA**.

4.3.3 Phase 2 (Capacity: 400 l/s)

Table 4-8 below provides a summary of the expected maximum electrical demand associated with the second (final) phase of the project.

Table 4-8: Electrical Load Summary (Capacity 400l/s)

Description	Comment	Duty	Assist	Std/by	Rating (kW)	Total Power (kW)	Power Factor	Total Power (kVA)
Inlet Works: Screens	2x Existing Huber mechanical screens can be re-used	1	0	1	1.5	1.5	0.85	1.75
Inlet Works: Screens	2x New mechanical screens to be added	1	0	1	1.5	1.5	0.85	1.75

Inlet Works: Conveyors	2x Existing conveyors can be re-used	1	0	1	1.5	1.5	0.85	1.75
Inlet Works: Conveyors	2x New mechanical conveyors to be added	1	0	1	1.5	1.5	0.85	1.75
Sewerage Pumps	4x New Pumps & Motors	2	1	1	132	396	0.86	460.5
Small Power & Lighting	Building & Security Lights	1	0	0	1.5	1.5	1.0	1.5
						403.5		**469**

The maximum expected electrical demand for this stage of the pump station upgrade is calculated to be **469 kVA**.

4.4 Proposed Equipment

4.4.1 Medium Voltage Reticulation

Any upgrading/modifications to the existing bulk MV electrical supply to the Thembalethu Pump Station No.6 are excluded from the scope of work for this project and will be handled by the George Municipality directly if required. Although currently only being a radial (single feed) supply, not guaranteeing any redundancy, the existing medium voltage supply capacity is sufficient to cater for the maximum planned (future) load requirements. It is recommended that the spare 11kV feeder on the existing 3-way RMU be used to bring in an alternative supply to the pump station, in order to provide a redundant ring feed supply, thereby providing a more reliable source of bulk supply.

4.4.2 Equipment Room Layouts

It is assumed that all existing equipment rooms are big enough to accommodate any future equipment requirements. This can, however, be confirmed once actual equipment sizes are provided by the various suppliers. No electrical equipment room modifications and currently anticipated and no expansions are allowed for as part of this project.

4.4.3 Medium Voltage Switchgear

The existing 11kV RMU (3-way) and associated Metering Unit, as discussed in detail in Section 3.4.3 of this report, is correctly rated to accommodate the maximum expected load for the future pump station requirements. It is important to note that there is currently only one (1) transformer feeder, supplying the existing 315kVA transformer. Seeing that a second power transformer will be installed in the future, an additional transformer feeder will have to be added to the existing gas-insulated switchgear. This panel should have the same rating, as well as protection, metering and control functionality as the existing transformer feeder panel.

Schneider Electric did indicate that the existing RM6 type, 17.5kV gas-insulated switchgear currently used can be extended on the right-hand side of the panel, by adding an additional transformer feeder circuit breaker panel. This addition can be done on-site.

4.4.4 Power Transformers

4.3The existing 315kVA rated power transformer will not be sufficient to accommodate the expected load for the Phase 1 (238 ℓ/s) upgrade of the pump station. Based on the load calculations, a new 630kVA-rated transformer will be required to supply the pump station loads for phase 1.

Furthermore, it should be noted that the installation of only one (1) transformer will result in a non-redundant system with a single point of failure. It is therefore recommended that two (2) 630kVA power transformers be installed to supply the total pump station load. Although each transformer will under normal operating conditions only supply 50% of the load, the dual installation will ensure that any one of the transformers can supply the total pump station load under a single contingency (N-1) condition.

The existing transformer room is big enough to house two (2) 630kVA transformers, provided that the existing 315kVA transformer be de-commissioned and removed from the site to make space for one of the new 630kVA transformers. Furthermore, it should be noted that an existing transformer is an oil-filled unit, which does pose a fire risk, especially when installed in a dedicated room (as is the current case). With open cable trenches, protruding to the other rooms, the risk of burning transformer oil being spread quickly throughout the entire building is a major fire hazard. For this reason, it is recommended that the new transformers be of the dry-type (vacuum pressure-impregnated cast-resin).

Although approximately 30% more expensive than the oil-filled units, VPI transformers utilise high-temperature (Class H-rated) insulation for the insulating materials. The windings are dried out and vacuum/pressure impregnated using silicone or polyester-based varnish before being baked to cure the varnish. The design and construction of the windings together with the VPI treatment of the winding ensure that it is electrically sound as well as mechanically strong. Although first produced as supply transformers for high-rise buildings, it became evident that this design is perfect for flameproof and high protection class non-flameproof enclosures where their sturdy electrical and mechanical construction allows them to handle harsh environmental and electrical requirements e.g. the repeated D.O.L. starting of large motors, frequent short circuits and excessive operating temperatures.

An image of a typical dry-type transformer (and enclosure) is shown in Figure 4-11 below.

Figure 4-11: Typical Dry-type Transformer (credit: Toshiba)

4.4.5 Medium Voltage Power Cables

Although it could not physically be confirmed on site, it can be seen from the existing single line diagram (Figure 3-10), that an 11kV, 25mm^2, Copper power cable is used between the MV Metering Unit and the existing 315kVA main power transformer. Although this cable is load-rated to carry 115A, 2.2MVA @11kV, when installed in ducts/trenches, it should be noted that this cable is fault-rated to withstand a 10kA symmetrical short-circuit fault for only 200ms, before damaging the cable. In lieu of the fact that this cable is supplied from a circuit breaker and protection relay and not a fast-acting fuse, we are of the opinion that this cable is not sufficiently protected against fault conditions.

Assuming a maximum symmetrical short-circuit fault level of 10kA (@11kV) at this pump station, we would recommend that a cable be selected to withstand this fault rating for at least 500ms, in order to allow sufficient time for the protection element to detect the fault and the circuit breaker to clear the fault, without causing any thermal damage to the cable. For this reason, it is recommended that the MV cables between the 11kV RMU and the transformer primary windings be rated as follows:

- Rated Voltage: 6.35/11kV
- Conductor Type: Copper
- Insulation Medium: XLPE
- Conductor Size: $50mm^2$
- Number of Cores/Cable: Three core
- Armoring: None

4.4.6 Low Voltage Switchgear

(a) Main Incoming Section

Based on the assumption that two (2) 630kVA power transformers will be used to provide a redundant supply to the total LV load, and a single standby diesel generator incorporated to provide backup power to the total facility, it is recommended that a five (5) breaker main incoming low voltage section (see the typical layout in the image below) be considered. This arrangement will consist of the following:

- Panel 1: Main LV Incomer - Transformer No.1 (1250A)
- Panel 2: LV Feeder 1 - MCC No.1 (800A)
- Panel 3: Standby LV Incomer – Generator No.1 (1250A)
- Panel 4: LV Feeder 2 - MCC No.2 (800A)
- Panel 5: Main LV Incomer - Transformer No.2 (1250A)

Figure 4-12: Proposed Main LV Incoming Section

(b) All mains fail detection, automatic change-over functionality and control between the different sources will be incorporated in dedicated control devices, that will be housed on the panels (as indicated in the example above). Based on the 1.5 MVA rating of the standby generator, it is recommended that the busbars of this Main LV Incoming Section be rated 2000A, 31.5kA (1s).Motor Control Centres

Based on the new pumps and associated equipment to be installed as part of the upgrade for each of the two (2) sumps, it is recommended that a dedicated new MCC be installed for each sump's equipment. A typical example of such an MCC arrangement and size is shown in the figure below.

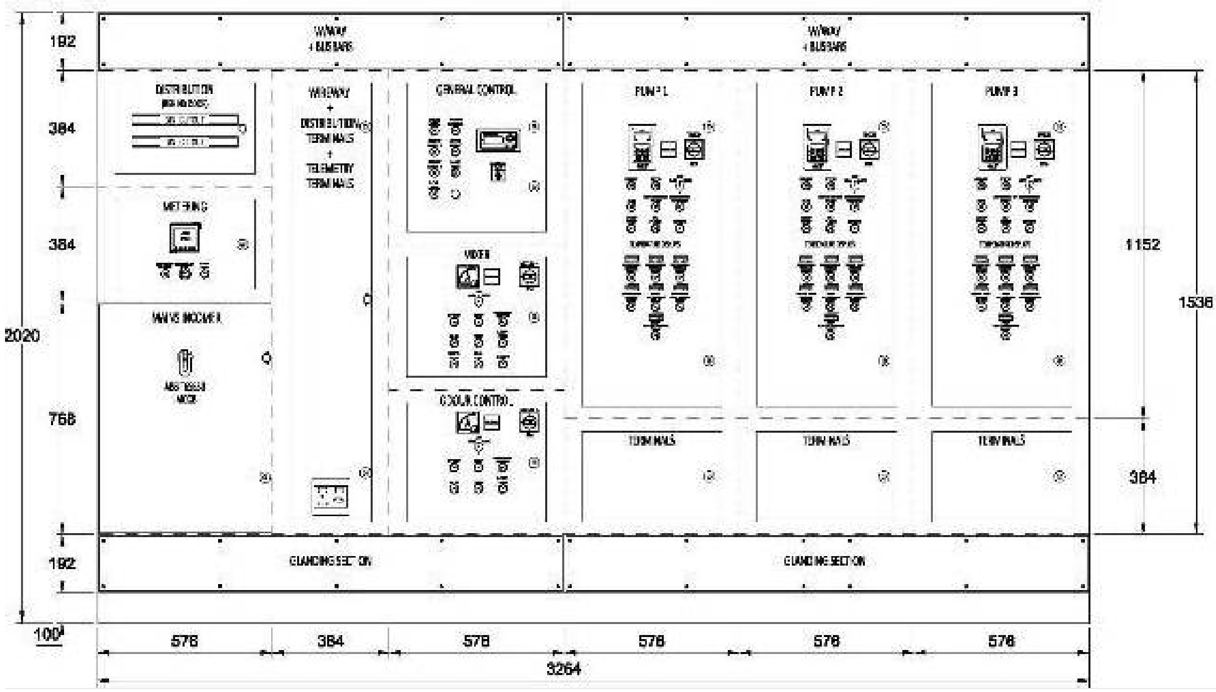


Figure 4-13: Typical MCC Arrangement (credit: Tricom Africa)

Each MCC layout will include at least the following functional units:

<u>MCC 1 (Sump 1)</u>

1. Main incoming section (1000A)
2. Local distribution section
3. Control section: mechanical screen 1 (1.5kW)
4. Control section: screw conveyor 1 (1.5kW)
5. Control section: sewage pump 1 (132kW)
6. Control section: sewage pump 2 (132kW)
7. Local control section (including RTU/controller)
8. Wireways & distribution terminals

<u>MCC 2 (Sump 2)</u>

1. Main incoming section (1000A)
2. Local distribution section
3. Control section: mechanical screen 2 (1.5kW)
4. Control section: screw conveyor 2 (1.5kW)
5. Control section: sewage pump 3 (132kW)
6. Control section: sewage pump 4 (132kW)
7. Local control section (including RTU/controller)
8. Wireways & distribution terminals

Furthermore, it recommended that the screw conveyor and mechanical screens be equipped with WEG CFW-11 variable frequency drives, whilst the six (6) sewage pumps are started via WEG variable speed drives with the correct ratings.

All power and control cables will be bottom entry via cable trenches and neatly managed between the MCC and the motors by means of heavy-duty cable racks, mounted against the walls.

4.4.7 Standby Diesel Generator

The current generator on site, sized at 403 kVA (442kVA standby) according to the nameplate values, is not of sufficient size to power the new motors after the upgrade required at phase one. The minimum generator requirements are

Capacity for one (1) motor running:	180.5 kVA (1x 132kW, pf=0.86, eff=0.85)
Capacity for one (1) motor starting (VSD):	361 kVA (2x full load current)
Total generator capacity required:	541.5 kVA
Generator capacity (prime rated):	600 kVA
Generator capacity (emergency-short time):	1100 kVA

The following design is considered for the final phase design (400 L/s).

The RFQ document, received from the George Municipality, for this project calls for the installation of a 1500 kVA (1200 kW prime-rated) standby diesel generator to provide backup power to the entire pump station facility. Based on the final load calculations (refer to Section 4.3), SMEC is of the opinion that this rating is too high for the application. Oversizing a standby generator for any specific installation leads to a number of disadvantages, such as a larger footprint, higher fuel consumption, thicker power cables required, and higher capacity switchgear ratings, to mention but a few. The biggest concern, however, is the fact that if a diesel engine is operated at lower than 30% of its design capacity, it leads to carbonisation of its combustion chambers, hence requiring much more maintenance or additional load banks to be installed to increase the loading on the machine for short durations to avoid carbonisation.

Furthermore, keeping in mind that the upgrading of Thembalethu Sewage Pump Station No.6 will be done in phases, the initial stage (capacity of 238l/s) will require a maximum of only 2x 132kW motor to be operated under peak flow conditions. As detailed in Section 4.3.2 a maximum demand of only 312 kVA is estimated for this phase of the project. The 1500 kVA diesel generator will be able to support this load.

Based on the calculations detailed in Section 4.3.3 of this report, for the final stage (capacity of 400l/s) a maximum demand of 469 kVA is estimated with 3x 132 kW motors being required to be in operation at the same time. For this ultimate scenario, it would mean that the 1500 kVA diesel generator will only be operated at 31% of its design capacity. (This assumption is based on full load running conditions for the motors and does not take motor starting conditions into account).

SMEC would like to recommend that an **800 kVA generator (640 kW prime rated)** be considered instead, as this would be a much better-suited rating for this specific application. When considering the worst-case scenario for the 400l/s stage, the following high-level calculation can be done to confirm the generator requirements:

Capacity for one (1) motor starting (DOL):	1084kVA (6x full load current)
Total generator capacity required:	1446 kVA
Generator capacity (prime rated):	800 kVA
Generator capacity (emergency-short time):	1600 kVA
Capacity for two (2) motors running:	362 kVA (2x 132kW, pf=0.86, eff=0.85)

This means that an 800 kVA generator will have sufficient capacity to start a fourth motor when the other three motors are already in operation. A sequential starting simulation was done to confirm this calculation and has been included in Annexure A for reference purposes. An important factor to keep in mind during the detailed design phase of the project will be to ensure that more than one motor is not started at the same time. This could easily be incorporated into the MCC design by means of "time delay to start" relays, with different time settings. This will ensure the sequential starting of the motors whenever a power interruption has been experienced.

The expected loading on the 800 kVA unit for the different stages is expected to be:

Stage 1 (238l/s):	261/800 kVA = 39%
Stage 2 (400l/s):	520/800 kVA = 59%

These values (even for Stage 1 requirements) are higher than the minimum 30% operating capacity of the generator.

Typical dimensions for an 800 kVA generator set are indicated in the figure below. As can be seen from this image, this unit will definitely be accommodated in the existing generator room.

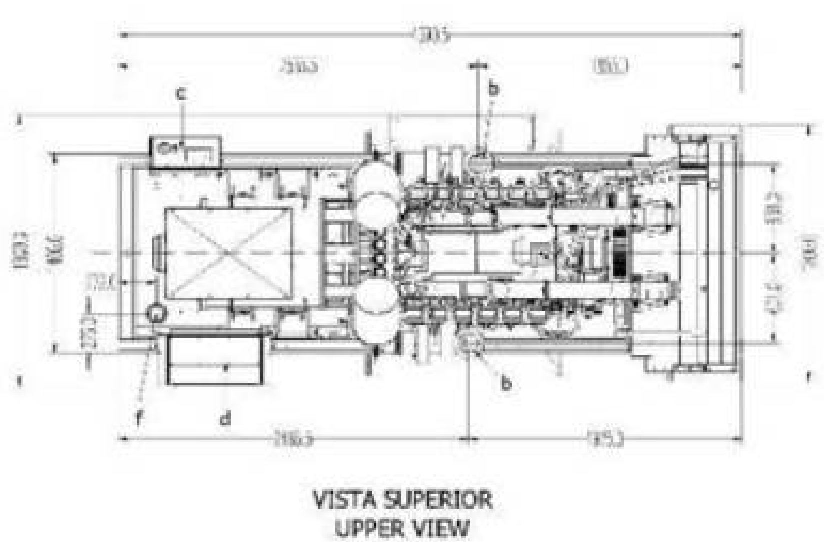


Figure 4-14: Typical 800kVA Generator General Arrangement (credit: Himoinsa)

Typical fuel consumption values for the 800kVA (640kW) standby diesel generator are specified as follows:

- Fuel consumption 100% prime rated power: 156.64 l/h
- Fuel consumption 70% prime rated power: 112.28 l/h
- Fuel consumption 50% prime rated power: 84.09 l/h

4.4.8 Telemetry & SCADA

The telemetry and SCADA for George Municipality applications are currently done under a separate SLA by Spectrum Communications. The existing Spectrum Teleflex 5 RTU that acts as both controller and Telemetry RTU would be expandible to allow for all the additional equipment, associated with the new motor control applications. It is recommended the same type of equipment be used as part of the upgrade project for the fact that the replacement parts are on hand in George with no lead time on replacement, repair, or servicing of this equipment.

Seeing that this portion of the work will be sub-contracted to Spectrum, a budgetary figure has been allowed for a hardware upgrade, control algorithm alteration/rewrite SCADA and commissioning

4.4.9 Earthing and Bonding

For the proposed new pump station building a network of inter-connected earth electrodes (consisting of earth rods and conductors) will be installed around the building to ensure an overall resistance to earth of 1 Ω or less providing an effective earth mat. The minimum requirements for the earth rods and electrodes are provided in the tables below. The number of earth rods to be installed around the building will be calculated during the detailed design stage based on the soil resistivity measurements taken on-site as per the position of the new building to be constructed.

Earth Electrode Rods:

Table 4-9: Standard for Earth Rod Dimensions

Material	High Tensile Steel, Copper Coated
Size	Ø 16 mm
Length	1800 mm

Earth Electrode Conductors:

Table 4-10: Standard for Earth Electrode Dimensions

Material	Bare Copper (Stranded)	Bare Copper (Solid)	Copper-Clad Steel (Stranded)
Size	70 mm^2	Ø 10 mm	95 mm^2

Earth electrodes shall be installed as deep as possible, but not less than 900mm below the natural ground level. Deep-buried electrodes exhibit less steep voltage gradients at the soil surface during times of discharge and reduce the risk of mechanical damage or theft of the earth electrode. The network of underground earth electrodes and conductors around the building will be bonded onto a 50mm x 6mm bare copper bar (main earth bar), installed inside the pump station building equipment room by means of a 120mm^2 bare copper conductor.

Each of the other equipment rooms within the building will also be equipped with a 50mm x 6mm bare copper earth bar (safety earth bar). These safety earth bars within the rooms will be connected to the building's main earth bar by means of 70mm^2 PVC-covered copper conductors to ensure the integrity of the equipotential platform created within the building.

All accessible conductors, portions of the electrical plant, or equipment which do not form part of an electrical circuit, but have the possibility of accidentally becoming energised during normal or fault conditions, shall be bonded to the nearest safety earth bar.

4.4.10 Building Small Power & Lighting

An allowance has been made in the budget estimate to provide some basic small power and lighting requirements for the additional offices/store rooms that will be constructed as part of the upgrade project. All new sub-distribution boards, light switches, conduits and socket outlets will be recessed in the walls (as per the current design).

All luminaires specified for the new and/or existing rooms will be energy-efficient LED type and will also be vaporproof.

4.5 Rising Main

The planning and design of the water transfer infrastructure are based on the following principles:

- The provision and installation of isolating, air, non-return and scour valves will be limited to essential locations as required for the efficient functioning of the system;
- Pipelines are to be routed such that it has minimal interference with other structures, parallel to the existing pipe;
- Pipelines to follow services corridor and existing pipe route crossing the Schaapkop River over the existing steel pipe bridge;
- All valve assemblies are to be housed in valve chambers;
- Pipes are to be placed underground except over the existing pipe bridge.

4.5.1 Horizontal Alignment

The rising main route will follow the existing 250mm diameter pipeline with a provisional parallel offset of 2.5m.

Bearing-type anchor blocks will be constructed at each horizontal bend where the flow changes direction. The purpose of this block is to support the bend, reduce movement of the pipeline and stop the pipe joints from being pulled apart causing a joint failure. The bearing-type anchor block is part of the design to safely transit the unbalanced thrust forces to the undisturbed soil.

The horizontal alignment has a point of intersection (PI) at each location where there is a change in the flow direction. During the Concept and Viability report, it was attempted to use locally manufactured PVC pipe bends, including an 11.25°, 22.5°, and 45°.90° bends will not be used as far as possible.

The pipe manufacturer allows for a 1° deflection over one pipe length in each joint to absorb minor changes in directions.

4.5.2 Vertical Profile

The vertical profile is mainly affected by the ground levels along the path of the horizontal alignment, which follows the route and the profile of the existing rising main.

In the vertical design of the pipe, provision has been made for air valves at all high points and significant changes in grade along the entire route, including at the pumps, the control chamber and the crossing of the Schaapkop river bridge. Provision for scouring valves at all low points and between valved sections of the pipeline was made.

The scour valve will ensure the pipe can be emptied to remove all the sediment trapped at the low point, but also allow the pipe to drain in a reasonable time in case of maintenance.

As it is an environmentally sensitive area, scouring into waterways will not be allowed. Perrot Couplings are allowed onto which a piped suction system from Water Spillage Truck (Honey Sucker) can be connected to take up the water volume to prevent discharging into the watercourse.

4.5.3 Pipeline Material Selection

(a) <u>Ductile Iron Pipes</u>

A portion of the rising main will cross the Schaapkop Pipe Bridge and will be exposed above ground. The . The existing 250mm diameter rising main crossing the Schaapkop pipe bridge is Ductile Iron, and has been selectred to be used for the new 400mm dimeter as well.

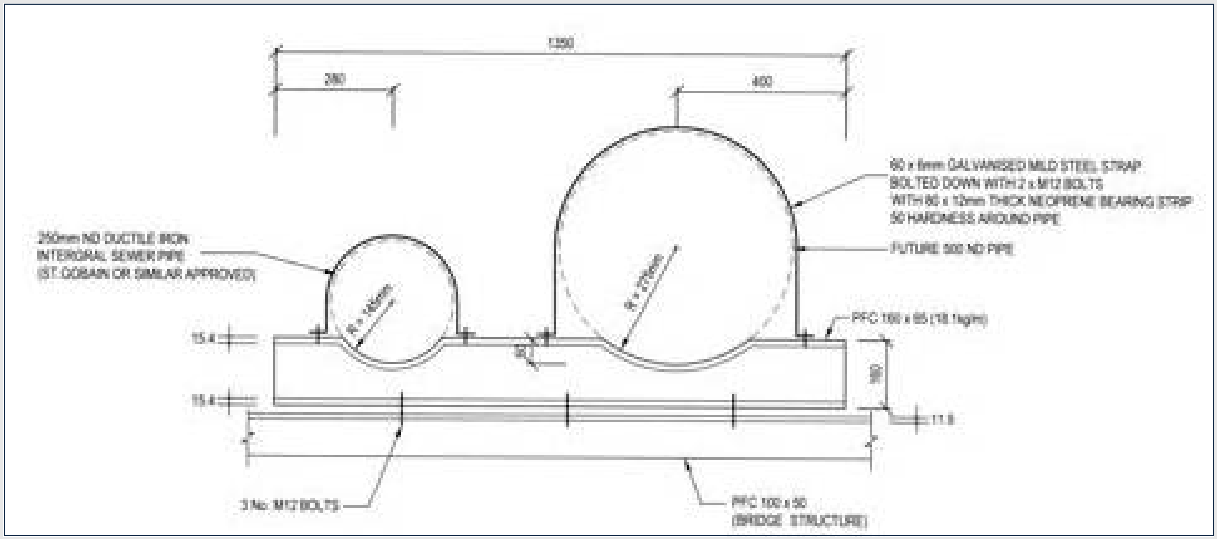


Figure 4-15: Pipe fixture on bridge structure

Ductile iron pipes are as robust as steel pipes and are slightly less prone to corrosion and cathodic reaction. They are also normally epoxy lined and coated to improve corrosion protection.

Ductile Iron pipes normally have spigot and socket joints which simplifies installation Due to the Spigot and Socket jointing system, the installation of valves and other specials require special CI attention and CI fittings.

The ductile iron pipes are also normally supplied in lengths between 6- to 12m which also means that the pipes become heavy at large diameters. This will require specialist lifting equipment for installing the pipes.

(b) <u>PVC-U Pipes</u>

This pipe has been selected due to their better hydraulic performance and better mechanical performance for the 400 mm diameter pipe. Stainless-Steel, epoxy-coated fittings will be used for special bends where required

- PVC–O pipes have a higher resistance to impact. t
- PVC–O pipes offer lower celerity than steel piping systems (four times less than ductile iron pipes), which means lower transient pressures during sudden variations in water volume and pressure. This reduces and almost eliminates the possibility of breakage during opening and closing in the water network and when pumping gets under way.

- Increased hydraulic capacity **–**The internal surface is extremely smooth, reducing head loss and making reducing the potential for deposit.

A complementary range of valves and fittings is available. OPVC pressure bends are manufactured to PN16 working pressures.. The range of bends is available in 11.25˚, 22.5˚, 45˚ and 90˚. They are also lighter in weight than the metal pipes which will lend itself to easier construction in the areas where space could be restricted.

"Viking Johnson" or similar flexible couplings are used to connect these fittings to plain-ended pipes. The "Viking Johnson" joint is a mechanical joint in which a rubber seal is compressed against the pipe spigots by tightening the bolts on the joint. The correct "barrel" length of the "Viking Johnson" joint must be used to allow for expansion and contraction of the PVC pipe or any possible movement after installation of the pipeline.

4.5.4 Water Hammer Analysis

(a) Introduction

A water hammer analysis was conducted of the Thembalethu transmission system. The objective of the analysis was to identify and optimise water hammer mitigation measures.

The Thembalethu transmission system consist of a pump station with an approximately 680 m long force main that discharges into a manhole. The system was modelled with three steady flow scenarios:

1. Design Condition, low flow – where the design flow equals 125 l/s and sewage being pumped via one force main.
2. Design Condition, high flow – for this scenario the design flow equals 238 l/s while pumping via one force main.
3. Ultimate Condition – a design flow totalling 400 l/s and sewage being pumped via a seconTd force main. The second force main will be horizontally aligned parallel to the Design Condition's force main route with a 5 m distance between the two pipelines. Furthermore, the two force mains' pipe diameters and materials are identical.

(b) Assumptions

The following assumptions where made during the model construction to ensure that the desired design flows are attained for the two different steady state conditions.

(i) Pump Station Characteristics

Refer to Figure 4-16 below that reflects the assumed pipework diameters. All pipework was assumed to be manufactured of stainless steel. The wave celerities of the different pipework diameters are provided in Table 4-11 below.

Table 4-11: Pump Station Pipe Work Hydraulic Data

Outside Diameter (mm)	Wall Thickness (mm)	Material	Wave Celerity (m/s)	Design Condition – Flow Velocity (m/s)	Ultimate Condition – Flow Velocity (m/s)
273.1	3.4	Stainless Steel	1,109.9	1.61	2.42
323.8	4.0	Stainless Steel	1,108.0	1.15	1.72
355.6	4.0	Stainless Steel	1,084.8	1.89	2.85
457.2	4.2	Stainless Steel	1,032.4	1.13	2.57

The pump curves were obtained from a pump manufacturer and is reflected in Figure 4-17 below. The duty point of one pump is 133.3 l/s at 65 m pumping head. Three duty pumps and one standby pump will be installed for the ultimate condition. It is assumed that for the low flow design condition (125 l/s), one (1) duty pump will operate at 95 % of its rated speed namely, 1,418.9 r.p.m. For the high flow design condition (238 l/s), two duty pumps will operate at 98 % of its rated speed – 1,460.7 r.p.m.

The pumps' installed motor power rating will be 132 kW and the mass moment of inertia of the pumps were estimated using an empirical equation – 4.53 kg.m². The pump specific speed is calculated as 23.8u with the following equation: $n_s = \frac{N\sqrt{Q}}{H^{0.75}}$ where, n_s is specific speed, Q is discharge rate (m³/s) and H is the pumping head (m).

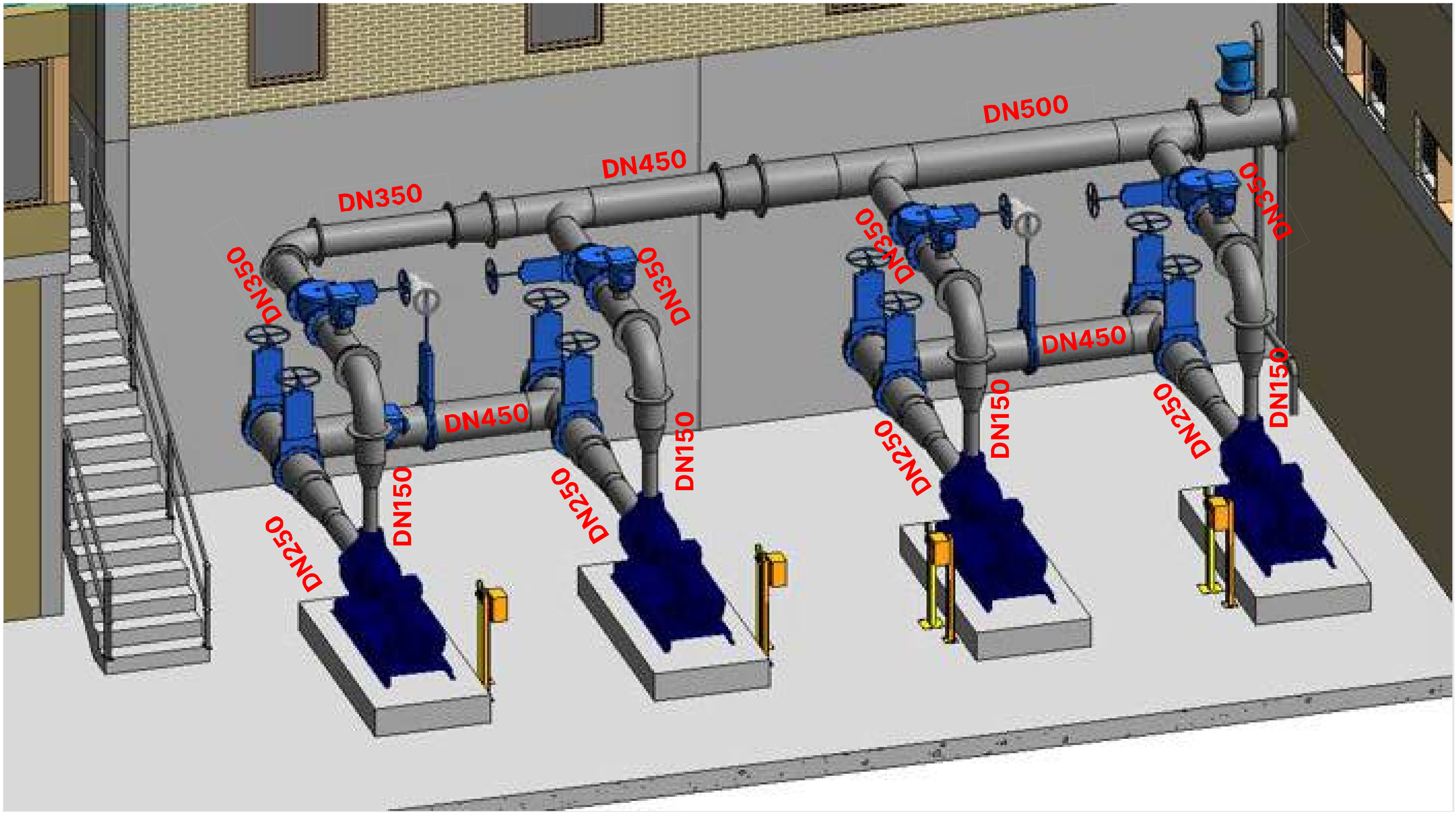


Figure 4-16: Isometric View of the Pump Stationwith Pipe Diameters

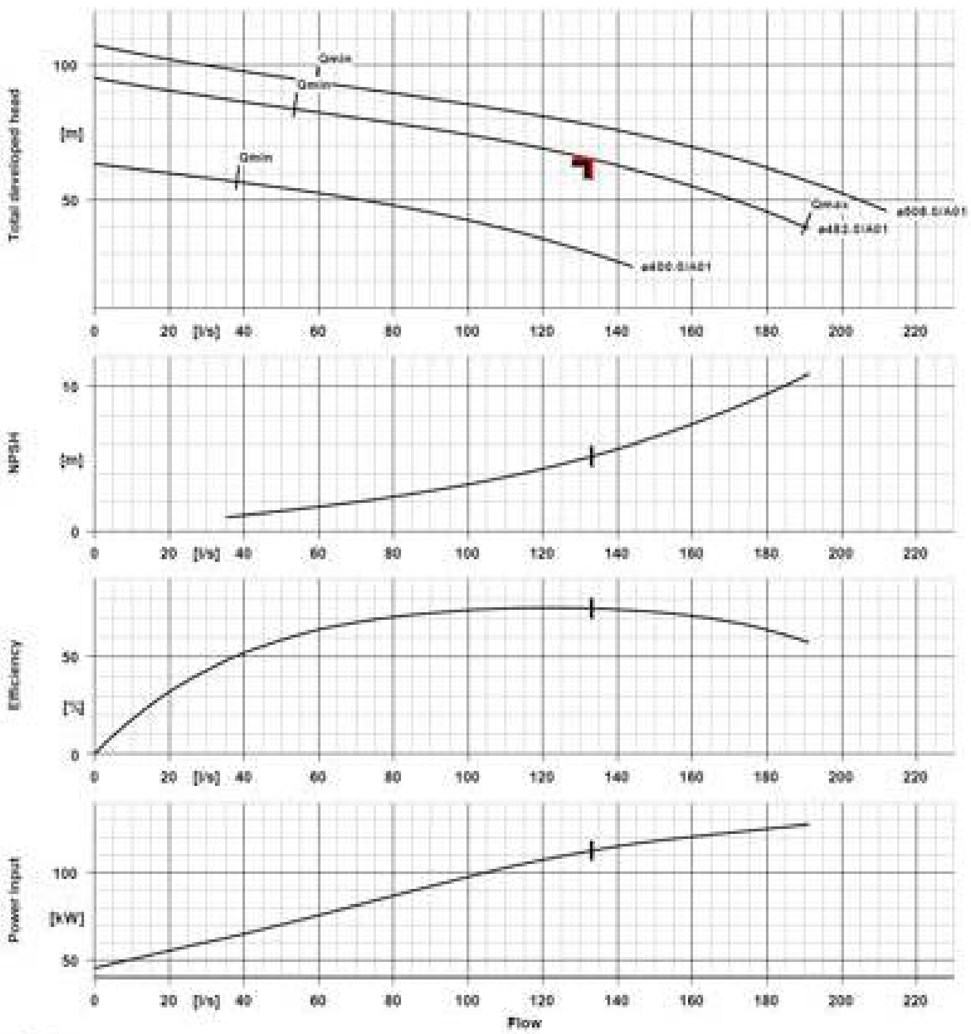
Performance curve

Customer item no.:
Communication dated: 19/04/2023
Doc. no.: Quick quote
Quantity: 1

Number: ES 8002359938
Item no.:100
Date: 19/04/2023
Page: 3 / 8

Sewatec K 150-503G 3EN 315M 04

Version no.: 1



Curve data

Speed of rotation	1492 rpm	Efficiency	75.1 %
Fluid density	998 kg/m³	Power absorbed	112.67 kW
Viscosity	1.00 mm²/s	NPSH 3%	5.18 m
Flow rate	133.000 l/s	Curve number	K43630/0
Requested flow rate	133.000 l/s	Effective impeller diameter	482.0 mm
Total developed head	65.00 m	Acceptance standard	Tolerances to ISO 9906 Class 3B; below 10 kW acc. to paragraph 4.4.2
Requested developed head	65.00 m		

Figure 4-17: Pump Characteristic Curves

(ii) Force Main Characteristics

The following force main data was used for both the Design Condition and the Ultimate Condition:

Table 4-12: Force Main Hydraulic Data

Outer Diameter (mm)	Wall Thickness (mm)	Material	Wave Celerity (m/s)	Length (m)	Description	Design Condition – Flow Velocity (m/s)	Ultimate Condition – Flow Velocity (m/s)
400	18.4	UPVC, Class 12	430.9	636.6	Buried pipe	1.73	1.97
429	8.1	Ductile iron, Class K9	1,166.1	36.9	Pipe bridge	1.34	1.52

The pipes' hydraulic friction losses were calculated with the Darcy Weisbach equation. The absolute roughness of the pipes was assumed as 0.03 mm.

(c) Transient Events

Six transient flow scenarios were identified and were modelled using Bentley's Hammer software. The transient flows consisted of pump start and pump trip. The scenarios that were modelled include:

1. Scenario 1: Design Condition, Low Flow.
    - 1.1. Scenario 1.1: Pump Trip.
    - 1.2. Scenario 1.2: Pump Start.
2. Scenario 1: Design Condition, High Flow.
    - 2.1. Scenario 2.1: Pump Trip.
    - 2.2. Scenario 2.2: Pump Start.
3. Scenario 2: Ultimate Condition.
    - 3.1. Scenario 3.1: Pump Trip.
    - 3.2. Scenario 3.2: Pump Start.

For Scenarios 1.1, 2.1 and 3.1 (pump trip), all the pumps were modelled to simultaneous stop and run down to a stationary condition as a function of the pump impeller, coupling and motor rotor's mass moment of inertia.

Scenarios 1.2, 2.2 and 3.2 consists of starting the duty pumps and gradually increasing its speed from 0 to 95 % over a period of 7.9 seconds, 0 % to 98 % over a period of 10.8 seconds and 0 % to 100 % over a period of 12 seconds respectively.

(d) Results

The water hammer results are represented as several plots reflected in the images from Figure 4-18 to Figure 4-40.

(i) Scenario 1.1, Low Flow Design Condition, Trip

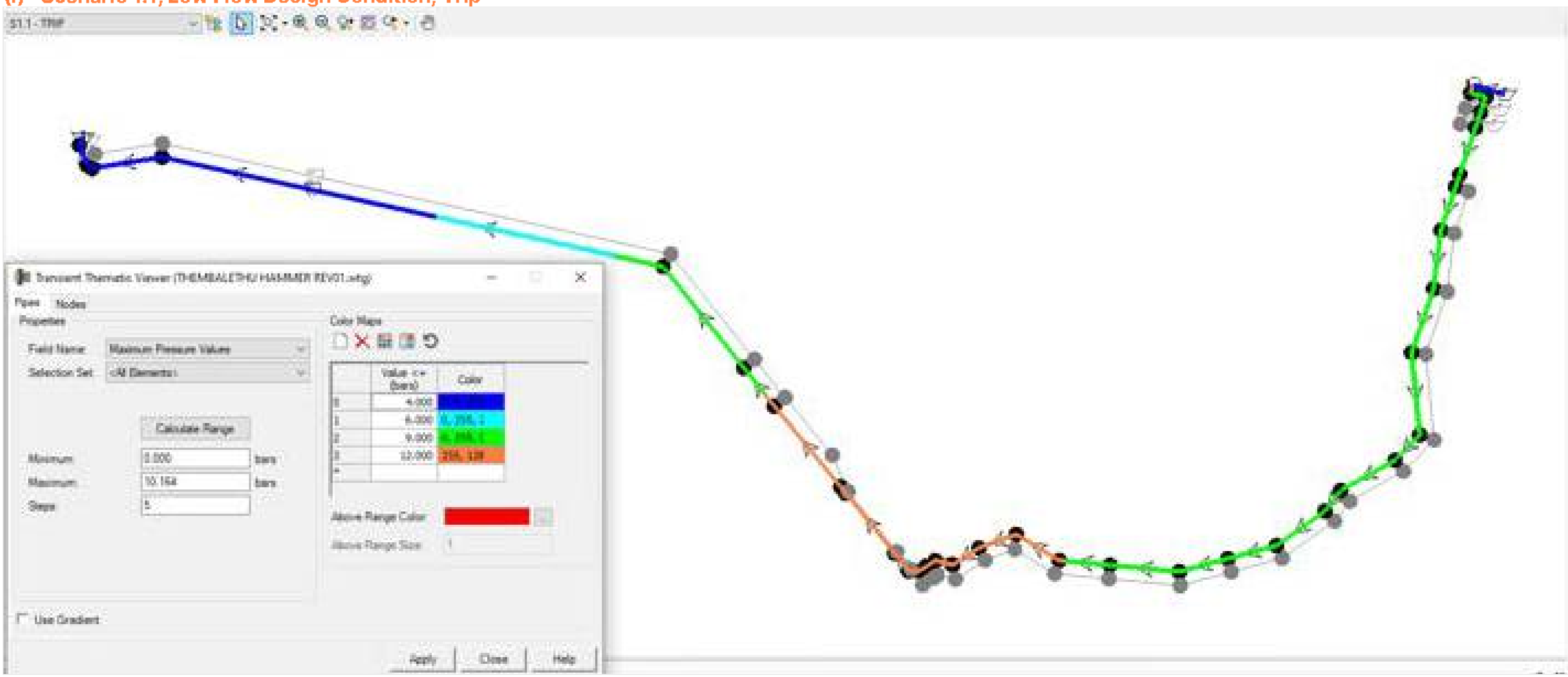


Figure 4-18: Scenario 1.1 – Maximum Water Hammer Pressure Values

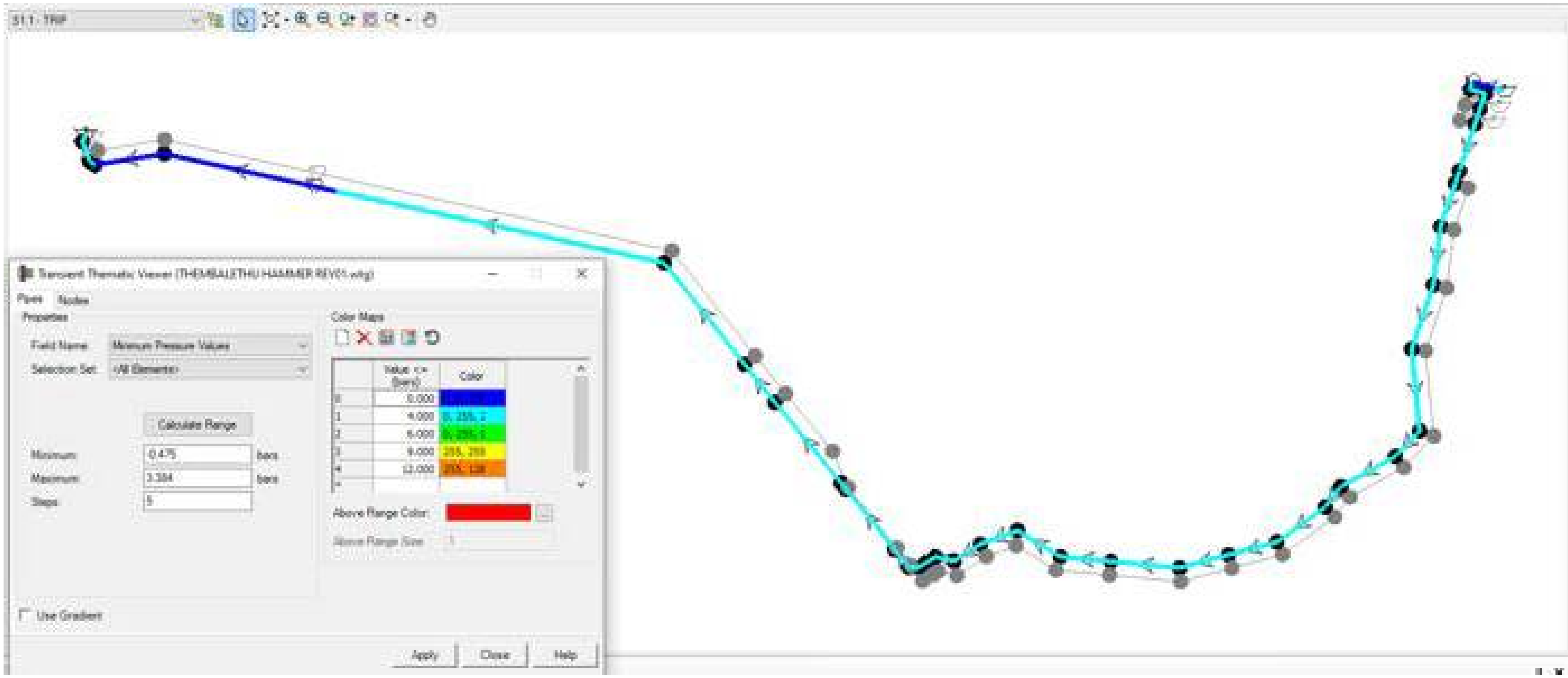


Figure 4-19: Scenario 1.1 – Minimum Water Hammer Pressure Values

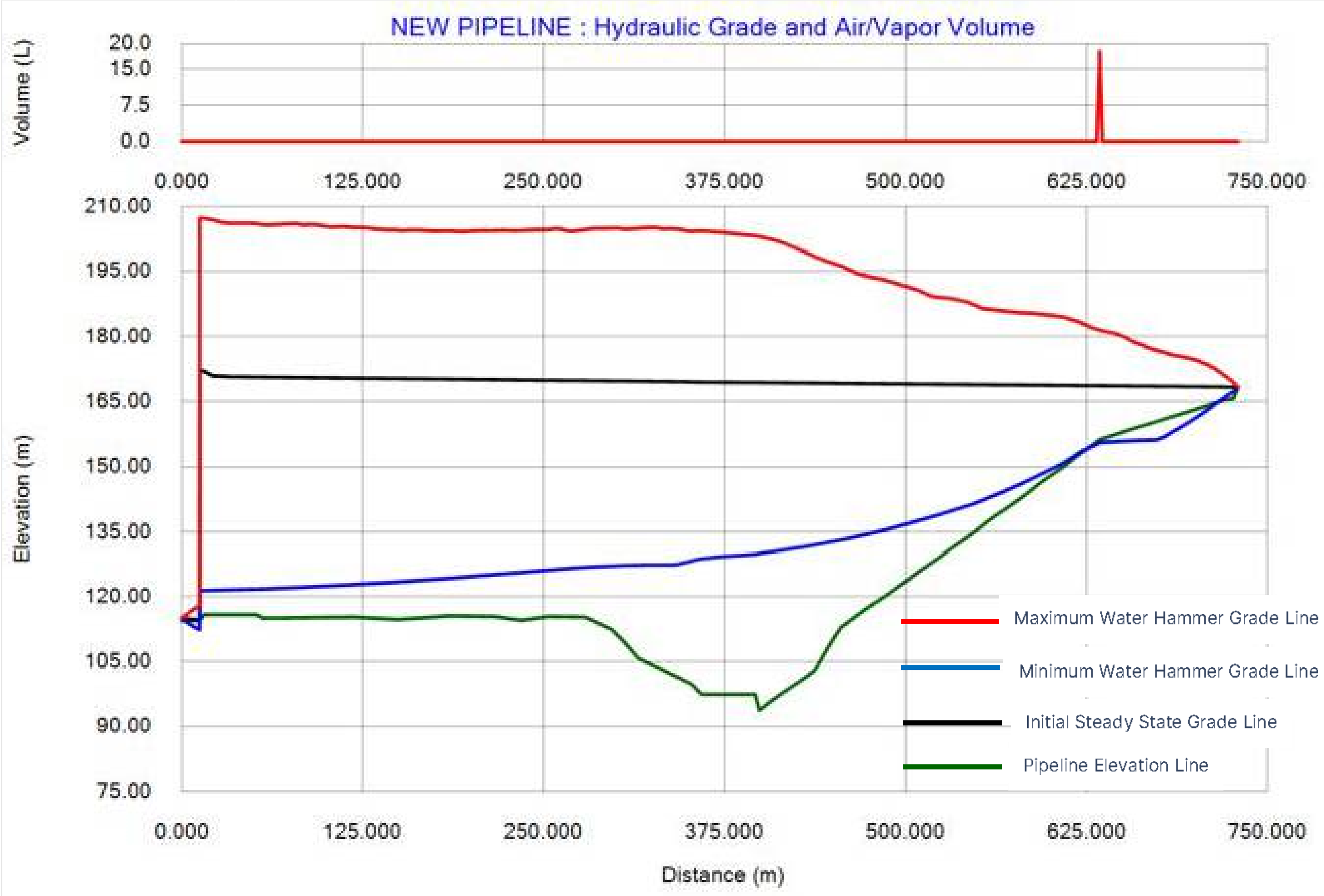


Figure 4-20: Scenario 1.1 – Maximum and Minimum Water Hammer Grade Line Envelopes

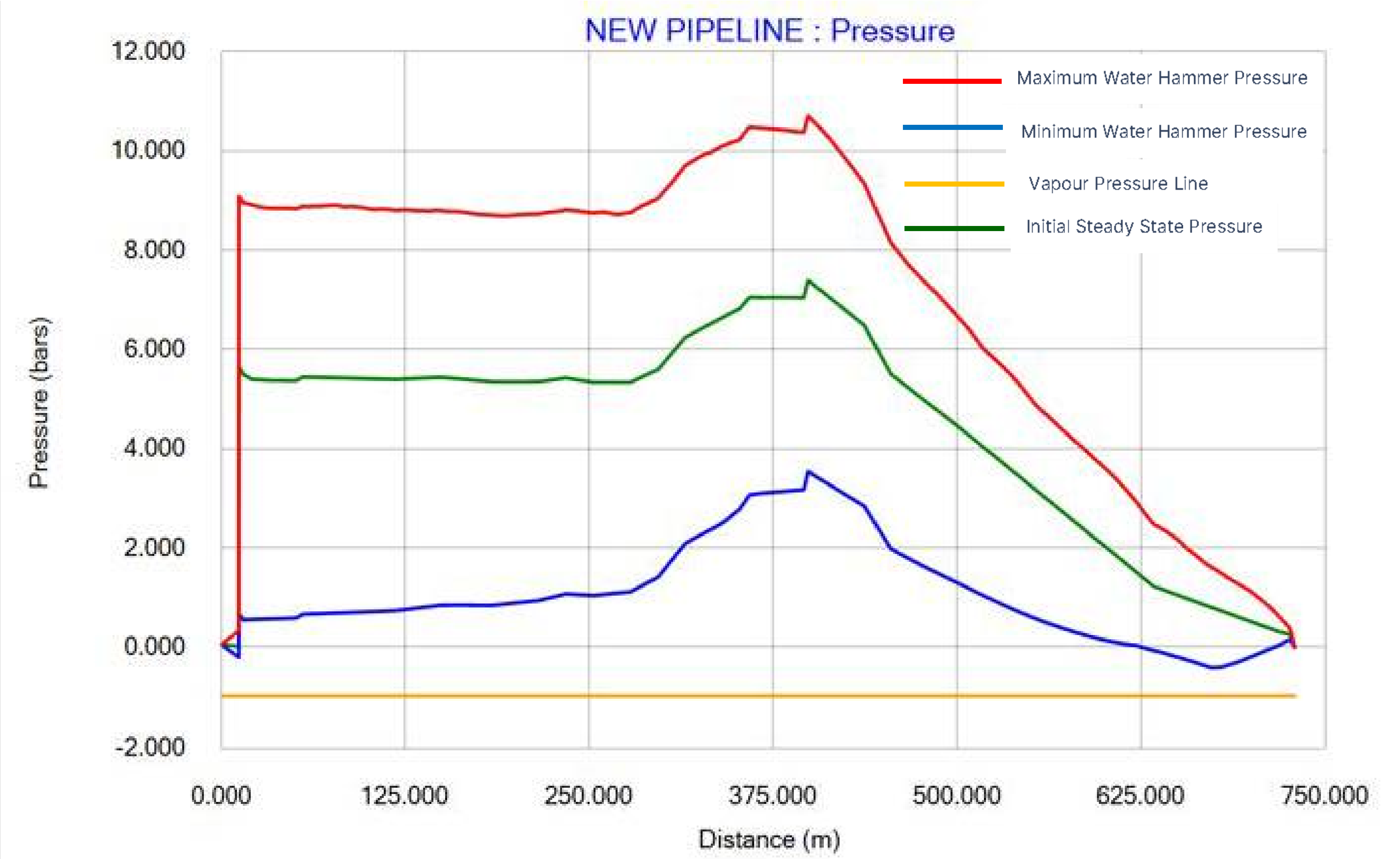


Figure 4-21: Scenario 1.1 – Maximum and Minimum Water Hammer Pressures Along Pipeline

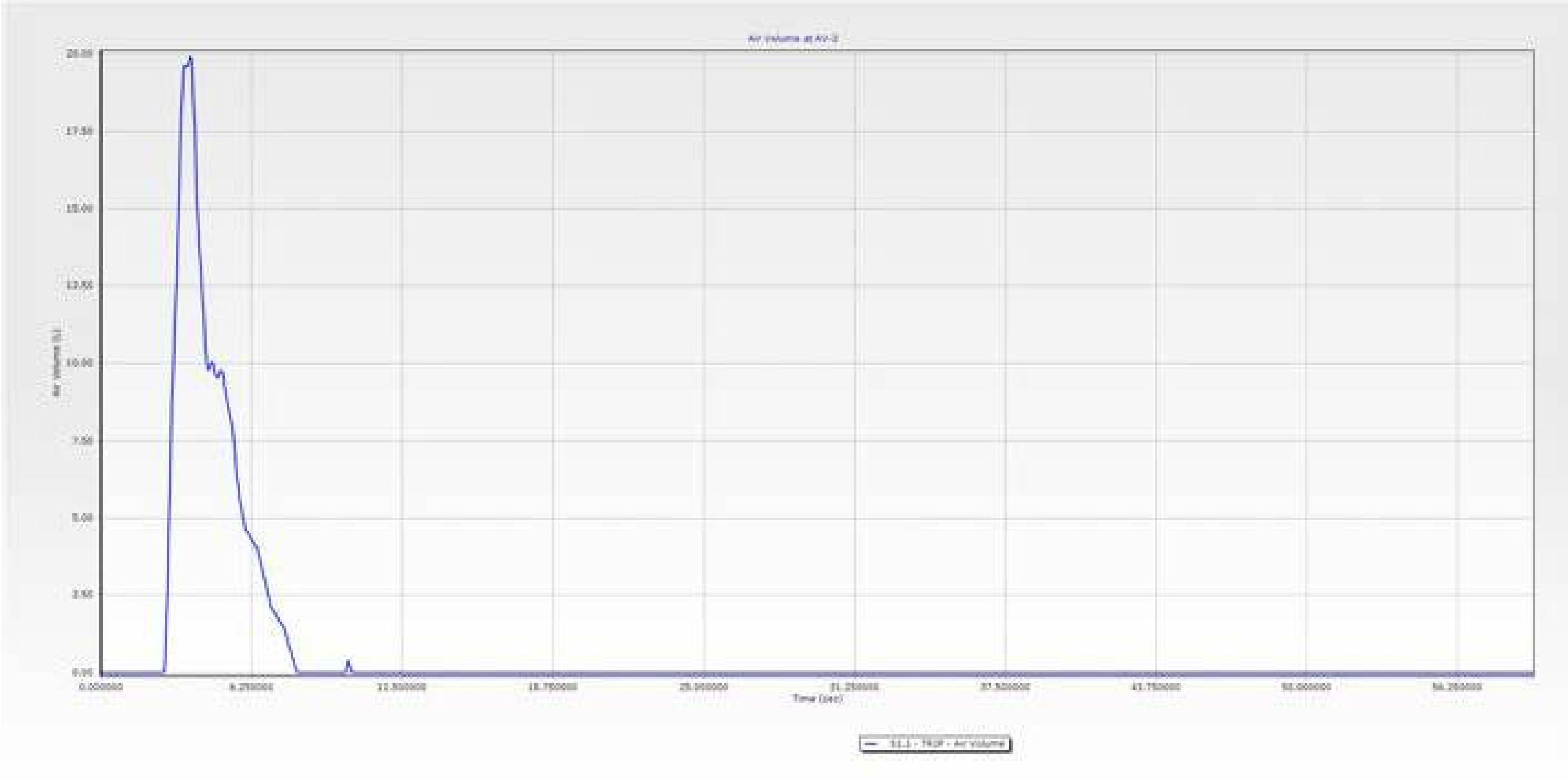


Figure 4-22: Scenario 1.1 – Air Volume Inside a Strategically Positioned Air Valve

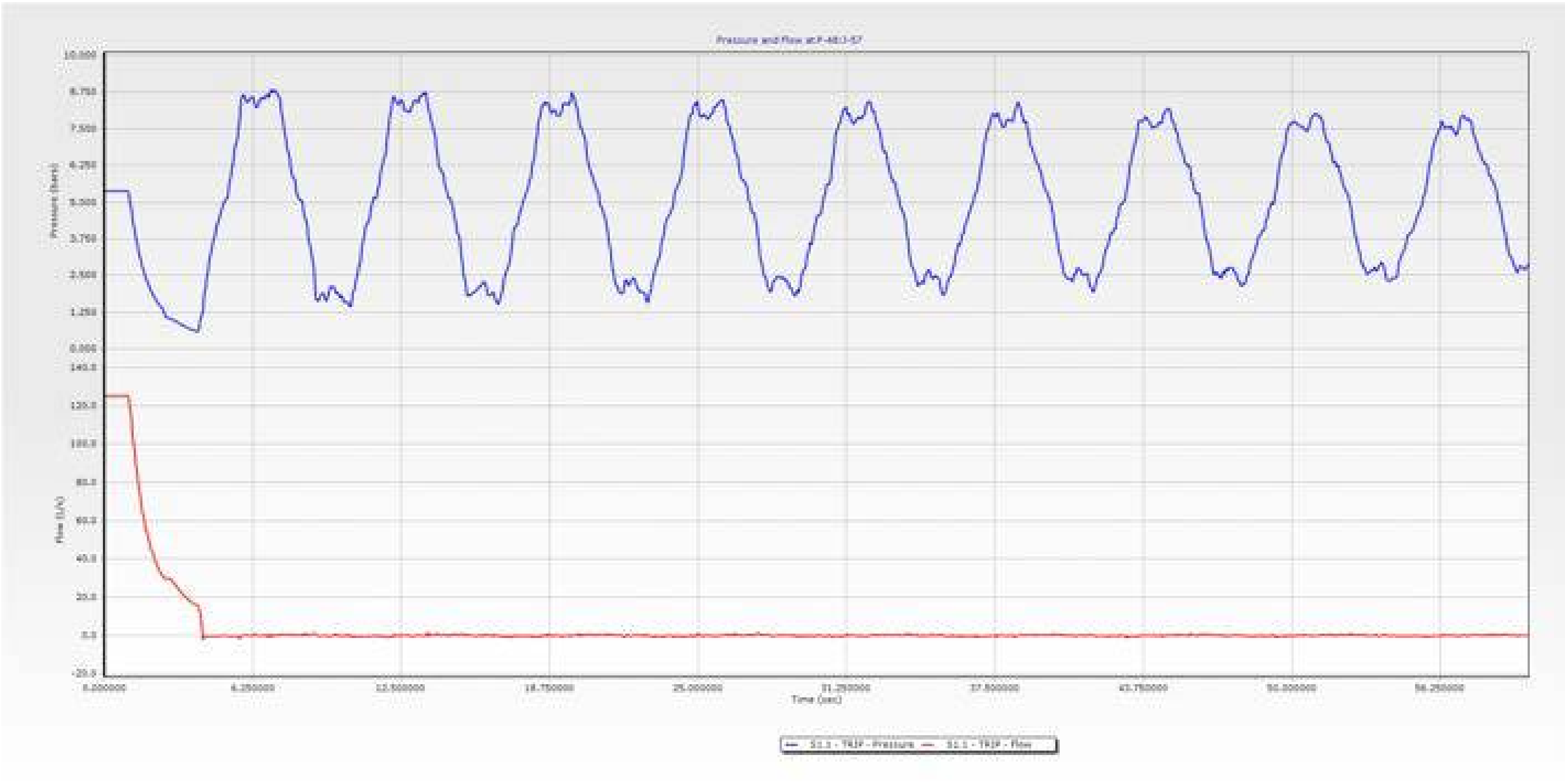


Figure 4-23: Scenario 1.1 – Pressure and Flow Directly Downstream of the Pump Station

(ii) Scenario 1.2, Low Flow, Design Condition, Start

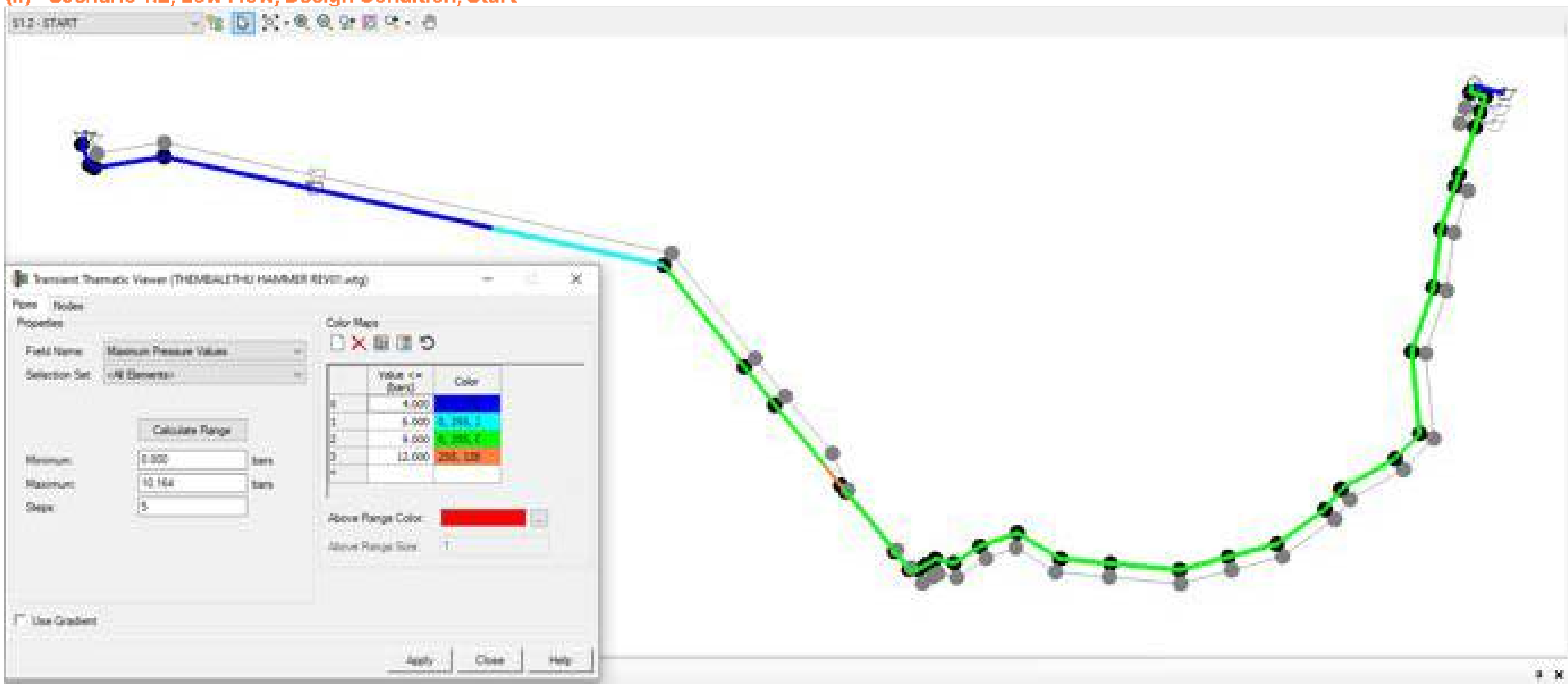


Figure 4-24: Scenario 1.2 – Maximum Water Hammer Pressure Values

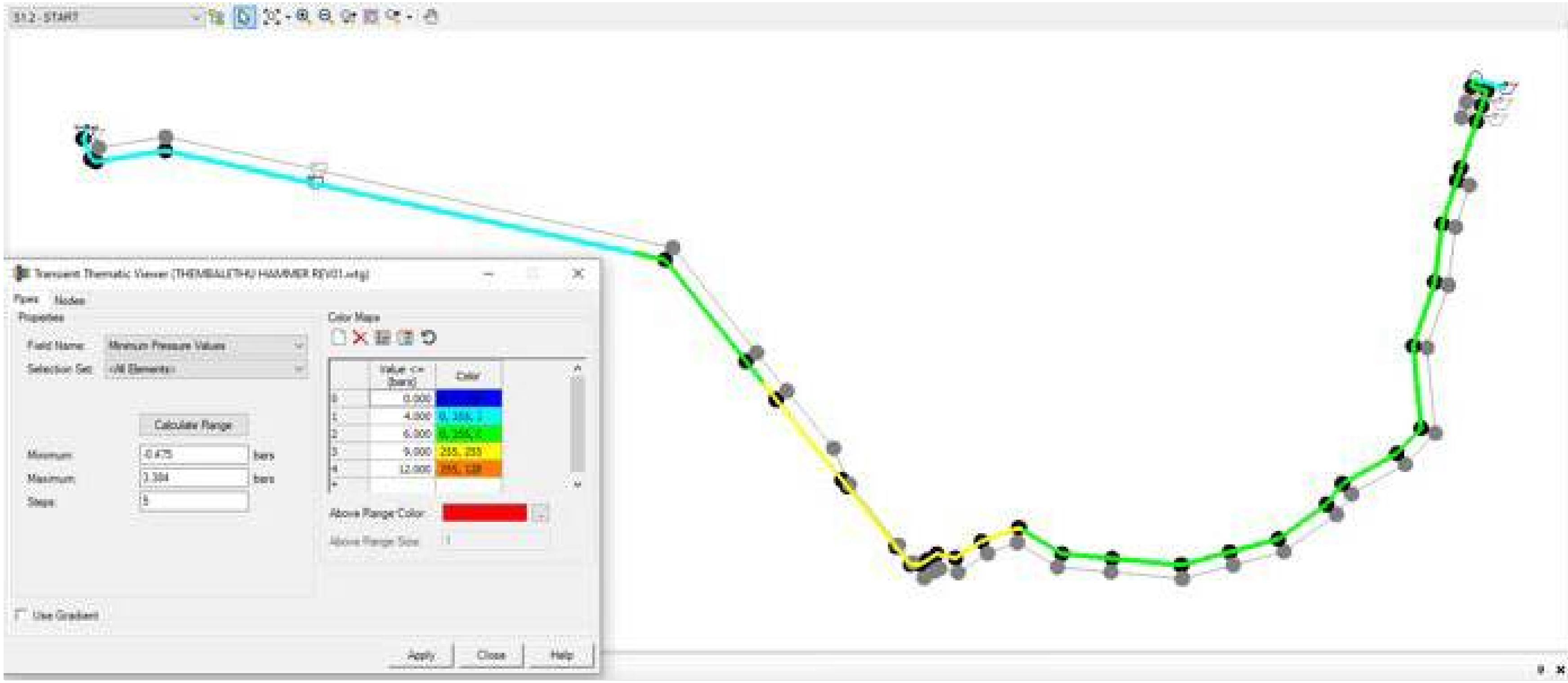


Figure 4-25: Scenario 1.2 – Minimum Water Hammer Pressure Values

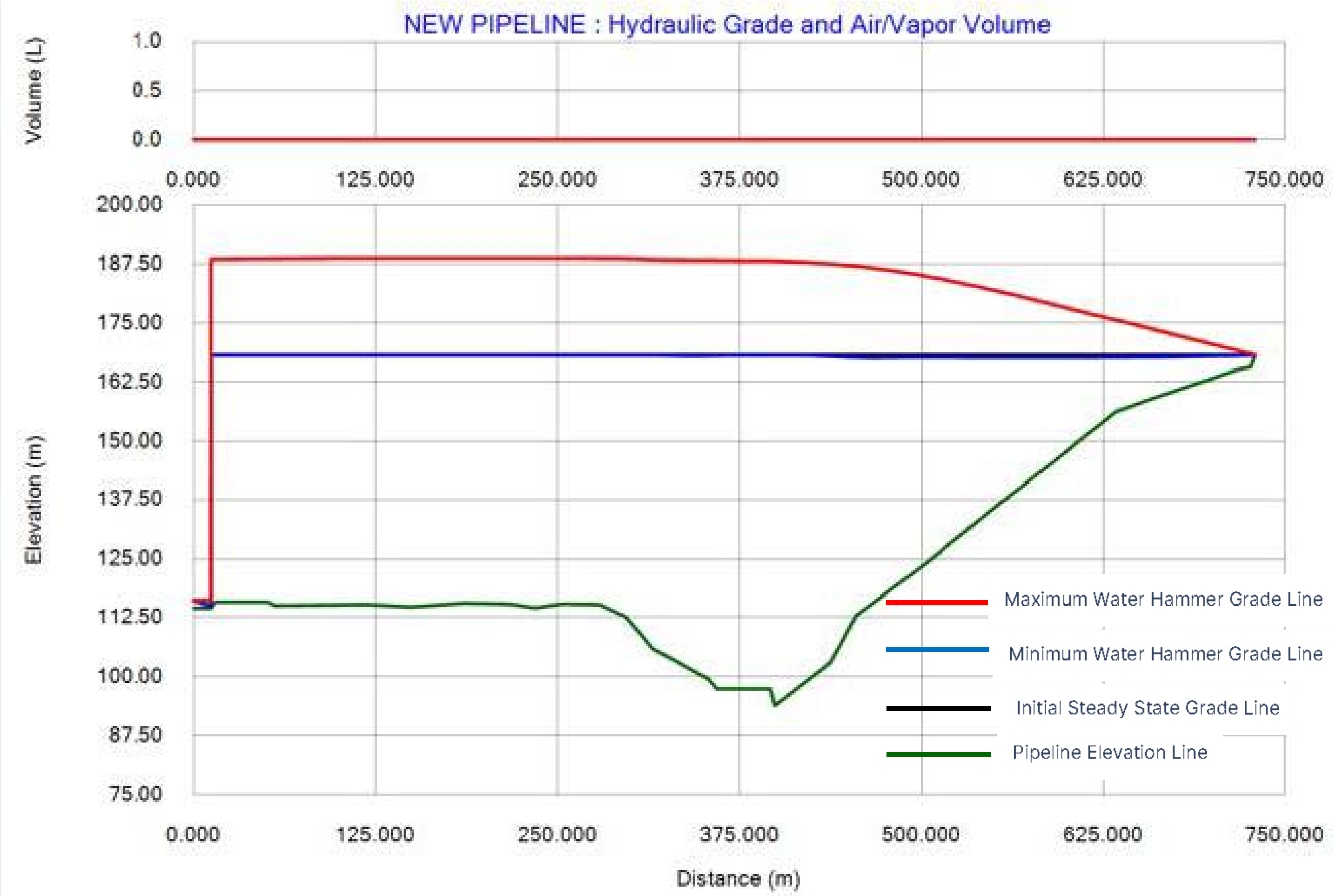


Figure 4-26: Scenario 1.2 – Maximum and Minimum Water Hammer Grade Line Envelopes

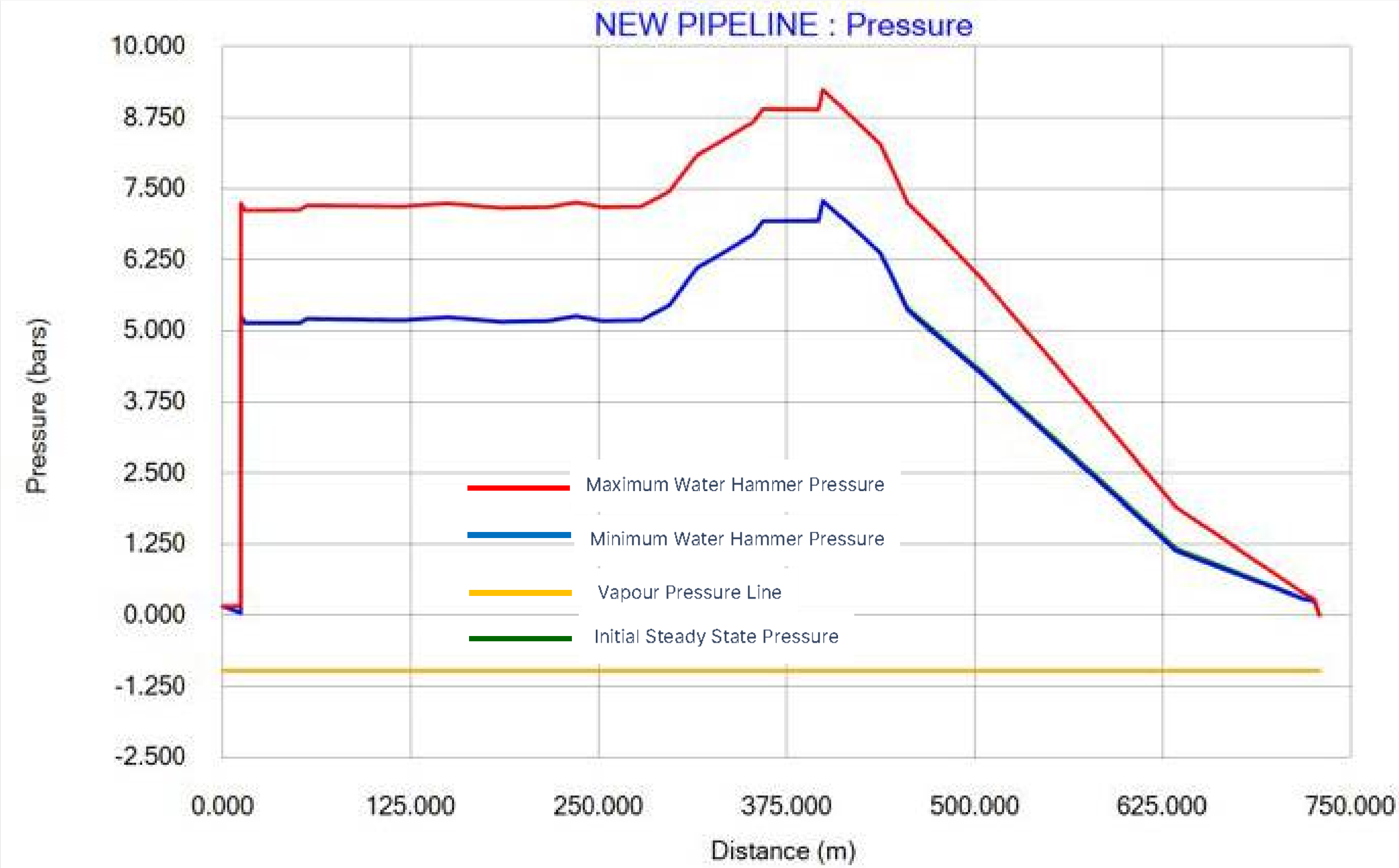


Figure 4-27: Scenario 1.2 – Maximum and Minimum Water Hammer Pressures Along Pipeline

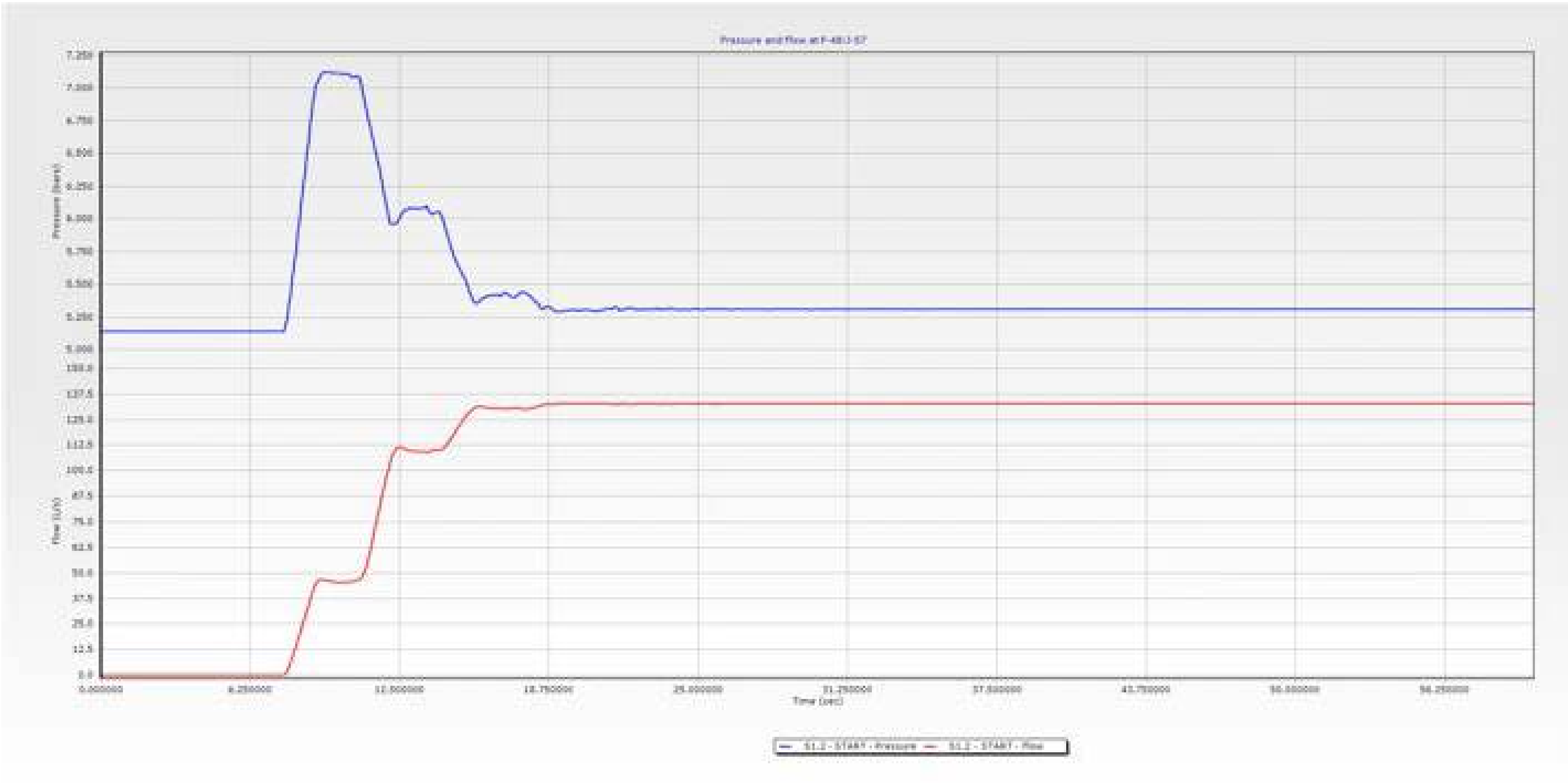


Figure 4-28: Scenario 1.2 – Pressure and Flow Directly Downstream of the Pump Station

(iii) Scenario 2.1, High Flow, Design Condition, Trip

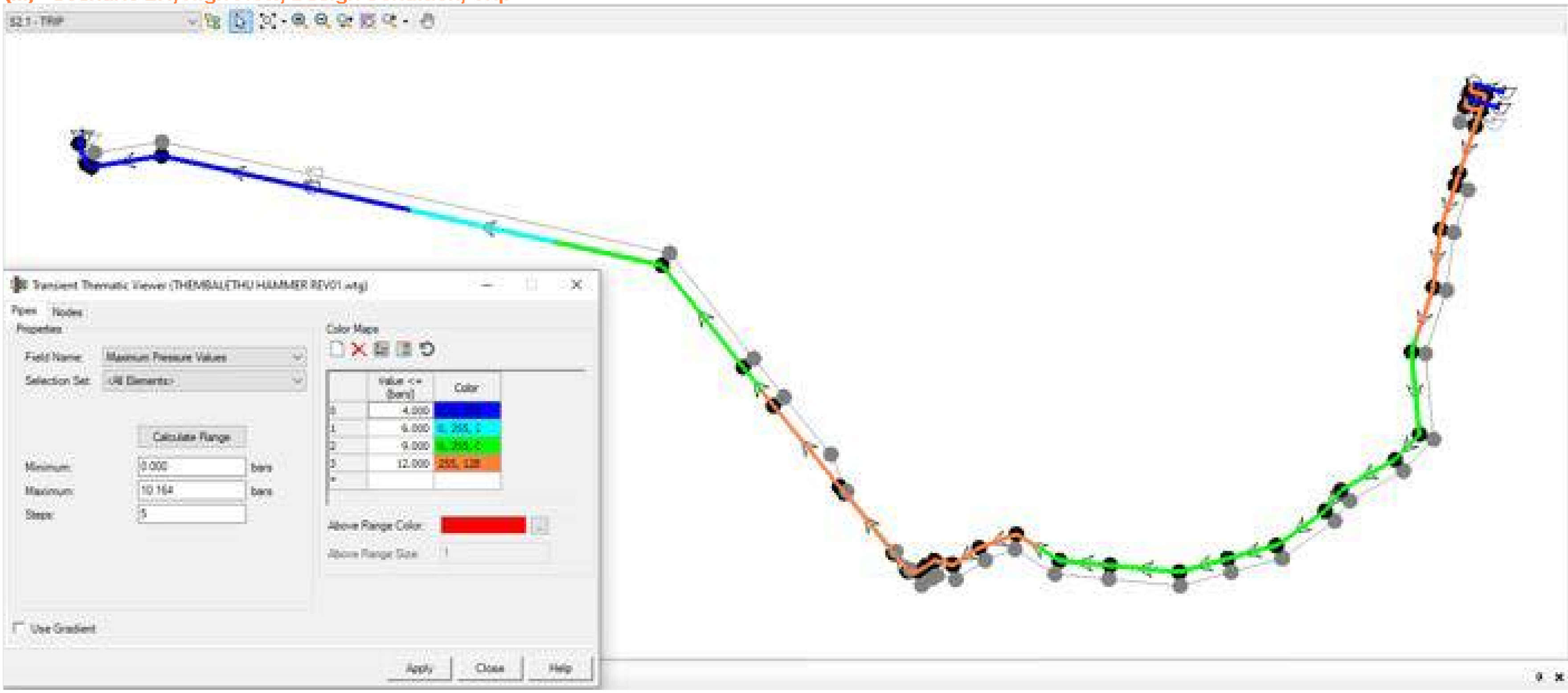


Figure 4-29: Scenario 2.1 – Maximum Water Hammer Pressure Values

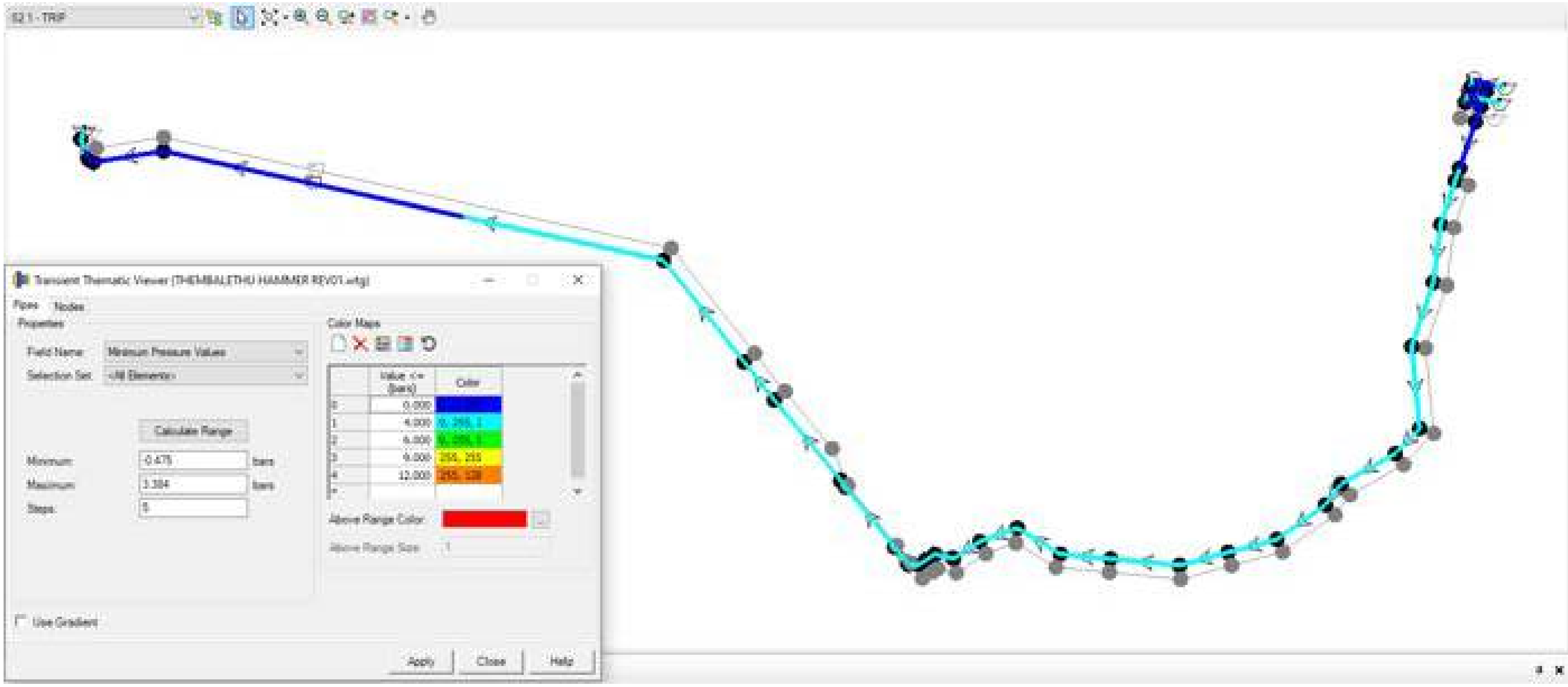


Figure 4-30: Scenario 2.1 – Minimum Water Hammer Pressure Values

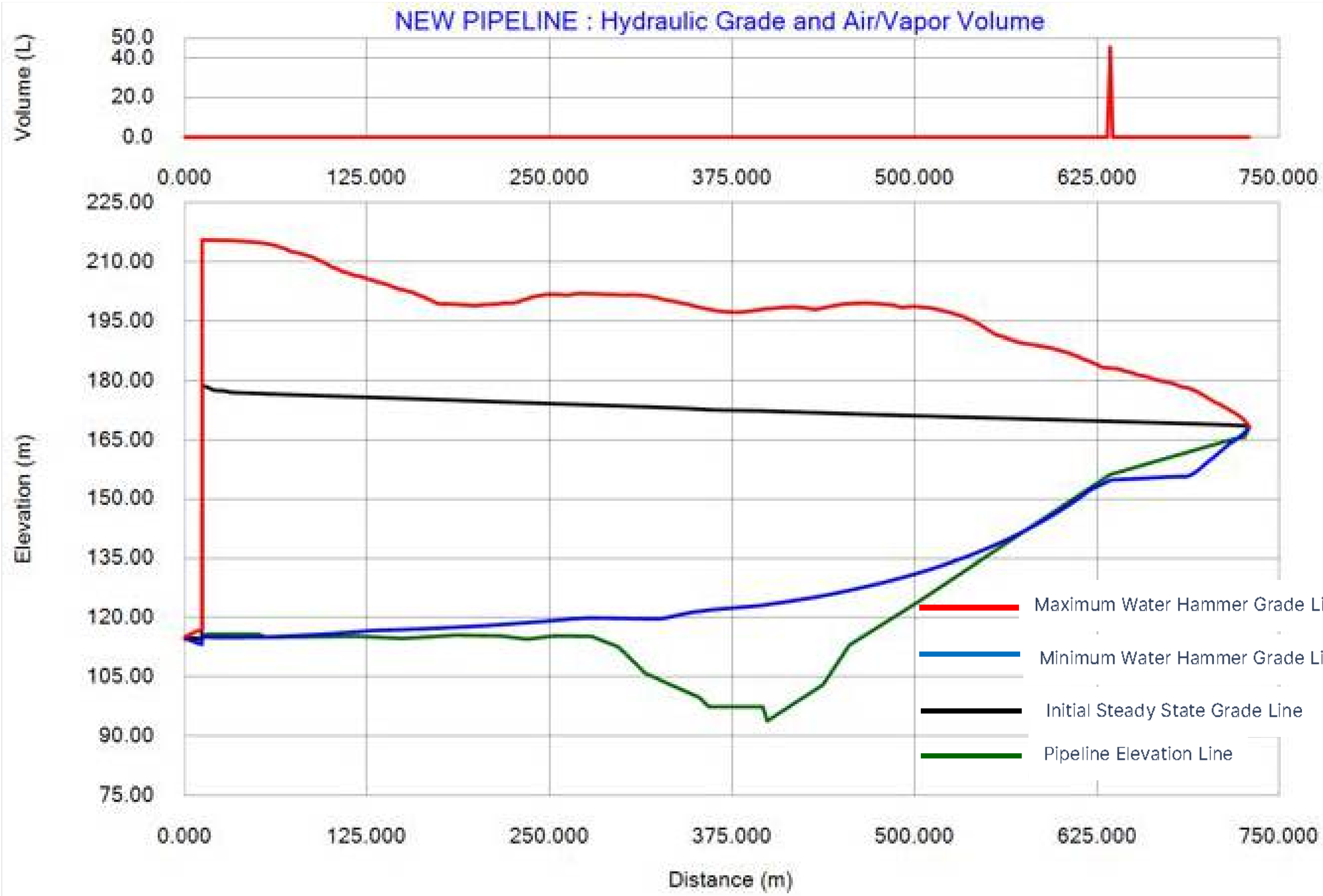


Figure 4-31: Scenario 2.1 – Maximum and Minimum Water Hammer Grade Line Envelopes Along the New Pipeline

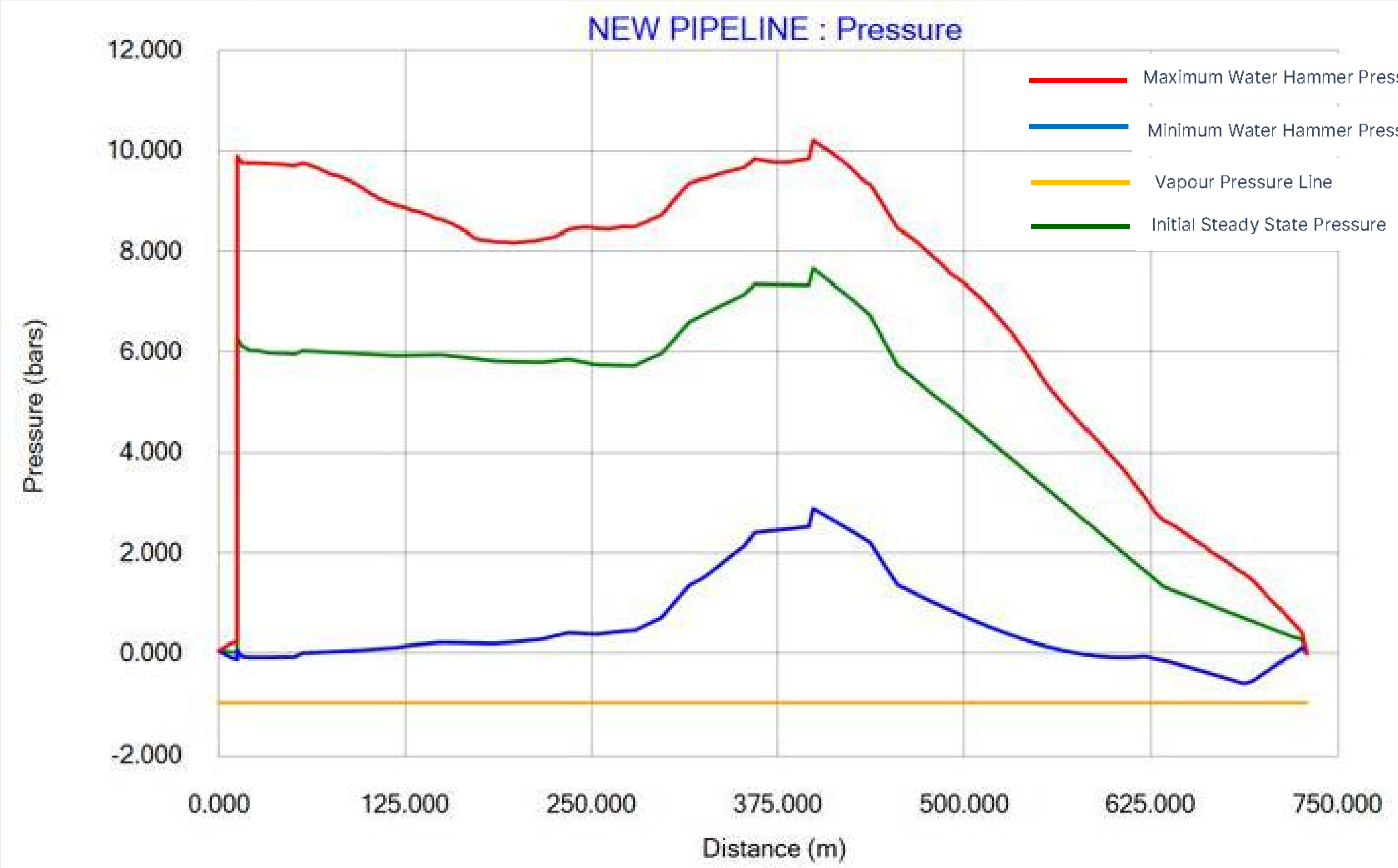


Figure 4-32: Scenario 2.1 – Maximum and Minimum Water Hammer Pressures Along the New Pipeline

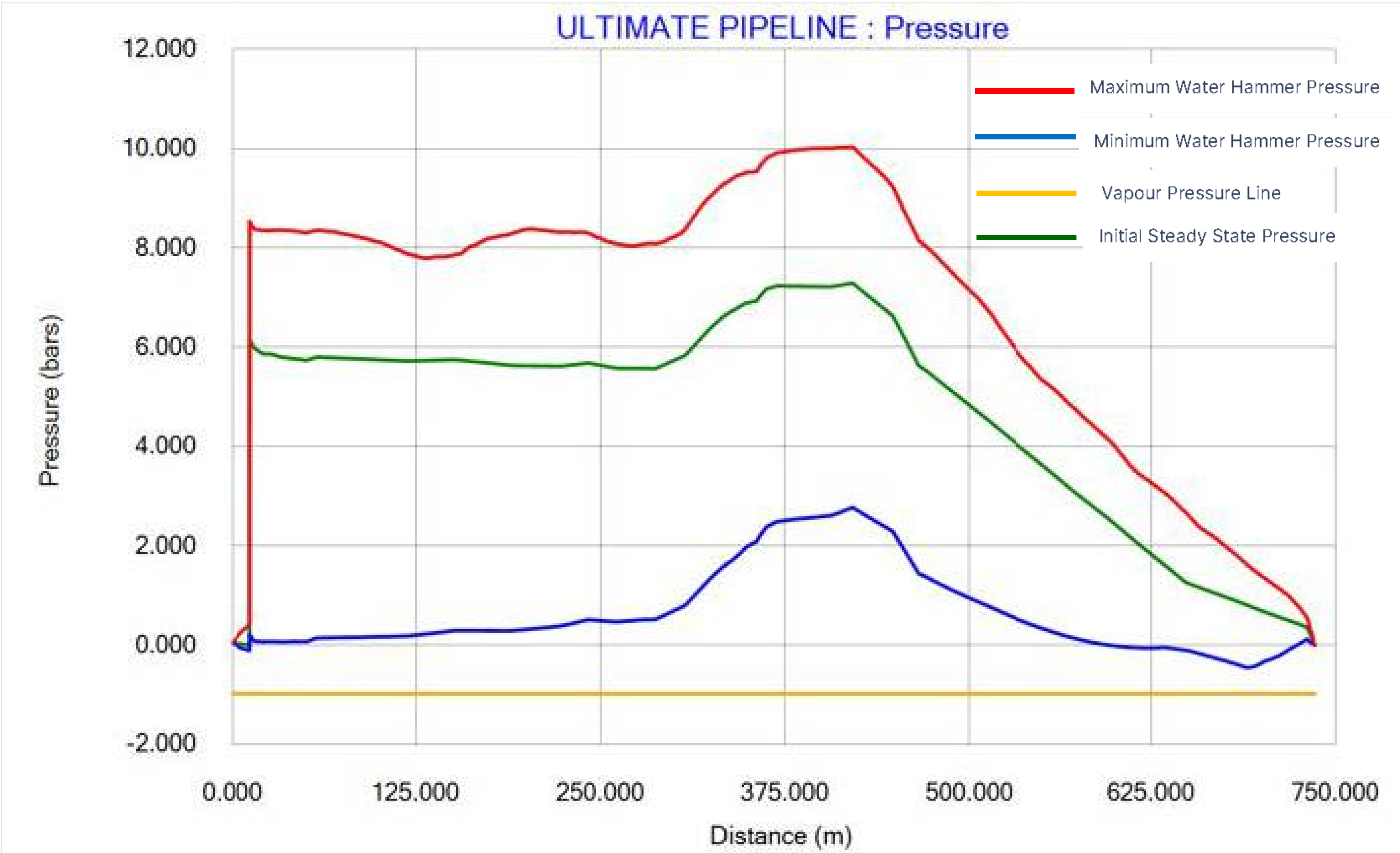


Figure 4-33: Scenario 2.1 – Maximum and Minimum Water Hammer Pressures Along the Future Pipeline

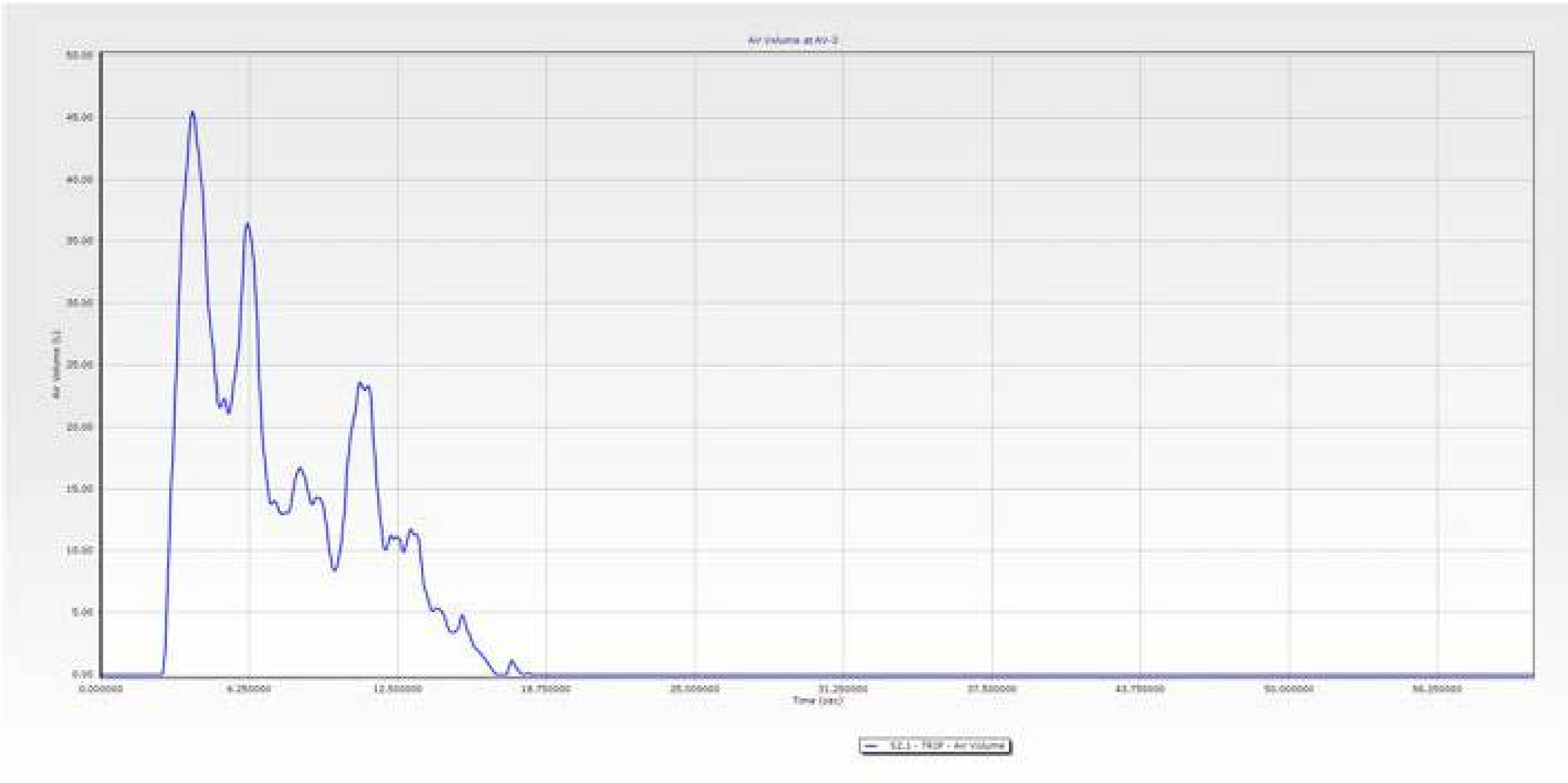


Figure 4-34: Scenario 2.1 – Air Volume Inside a Strategically Positioned Air Valve Along the New Pipeline

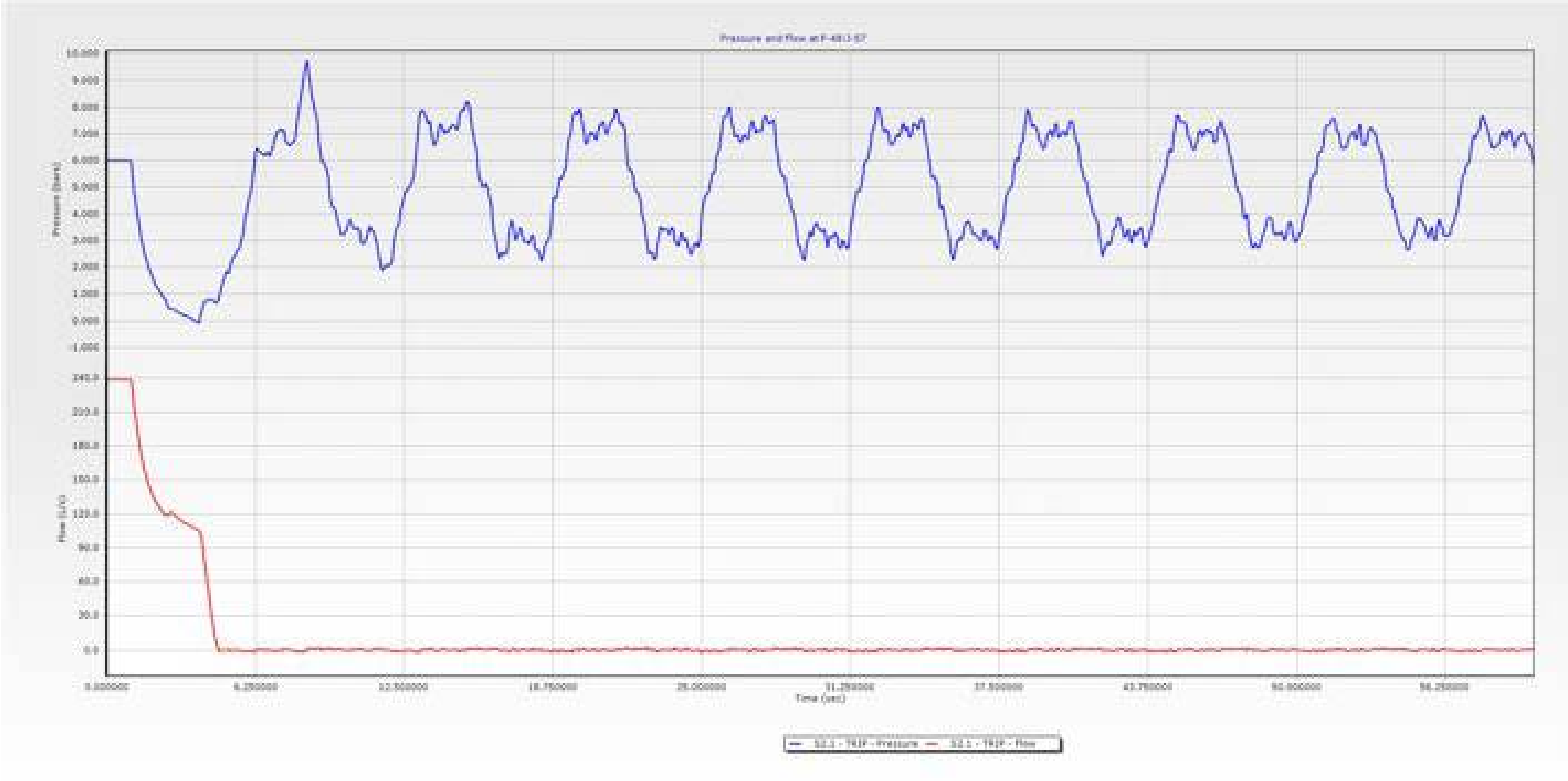


Figure 4-35: Scenario 2.1 – Pressure and Flow Directly Downstream of the Pump Station

(iv) Scenario 2.2, High Flow, Design Condition, Start

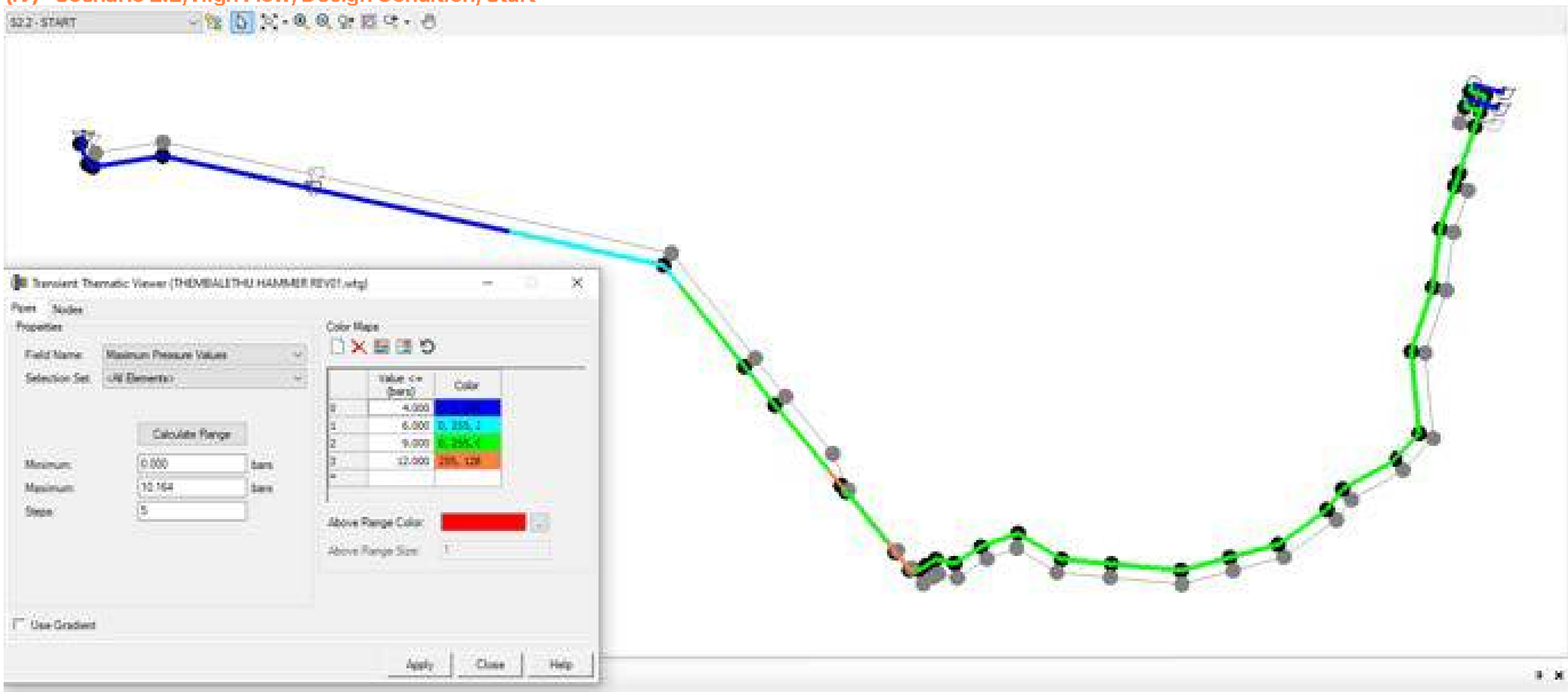


Figure 4-36: Scenario 2.2 – Maximum Water Hammer Pressure Values

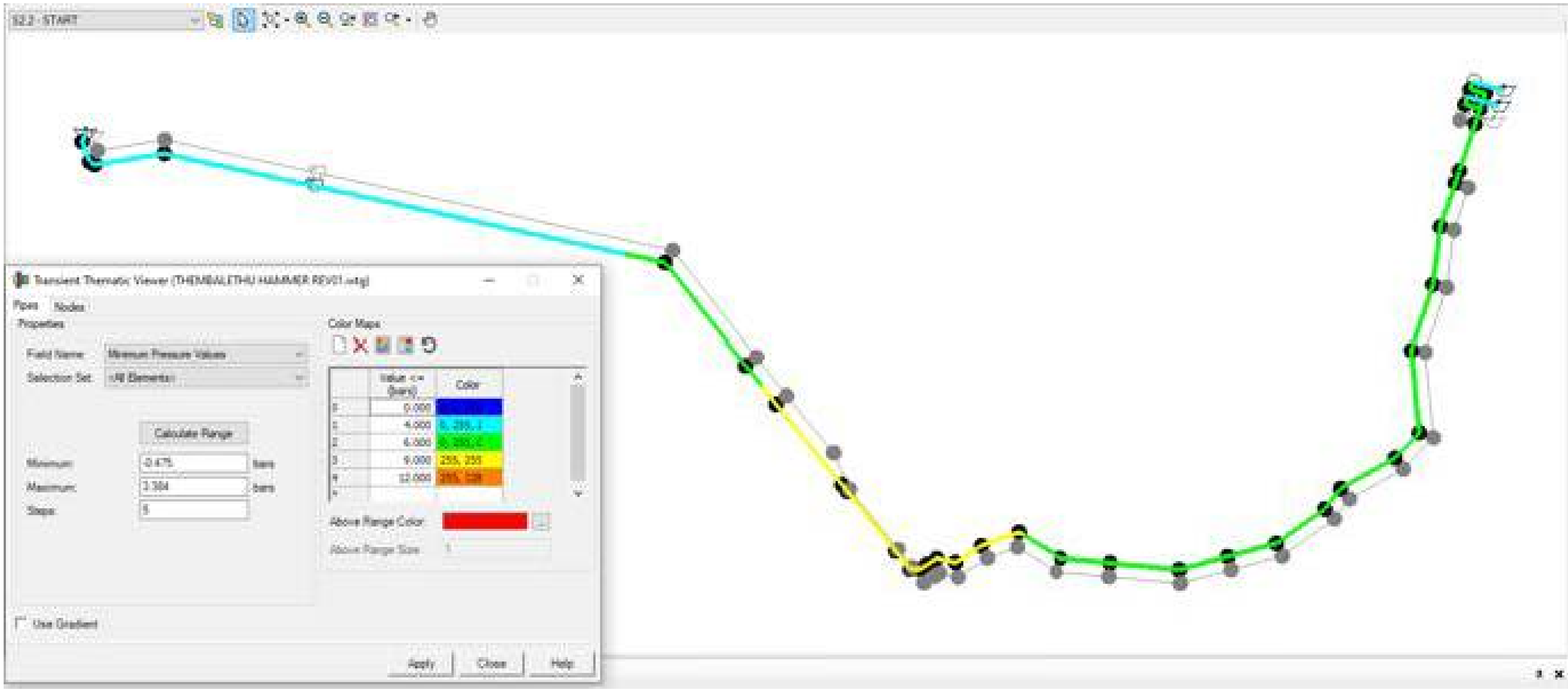


Figure 4-37: Scenario 2.2 – Minimum Water Hammer Pressure Values

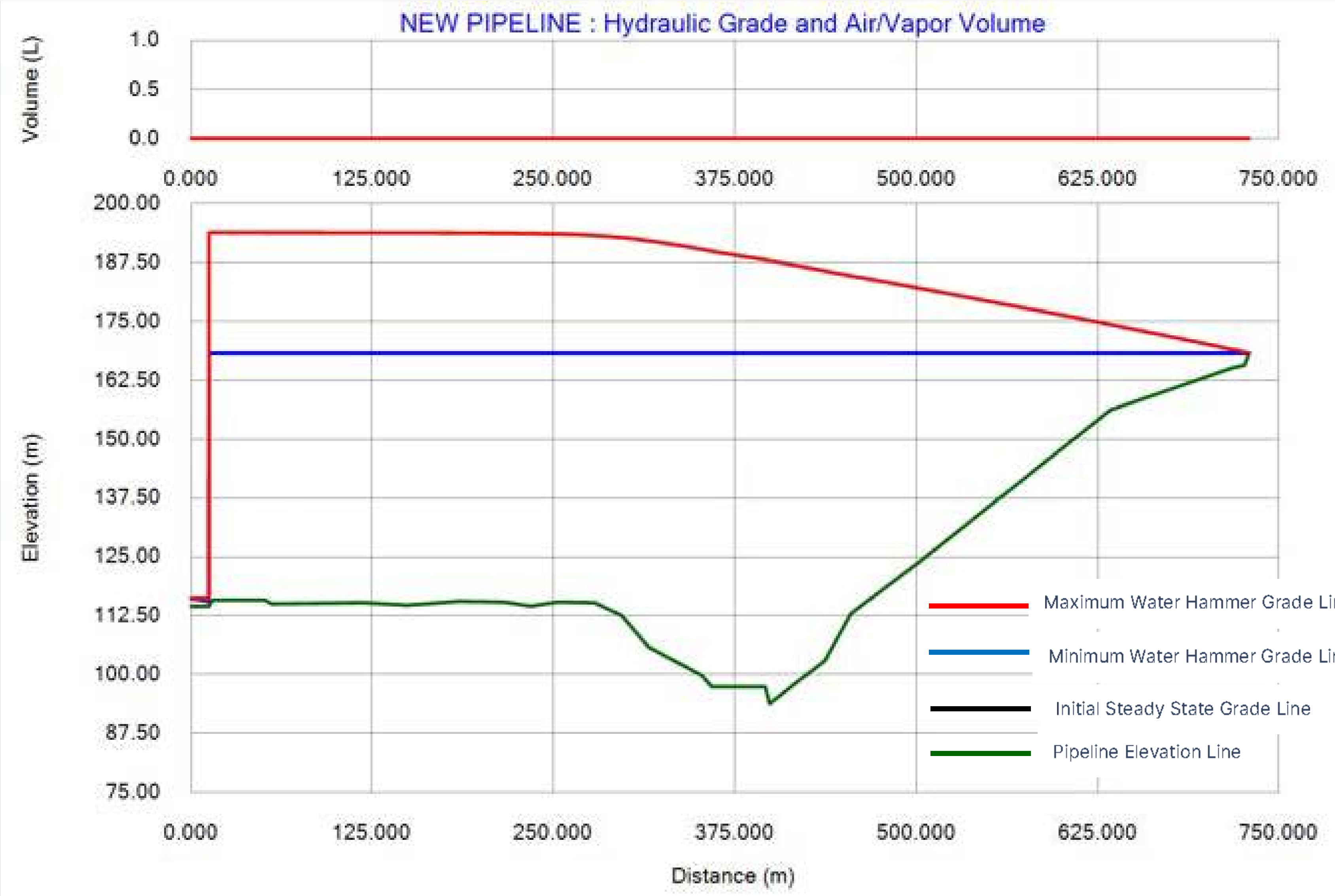


Figure 4-38: Scenario 2.2 – Maximum and Minimum Water Hammer Grade Line Envelopes Along the New Pipeline

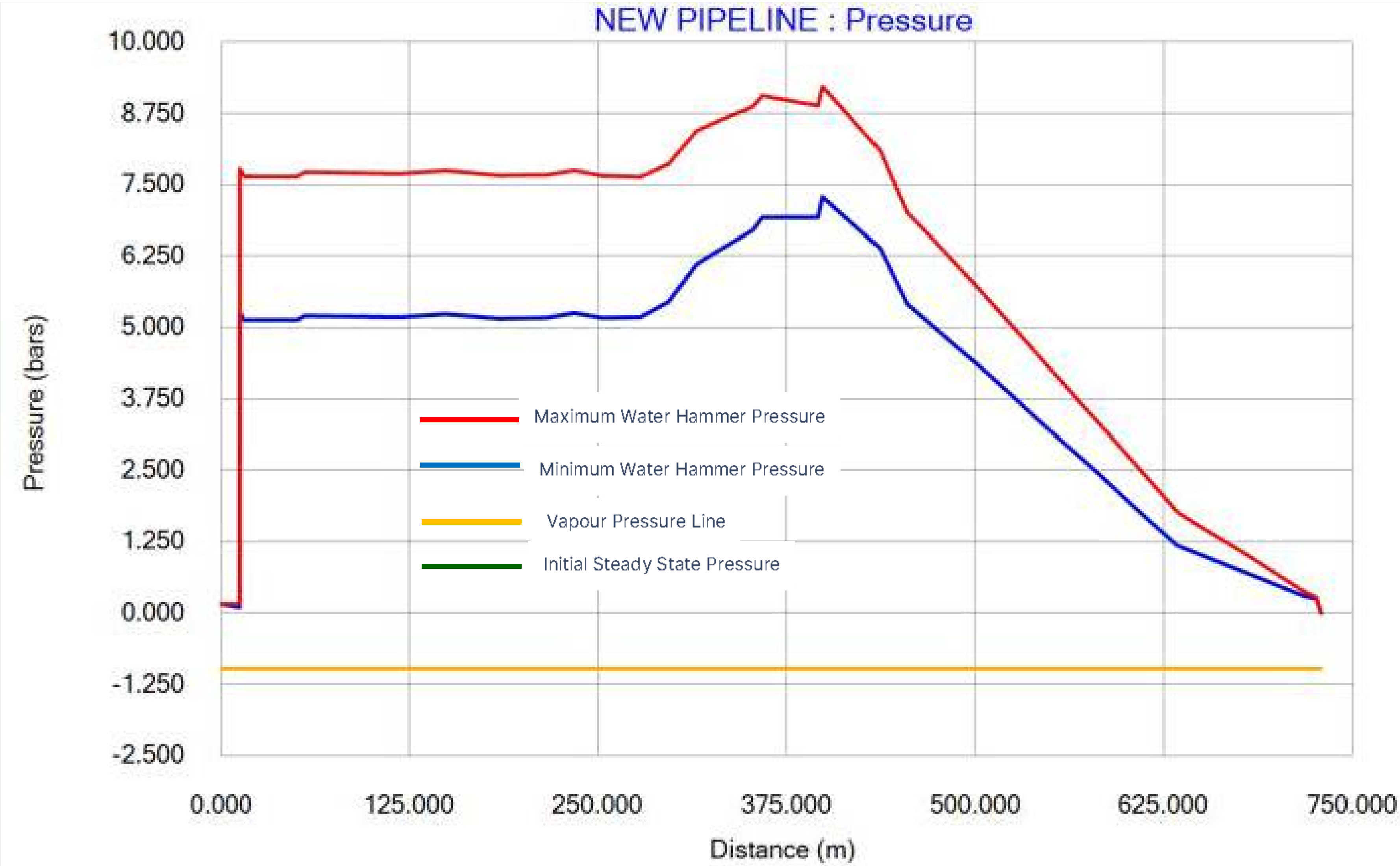


Figure 4-39: Scenario 2.2 – Maximum and Minimum Water Hammer Pressures Along the New Pipeline

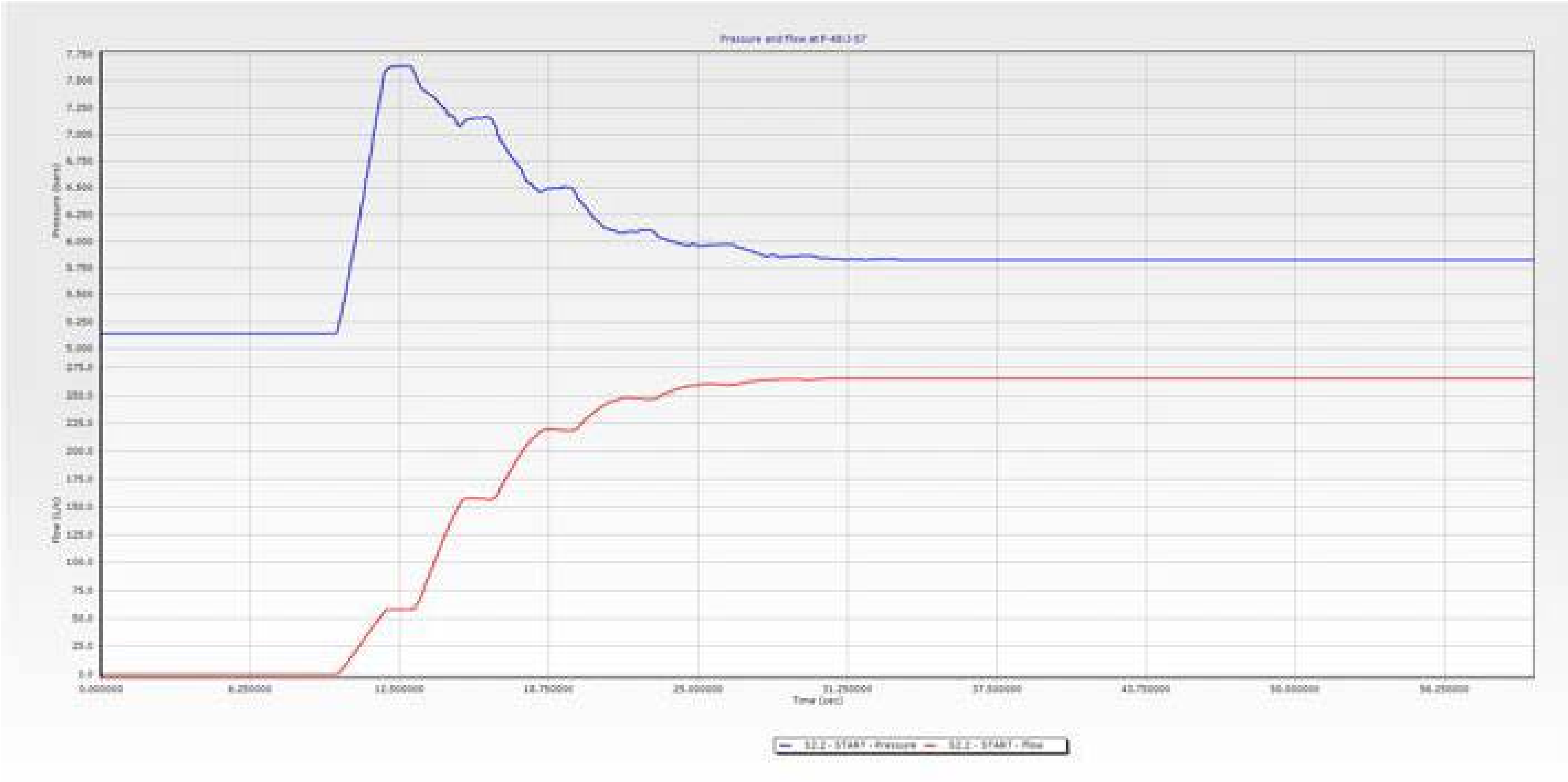


Figure 4-40: Scenario 2.2 – Pressure and Flow Directly Downstream of the Pump Station

(v) Scenario 3.1, Ultimate Condition, Trip

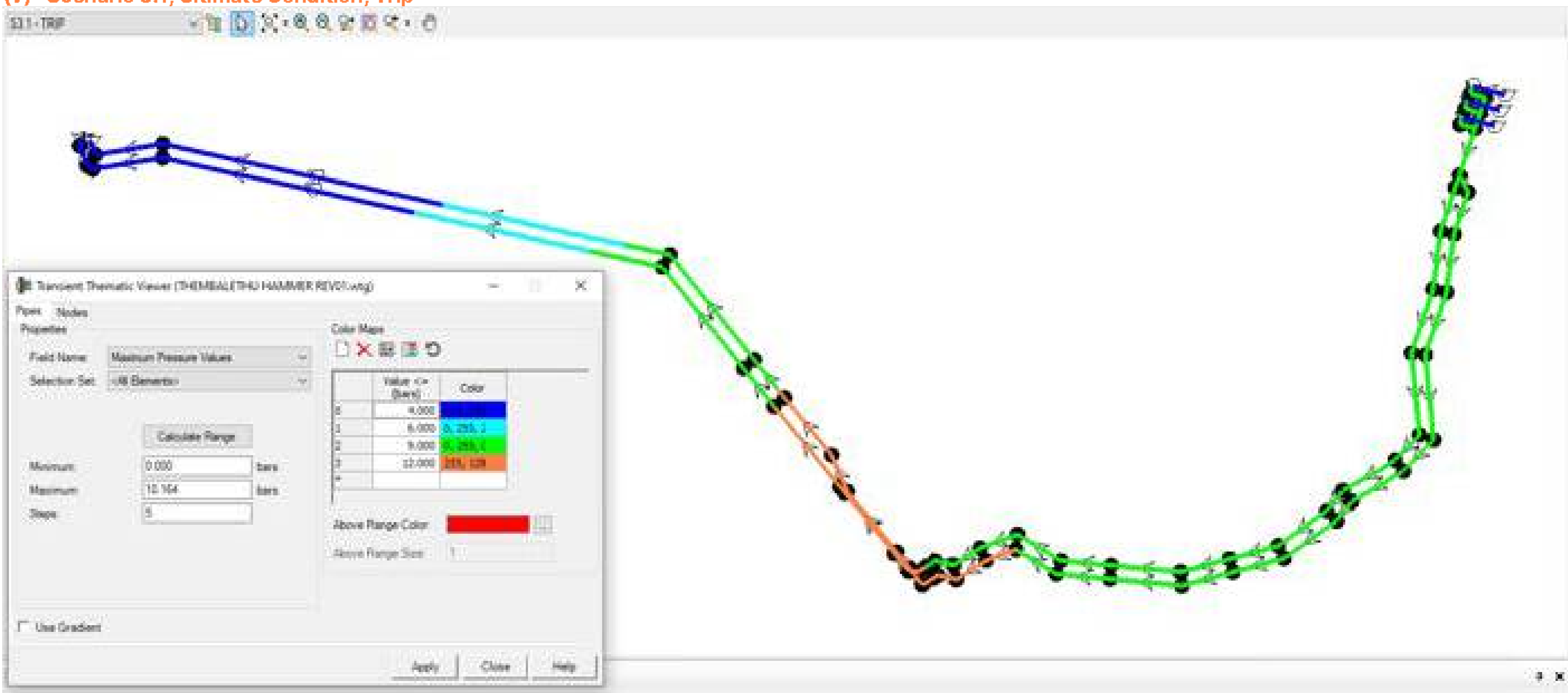


Figure 4-41: Scenario 3.1 – Maximum Water Hammer Pressure Values

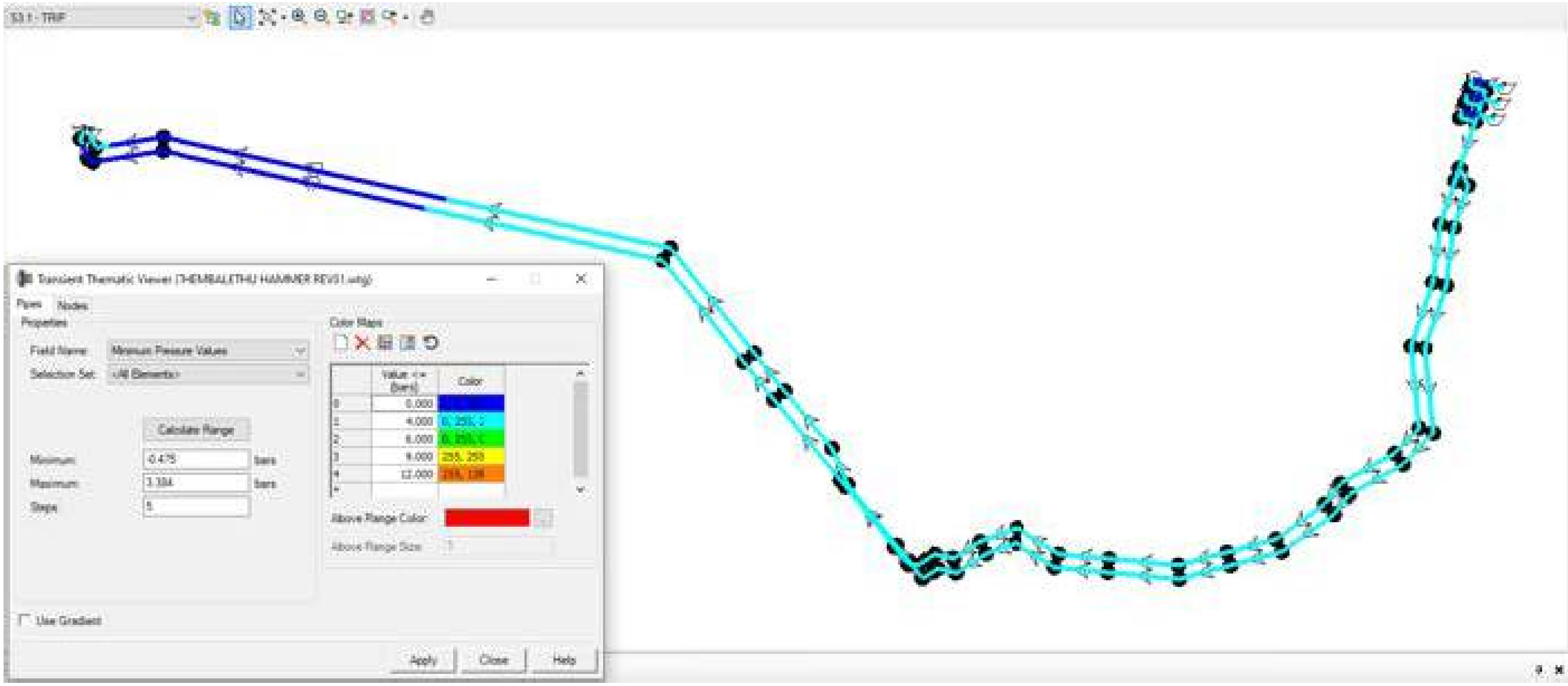


Figure 4-42: Scenario 3.1 – Minimum Water Hammer Pressure Values

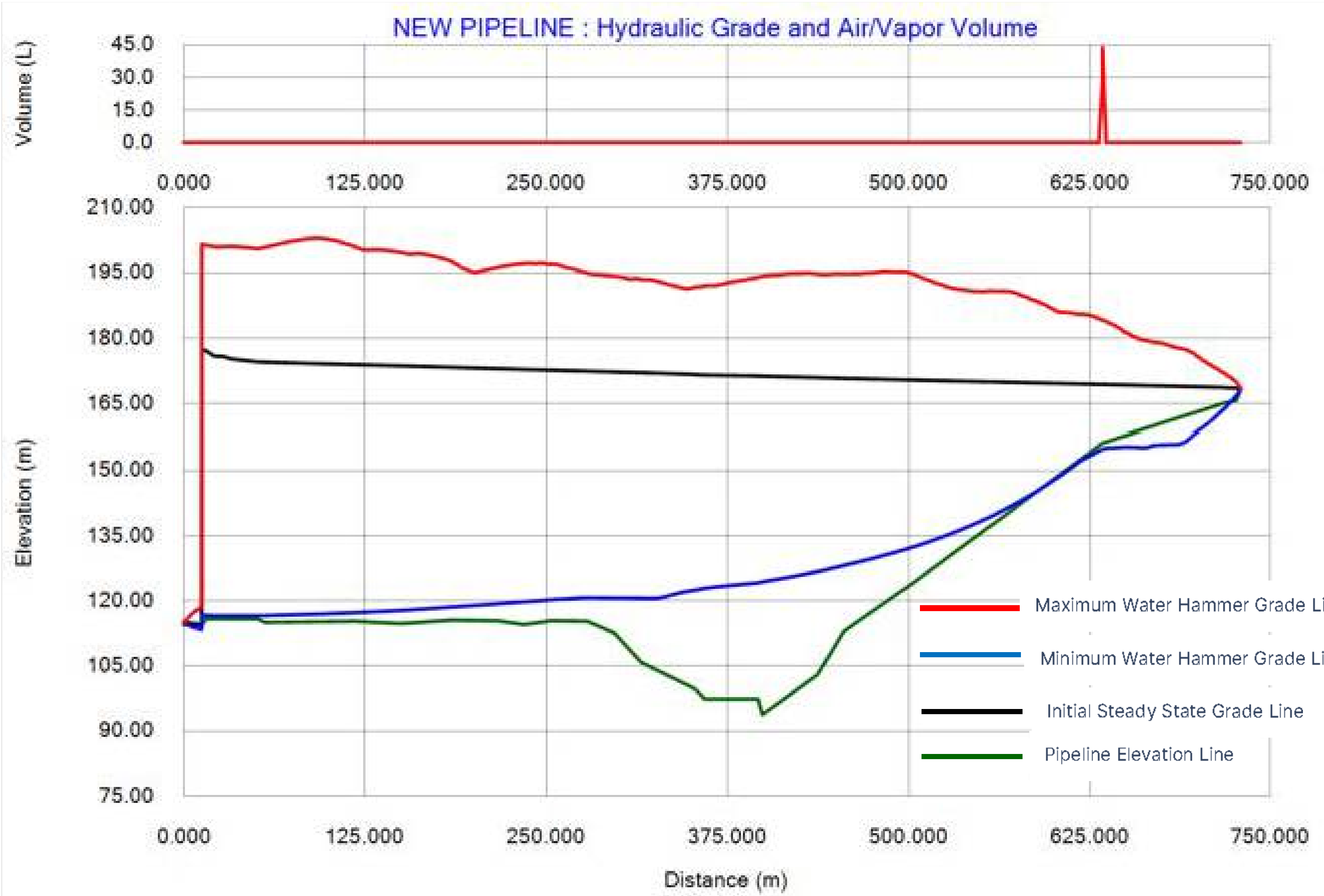


Figure 4-43: Scenario 3.1 – Maximum and Minimum Water Hammer Grade Line Envelopes Along the New Pipeline

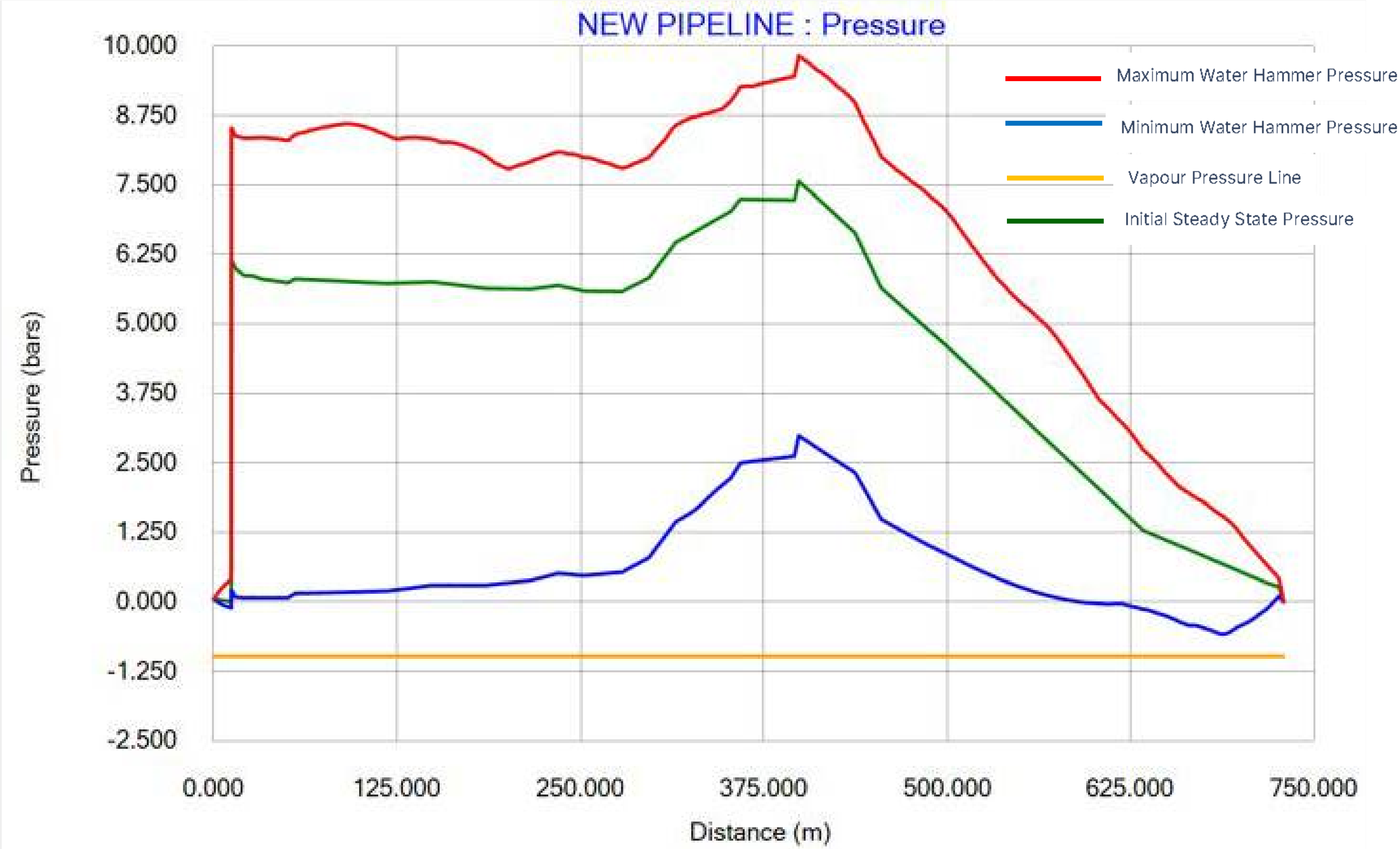


Figure 4-44: Scenario 3.1 – Maximum and Minimum Water Hammer Pressures Along the New Pipeline

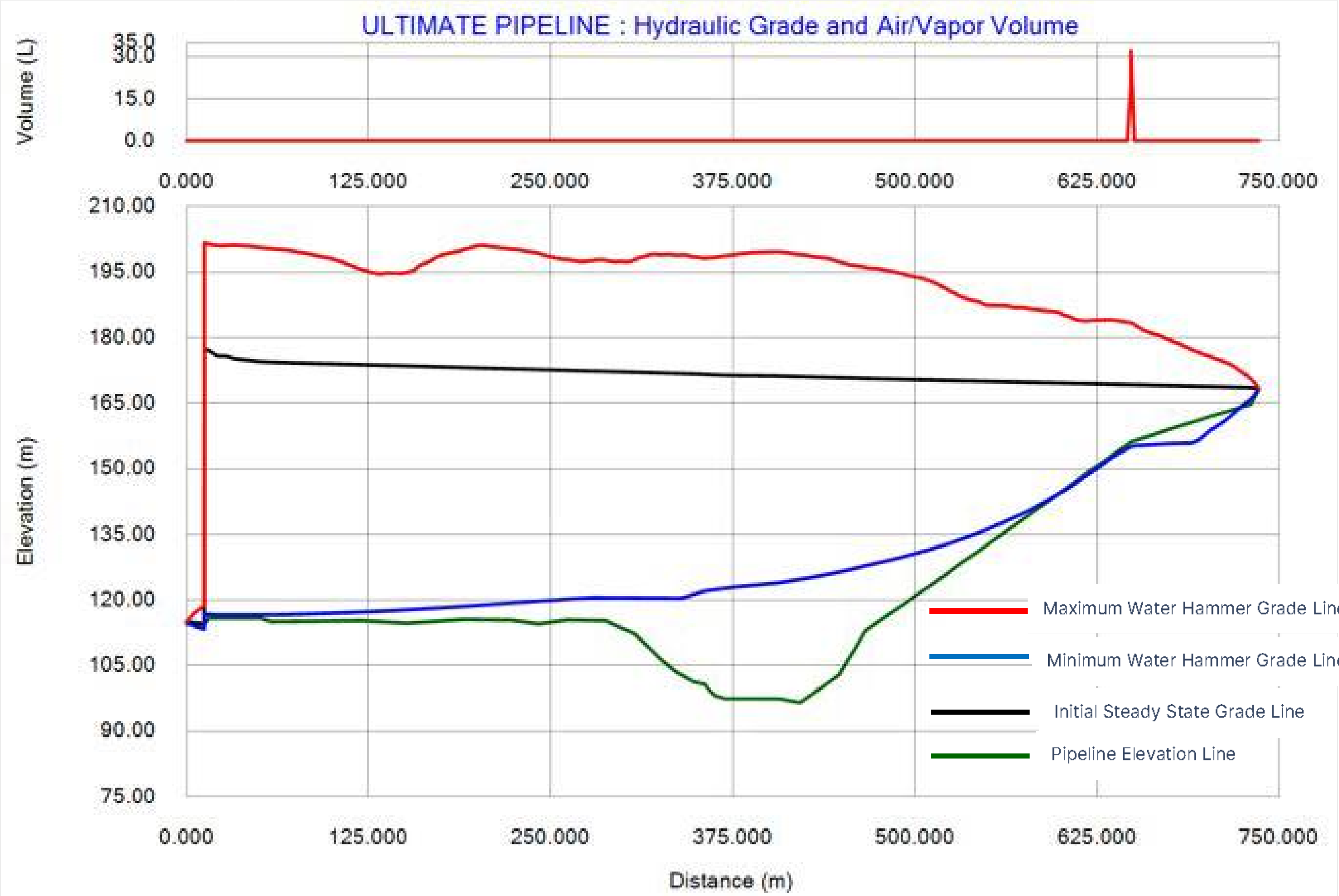


Figure 4-45: Scenario 3.1 – Maximum and Minimum Water Hammer Grade Line Envelopes Along the Future Pipeline

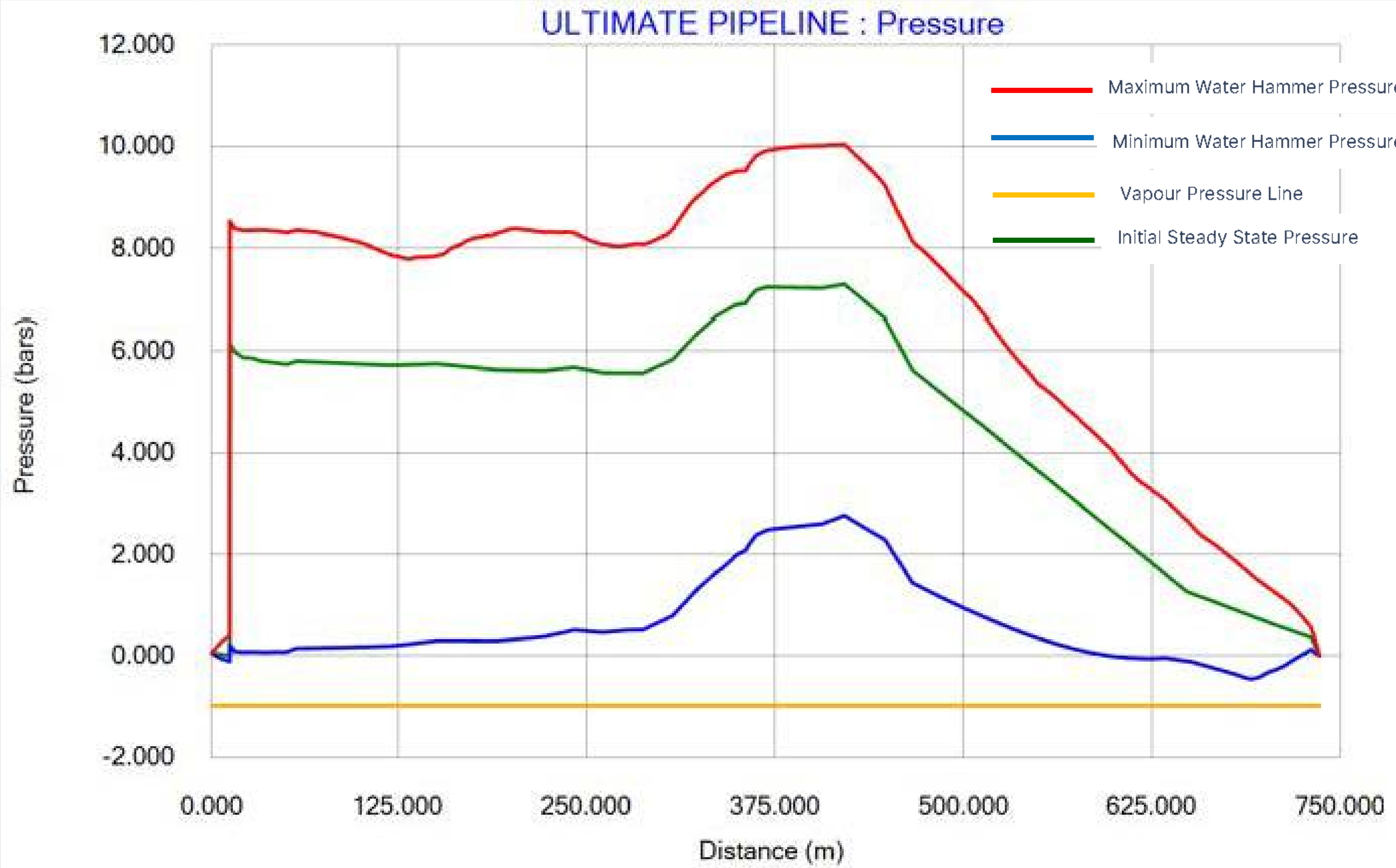


Figure 4-46: Scenario 3.1 – Maximum and Minimum Water Hammer Pressures Along the Future Pipeline

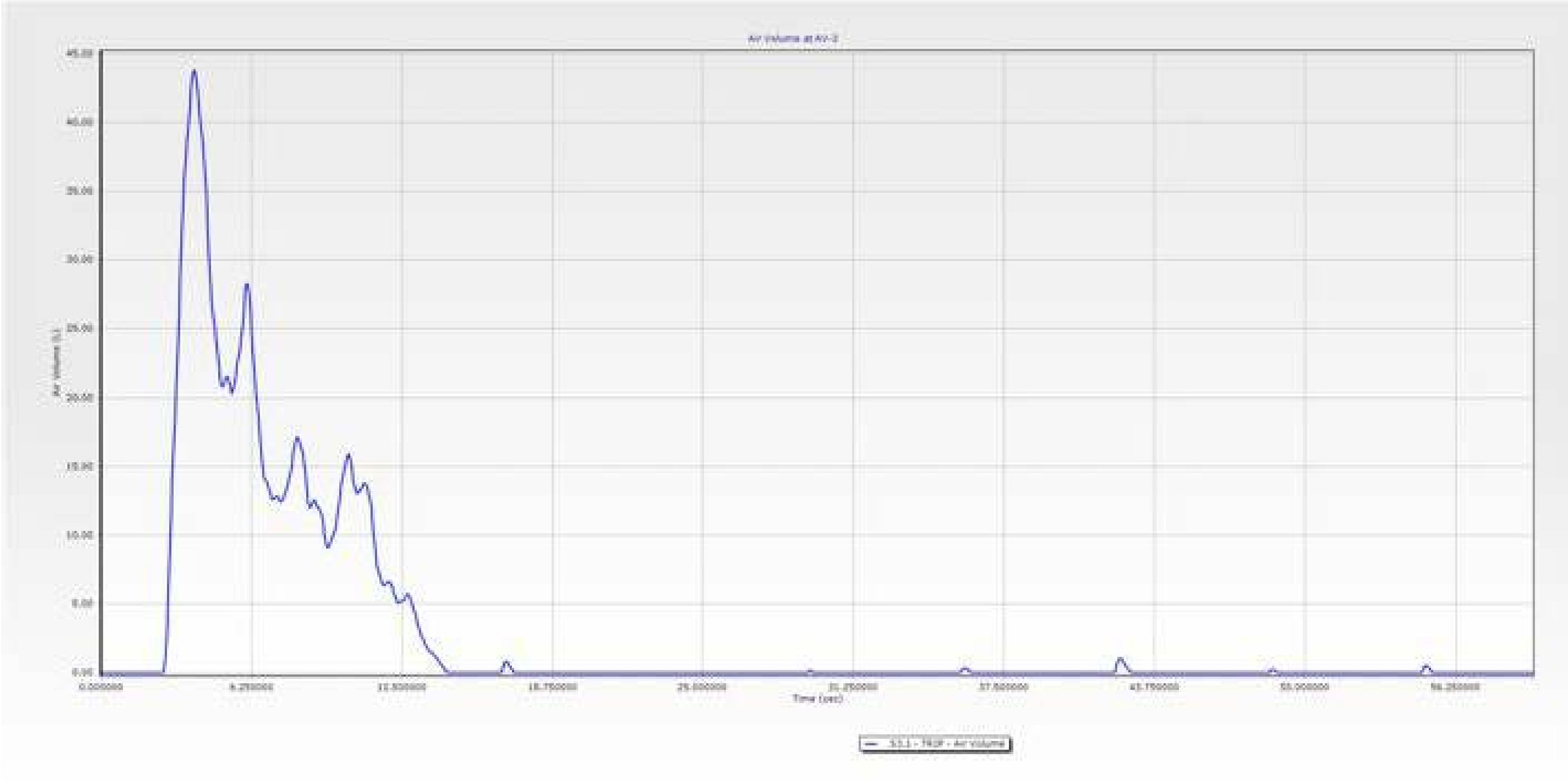


Figure 4-47: Scenario 3.1 – Air Volume Inside a Strategically Positioned Air Valve Along the New Pipeline

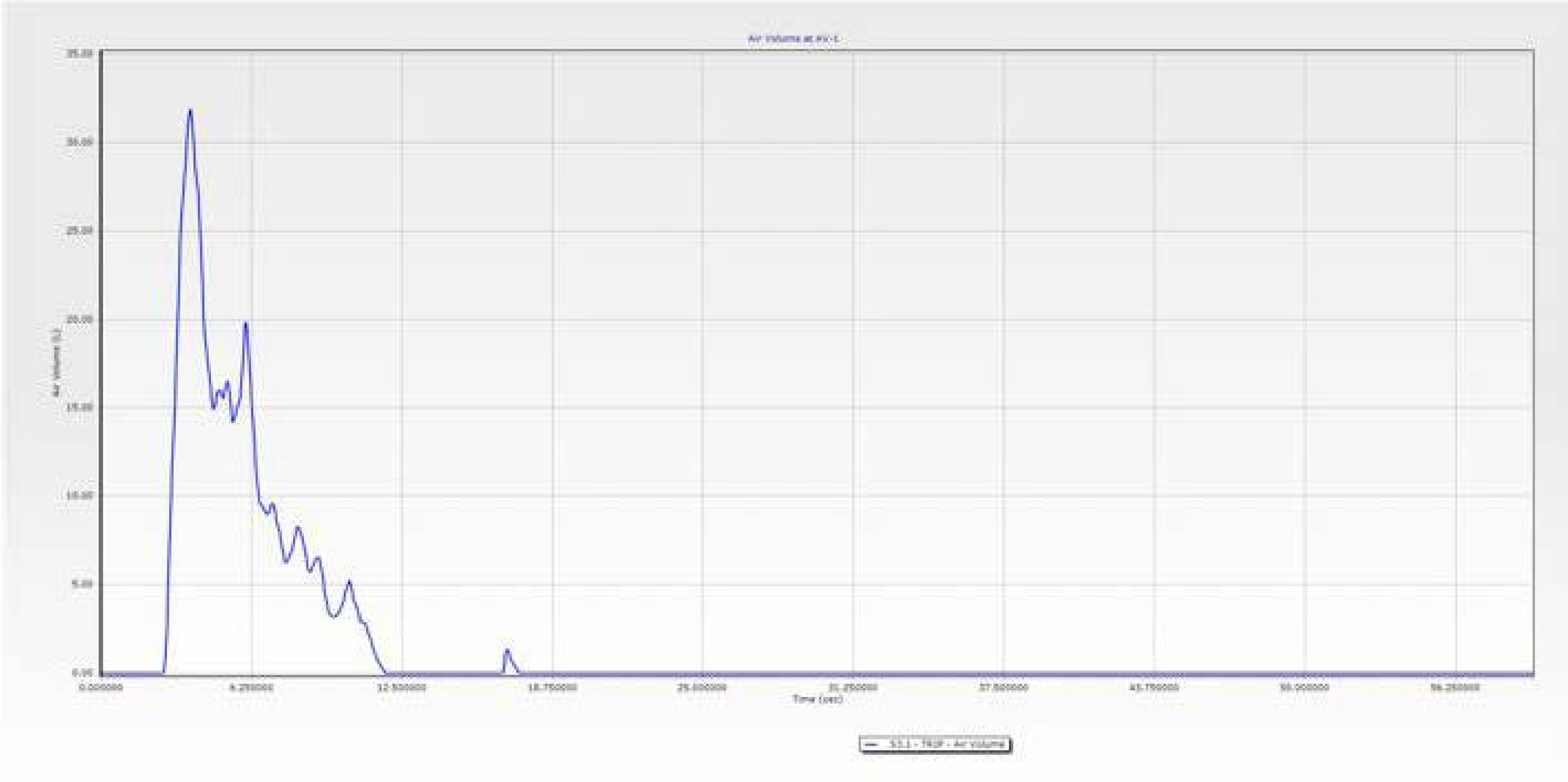


Figure 4-48: Scenario 3.1 – Air Volume Inside a Strategically Positioned Air Valve Along the Future Pipeline

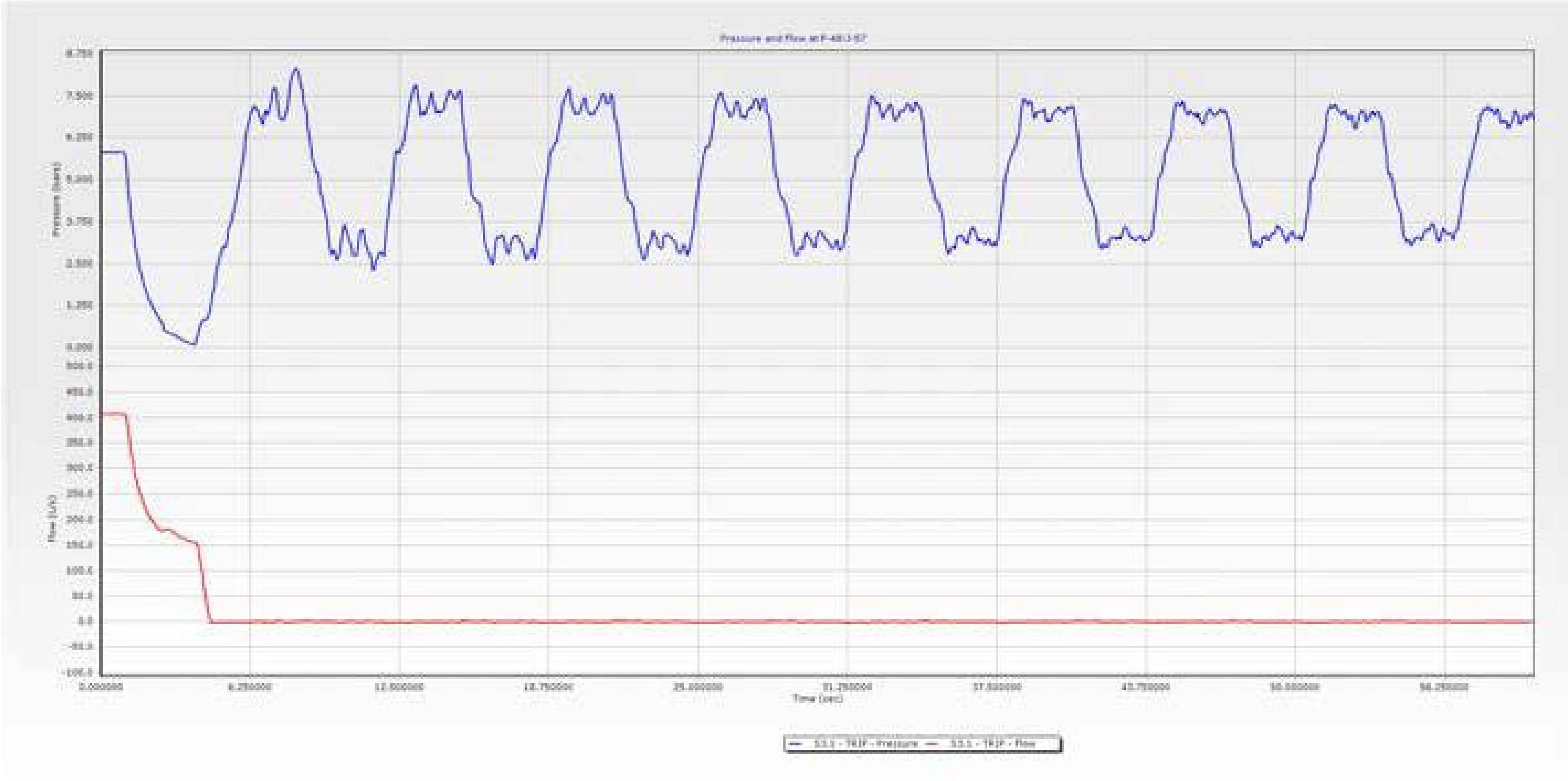


Figure 4-49: Scenario 3.1 – Pressure and Flow Directly Downstream of the Pump Station

(vi) Scenario 3.2, Ultimate Condition, Start

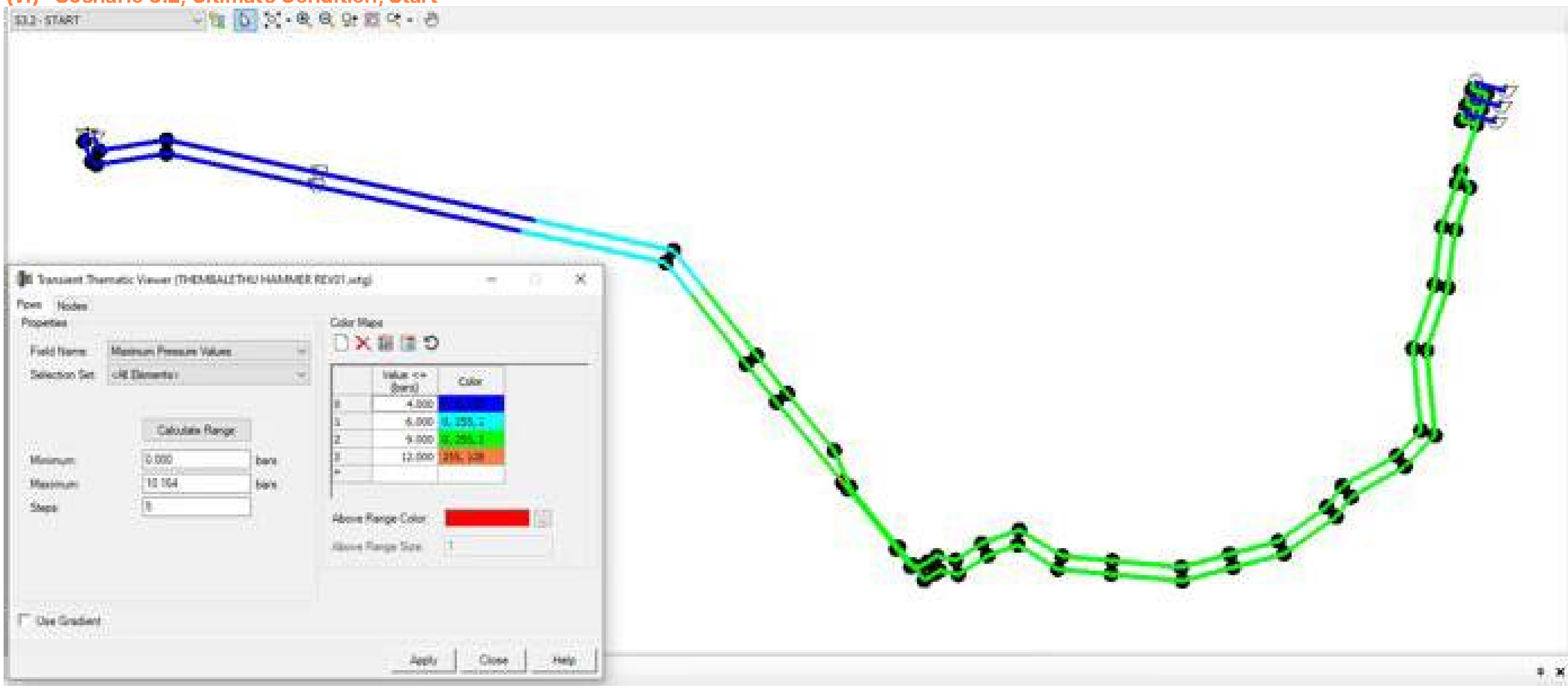


Figure 4-50: Scenario 3.2 – Maximum Water Hammer Pressure Values

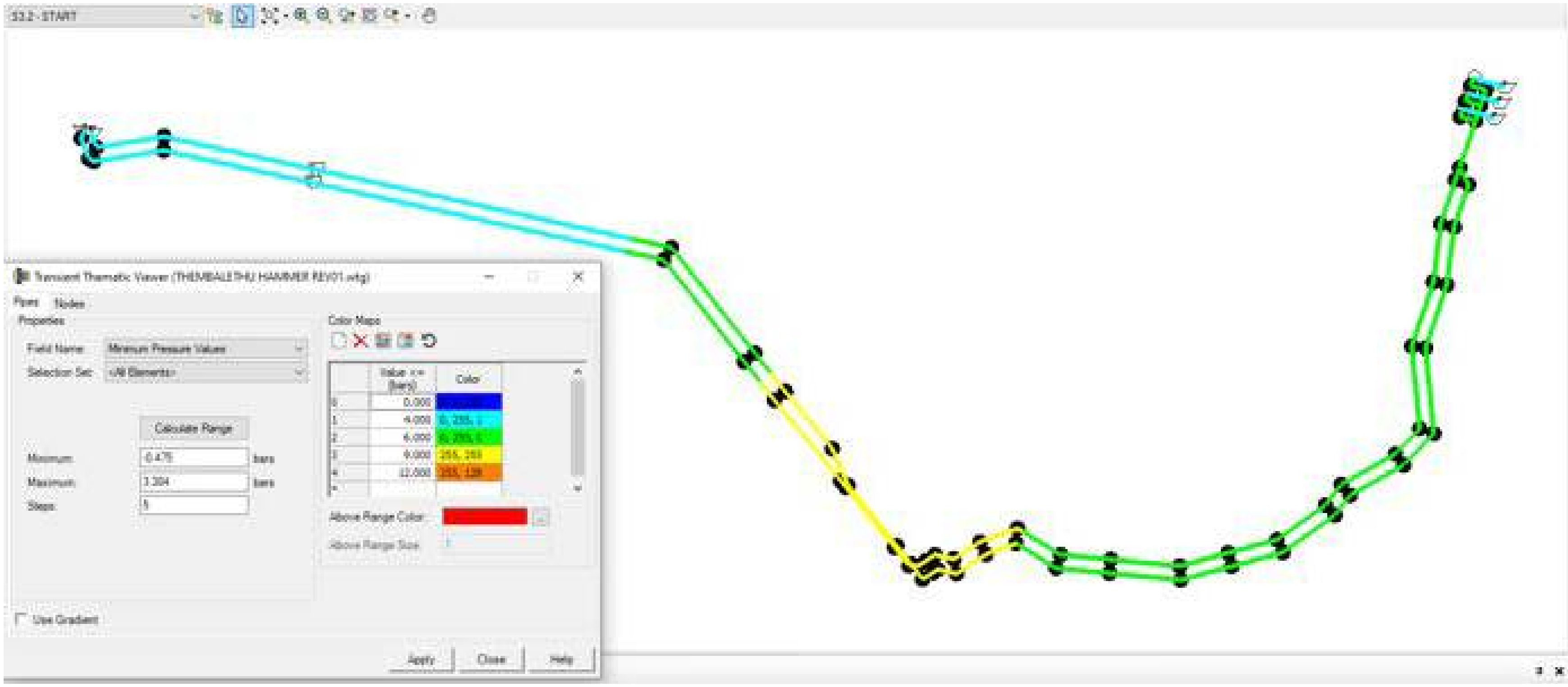


Figure 4-51: Scenario 3.2 – Minimum Water Hammer Pressure Values

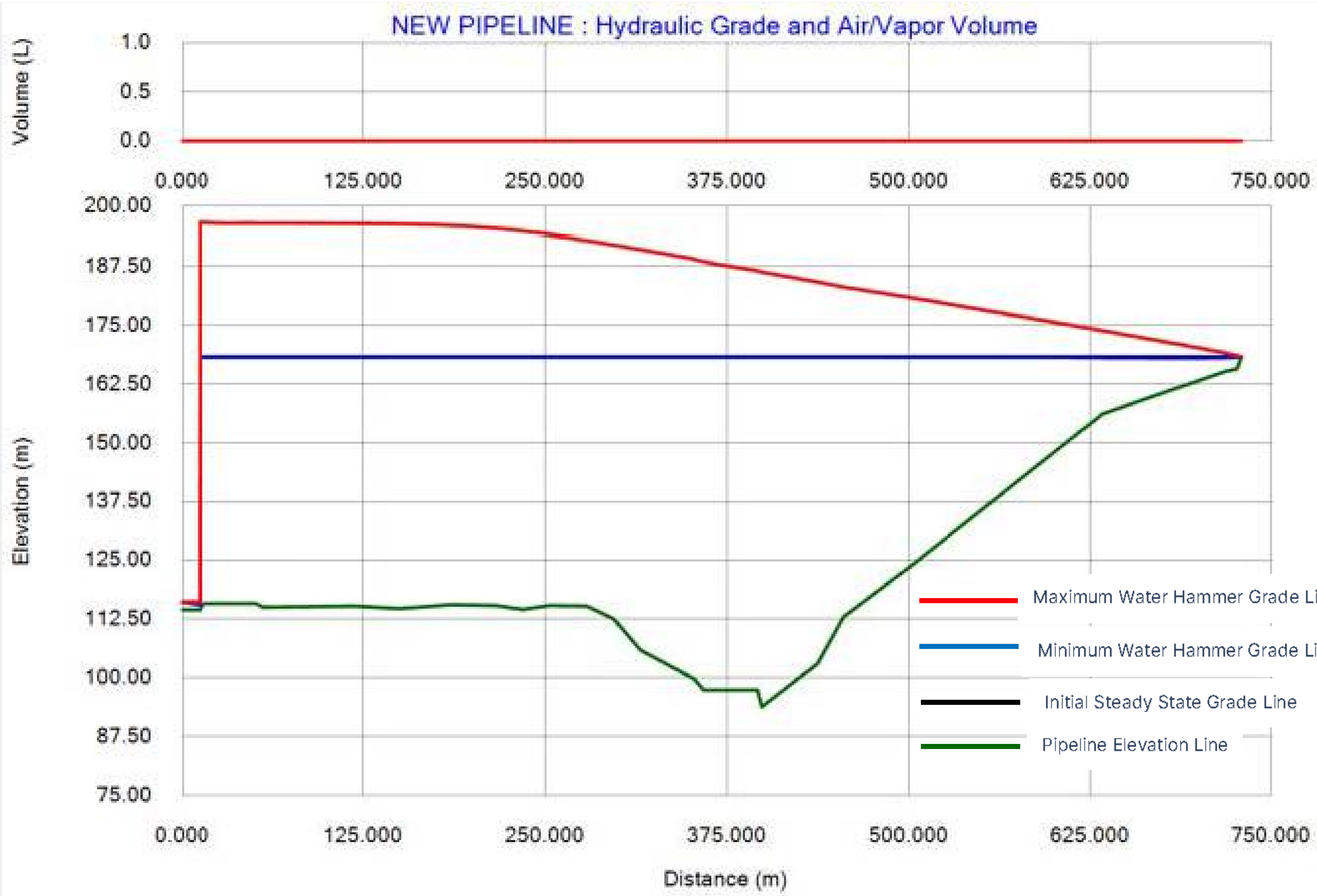


Figure 4-52: Scenario 3.2 – Maximum and Minimum Water Hammer Grade Line Envelopes Along the New Pipeline

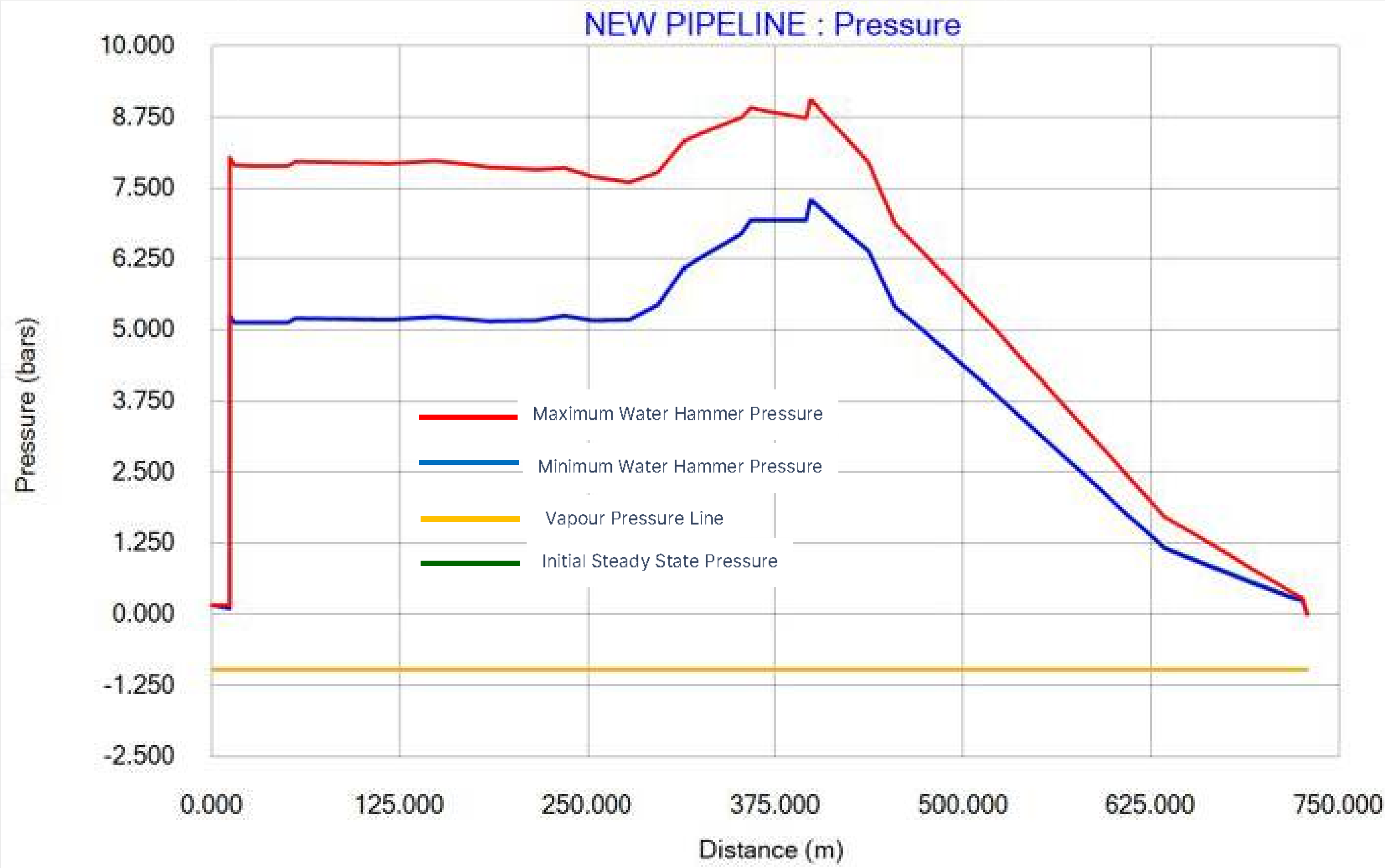


Figure 4-53: Scenario 3.2 – Maximum and Minimum Water Hammer Pressures Along the New Pipeline

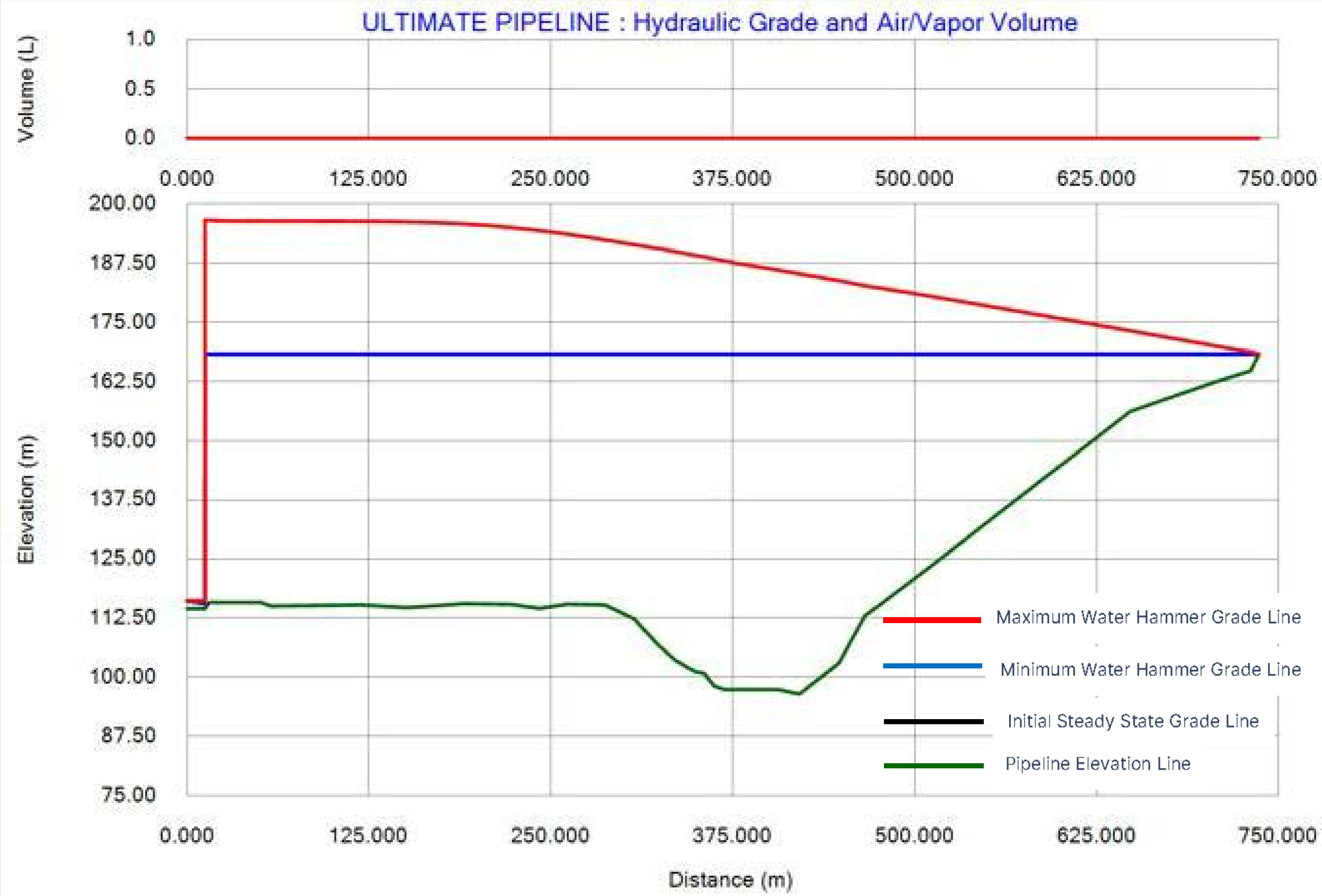


Figure 4-54: Scenario 3.2 – Maximum and Minimum Water Hammer Grade Line Envelopes Along the Future Pipeline

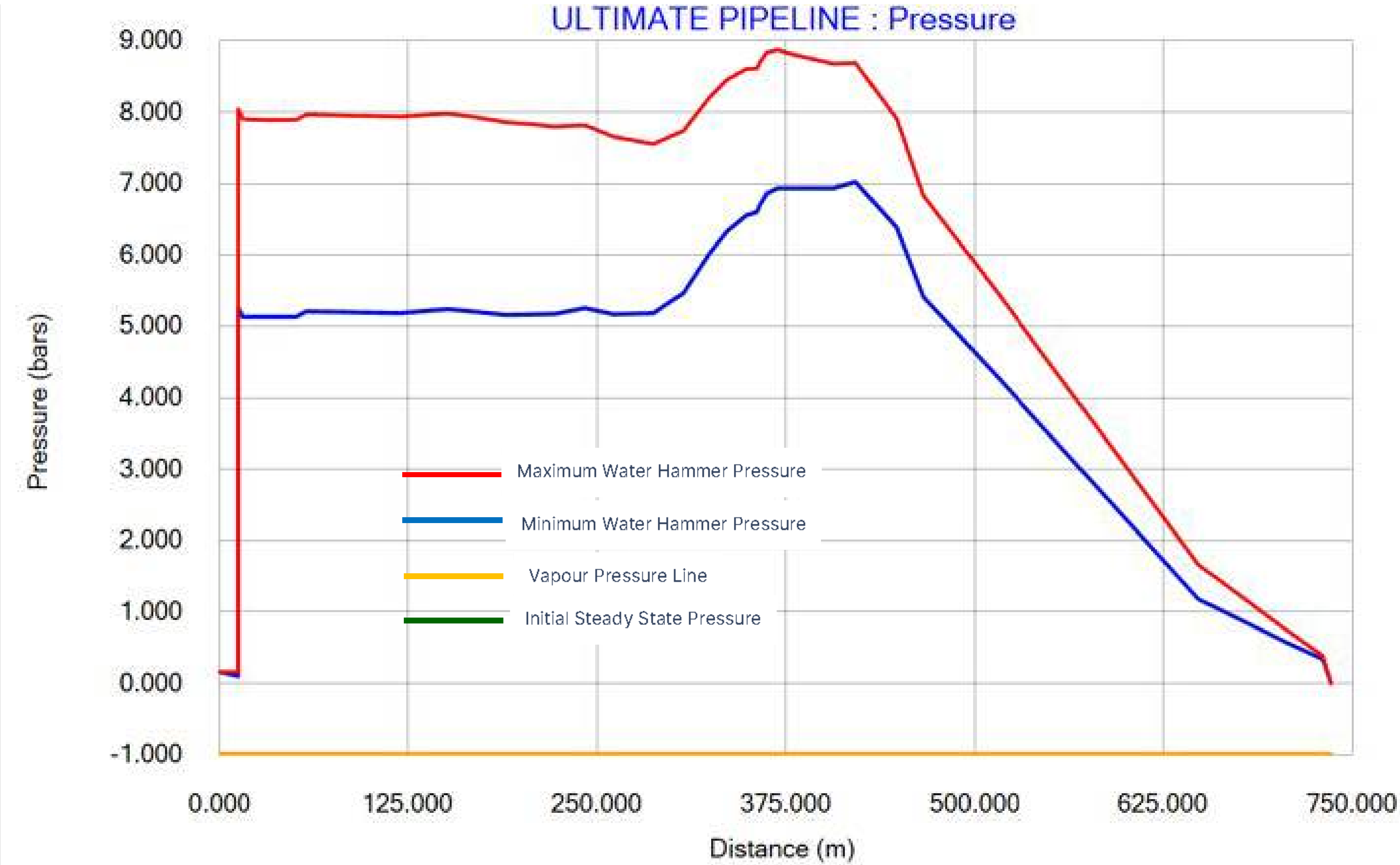


Figure 4-55: Scenario 3.2 – Maximum and Minimum Water Hammer Pressures Along the Future Pipeline

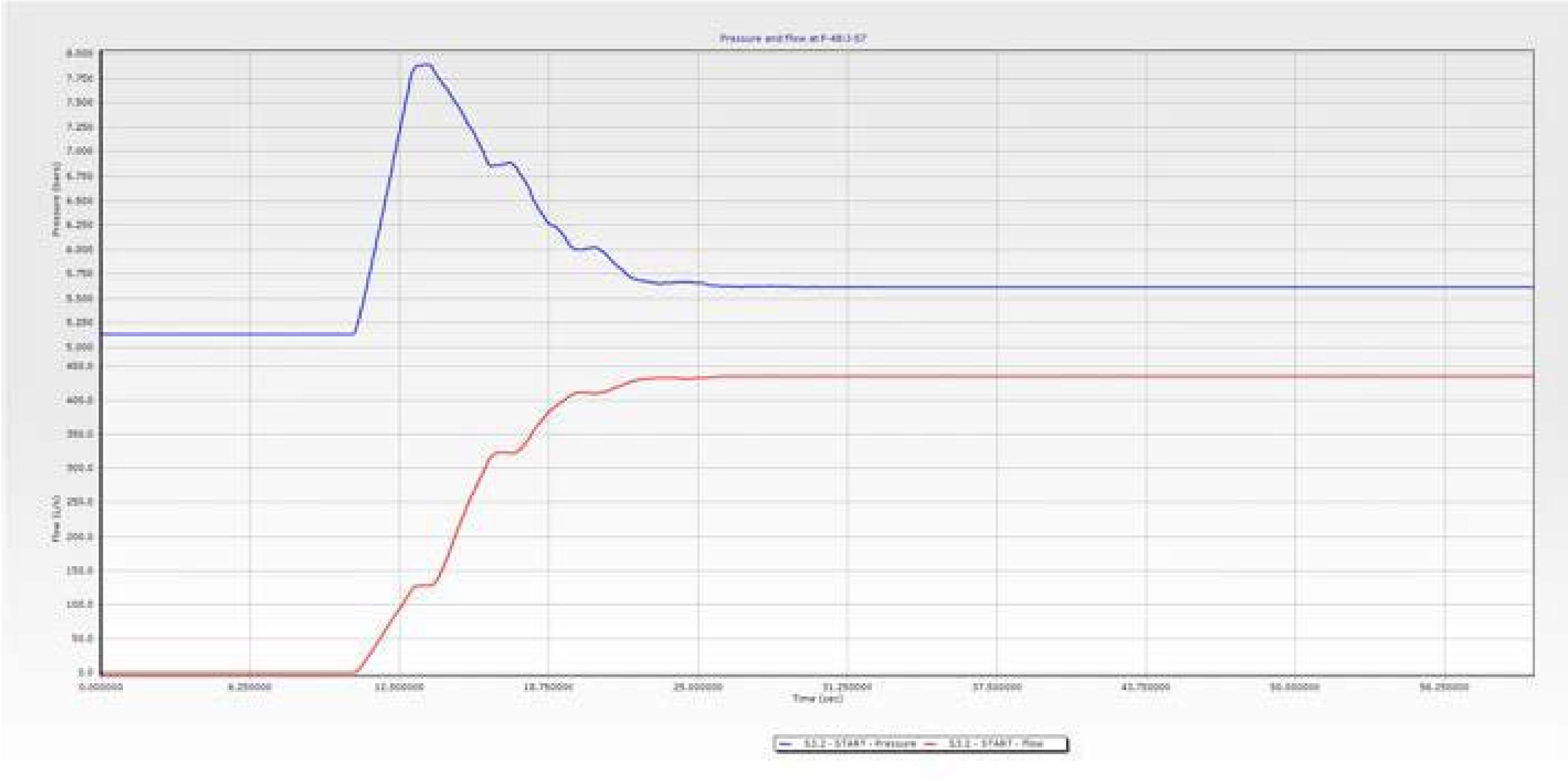


Figure 4-56: Scenario 3.2 – Pressure and Flow Directly Downstream of the Pump Station

(e) Conclusions

The system's maximum water hammer pressure will occur during a pump trip with the Ultimate Condition as the initial steady state condition. The maximum pressure will be 10 Bar at chainage 364 m (according to the drawings).

Furthermore, vapour conditions will occur when pumps trip for both the Design and Ultimate Condition. Vapour conditions will occur at chainage 601.8 m and elevation 156.2 m (according to the drawings). Vapour conditions are unacceptable because when vapour conditions develop, the water column 'breaks' and 'collapses' again when the water column reverses flow direction. This collapsing column results in cavitation and results in localised pressure spikes that could compromise the pipe's structural integrity.

(f) Recommendations

The following recommendations are made to alleviate maximum and minimum water hammer pressures:

1. For the Design Condition, two duty pumps must start simultaneously with a gradual increase in speed. The two pumps need to accelerate from 0 % speed to 90 % over a period of 10.8 s.
2. For the Ultimate Condition, three duty pumps must start simultaneously with a gradual increase in speed. The three pumps need to accelerate from 0 % speed to 100 % over a period of 12 s.
3. Both force mains require a strategically positioned air valves. The air valves need to be positioned at chainage 601.8 m with an elevation of 156.2 m. The air valves must be of a special type namely:
    a. Sewage type.
    b. Tripple acting type (incl. anti-slam orifice).
    c. Inclusive of a mechanism (for instance a spring) to keep the valve closed under low pressure (1.27 Bar) conditions during steady flow conditions.
    d. Intake orifice diameter size of at least 25 mm.
    e. Anti-slam orifice diameter size of at least 5 mm.

4.6 Design Specifications

The following Standardised Specifications shall generally apply to the design and construction of the collection system and general civil works:

SANS 1200A	General
SANS 1200C	Site Clearance
SANS 1200D	Earthworks
SANS 1200DB	Earthworks (Pipe trenches)
SANS 1200DK	Gabions and Pitching
SANS 1200DM	Earthworks (Roads, Sub grade)
SANS 1200G	Concrete
SANS 1200H	Structural Steel
SANS 1200HC	Coorosion protection for Structural Steelwork
SANS 1200L	Medium-Pressure Pipelines
SANS 1200LB	Bedding (Pipes)
SANS 1200LC	Cable Ducts
SANS 1200LD	Sewers
SANS 1200LE	Stormwater Draingage
SANS 1200M	Roads
SANS 1200ME	Subbase
SANS 1200MF	Base
SANS 1200MJ	Segmented Paving
SANS 1200MK	Kerbing and Channeling

4.6.1 Pipework and fittings

The following specifications shall generally apply to pipes and fittings:

- SANS 719 : Electric welded carbon steel pipes for aqueous fluids – large bore for pipelines and fittings exceeding 150 mm in diameter
- SANS 1123 : Pipe flanges
- SANS 664 : Cast iron gate valves for waterworks
- BS5155 : Butterfly valves
- SANS 16422 : Pipes and joints made of oriented unplasticized polyvinyl chloride (PVCO) for the conveyance of water under pressure.

The positions of air valves, scour valves, horizontal bends, vertical bends are indicated on the longitudinal sections. Details are indicated on separate plans in **Annexure A**

4.6.2 Associated Infrastructure

(a) Bulk earthworks and roads

1. Earthworks

The following design standards apply:

- South African Bureau of Standards (SANS)
- SANS 1200 for services (Water & sewer)
- TRH14 Guidelines for road construction materials
- TRH20 The structural design, construction and maintenance of unpaved roads

All platforms are to be free draining with no ponding. Surface drainage with open canals is the primary solution. Stormwater originating to be drained around and away from site

Subsurface drainage is the secondary solution. In areas where ponding cannot be eliminated, sub-surface drainage conduits are to be designed. Safety and ease of maintenance and operation are the main considerations.

2. Access Roads

The geometric design standards must be designed according to the TRH17 guidelines. The design standards for the roads are summarized in table 3 below.

Table 4-13:Summary of design standards for access roads

Description		Value
Width	Road width	5.0 m
Cross-fall	General cross-fall slope	2%
Surfacing	General surface (Base)	150mm G5 Base material compacted
	Grades above 14%	150mm Concrete surface with Mesh 193 reinforcement
	Sub-Base	• Grades above 14% - 200mm C4 stabilised material Compacted

The following design standards apply:

- South African Bureau of Standards (SANS)
- COLTO
- SANS 1200
- SATCC Code of Practice for the Design of Road Pavements
- SADC Roads and Bridge Design Standards and Specification;

- TRH4 - Structural Design of Flexible Pavements for Interurban and Rural Roads, COLTO;
- TRH14 Guidelines for road construction materials
- TRH20 The structural design, construction and maintenance of unpaved roads

1.1.1. Stormwater

The Road Drainage Manual published by the South African National Roads Agency is used in the design of all stormwater-related infrastructure.

(b) Thrust Blocks

The purpose of the thrust block is to support the bend and stop the pipe joints from being pulled apart causing a joint failure. The thrust block is part of the design to safely transit the unbalanced thrust forces to the undisturbed soil. As mentioned above, no thrust blocks will be designed for changes in the vertical profile due to changes in the direction being smaller than 10 degrees, but several thrust blocks are needed to support the pipe along with changes in the horizontal alignment of the new pipe.

The internal pressure of the pipe acts perpendicular to any plane with a force equal to the pressure, P, times the area of the pipe (using the internal pipe diameter). The thrust block design is based on the SANS 2001-DP2:2010 manual for medium-pressure pipelines.

The shape of the thrust block is designed as a trapezium with a height that is adequate to ensure the area required to withstand the thrust forces with a minimum thickness of 100mm around the pipe.

The concrete of the thrust blocks is Class 25/19 for all Bends and Tees.

4.6.3 Valves, Fittings and Specials

(a) Valve Chambers and Ancillary Equipment

The following design approach was followed for the various components:

- Reinforced brick and concrete valve chambers;
- Stainless-Steel of grade 316L pipework to SANS 719, Grade B – painted epoxy lined; high build polyurethane coated; and
- All valves and fittings shall be internally and externally coated with fusion-bonded epoxy.

(b) Scour Valves

The design of the rising main includes the provision of scour valves.

The scour assembly will be connected to the main pipe with an 500mm Scour T-Piece of stainless-steel flanged all ends.

Gate valves shall be of the RSV gate type, VOSA, Premier, or similar approved, double flanged with Ductile Iron bodies and stainless-steel trim and shall conform with all relevant sections of SANS 664 or BS 5163, specifications and subsequent amendments. Flanges shall be drilled to BS4504 or SANS 1123 for 16 bar working pressure as specified, and compatible with pipework flanges.

The gate shall be guided within the body of the valve to fit accurately onto the seat and to avoid possible buckling. Where extended spindles are required, they shall be suitably supported to prevent swaying and buckling and to guarantee the intended use of the valve. All gate valves shall be drop-tight when tested in accordance with the requirements of BS 5163.

All valves shall be capable of being operated manually with a maximum applied torque of 100Nm.

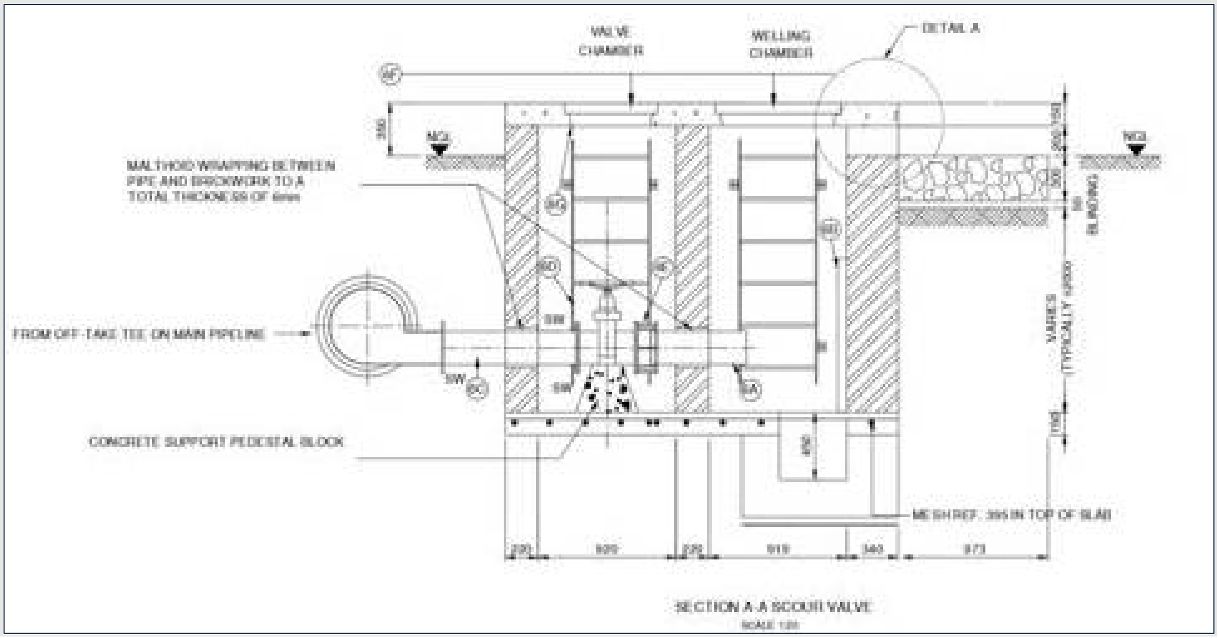


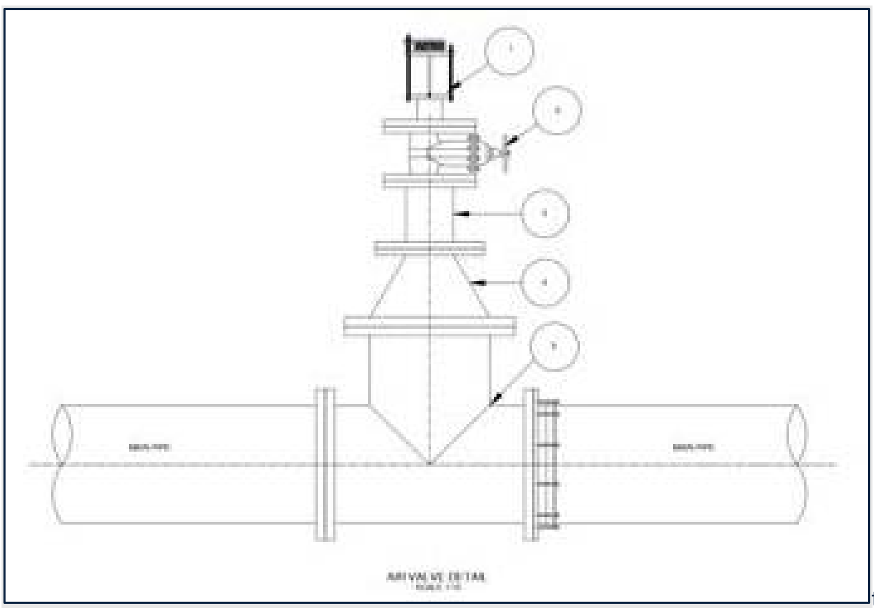
Figure 4-57: Scour assembly

The end piece will be fitted with a “Perrot” Coupling or similar approved. All other valves shall be provided with a cap top for use with a valve key.

(c) Air Valve

The design of the rising main includes the provision of air valves.

The air valve will be connected to the main pipe with an unequal 500mm T-Piece with a 300mm branch stainless-steel flanged fitting.



t

Figure 4-58: Airvalve assembly

In the chamber the following fittings will be accessible:

- Equal Tee-connection fitting
- Flanged Reducer (500 mm to 300 mm Reducer)
- Flanged Riser piece
- 150mm RSV Gate Valve
- 150mm Air Valve RGX
- 500 mm Flanged adaptor

Air release and vacuum break valves shall be double orifice with anti-shock orifice mechanism, of type "Vent-O-Mat Series RGX – Anti-Surge" or similar approved with flanged inlets and rated for a minimum of 16 bar working pressure as specified.

The valve shall have an integral surge alleviation mechanism which shall operate automatically to limit transient pressure rise or shock induced by closure due to high-velocity air discharge or the subsequent re-joining of separated water columns. The limitation of pressure rise must be achieved by deceleration of approaching water prior to valve closure.

The intake/discharge orifice area shall be equal to the nominal size of the valve. The inlet shall be fitted with an isolating valve with a vertical spindle, key operated from above.

(d) Non-Return Valves

Flanged multi-door check valve, Three piece design, multi-door, replaceable centre, lever arm and counterweight. Rapid closing times without slamming.

4.6.4 Control Assembly

A surge and flow control arrangement will be installed which will include Air relief valves, and surge anticipating valve arrangement, which is an off-line, hydraulically operated, diaphragm-actuated valves and flow control valve to arrange flow regime with the pipe to ensure design velocities are kept.

The surge anticipating valve , sensing line pressure, opens in response to the pressure drop associated with abrupt pump stoppage. The pre-opened valve dissipates the returning high-pressure wave, eliminating the surge. It smoothly closes drip tight as quickly as the relief feature allows while preventing a closing surge.

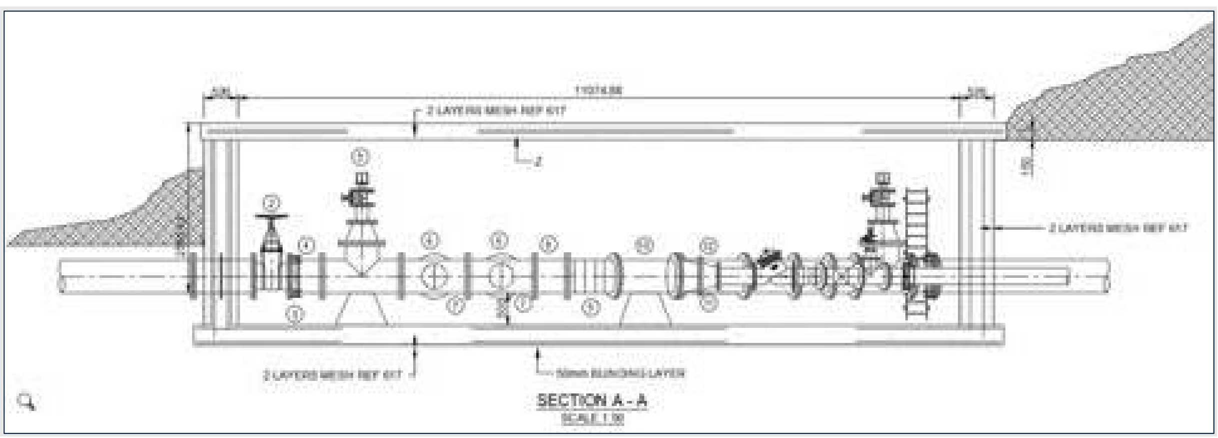


Figure 4-59: Control assembly section

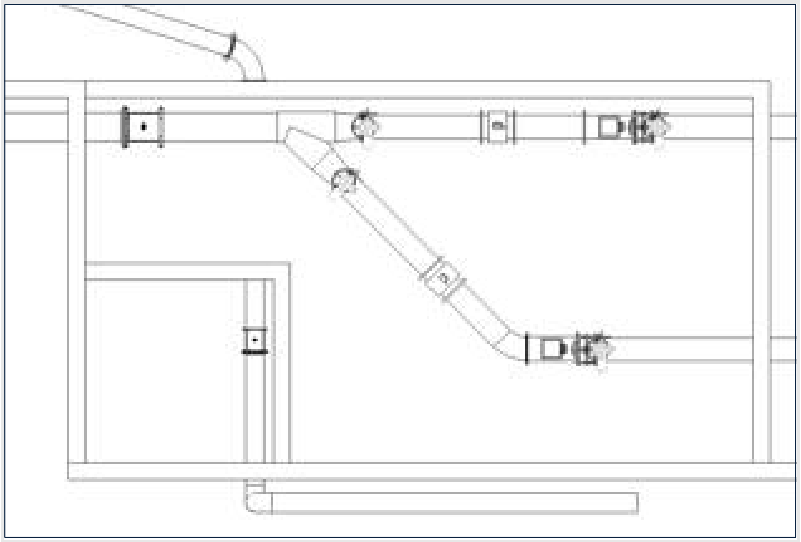


Figure 4-60: Control assembly

4.6.5 Corrosion Protection

All the fittings and couplings will be 316L Stainless-Steel FBE coated, or two-pack epoxy coated galvanised mild steel, epoxy-coated ensuring protection against corrosion. For sizes 400mm, plain-ended fabricated bends, equal tees, scour tees, reducing tees, reducers, flanged adaptors, end caps and saddles are available. These fittings are suitably protected against corrosion.

All joints shall be Stainless-Steel flanged and drilled to SABS 1123:1977 Table 1600/3. All joints shall be protected by rapping with Denso S43R23 WRAP.

5 Operation and Maintenance

5.1 Operational and Maintenance Requirements

The operation and maintenance requirements of the proposed schemes will be similar to the requirements of the existing water supply which is currently maintained by the Civil Engineering Services Directorate: Water and Sanitation Department of George Municipality.

5.2 Institutional Training Requirements

No specific institutional training is required as the project components are similar to existing infrastructure already being maintained by the Municipality.

5.3 Cost Recovery Plan

There is currently no cost recovery on this scheme. Operations and maintenance costs will be funded from their own funds.

6 Capital Cost Estimate

7 Conclusion and Recommendations

1. The George Municipality needs to upgrade the existing Thembalethu sewer pumpstation No. 6 and associated rising mainly due to it being overloaded and exceeding its capacity on a regular basis. The current capacity of the pumpstation is 60 ℓ/s and needs to be upgraded to cater for future flows for the next 20 years of 238 ℓ/s. In terms of the sanitation master plan of the George Municipality, further upgrades to the pumpstation will need to be carried out in the future to cater for the ultimate capacity of 400 ℓ/s as per the GMSMP.

2. The upgrades include the addition of a Ø400mm rising main, to be installed parallel to the existing Ø250mm rising main for rounded 710m from the control chamber at the pump stationAt a later date, a second Ø400mm rising main can be installed parallel to the newly proposed Ø400mm rising main. This can replace the existing Ø250mm rising main if George Municipality wishes to remove the existing Ø250mm rising main.The two rising mains will be used in conjunction in future to accommodate the 400 ℓ/s flow requirement. The layout of the pump station, therefore, was carefully considered to be compatible with both the current upgrades, as well as future planned upgrades.

3. The Environmental Impact Assessment (EIA) and Water Use License Application (WULA) were concluded in 2014 and the environmental authorisation is still valid and encompasses all the activities triggered. SMEC will incorporate the terms and conditions of the authorization in the design of the project.

4. The pump station was designed with the space allowance for 3 pumps to be installed initially (each with a 134 ℓ/s capacity) to meet the initial requirement of 238 ℓ/s with a standby pump; as well as allowing sufficient space to install an additional pump in the future to meet the final demand of 400 ℓ/s. This configuration will ensure that there is always standby availability for the pumps if any of the pumps have a failure or need maintenance. The pumps will be controlled with VSDs to reduce electrical load, minimize the transient events during normal operations and provide various flow regimes.

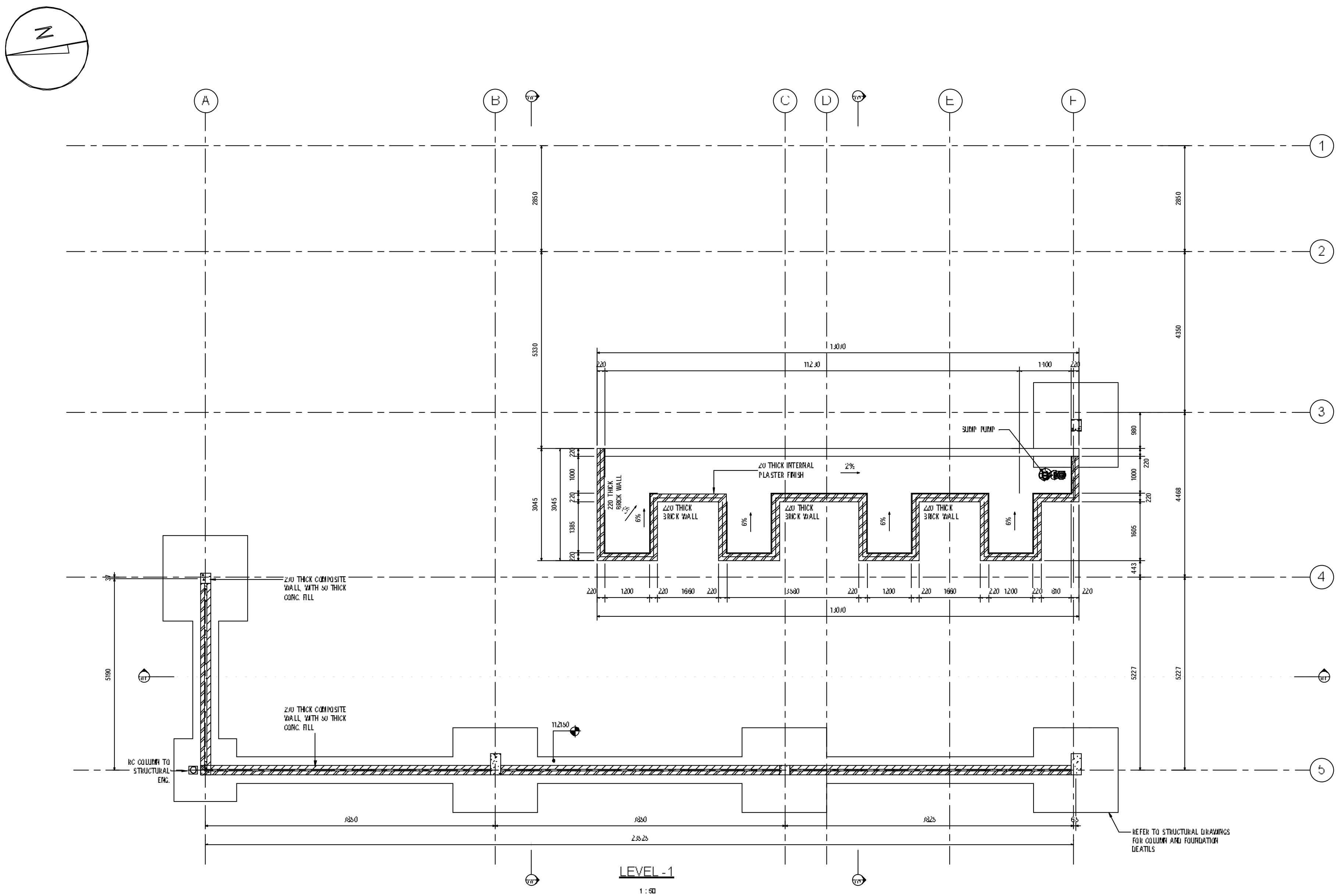
5. The additional electrical load requirements with the upgrading of the pumpstation required the electrical control, switchgear and backup power generation to be increased and upgraded. It is recommended that the spare 11kV feeder on the existing 3-way RMU be used to bring in an alternative supply to the pump station, in order to provide a redundant ring feed supply, thereby ensuring a more reliable source of bulk supply. It should be noted that an existing transformer is an oil-filled unit, which does pose a fire risk, especially when installed in a dedicated room (as is the current case). With open cable trenches, protruding to the other rooms, the risk of burning transformer oil being spread quickly throughout the entire building is a major fire hazard. For this reason, it is recommended that the new transformers be of the dry-type (vacuum pressure-impregnated cast-resin).

6. Based on the new pumps and associated equipment to be installed as part of the upgrade for each of the two (2) sumps, it is recommended that a dedicated new MCC be installed for each sump's equipment.

7. SMEC recommend that an **800 kVA generator (640 kW prime rated)** be considered instead of the 1.5MVa included in the initial scope of work as set out in the RFQ, as this would be a much better-suited rating for this specific application.

8. The alignment of the rising main will follow the alignments of the existing 250mm diameter pipeline crossing the existing pipe bridge where allowance has been made to discharge into the receiving manhole at the end of the upgrade route.

Annexure A **Pump Station Drawings**



LEVEL -1

1 : 50

PRELIMINARY

REV	DATE	AMENDMENT / REVISION DESCRIPTION	DRAWN BY	APPROVAL
2	03/10/2023	FOR TENDER	-	-
1	19/05/2023	DETAIL DESIGN	-	-

TITLE	NAME
DRAFTER	G. MAREDI
DRAFTING CHECK	G. WHALLEY
DESIGNER	S. FAUSTINO
DESIGN CHECK	G. WHALLEY
PROJECT MANAGER	T.CRONJE
PROJECT DIRECTOR	T.CRONJE

DRAWING APPROVED

ENGINEER: ....

PR. ENG NR: ....

SIGNATURE: ....

SCALES A - ON A1 SIZE DRAWING

SCALE 1:1

SCALE 1:50

SCALE 1:100

DESIGNER: SMEC South Africa — Member of the Surbana Jurong Group

SABS ISO 9001

CLIENT: GEORGE — THE CITY FOR ALL REASONS

GEORGE MUNICIPALITY

THEMBALETHU PUMP STATTION

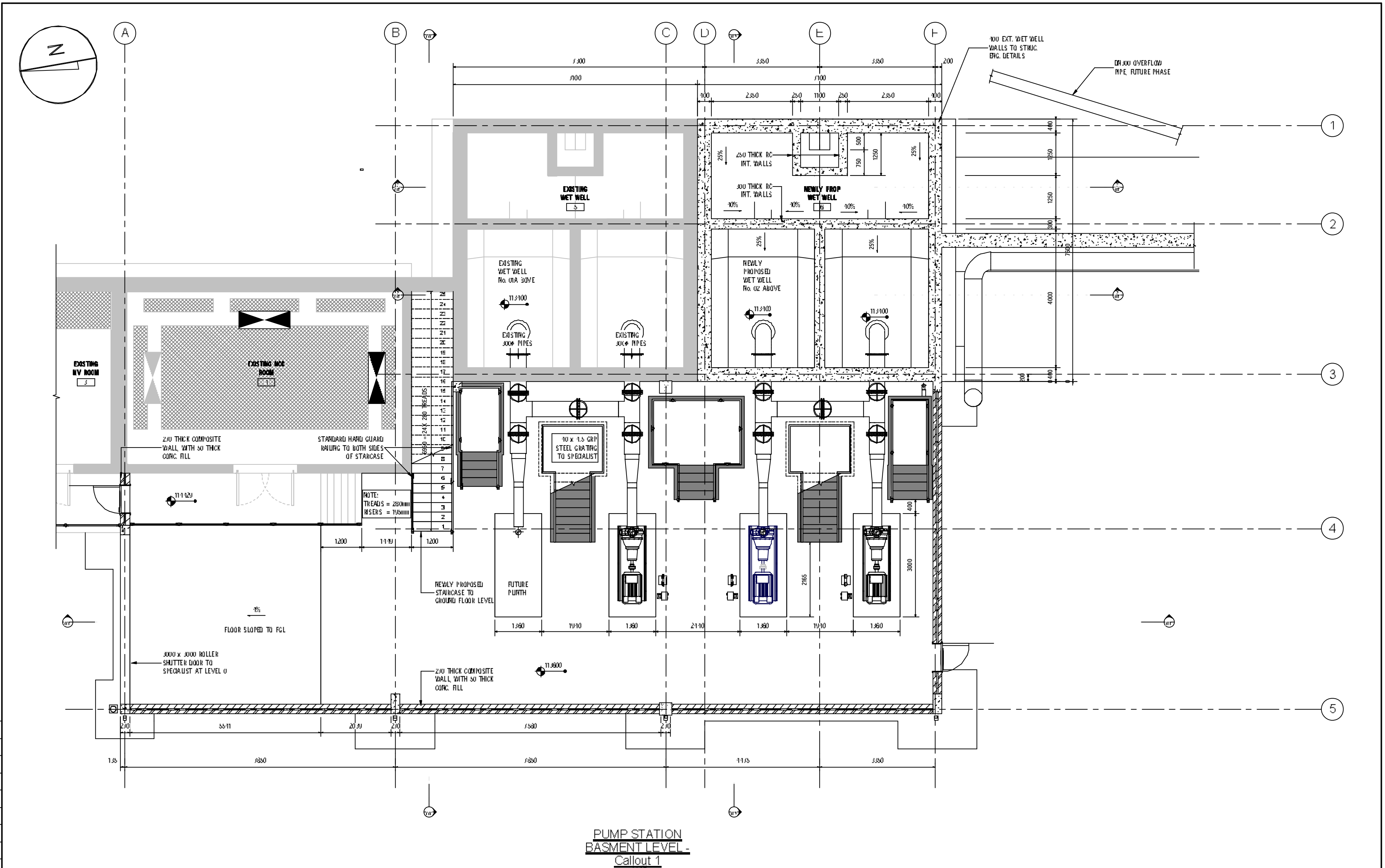
PLAN LAYOUT - LEVEL -1

PROJECT No.	PHASE	DRAWING NUMBER	REVISION
C1924	PS	003	2

A1 — 150 mm ON ORIGINAL

DRAWING FILE LOCATION / NAME

PLOT DATE TIME 2023/10/27 12:32:01



PRELIMINARY

REV	DATE	AMENDMENT / REVISION DESCRIPTION	SIGNATURE	APPROVAL
2	03/10/2023	FOR TENDER		
1	19/05/2023	DETAIL DESIGN		

TITLE	NAME
DRAFTER	G. MAREDI
DRAFTING CHECK	G. WHALLEY
DESIGNER	S. FAUSTINO
DESIGN CHECK	G. WHALLEY
PROJECT MANAGER	T.CRONJE
PROJECT DIRECTOR	T.CRONJE

DRAWING APPROVED

ENGINEER: ....

PR. ENG NR: ....

SIGNATURE: ....

SCALES / A1 SIZE DRAWING

SCALE 1:1

SCALE 1:50

SCALE 1:100

DESIGNER

SMEC South Africa

Member of the Surbana Jurong Group

SABS ISO 9001

CLIENT

GEORGE THE CITY FOR ALL REASONS

GEORGE MUNICIPALITY

THEMBALETHU PUMP STATTION

PLAN LAYOUT - BASEMENT

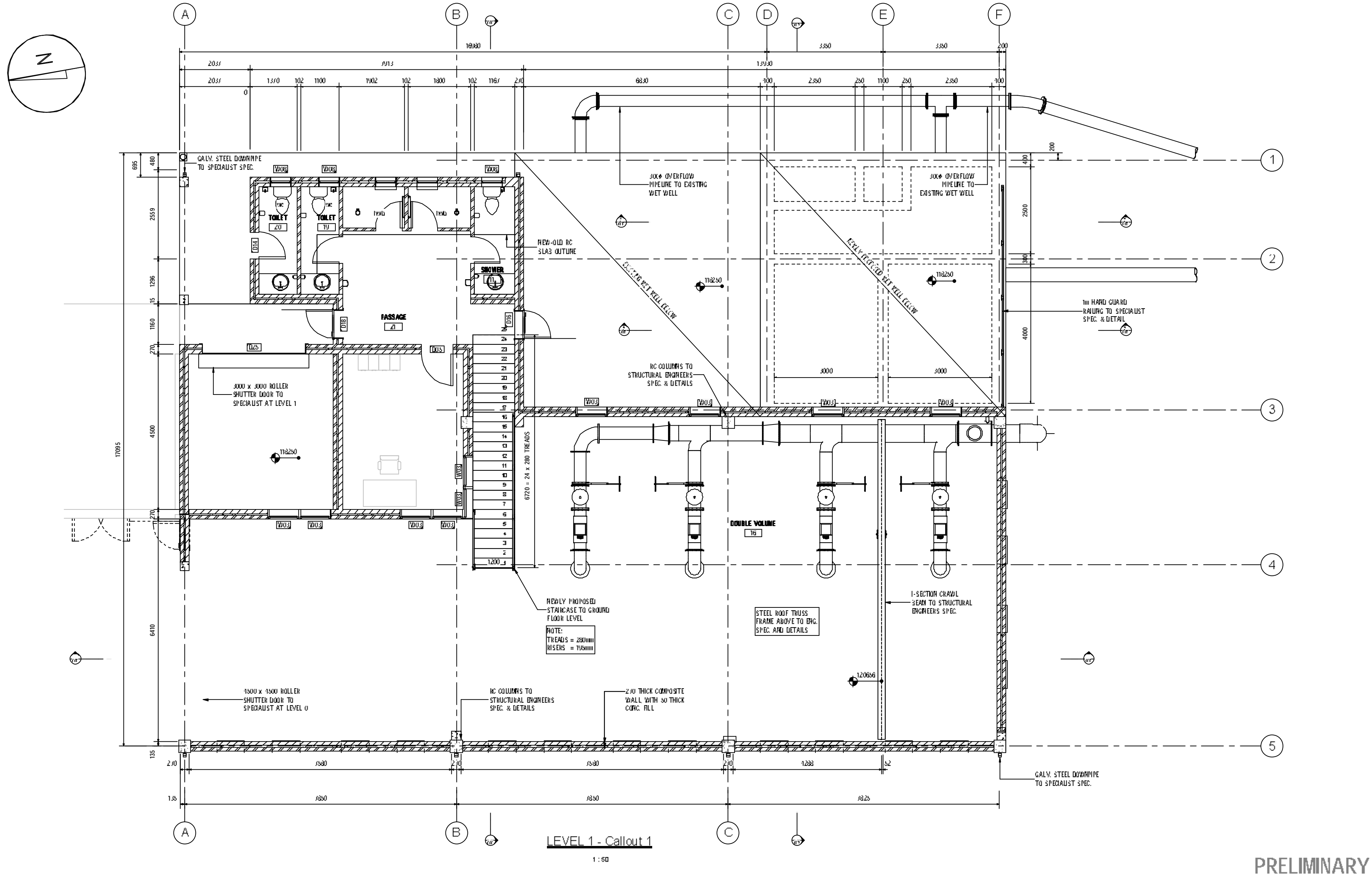
PROJECT NO.	PHASE	DRAWING NUMBER	REVISION
C1924	PS	004	2

PLOT DATE TIME 2023/10/27 12:33:35

DRAWING FILE LOCATION / NAME

150 mm ON ORIGINAL

A1



LEVEL 1 - Callout 1

1 : 50

PRELIMINARY

REV	DATE	AMENDMENT / REVISION DESCRIPTION
2	03/10/2023	FOR TENDER
1	19/05/2023	DETAIL DESIGN

TITLE	NAME
DRAFTER	G. MAREDI
DRAFTING CHECK	G. WHALLEY
DESIGNER	S. FAUSTINO
DESIGN CHECK	G. WHALLEY
PROJECT MANAGER	T.CRONJE
PROJECT DIRECTOR	T.CRONJE

DRAWING APPROVED

ENGINEER: ....

PR ENG NR: ....

SIGNATURE: ....

SCALE 1:1 / SCALE 1:50 / SCALE 1:100

DESIGNER: SMEC South Africa — Member of the Surbana Jurong Group; SABS ISO 9001

CLIENT: GEORGE — THE CITY FOR ALL REASONS

GEORGE MUNICIPALITY

THEMBALETHU PUMP STATTION

PLAN LAYOUT - LEVEL 1 DETAIL

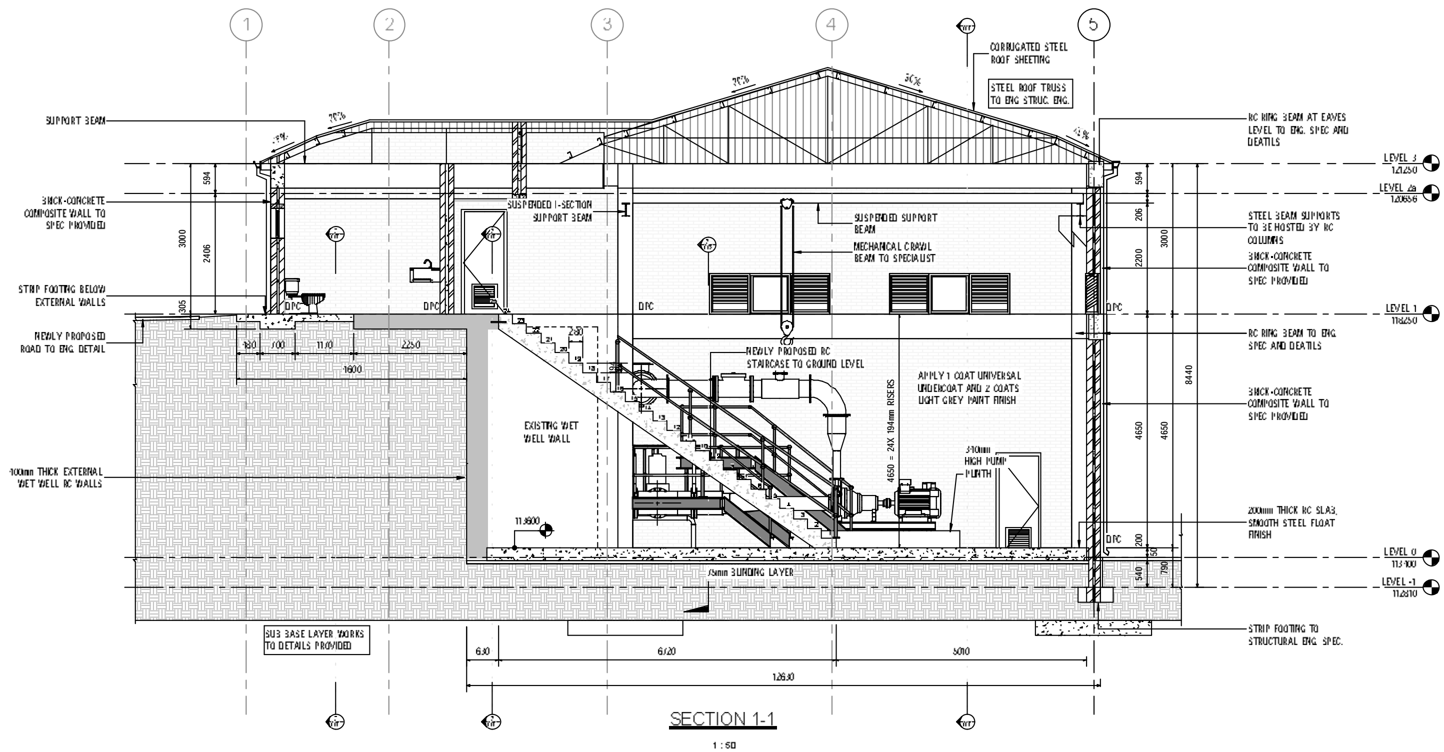
PROJECT No.	PHASE	DRAWING NUMBER	REVISION
C1924	PS	005	2

PLOT DATE TIME 2023/10/27 12:37:20

DRAWING FILE LOCATION / NAME

150 mm ON ORIGINAL

A1



SECTION 1-1

1 : 50

PRELIMINARY

REV	DATE	AMENDMENT / REVISION DESCRIPTION
2	03/10/2023	FOR TENDER
1	19/05/2023	DETAIL DESIGN

TITLE	NAME
DRAFTER	G. MAREDI
DRAFTING CHECK	G. WHALLEY
DESIGNER	S. FAUSTINO
DESIGN CHECK	G. WHALLEY
PROJECT MANAGER	T.CRONJE
PROJECT DIRECTOR	T.CRONJE

DRAWING APPROVED

ENGINEER: ....

PR ENG NR: ....

SIGNATURE: ....

SCALE 1:1 SCALE 1:50 SCALE 1:100

DESIGNER: SMEC South Africa — Member of the Surbana Jurong Group

SABS ISO 9001

CLIENT: GEORGE — THE CITY FOR ALL REASONS

GEORGE MUNICIPALITY

THEMBALETHU PUMP STATTION

PUMP STATION SECTION 1-1

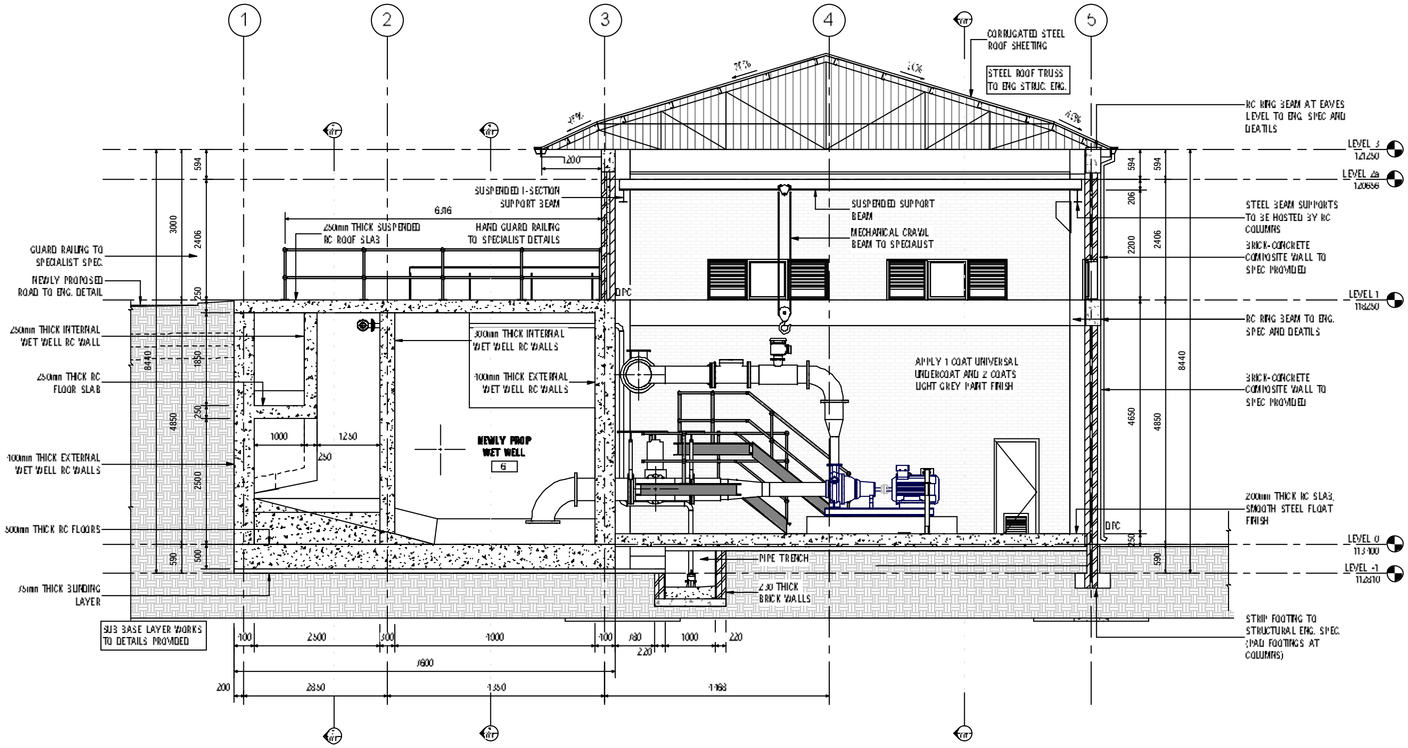
PROJECT NO.	PHASE	DRAWING NUMBER	REVISION
C1924	PS	006	2

PLOT DATE TIME 2023/10/27 12:38:19

DRAWING FILE LOCATION / NAME

150 mm ON ORIGINAL

A1



SECTION 2-2

1 : 50

PRELIMINARY

REV	DATE	AMENDMENT / REVISION DESCRIPTION	INITIALS	APPROVAL
2			-	-
1			-	-

TITLE	NAME
DRAFTER	G. MAREDI
DRAFTING CHECK	G. WHALLEY
DESIGNER	S. FAUSTINO
DESIGN CHECK	G. WHALLEY
PROJECT MANAGER	T.CRONJE
PROJECT DIRECTOR	T.CRONJE

DRAWING APPROVED

ENGINEER: ....

PR ENG NR: ....

SIGNATURE: ....

SCALES - AT A1 SIZE DRAWING

SCALE 1:1

SCALE 1:50

SCALE 1:100

DESIGNER

SMEC South Africa
Member of the Surbana Jurong Group

SABS ISO 9001

CLIENT

GEORGE THE CITY FOR ALL REASONS

GEORGE MUNICIPALITY

THEMBALETHU PUMP STATTION

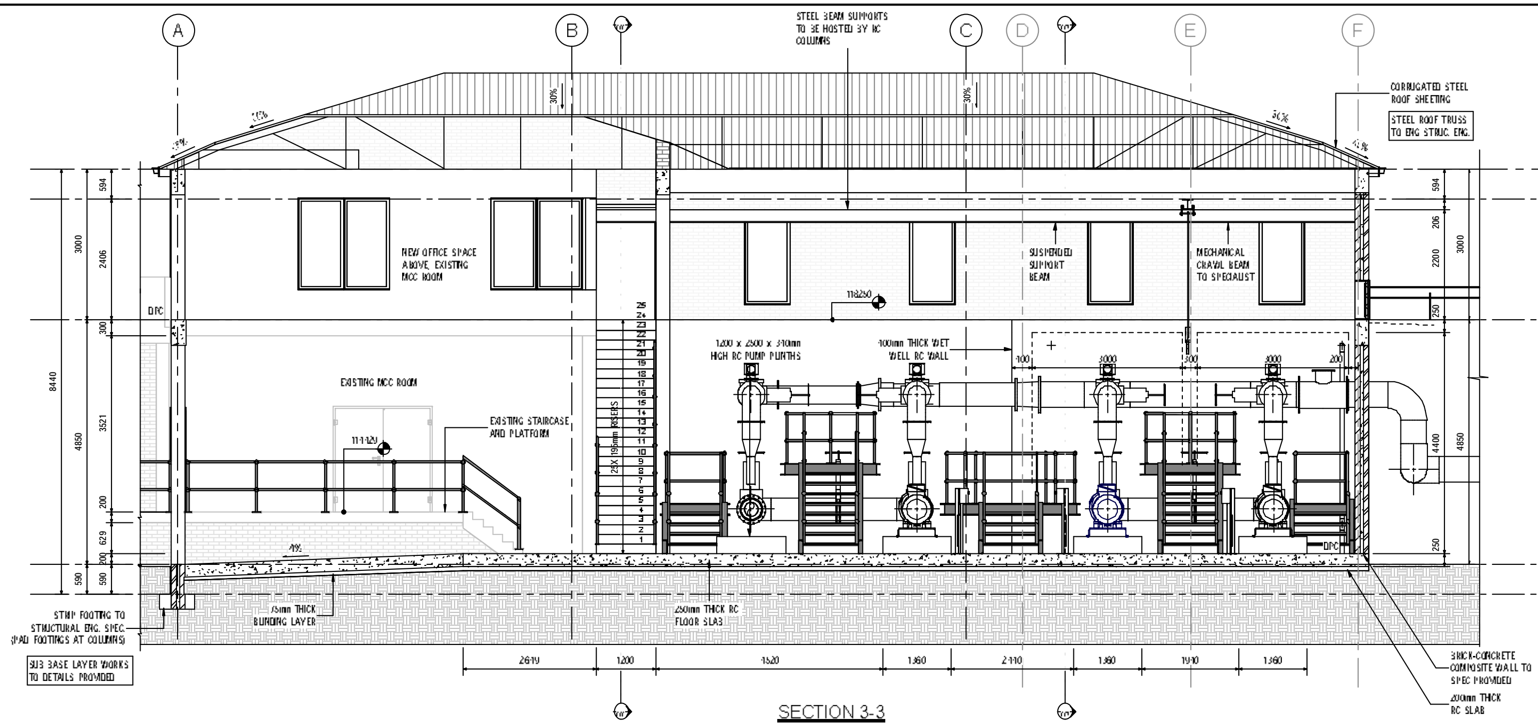
PUMP STATION SECTION 2-2

PROJECT NO.	PHASE	DRAWING NUMBER	REVISION
C1924		007	

A1 150 mm ON ORIGINAL

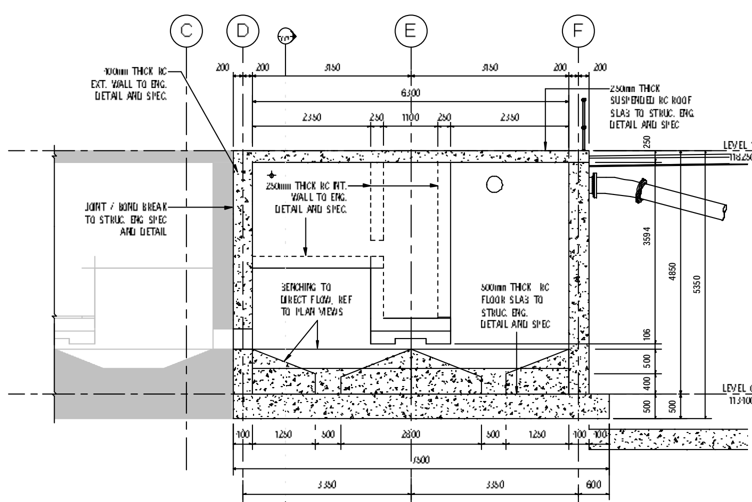
DRAWING FILE LOCATION / NAME

PLOT DATE TIME 2023/10/27 12:39:01



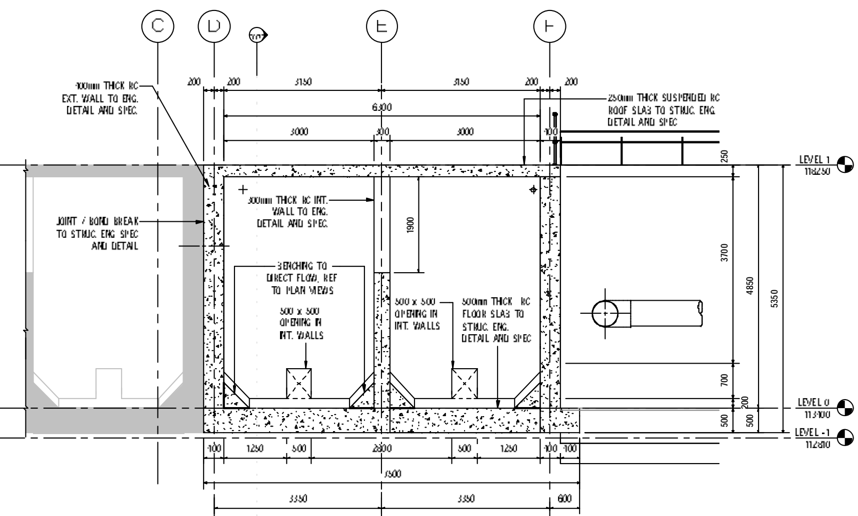
SECTION 3-3

1 : 50



SECTION 4-4

1 : 50



SECTION 5-5

1 : 50

PRELIMINARY

REV	DATE	AMENDMENT / REVISION DESCRIPTION	INITIAL	APPROVAL
2	03/10/2023	FOR TENDER	-	-
1	19/05/2023	DETAIL DESIGN	-	-

TITLE	NAME
DRAFTER	G. MAREDI
DRAFTING CHECK	G. WHALLEY
DESIGNER	S. FAUSTINO
DESIGN CHECK	G. WHALLEY
PROJECT MANAGER	T.CRONJE
PROJECT DIRECTOR	T.CRONJE

DRAWING APPROVED
ENGINEER: ....
PR ENG NR: ....
SIGNATURE: ....

SCALES AT A1 SIZE DRAWING
SCALE 1:1
SCALE 1:50
SCALE 1:100

DESIGNER
SMEC South Africa
Member of the Surbana Jurong Group
SABS ISO 9001

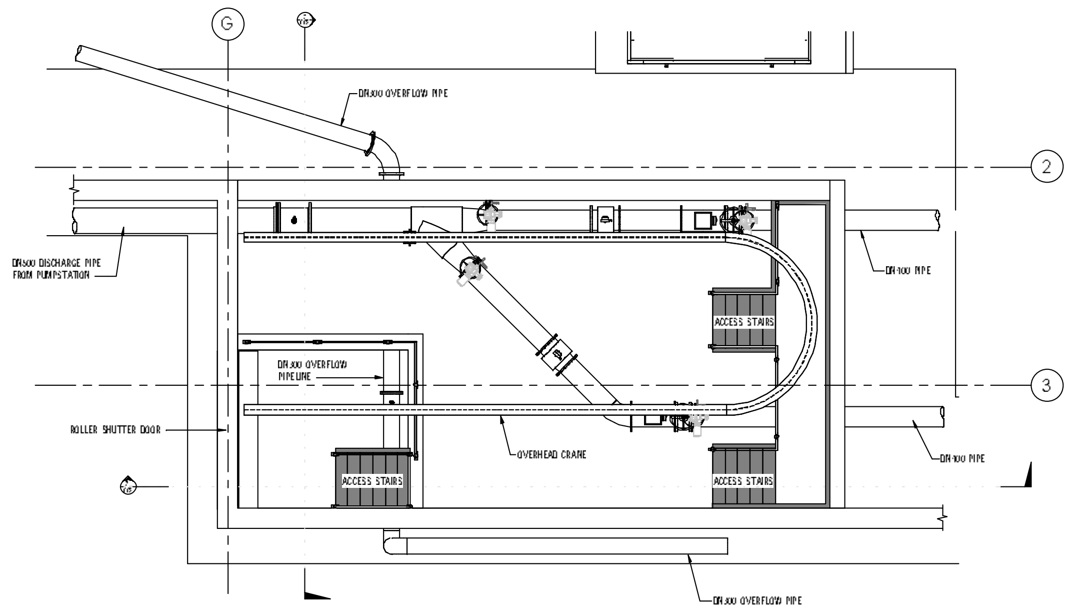
CLIENT
GEORGE THE CITY FOR ALL REASONS

GEORGE MUNICIPALITY
THEMBALETHU PUMP STATTION

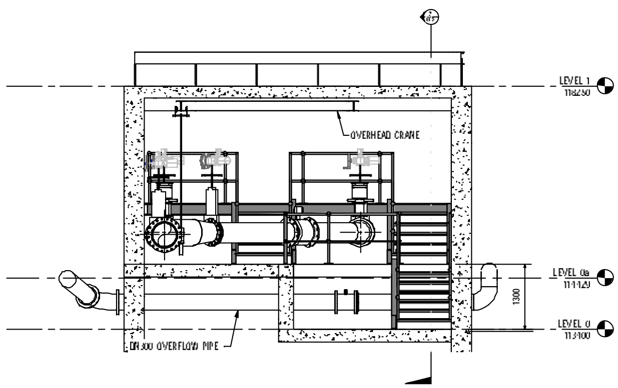
PUMP STATION SECTION 3-3

PROJECT NO.	PHASE	DRAWING NUMBER	REVISION
C1924	PS	008	2

PLOT DATE TIME 2023/10/27 12:39:35
DRAWING FILE LOCATION / NAME
150 mm ON ORIGINAL
A1

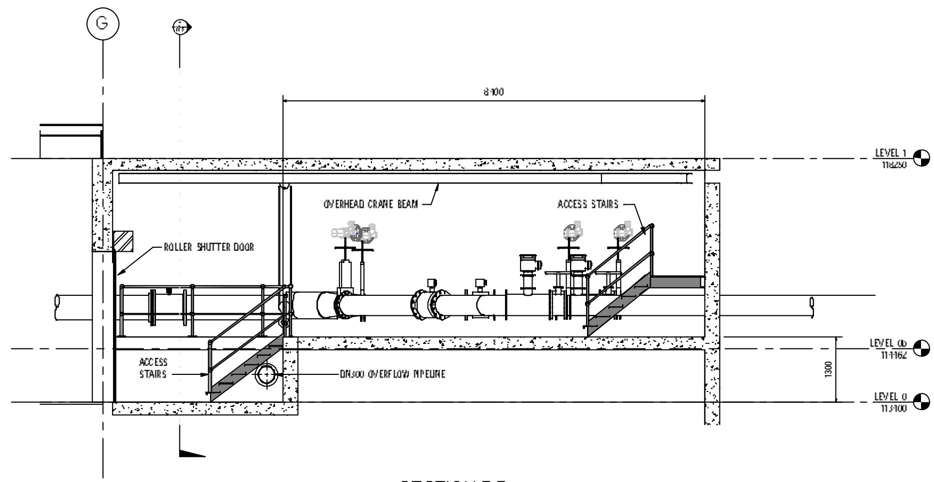


LEVEL 0 SITE PLAN
-FLOW METER
CHAMBER



SECTION 6-6

1 : 50



SECTION 7-7

1 : 50

PRELIMINARY

REV	DATE	AMENDMENT / REVISION DESCRIPTION		
2	03/10/2023	FOR TENDER		
1	19/05/2023	DETAIL DESIGN		

TITLE	NAME
DRAFTER	G. MAREDI
DRAFTING CHECK	G. WHALLEY
DESIGNER	S. FAUSTINO
DESIGN CHECK	G. WHALLEY
PROJECT MANAGER	T.CRONJE
PROJECT DIRECTOR	T.CRONJE

DRAWING APPROVED
ENGINEER: ....
PR. ENG NR: ....
SIGNATURE: ....

SCALE 1:1
SCALE 1:50
SCALE 1:100

DESIGNER: SMEC South Africa — Member of the Surbana Jurong Group
SABS ISO 9001

CLIENT: GEORGE — THE CITY FOR ALL REASONS

GEORGE MUNICIPALITY
THEMBALETHU PUMP STATTION

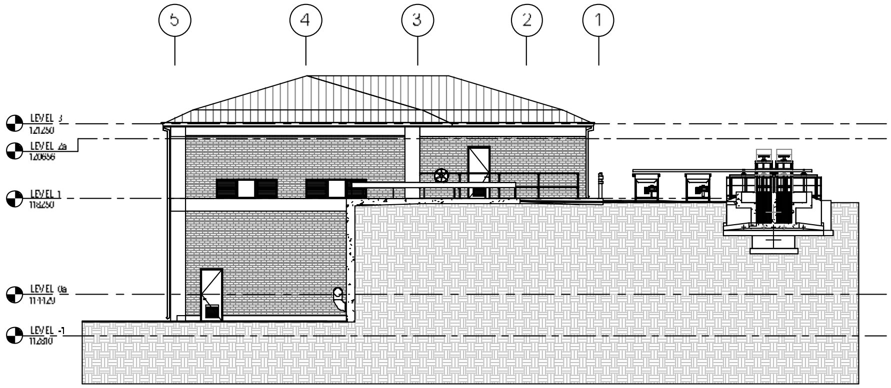
FLOW METER CHAMBER

PROJECT NO.	PHASE	DRAWING NUMBER	REVISION
C1924	PS	009	2

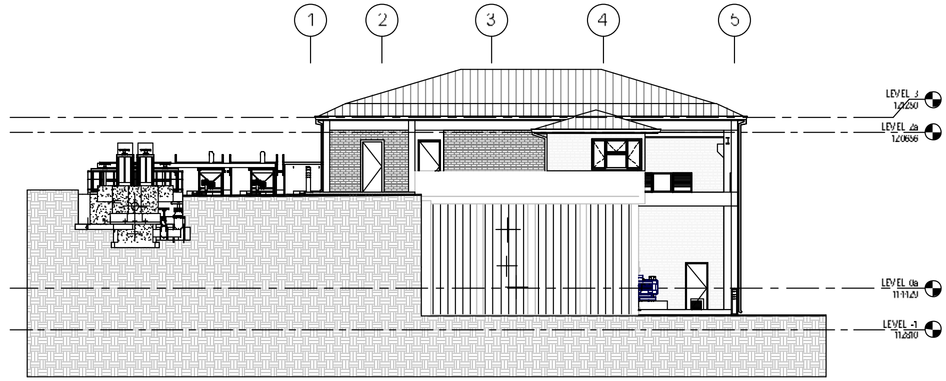
A1 150 mm ON ORIGINAL

PLOT DATE TIME 2023/10/27 12:40:44

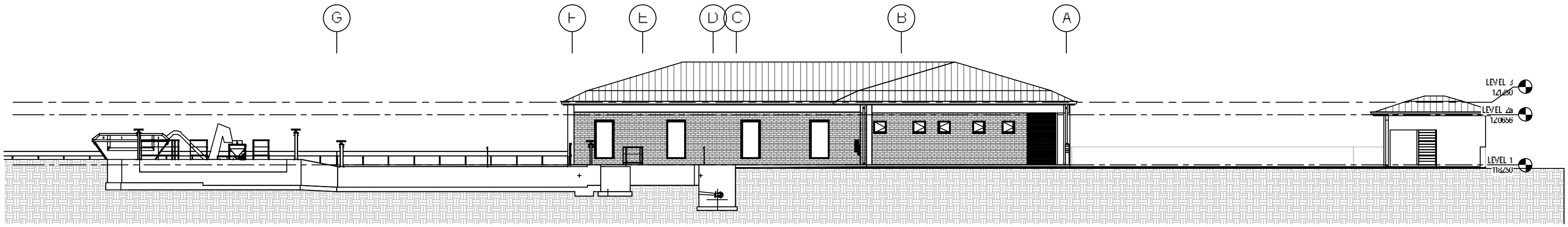
DRAWING FILE LOCATION / NAME



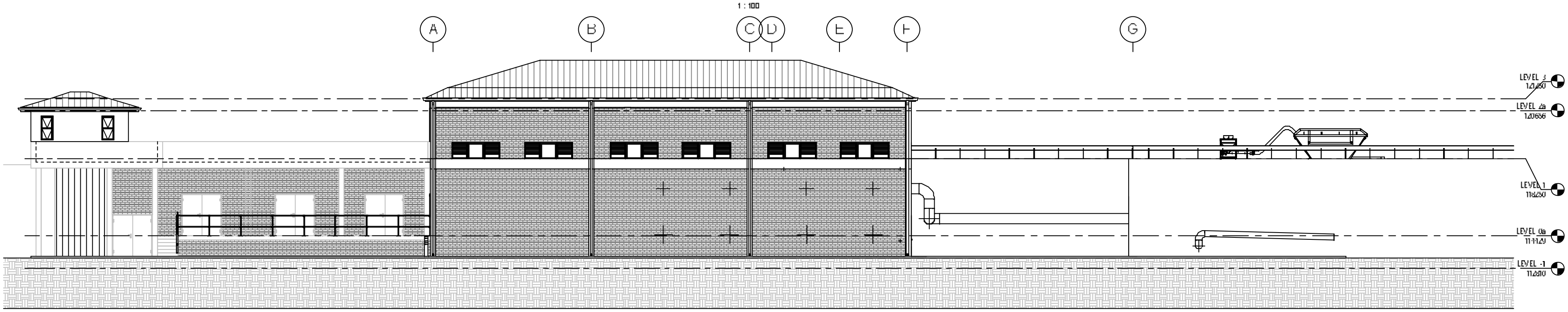
PUMP STATION EAST ELEVATION
1 : 100



PUMP STATION WEST ELEVATION
1 : 100



PUMP STATION NORTH ELEVATION
1 : 100



PUMP STATION SOUTH ELEVATION
1 : 100

PRELIMINARY

REV	DATE	AMENDMENT / REVISION DESCRIPTION	TITLE	NAME
2	03/10/2023	FOR TENDER	DRAFTER	G. MAREDI
1	19/05/2023	DETAIL DESIGN	DRAFTING CHECK	G. WHALLEY
			DESIGNER	S. FAUSTINO
			DESIGN CHECK	G. WHALLEY
			PROJECT MANAGER	T.CRONJE
			PROJECT DIRECTOR	T.CRONJE

DRAWING APPROVED
ENGINEER: ....
PR ENG NR: ....
SIGNATURE: ....

SCALES AT A1 SIZE DRAWING
SCALE 1:1
SCALE 1:50
SCALE 1:100

DESIGNER: SMEC South Africa — Member of the Surbana Jurong Group
SABS ISO 9001

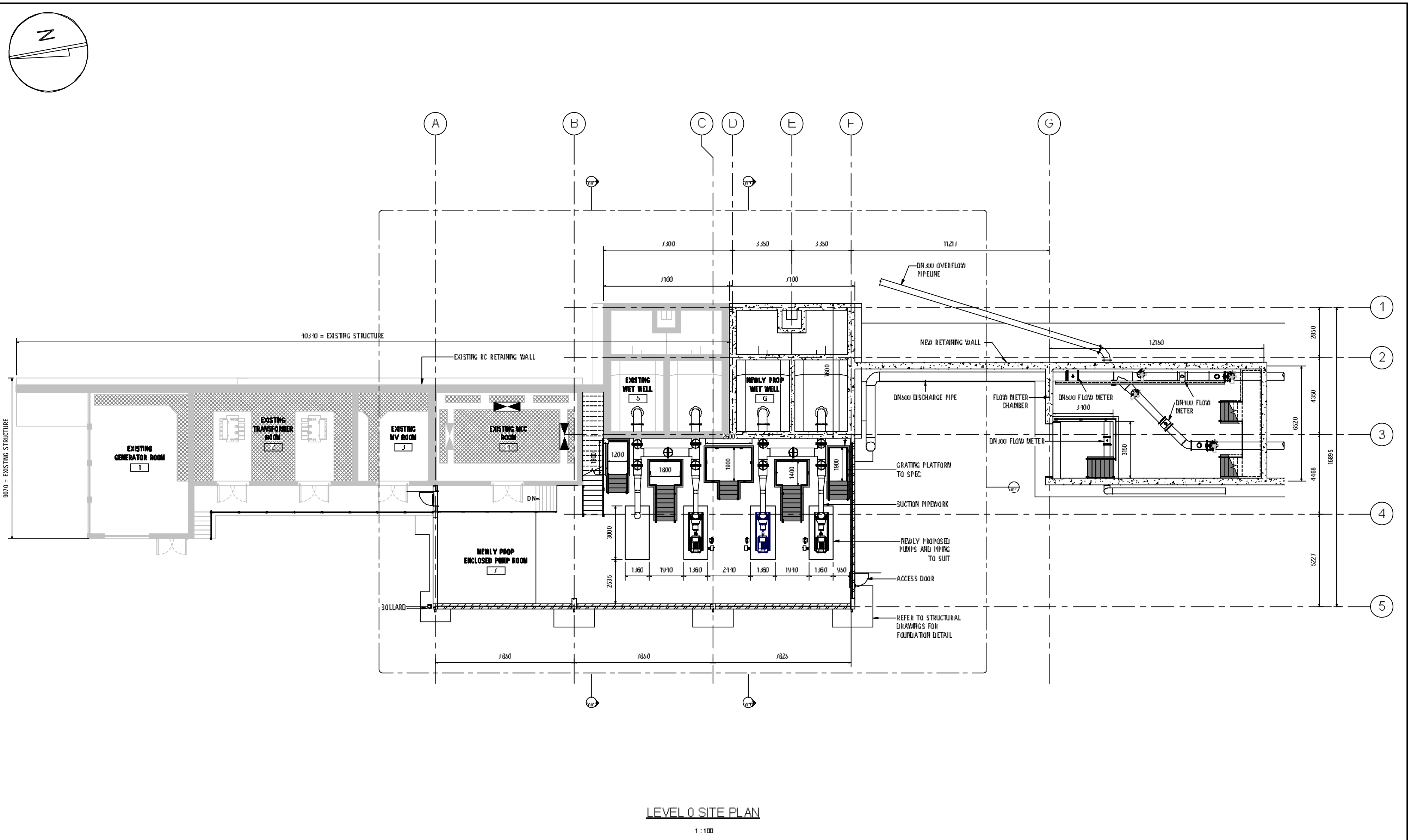
CLIENT: GEORGE — THE CITY FOR ALL REASONS

GEORGE MUNICIPALITY
THEMBALETHU PUMP STATION

PUMP STATION ELEVATIONS

PROJECT NO.	PHASE	DRAWING NUMBER	REVISION
C1924	PS	070	2

PLOT DATE TIME 2023/10/27 12:46:19
DRAWING FILE LOCATION / NAME
150 mm ON ORIGINAL
A1



LEVEL 0 SITE PLAN

1 : 100

PRELIMINARY

REV	DATE	AMENDMENT / REVISION DESCRIPTION	TITLE	NAME
2	03/11/2023	FOR TENDER	DRAFTER	G. MAREDI
1	19/05/2023	DETAIL DESIGN	DRAFTING CHECK	G. WHALLEY
			DESIGNER	S. FAUSTINO
			DESIGN CHECK	G. WHALLEY
			PROJECT MANAGER	T.CRONJE
			PROJECT DIRECTOR	T.CRONJE

DRAWING APPROVED
ENGINEER: ....
PR ENG NR: ....
SIGNATURE: ....

SCALE 1:1 / SCALE 1:50 / SCALE 1:100

DESIGNER: SMEC South Africa — Member of the Surbana Jurong Group

SABS ISO 9001

CLIENT: GEORGE — THE CITY FOR ALL REASONS

GEORGE MUNICIPALITY

THEMBALETHU PUMP STATTION

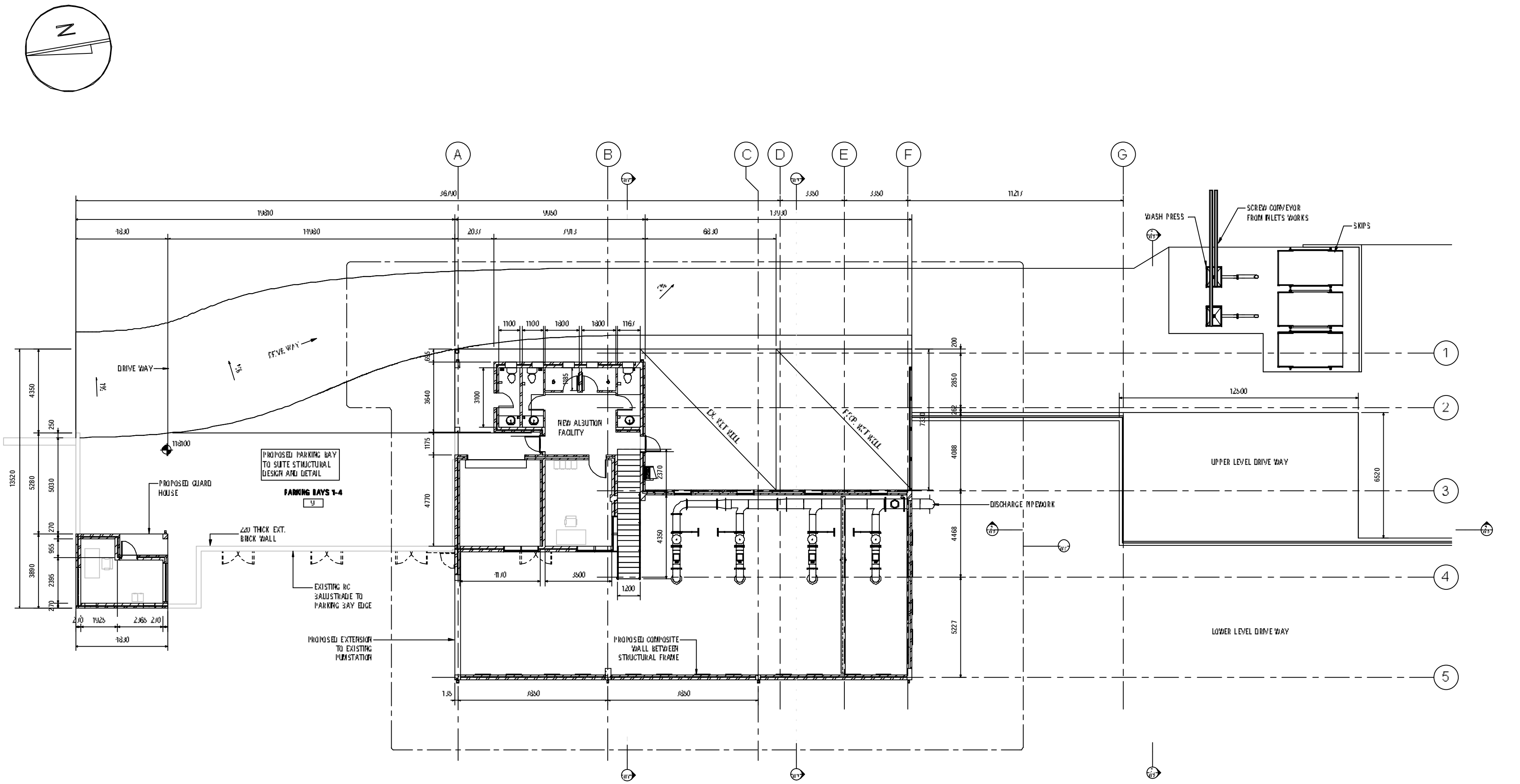
PLAN LAYOUT - LEVEL 0

PROJECT NO.	PHASE	DRAWING NUMBER	REVISION
C1924	PS	001	2

PLOT DATE TIME 2023/10/27 11:59:21

DRAWING FILE LOCATION / NAME

A1 150 mm ON ORIGINAL



LEVEL 1 SITE PLAN

1 : 100

PRELIMINARY

REV	DATE	AMENDMENT / REVISION DESCRIPTION		TITLE	NAME
2	03/10/2023	FOR TENDER		DRAFTER	G. MAREDI
1	19/05/2023	DETAIL DESIGN		DRAFTING CHECK	G. WHALLEY
				DESIGNER	S. FAUSTINO
				DESIGN CHECK	G. WHALLEY
				PROJECT MANAGER	T.CRONJE
				PROJECT DIRECTOR	T.CRONJE

DRAWING APPROVED

ENGINEER: ....

PR ENG NR: ....

SIGNATURE: ....

SCALE 1:1 SCALE 1:50 SCALE 1:100

DESIGNER: SMEC South Africa, Member of the Surbana Jurong Group; SABS ISO 9001

CLIENT: GEORGE THE CITY FOR ALL REASONS

GEORGE MUNICIPALITY

THEMBALETHU PUMP STATTION

PLAN LAYOUT - LEVEL 1

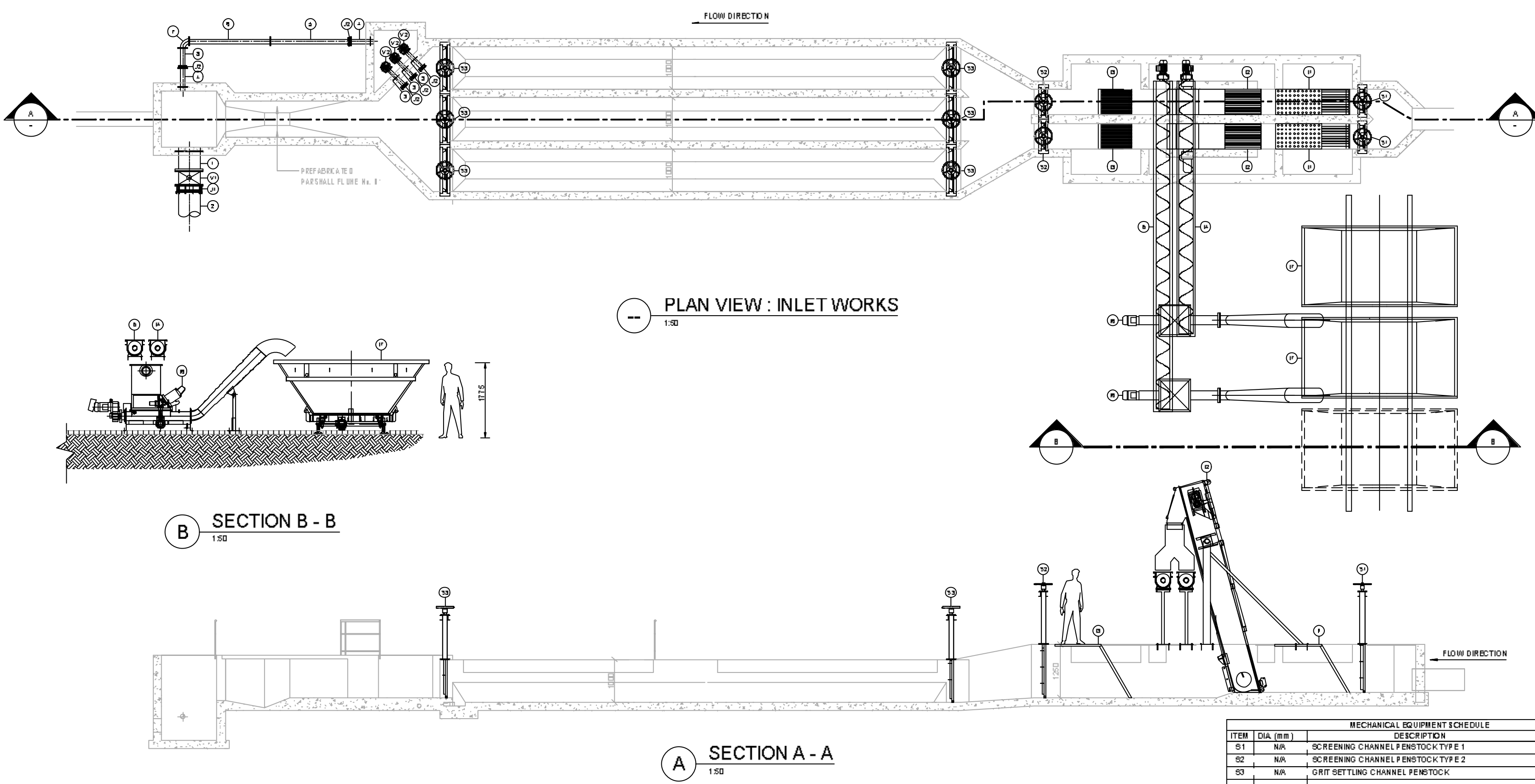
PROJECT No.	PHASE	DRAWING NUMBER	REVISION
C1924	PS	002	2

PLOT DATE TIME 2023/10/27 12:20:05

DRAWING FILE LOCATION / NAME

150 mm ON ORIGINAL A1

Annexure B **Mechanical Drawings**



PLAN VIEW : INLET WORKS
1:50

SECTION B - B
1:50

SECTION A - A
1:50

NOTES:
1. ALL PIPING FLANGED TO SABS 1123, TABLE1000/3.
2. ALL CASTING OF PIPEWORK TO THE CIVIL CONTRACTOR.
3. MBGL = METRES BELOW GROUND LEVEL
4. FBE = FLANGED BOTH END
5. FAE = FLANGED ALL END
6. F+PE = FLANGED + PLAIN END
7. VJFA = FLANGE ADAPTOR
8. TBC = TO BE CONFIRMED
9. CONTRACTOR TO SUBMIT WORKSHOP DRAWING FOR APPROVAL.
10. CONTRACTOR TO PROVIDE PIPE SUPPORTS TO SECURE ALL PIPEWORK
11. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE INDICATED.
12. LEGEND:

PIPE SUPPORT
MECHANICAL DIMENSIONS
BUILDING/CIVIL DIMENSIONS

MECHANICAL EQUIPMENT SCHEDULE				
ITEM	DIA. (mm)	DESCRIPTION	CONFIG.	QTY
S1	N/A	SCREENING CHANNEL PENSTOCK TYPE 1	N/A	4
S2	N/A	SCREENING CHANNEL PENSTOCK TYPE 2	N/A	4
S3	N/A	GRIT SETTLING CHANNEL PENSTOCK	N/A	6
I1	N/A	50 mm MANUAL HAND RAKE SCREEN WITH DRAINAGE PLATFORM AND RAKE TO SUIT	N/A	2
I2	N/A	10 mm MECHANICAL FRONT RAKE SCREEN	N/A	2
I3	N/A	6 mm MANUAL HAND RAKE SCREEN WITH DRAINAGE PLATFORM AND RAKE TO SUIT	N/A	2
I4	N/A	CENTRELESS SCREW CONVEYOR TYPE 1	N/A	1
I5	N/A	CENTRELESS SCREW CONVEYOR TYPE 2	N/A	2
I6	N/A	WASHER COMPACTOR	N/A	2
I7	N/A	6 m³ SKIP	N/A	2
1	Ø500	PUDDLE PIPE	F+PE	1
2	Ø500	PIPE	F+PE	1
3	Ø80	PUDDLE PIPE	F+PE	3
4	Ø80	PUDDLE PIPE	F+PE	1
5	Ø80	PIPE	F+PE	1
6	Ø80	PIPE	FBE	1
7	Ø80	90° BEND	FBE	1
8	Ø80	PIPE	F+PE	1
V1	Ø500	GATE VALVE, PN10 + EXTENSION SPINDLE + BELL-TOBIE	N/A	1
V2	Ø80	GATE VALVE, PN10	N/A	3
J1	Ø500	FLANGE ADAPTOR	N/A	1
J2	Ø80	FLANGE ADAPTOR	N/A	5

REVISIONS						
NO.	DATE	DESCRIPTION	INITIAL			
1	27/10/2023	TENDER PURPOSES	DA			
				DESIGNED	TB	
				CHECKED	TB	
				DRAWN	DA	
				CHECKED	TA	

SIGNED: SMEC South Africa
DATE

SMEC
Member of the Surbana Jurong Group
PO Box 10682 George 6530
12 Progress St George 6529
e-mail: george@smec.com
website: www.smec.com
Tel (044) 873-6029
Fax (044) 873-6039

GEORGE
THE CITY FOR ALL REASONS
PO BOX 19 George 6530
71 York St George 6530

SIGNED: abc
DATE

PROVISON OF PROFESSIONAL SERVICES FOR UPGRADING OF THEMBALETHU No. 6 SEWER PUMP STATION

LAYOUT OF MECHANICAL SCREENING EQUIPMENT

SIZE	SCALE
A1	1:50

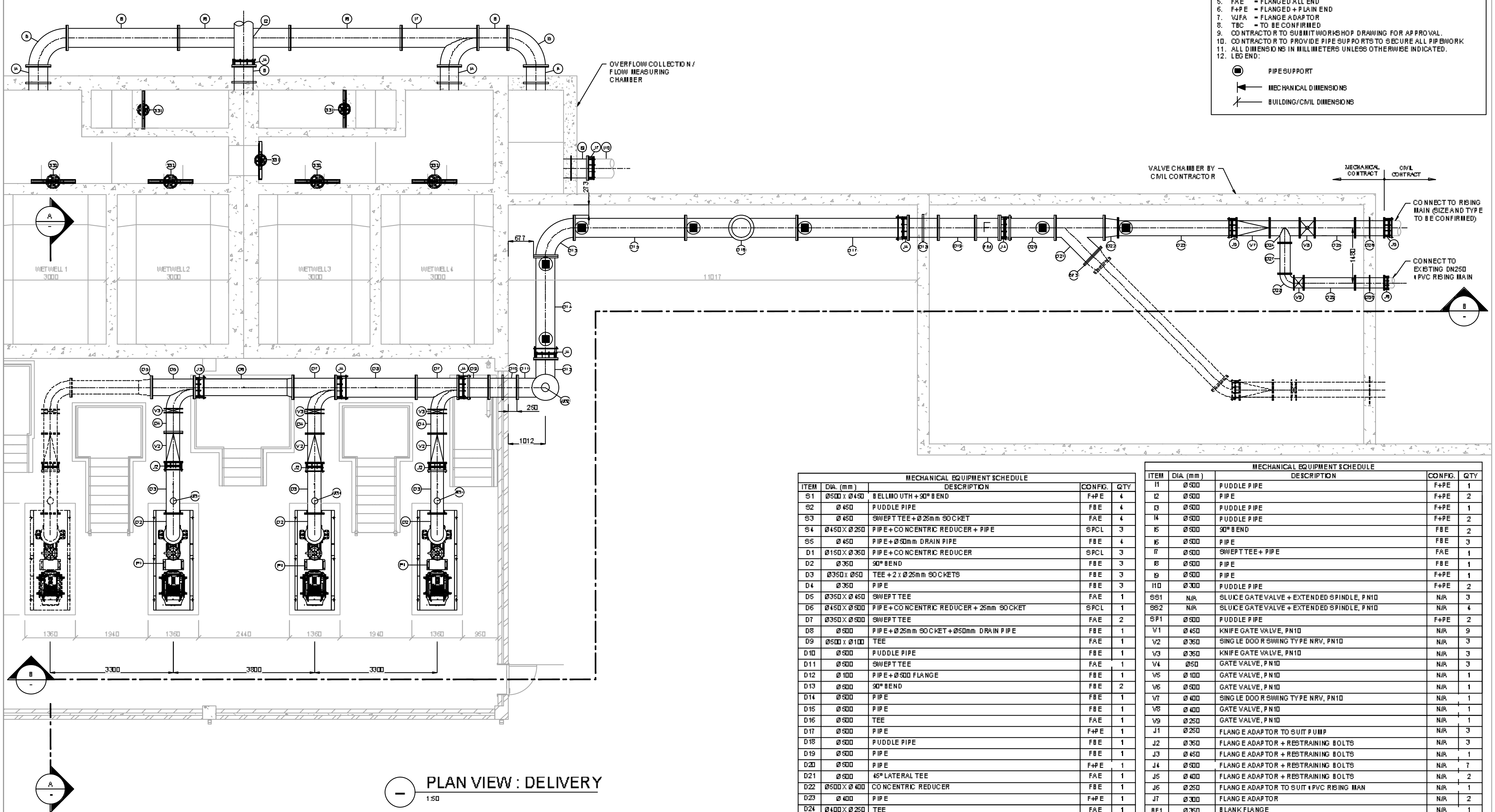
PROJECT DRAWING NUMBER		
C1924	MECH	001

REV	SHEET No.	
1	1	1

SCALE BAR 1 : 1000

NOTES:
1. ALL PIPING FLANGED TO SABS 1123, TABLE1000/3.
2. ALL CASTING OF PIPEWORK TO THE CIVIL CONTRACTOR.
3. MBGL = METRES BELOW GROUND LEVEL
4. FBE = FLANGED BOTH END
5. FAE = FLANGED ALL END
6. F+PE = FLANGED + PLAIN END
7. VJFA = FLANGE ADAPTOR
8. TBC = TO BE CONFIRMED
9. CONTRACTOR TO SUBMIT WORKSHOP DRAWING FOR APPROVAL.
10. CONTRACTOR TO PROVIDE PIPE SUPPORTS TO SECURE ALL PIPEWORK
11. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE INDICATED.
12. LEGEND:

PIPE SUPPORT
MECHANICAL DIMENSIONS
BUILDING/CIVIL DIMENSIONS



PLAN VIEW : DELIVERY
1:50

MECHANICAL EQUIPMENT SCHEDULE				
ITEM	DIA. (mm)	DESCRIPTION	CONFIG.	QTY
S1	Ø500 x Ø450	BELLMOUTH + 90° BEND	F+PE	4
S2	Ø450	PUDDLE PIPE	FBE	4
S3	Ø450	SWEPT TEE + Ø25mm SOCKET	FAE	4
S4	Ø450 X Ø250	PIPE + CONCENTRIC REDUCER + PIPE	SPCL	3
S5	Ø450	PIPE + Ø50mm DRAIN PIPE	FBE	4
D1	Ø150 X Ø350	PIPE + CONCENTRIC REDUCER	SPCL	3
D2	Ø350	90° BEND	FBE	3
D3	Ø350 x Ø50	TEE + 2 x Ø25mm SOCKETS	FBE	3
D4	Ø350	PIPE	FBE	3
D5	Ø350 X Ø450	SWEPT TEE	FAE	1
D6	Ø450 X Ø500	PIPE + CONCENTRIC REDUCER + 25mm SOCKET	SPCL	1
D7	Ø350 X Ø500	SWEPT TEE	FAE	2
D8	Ø500	PIPE + Ø25mm SOCKET + Ø50mm DRAIN PIPE	FBE	1
D9	Ø500 x Ø100	TEE	FAE	1
D10	Ø500	PUDDLE PIPE	FBE	1
D11	Ø500	SWEPT TEE	FAE	1
D12	Ø100	PIPE + Ø500 FLANGE	FBE	1
D13	Ø500	90° BEND	FBE	2
D14	Ø500	PIPE	FBE	1
D15	Ø500	PIPE	FBE	1
D16	Ø500	TEE	FAE	1
D17	Ø500	PIPE	F+PE	1
D18	Ø500	PUDDLE PIPE	FBE	1
D19	Ø500	PIPE	FBE	1
D20	Ø500	PIPE	F+PE	1
D21	Ø500	45° LATERAL TEE	FAE	1
D22	Ø500 X Ø400	CONCENTRIC REDUCER	FBE	1
D23	Ø400	PIPE	F+PE	1
D24	Ø400 X Ø250	TEE	FAE	1
D25	Ø400	PIPE	FBE	1
D26	Ø400	PUDDLE PIPE	FBE	1
D27	Ø250	PIPE	FBE	1
D28	Ø250	90° BEND	FBE	1
D29	Ø250	PIPE	FBE	1
D30	Ø250	PUDDLE PIPE	FBE	1

MECHANICAL EQUIPMENT SCHEDULE				
ITEM	DIA. (mm)	DESCRIPTION	CONFIG.	QTY
I1	Ø500	PUDDLE PIPE	F+PE	1
I2	Ø500	PIPE	F+PE	2
I3	Ø500	PUDDLE PIPE	F+PE	1
I4	Ø500	PUDDLE PIPE	F+PE	2
I5	Ø500	90° BEND	FBE	2
I6	Ø500	PIPE	FBE	3
I7	Ø500	SWEPT TEE + PIPE	FAE	1
I8	Ø500	PIPE	FBE	1
I9	Ø500	PIPE	F+PE	1
I10	Ø300	PUDDLE PIPE	F+PE	2
SS1	N/A	SLUICE GATE VALVE + EXTENDED SPINDLE, PN10	N/A	3
SS2	N/A	SLUICE GATE VALVE + EXTENDED SPINDLE, PN10	N/A	4
SP1	Ø500	PUDDLE PIPE	F+PE	2
V1	Ø450	KNIFE GATE VALVE, PN10	N/A	9
V2	Ø350	SINGLE DOOR SWING TYPE NRV, PN10	N/A	3
V3	Ø350	KNIFE GATE VALVE, PN10	N/A	3
V4	Ø50	GATE VALVE, PN10	N/A	3
V5	Ø100	GATE VALVE, PN10	N/A	1
V6	Ø500	GATE VALVE, PN10	N/A	1
V7	Ø400	SINGLE DOOR SWING TYPE NRV, PN10	N/A	1
V8	Ø400	GATE VALVE, PN10	N/A	1
V9	Ø250	GATE VALVE, PN10	N/A	1
J1	Ø250	FLANGE ADAPTOR TO SUIT PUMP	N/A	3
J2	Ø350	FLANGE ADAPTOR + RESTRAINING BOLTS	N/A	3
J3	Ø450	FLANGE ADAPTOR + RESTRAINING BOLTS	N/A	1
J4	Ø500	FLANGE ADAPTOR + RESTRAINING BOLTS	N/A	7
J5	Ø400	FLANGE ADAPTOR + RESTRAINING BOLTS	N/A	2
J6	Ø250	FLANGE ADAPTOR TO SUIT uPVC RISING MAN	N/A	1
J7	Ø300	FLANGE ADAPTOR	N/A	2
BF1	Ø350	BLANK FLANGE	N/A	1
BF2	Ø450	BLANK FLANGE	N/A	1
BF3	Ø400	BLANK FLANGE	N/A	1
ARV1	Ø50	AIR RELEASE VALVE	N/A	3
ARV2	Ø100	AIR RELEASE VALVE	N/A	1
FM	Ø500	ELECTROMAGNETIC FLOWMETER	N/A	1
P1	N/A	PUMP SET, COMPLETE	N/A	3

REVISIONS

NO.	DATE	DESCRIPTION	INITIAL
1	27/10/2023	TENDER PURPOSES	DA

DESIGNED	TB
CHECKED	TB
DRAWN	DRA
CHECKED	TA

SIGNED: SMEC South Africa
DATE

SMEC
Member of the Surbana Jurong Group
PO Box 10632 George 6530
12 Progress St George 6529
e-mail: george@smec.com
website: www.smec.com
Tel (044) 873-6029
Fax (044) 873-6030

GEORGE
THE CITY FOR ALL REASONS
PO BOX 19 George 6530
71 York St George 6530

SIGNED: abc
DATE

PROVISION OF PROFESSIONAL SERVICES FOR UPGRADING THEMBALETHU No. 6 SEWER PUMP STATION

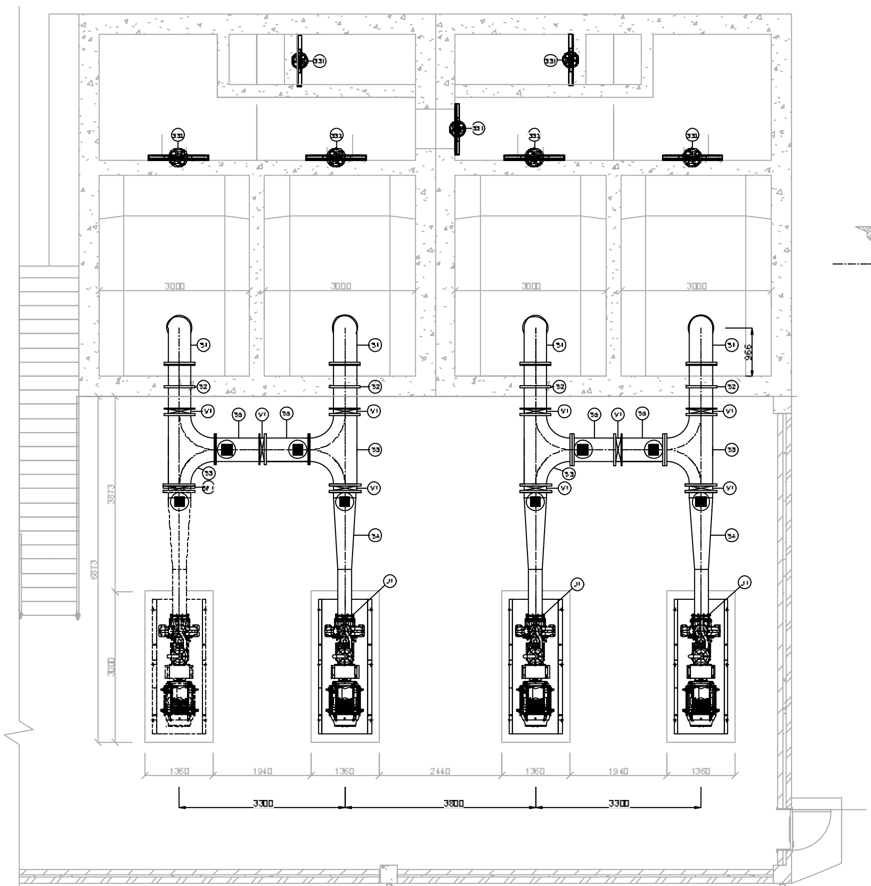
LAYOUT OF MECHANICAL PUMPING EQUIPMENT

SIZE	SCALE
A1	1:50

PROJECT DRAWING NUMBER: C1924 MECH 002

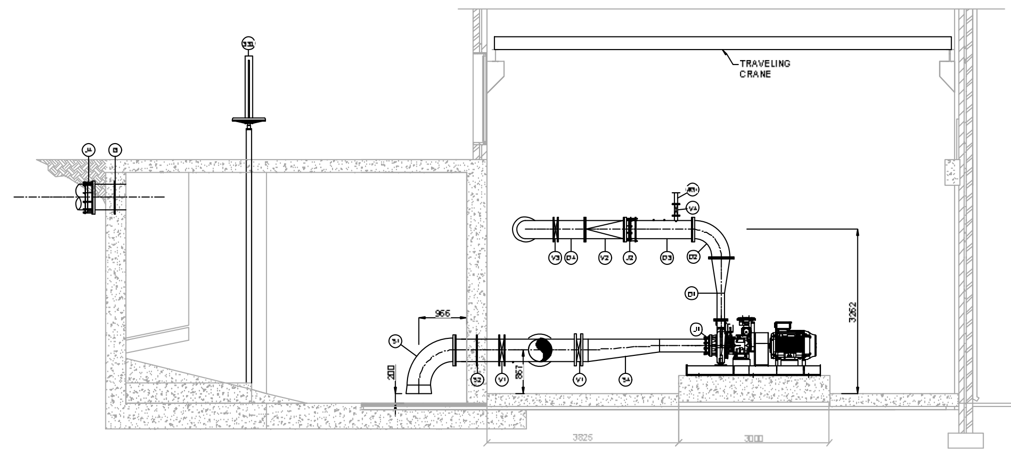
REV	SHEET No.
1	1 3

SCALE BAR 1:1000



PLAN VIEW : SUCTION

1:50



A SECTION

1:50

NOTES:
1. ALL PIPING FLANGED TO SABS 1123, TABLE1000/3.
2. ALL CASTING OF PIPEWORK TO THE CIVIL CONTRACTOR.
3. MBGL = METRES BELOW GROUND LEVEL
4. FBE = FLANGED BOTH END
5. FAE = FLANGED ALL END
6. F+PE = FLANGED + PLAIN END
7. VJFA = FLANGE ADAPTOR
8. TBC = TO BE CONFIRMED
9. CONTRACTOR TO SUBMIT WORKSHOP DRAWING FOR APPROVAL.
10. CONTRACTOR TO PROVIDE PIPE SUPPORTS TO SECURE ALL PIPEWORK
11. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE INDICATED.
12. LEGEND:

- PIPE SUPPORT
- MECHANICAL DIMENSIONS
- BUILDING/CIVIL DIMENSIONS

MECHANICAL EQUIPMENT SCHEDULE

ITEM	DIA. (mm)	DESCRIPTION	CONFIG.	QTY
S1	Ø500 x Ø450	BELLMOUTH + 90° BEND	F+PE	4
S2	Ø450	PUDDLE PIPE	FBE	4
S3	Ø450	SWEPT TEE + Ø25mm SOCKET	FAE	4
S4	Ø450 X Ø250	PIPE + CONCENTRIC REDUCER + PIPE	SPCL	3
S5	Ø450	PIPE + Ø50mm DRAIN PIPE	FBE	4
D1	Ø150 X Ø350	PIPE + CONCENTRIC REDUCER	SPCL	3
D2	Ø350	90° BEND	FBE	3
D3	Ø350 x Ø50	TEE + 2 x Ø25mm SOCKETS	FBE	3
D4	Ø350	PIPE	FBE	3
D5	Ø350 X Ø450	SWEPT TEE	FAE	1
D6	Ø450 X Ø500	PIPE + CONCENTRIC REDUCER + 25mm SOCKET	SPCL	1
D7	Ø350 X Ø500	SWEPT TEE	FAE	2
D8	Ø500	PIPE + Ø25mm SOCKET + Ø50mm DRAIN PIPE	FBE	1
D9	Ø500 x Ø100	TEE	FAE	1
D10	Ø500	PUDDLE PIPE	FBE	1
D11	Ø500	SWEPT TEE	FAE	1
D12	Ø100	PIPE + Ø500 FLANGE	FBE	1
D13	Ø500	90° BEND	FBE	2
D14	Ø500	PIPE	FBE	1
D15	Ø500	PIPE	FBE	1
D16	Ø500	TEE	FAE	1
D17	Ø500	PIPE	F+PE	1
D18	Ø500	PUDDLE PIPE	FBE	1
D19	Ø500	PIPE	FBE	1
D20	Ø500	PIPE	F+PE	1
D21	Ø500	45° LATERAL TEE	FAE	1
D22	Ø500 X Ø400	CONCENTRIC REDUCER	FBE	1
D23	Ø400	PIPE	F+PE	1
D24	Ø400 X Ø250	TEE	FAE	1
D25	Ø400	PIPE	FBE	1
D26	Ø400	PUDDLE PIPE	FBE	1
D27	Ø250	PIPE	FBE	1
D28	Ø250	90° BEND	FBE	1
D29	Ø250	PIPE	FBE	1
D30	Ø250	PUDDLE PIPE	FBE	1

MECHANICAL EQUIPMENT SCHEDULE

ITEM	DIA. (mm)	DESCRIPTION	CONFIG.	QTY
I1	Ø500	PUDDLE PIPE	F+PE	1
I2	Ø500	PIPE	F+PE	2
I3	Ø500	PUDDLE PIPE	F+PE	1
I4	Ø500	PUDDLE PIPE	F+PE	2
I5	Ø500	90° BEND	FBE	2
I6	Ø500	PIPE	FBE	3
I7	Ø500	SWEPT TEE + PIPE	FAE	1
I8	Ø500	PIPE	FBE	1
I9	Ø500	PIPE	F+PE	1
I10	Ø300	PUDDLE PIPE	F+PE	2
SS1	N/A	SLUICE GATE VALVE + EXTENDED SPINDLE, PN10	N/A	3
SS2	N/A	SLUICE GATE VALVE + EXTENDED SPINDLE, PN10	N/A	4
SP1	Ø500	PUDDLE PIPE	F+PE	2
V1	Ø450	KNIFE GATE VALVE, PN10	N/A	9
V2	Ø350	SINGLE DOOR SWING TYPE NRV, PN10	N/A	3
V3	Ø350	KNIFE GATE VALVE, PN10	N/A	3
V4	Ø50	GATE VALVE, PN10	N/A	3
V5	Ø100	GATE VALVE, PN10	N/A	1
V6	Ø500	GATE VALVE, PN10	N/A	1
V7	Ø400	SINGLE DOOR SWING TYPE NRV, PN10	N/A	1
V8	Ø400	GATE VALVE, PN10	N/A	1
V9	Ø250	GATE VALVE, PN10	N/A	1
J1	Ø250	FLANGE ADAPTOR TO SUIT PUMP	N/A	3
J2	Ø350	FLANGE ADAPTOR + RESTRAINING BOLTS	N/A	3
J3	Ø450	FLANGE ADAPTOR + RESTRAINING BOLTS	N/A	1
J4	Ø500	FLANGE ADAPTOR + RESTRAINING BOLTS	N/A	7
J5	Ø400	FLANGE ADAPTOR + RESTRAINING BOLTS	N/A	2
J6	Ø250	FLANGE ADAPTOR TO SUIT ‹PVC RISING MAN	N/A	1
J7	Ø300	FLANGE ADAPTOR	N/A	2
BF1	Ø350	BLANK FLANGE	N/A	1
BF2	Ø450	BLANK FLANGE	N/A	1
BF3	Ø400	BLANK FLANGE	N/A	1
ARV1	Ø50	AIR RELEASE VALVE	N/A	3
ARV2	Ø100	AIR RELEASE VALVE	N/A	1
FM	Ø500	ELECTROMAGNETIC FLOWMETER	N/A	1
P1	N/A	PUMP SET, COMPLETE	N/A	3

REVISIONS

NO.	DATE	DESCRIPTION	INITIAL		
				DESIGNED	TB
				CHECKED	TB
				DRAWN	DRA
1	27/10/2023	TENDER PURPOSES	DA	CHECKED	TA

SIGNED: SMEC South Africa

DATE

SMEC
Member of the Surbana Jurong Group
PO Box 10882 George 6530
12 Progress St George 6529
e-mail: george@smec.com
website: www.smec.com
Tel (044) 873-6029
Fax (044) 873-6039

GEORGE
THE CITY FOR ALL REASONS
PO BOX 19 George 6530
71 York St George 6530

SIGNED: abc

DATE

PROVIISION OF PROFESSIONAL SERVICES FOR UPGRADING OF THEMBALETHU No. 6 SEWER PUMP STATION

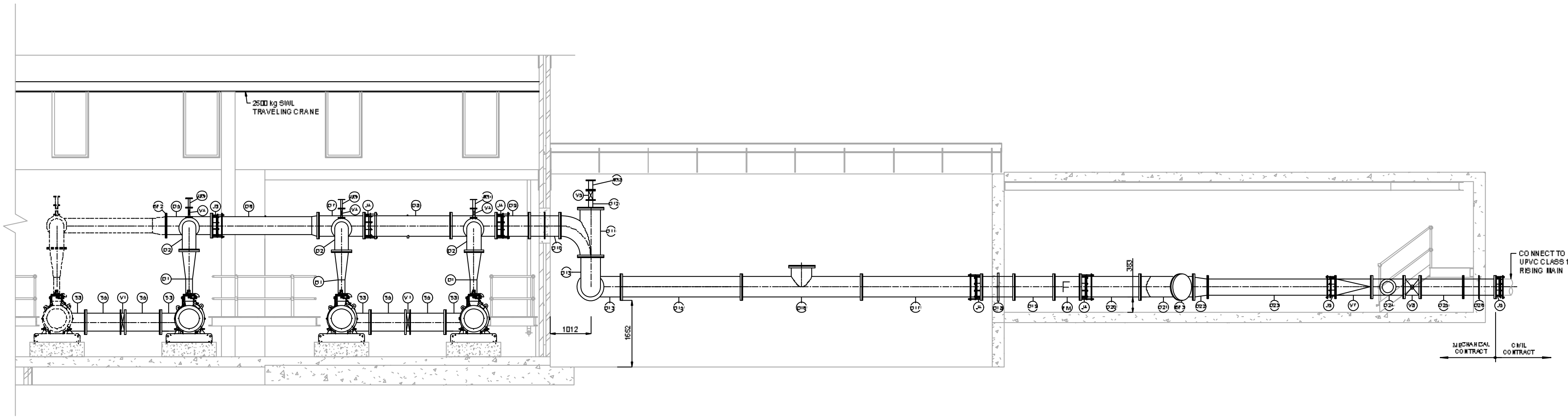
LAYOUT OF MECHANICAL PUMPING EQUIPMENT

SIZE	SCALE
A1	1:50

PROJECT DRAWING NUMBER: C1924 MECH 002

REV	SHEET No.
1	2 3

SCALE BAR 1:1000



B SECTION
1:50

NOTES:
1. ALL PIPING FLANGED TO SABS 1123, TABLE1000/3.
2. ALL CASTING OF PIPEWORKTO THE CIVIL CONTRACTOR.
3. MBGL = METRES BELOW GROUND LEVEL
4. FBE = FLANGED BOTH END
5. FAE = FLANGED ALL END
6. F+PE = FLANGED + PLAIN END
7. VJFA = FLANGE ADAPTOR
8. TBC = TO BE CONFIRMED
9. CONTRACTOR TO SUBMIT WORKSHOP DRAWING FOR APPROVAL.
10. CONTRACTOR TO PROVIDE PIPE SUPPORTS TO SECURE ALL PIPEWORK
11. ALL DIMENSIONS IN MILLIMETERS UNLESS OTHERWISE INDICATED.
12. LEGEND:

PIPE SUPPORT
MECHANICAL DIMENSIONS
BUILDING/CIVIL DIMENSIONS

MECHANICAL EQUIPMENT SCHEDULE

ITEM	DIA. (mm)	DESCRIPTION	CONFIG.	QTY
S1	Ø500 x Ø450	BELLMOUTH + 90° BEND	F+PE	4
S2	Ø450	PUDDLE PIPE	FBE	4
S3	Ø450	SWEPT TEE + Ø25mm SOCKET	FAE	4
S4	Ø450 X Ø250	PIPE + CONCENTRIC REDUCER + PIPE	SPCL	3
S5	Ø450	PIPE + Ø50mm DRAIN PIPE	FBE	4
D1	Ø150 X Ø350	PIPE + CONCENTRIC REDUCER	SPCL	3
D2	Ø350	90° BEND	FBE	3
D3	Ø350 x Ø50	TEE + 2 x Ø25mm SOCKETS	FBE	3
D4	Ø350	PIPE	FBE	3
D5	Ø350 X Ø450	SWEPT TEE	FAE	1
D6	Ø450 X Ø500	PIPE + CONCENTRIC REDUCER + 25mm SOCKET	SPCL	1
D7	Ø350 X Ø500	SWEPT TEE	FAE	2
D8	Ø500	PIPE + Ø25mm SOCKET + Ø50mm DRAIN PIPE	FBE	1
D9	Ø500 x Ø100	TEE	FAE	1
D10	Ø500	PUDDLE PIPE	FBE	1
D11	Ø500	SWEPT TEE	FAE	1
D12	Ø100	PIPE + Ø500 FLANGE	FBE	1
D13	Ø500	90° BEND	FBE	2
D14	Ø500	PIPE	FBE	1
D15	Ø500	PIPE	FBE	1
D16	Ø500	TEE	FAE	1
D17	Ø500	PIPE	F+PE	1
D18	Ø500	PUDDLE PIPE	FBE	1
D19	Ø500	PIPE	FBE	1
D20	Ø500	PIPE	F+PE	1
D21	Ø500	45° LATERAL TEE	FAE	1
D22	Ø500 X Ø400	CONCENTRIC REDUCER	FBE	1
D23	Ø400	PIPE	F+PE	1
D24	Ø400 X Ø250	TEE	FAE	1
D25	Ø400	PIPE	FBE	1
D26	Ø400	PUDDLE PIPE	FBE	1
D27	Ø250	PIPE	FBE	1
D28	Ø250	90° BEND	FBE	1
D29	Ø250	PIPE	FBE	1
D30	Ø250	PUDDLE PIPE	FBE	1

MECHANICAL EQUIPMENT SCHEDULE

ITEM	DIA. (mm)	DESCRIPTION	CONFIG.	QTY
I1	Ø500	PUDDLE PIPE	F+PE	1
I2	Ø500	PIPE	F+PE	2
I3	Ø500	PUDDLE PIPE	F+PE	1
I4	Ø500	PUDDLE PIPE	F+PE	2
I5	Ø500	90° BEND	FBE	2
I6	Ø500	PIPE	FBE	3
I7	Ø500	SWEPT TEE + PIPE	FAE	1
I8	Ø500	PIPE	FBE	1
I9	Ø500	PIPE	F+PE	1
I10	Ø300	PUDDLE PIPE	F+PE	2
SS1	N/A	SLUICE GATE VALVE + EXTENDED SPINDLE, PN10	N/A	3
SS2	N/A	SLUICE GATE VALVE + EXTENDED SPINDLE, PN10	N/A	4
SP1	Ø500	PUDDLE PIPE	F+PE	2
V1	Ø450	KNIFE GATE VALVE, PN10	N/A	9
V2	Ø350	SINGLE DOOR SWING TYPE NRV, PN10	N/A	3
V3	Ø350	KNIFE GATE VALVE, PN10	N/A	3
V4	Ø50	GATE VALVE, PN10	N/A	3
V5	Ø100	GATE VALVE, PN10	N/A	1
V6	Ø500	GATE VALVE, PN10	N/A	1
V7	Ø400	SINGLE DOOR SWING TYPE NRV, PN10	N/A	1
V8	Ø400	GATE VALVE, PN10	N/A	1
V9	Ø250	GATE VALVE, PN10	N/A	1
J1	Ø250	FLANGE ADAPTOR TO SUIT PUMP	N/A	3
J2	Ø350	FLANGE ADAPTOR + RESTRAINING BOLTS	N/A	3
J3	Ø450	FLANGE ADAPTOR + RESTRAINING BOLTS	N/A	1
J4	Ø500	FLANGE ADAPTOR + RESTRAINING BOLTS	N/A	7
J5	Ø400	FLANGE ADAPTOR + RESTRAINING BOLTS	N/A	2
J6	Ø250	FLANGE ADAPTOR TO SUIT uPVC RISING MAIN	N/A	1
J7	Ø300	FLANGE ADAPTOR	N/A	2
BF1	Ø350	BLANK FLANGE	N/A	1
BF2	Ø450	BLANK FLANGE	N/A	1
BF3	Ø400	BLANK FLANGE	N/A	1
ARV1	Ø50	AIR RELEASE VALVE	N/A	3
ARV2	Ø100	AIR RELEASE VALVE	N/A	1
FM	Ø500	ELECTROMAGNETIC FLOWMETER	N/A	1
P1	N/A	PUMPSET, COMPLETE	N/A	3

REVISIONS					
					DESIGNED TB
					CHECKED TB
					DRAWN DRA
	1	27/10/2023	TENDER PURPOSES	DA	
	NO.	DATE	DESCRIPTION	INITIAL	CHECKED TA

SIGNED
SMEC South Africa
DATE

SMEC
Member of the Surbana Jurong Group

PO Box 10882 George 6530
13 Progress St George 6529
e-mail: george@smec.com
website: www.smec.com
Tel (044) 873-6029
Fax (044) 873-6028

GEORGE
THE CITY FOR ALL REASONS

PO BOX 19 George 6530
71 York St George 6530

SIGNED
abc
DATE

PROVISION OF PROFESSIONAL SERVICES FOR UPGRADING OF THEMBALETHU No.6 SEWER PUMP STATION

LAYOUT OF MECHANICAL PUMPING EQUIPMENT

SIZE	SCALE
A1	1:50

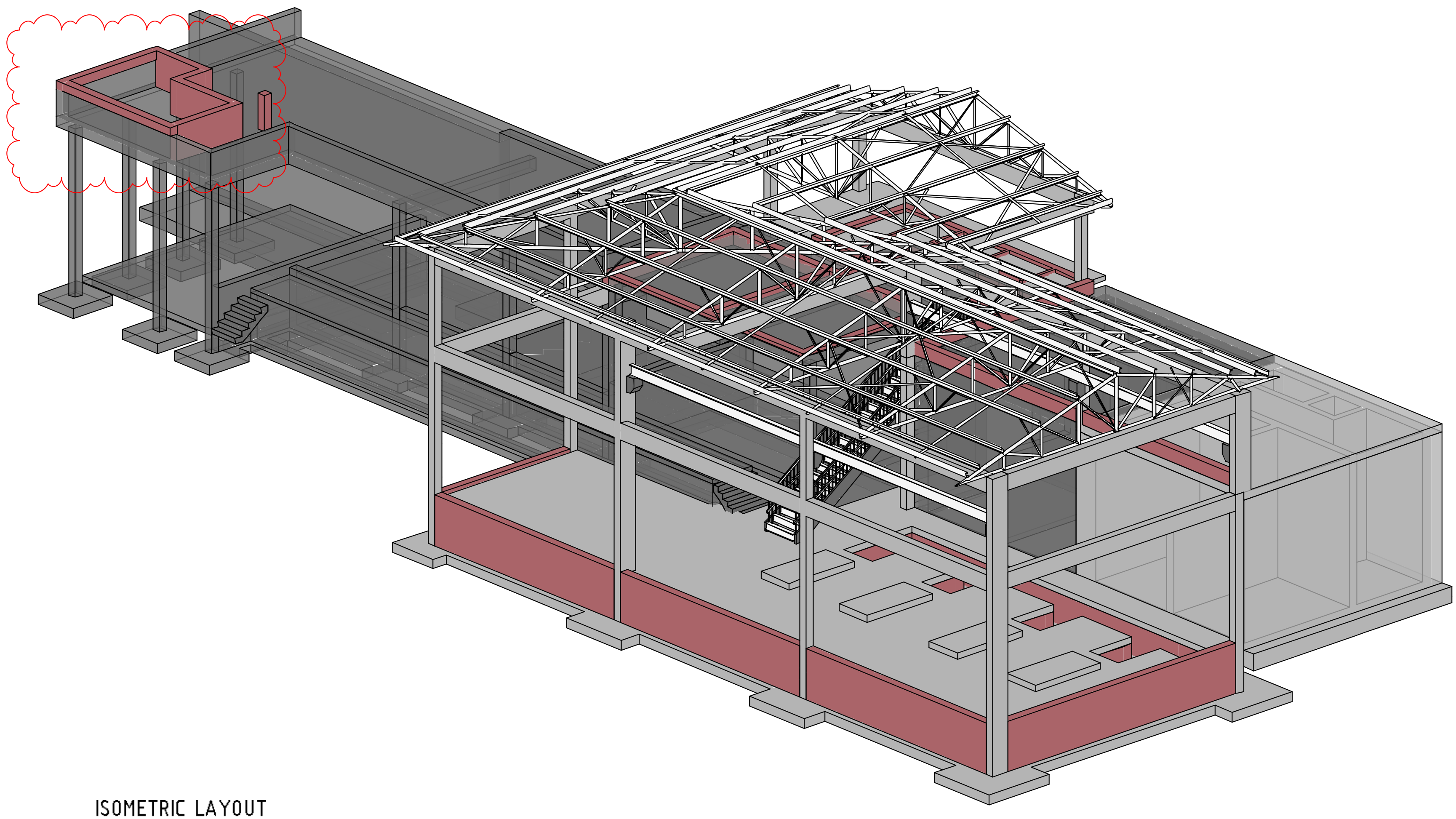
PROJECT DRAWING NUMBER
C1924 MECH 002

REV	SHEET No.
1	3 3

SCALE BAR 1:1000

Annexure C **Structural Drawings**

NOTES:
1. DARK GREY = EXISTING STRUCTURE



ISOMETRIC LAYOUT

PRELIMINARY

REV	DATE	AMENDMENT / REVISION DESCRIPTION	MVR No.	APPROVAL
A	16.10.2023	PRELIMINARY	-	-
B	26.10.2023	PRELIMINARY	-	-

TITLE	NAME
DRAFTER	T. GUMEDE
DRAFTING CHECK	R. PIETERS
DESIGNER	T.GUMEDE
DESIGN CHECK	R. PIETERS
PROJECT MANAGER	T.CRONJE
PROJECT DIRECTOR	T.CRONJE

DRAWING APPROVED
ENGINEER: ....
PR ENG NR: ....
SIGNATURE: ....

SCALES AT A0 A1 SIZE DRAWING
SCALE 1:1
SCALE 1:50
SCALE 1:100

DESIGNER
SMEC South Africa
Member of the Surbana Jurong Group
SABS ISO 9001

CLIENT
GEORGE THE CITY FOR ALL REASONS

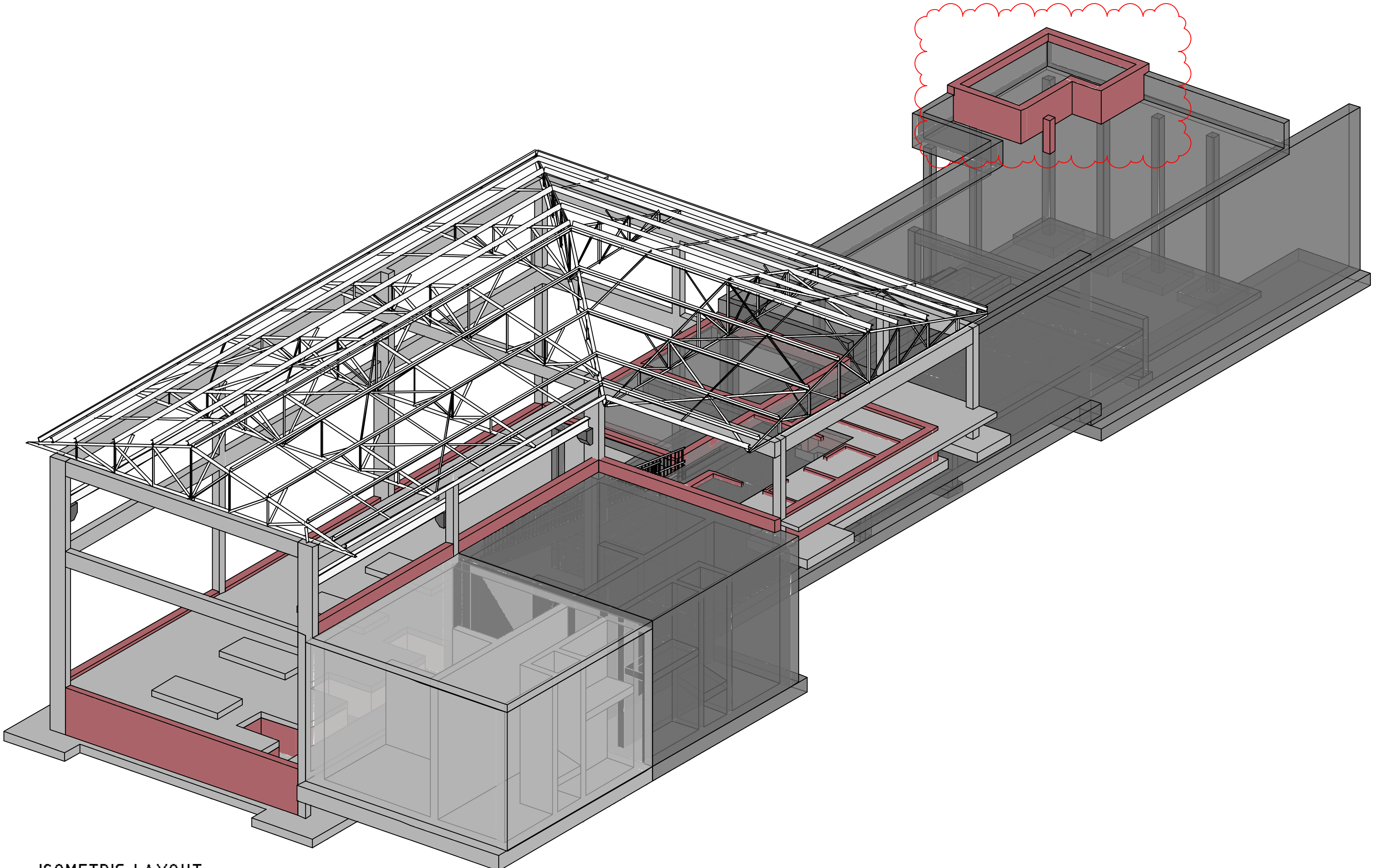
GEORGE MUNICIPALITY
THEMBALETHU PUMP STATTION
STRUCTURAL DRAWING
ISOMETRIC LAYOUT

SCALE	DRAWING TYPE	DRAWING NUMBER	REVISION
1	DCN	100	B

150 mm ON ORIGINAL
A1
DRAWING FILE LOCATION / NAME
PLOT DATE TIME 2023/10/26 10:50:15

NOTES:

1. DARK GREY = EXISTING STRUCTURE



ISOMETRIC LAYOUT

PRELIMINARY

REV	DATE	AMENDMENT / REVISION DESCRIPTION	MVR No	APPROVAL
A	16.10.2023	PRELIMINARY	-	-
B	24.10.2023	PRELIMINARY	-	-

TITLE	NAME
DRAFTER	T. GUMEDE
DRAFTING CHECK	R. PIETERS
DESIGNER	T.GUMEDE
DESIGN CHECK	R. PIETERS
PROJECT MANAGER	T.CRONJE
PROJECT DIRECTOR	T.CRONJE

DRAWING APPROVED

ENGINEER: ....

PR ENG NR: ....

SIGNATURE: ....

SCALES AT A0 A1 SIZE DRAWING

SCALE 1:1

SCALE 1:50

SCALE 1:100

DESIGNER

SMEC South Africa

Member of the Surbana Jurong Group

SABS ISO 9001

CLIENT

GEORGE THE CITY FOR ALL REASONS

GEORGE MUNICIPALITY

THEMBALETHU PUMP STATTION

STRUCTURAL DRAWING

ISOMETRIC LAYOUT

SCALE	DRAWING TYPE	DRAWING NUMBER	REVISION
1	DCH	101	A

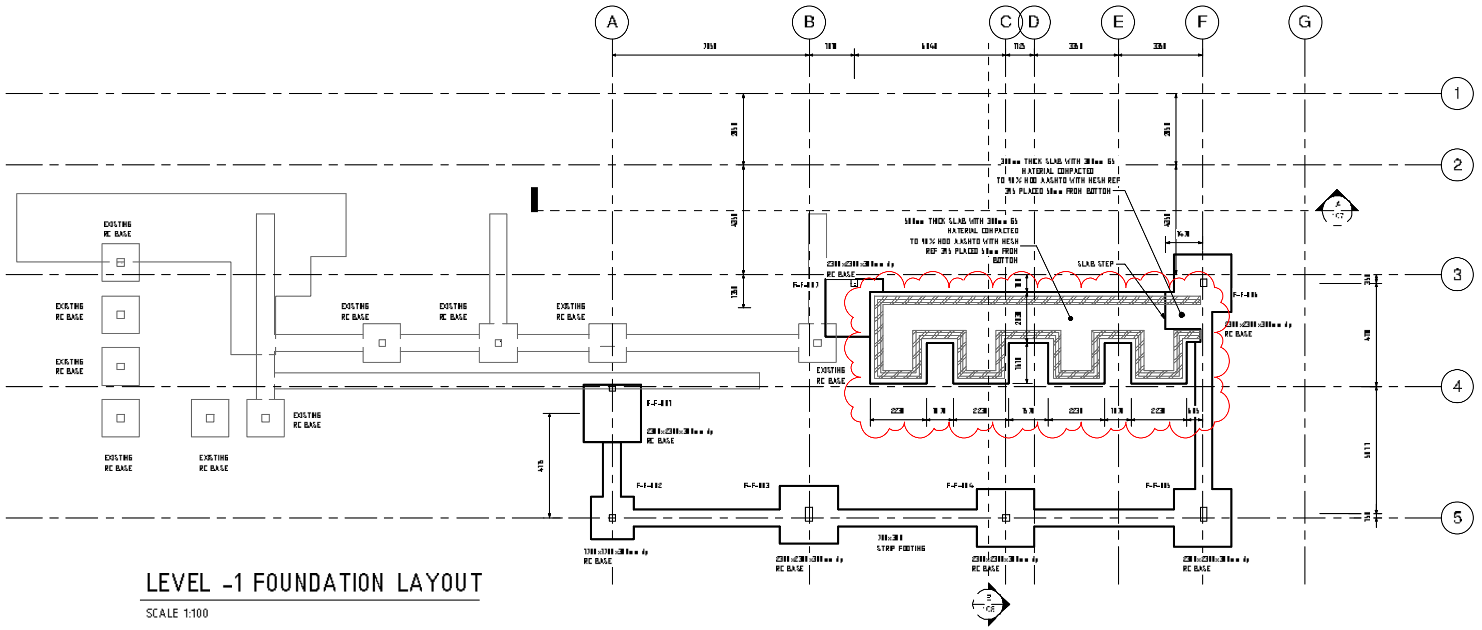
150 mm ON ORIGINAL

A1

DRAWING FILE LOCATION / NAME

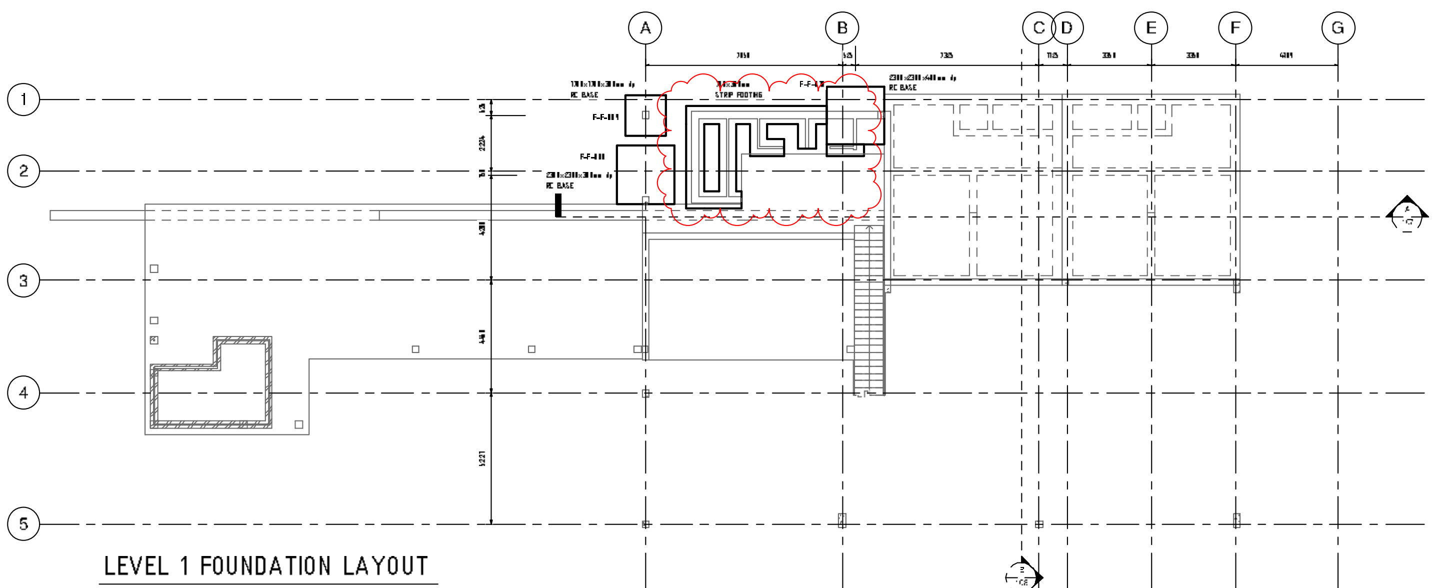
PLOT DATE TIME

2023/10/24 10:54:10



LEVEL -1 FOUNDATION LAYOUT

SCALE 1:100



LEVEL 1 FOUNDATION LAYOUT

SCALE 1:100

NOTES:

1. REFER TO DRAWING C1924-1-DNS-001 TO 003 FOR GENERAL NOTES.
2. REFER TO DRAWING C1934-1-DCN-109 FOR TYPICAL CONCRETE DETAILS.
3. REFER TO DRAWING C1934-1-DMA-110 FOR TYPICAL MASONRY DETAILS.
4. REFER TO DRAWING C1934-1-DST-111 TO 112 FOR TYPICAL STEEL DETAILS.
5. BRICKFORCE TO BE SUPPLIED IN EVERY 4TH BRICK COURSE FOR ALL MASONRY ELEMENTS ABOVE & BELOW SURFACE BED LEVEL.
6. BRICKWORK SETTING OUT AS PER LAYOUTS.
7. ALLOWABLE BEARING PRESSURE = 150KPa.
8. ALL BUILDING WORK AND MATERIALS ARE TO COMPLY WITH LOCAL AUTHORITY'S REQUIREMENTS AND ARE TO BE IN ACCORDANCE WITH SANS 10400 NATIONAL BUILDING REGULATIONS.
9. ALL DIMENSIONS TO BE VERIFIED ON SITE PRIOR TO START OF CONSTRUCTION. ANY DESCRAPANCIES TO BE REPORTED TO THE ENGINEER.

LEGEND

ELEMENT NOMENCLATURE

ELEMENT:	LEVEL:	ELEMENT No:
B-BEAM	B-BASEMENT	001-999
C-COLUMN	F-FOUNDATION	
F-FOOTING	G-GROUND	
P-PENETRATION	1-9 LEVELS OR	
S-STAIR	FLOORS HIGHER UP	
W-WALL		

W - 1 - 001

PRELIMINARY

REV	DATE	AMENDMENT / REVISION DESCRIPTION	NYE No	APPROVAL
A	16.10.2023	PRELIMINARY	-	-
B	17.10.2023	UPDATED FOUNDATION	-	-
C	19.10.2023	UPDATED FOUNDATION	-	-
D	23.10.2023	PRELIMINARY		

TITLE	NAME
DRAFTER	T. GUMEDE
DRAFTING CHECK	R. PIETERS
DESIGNER	T.GUMEDE
DESIGN CHECK	R. PIETERS
PROJECT MANAGER	T.CRONJE
PROJECT DIRECTOR	T.CRONJE

DRAWING APPROVED

ENGINEER: ....

PR ENG NR: ....

SIGNATURE: ....

SCALES AT A0 A1 SIZE DRAWING

SCALE 1:1

SCALE 1:50

SCALE 1:100

DESIGNER

SMEC South Africa — Member of the Surbana Jurong Group

SABS ISO 9001

CLIENT

GEORGE — THE CITY FOR ALL REASONS

GEORGE MUNICIPALITY

THEMBALETHU PUMP STATTION

STRUCTURAL DRAWING

FOUNDATION LAYOUT

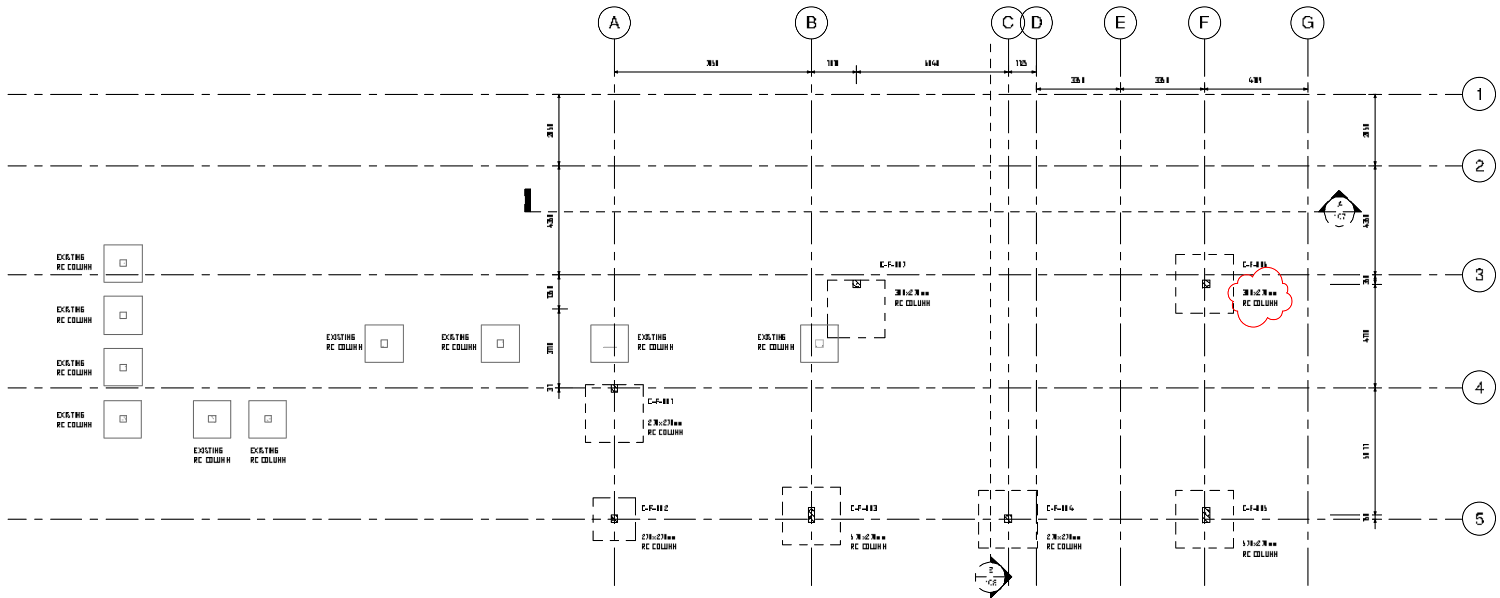
SCALE	DRAWING TYPE	DRAWING NUMBER	REVISION
1	DCH	102	D

150 mm ON ORIGINAL

A1

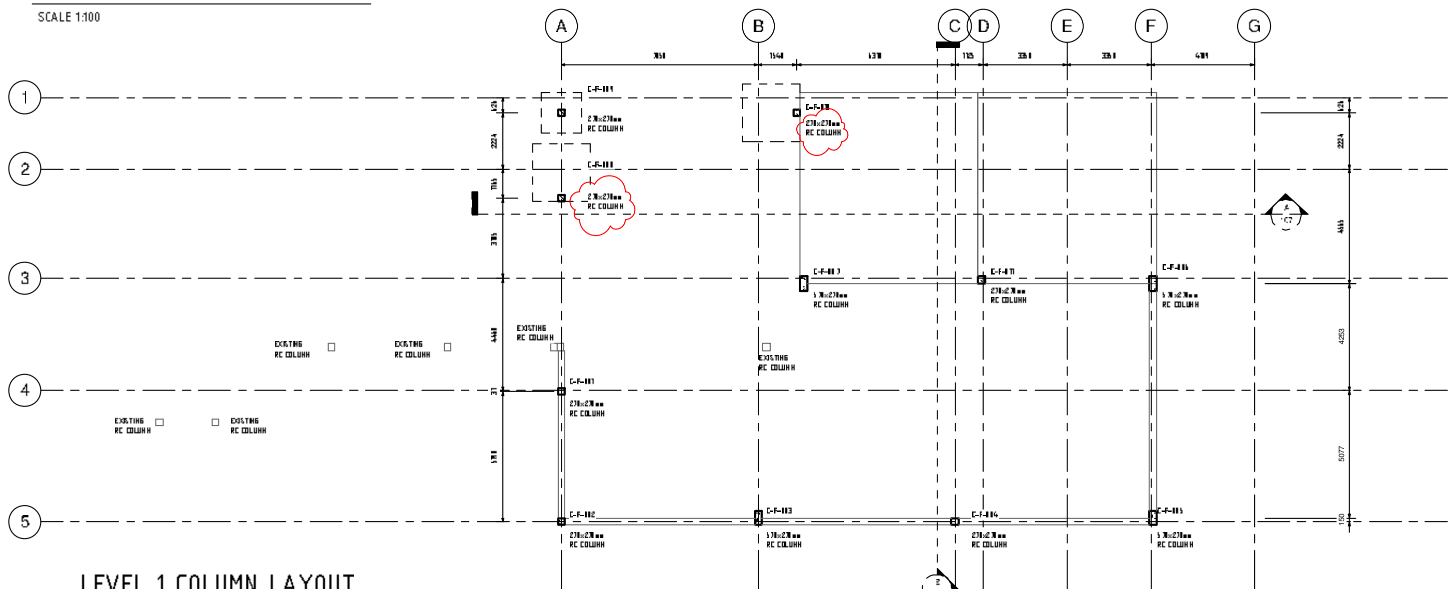
DRAWING FILE LOCATION / NAME

PLOT DATE TIME 2023/10/23 10:57:42



LEVEL -1 COLUMN LAYOUT

SCALE 1:100



LEVEL 1 COLUMN LAYOUT

SCALE 1:100

NOTES:

1. REFER TO DRAWING C1924-1-DNS-001 TO 003 FOR GENERAL NOTES.
2. REFER TO DRAWING C1934-1-DCN-110 FOR TYPICAL CONCRETE DETAILS.
3. REFER TO DRAWING C1934-1-DMA-111 FOR TYPICAL MASONRY DETAILS.
4. REFER TO DRAWING C1934-1-DST-112 FOR TYPICAL STEEL DETAILS.
5. BRICKFORCE TO BE SUPPLIED IN EVERY 4TH BRICK COURSE FOR ALL MASONRY ELEMENTS ABOVE & BELOW SURFACE BED LEVEL.
6. BRICKWORK SETTING OUT AS PER LAYOUTS.
7. ALLOWABLE BEARING PRESSURE = 150KPa.
8. ALL BUILDING WORK AND MATERIALS ARE TO COMPLY WITH LOCAL AUTHORITY'S REQUIREMENTS AND ARE TO BE IN ACCORDANCE WITH SANS 10400 NATIONAL BUILDING REGULATIONS.

LEGEND

ELEMENT NOMENCLATURE

ELEMENT:	LEVEL:	ELEMENT No:
B-BEAM	B-BASEMENT	001-999
C-COLUMN	F-FOUNDATION	
F-FOOTING	G-GROUND	
P-PENETRATION	1-9 LEVELS OR FLOORS HIGHER UP	
S-STAIR		
W-WALL		

[W] - [1] - [001]

PRELIMINARY

REV	DATE	AMENDMENT / REVISION DESCRIPTION
A	16.10.2023	PRELIMINARY
B	17.10.2023	UPDATED COLUMN SIZE LABEL

TITLE	NAME
DRAFTER	T. GUMEDE
DRAFTING CHECK	R. PIETERS
DESIGNER	T.GUMEDE
DESIGN CHECK	R. PIETERS
PROJECT MANAGER	T.CRONJE
PROJECT DIRECTOR	T.CRONJE

DRAWING APPROVED
ENGINEER: ....
PR ENG NR: ....
SIGNATURE: ....

SCALES AT A1 SIZE DRAWING
SCALE 1:1
SCALE 1:50
SCALE 1:100

DESIGNER: SMEC South Africa — Member of the Surbana Jurong Group

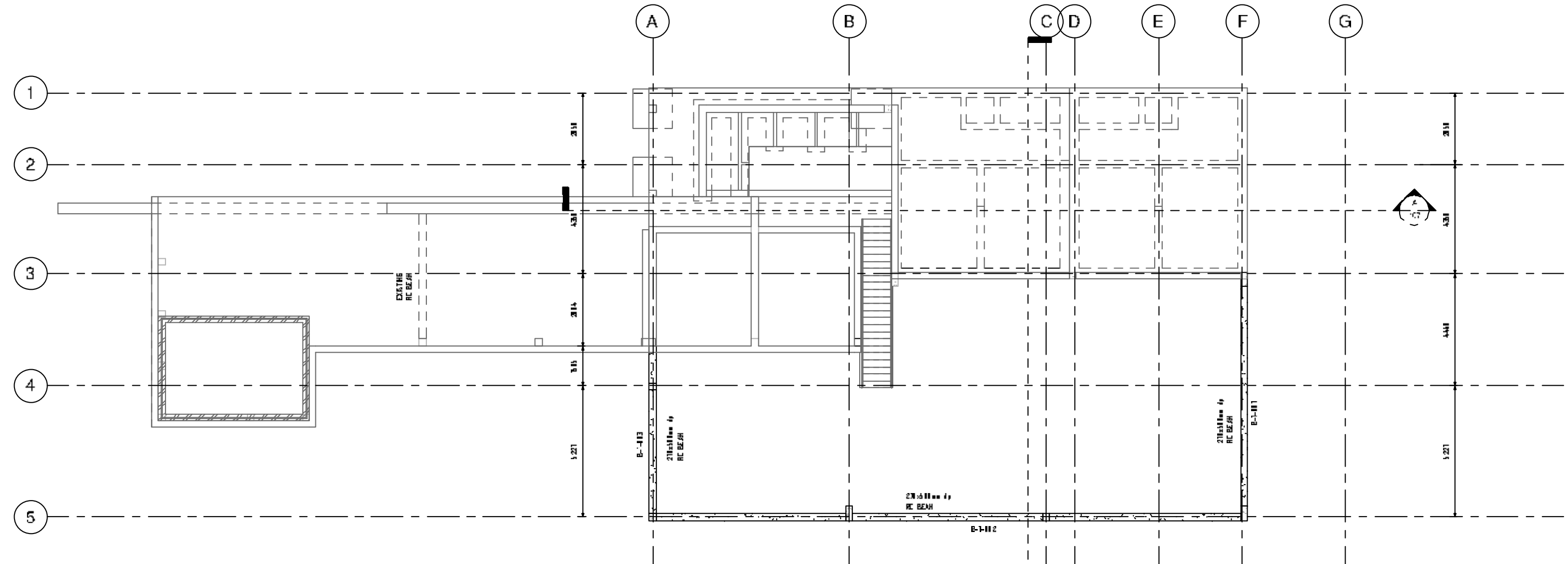
CLIENT: GEORGE — THE CITY FOR ALL REASONS

GEORGE MUNICIPALITY
THEMBALETHU PUMP STATION
STRUCTURAL DRAWING
COLUMN LAYOUT

SCALE	DRAWING TYPE	DRAWING NUMBER	REVISION
1	DCN	103	A

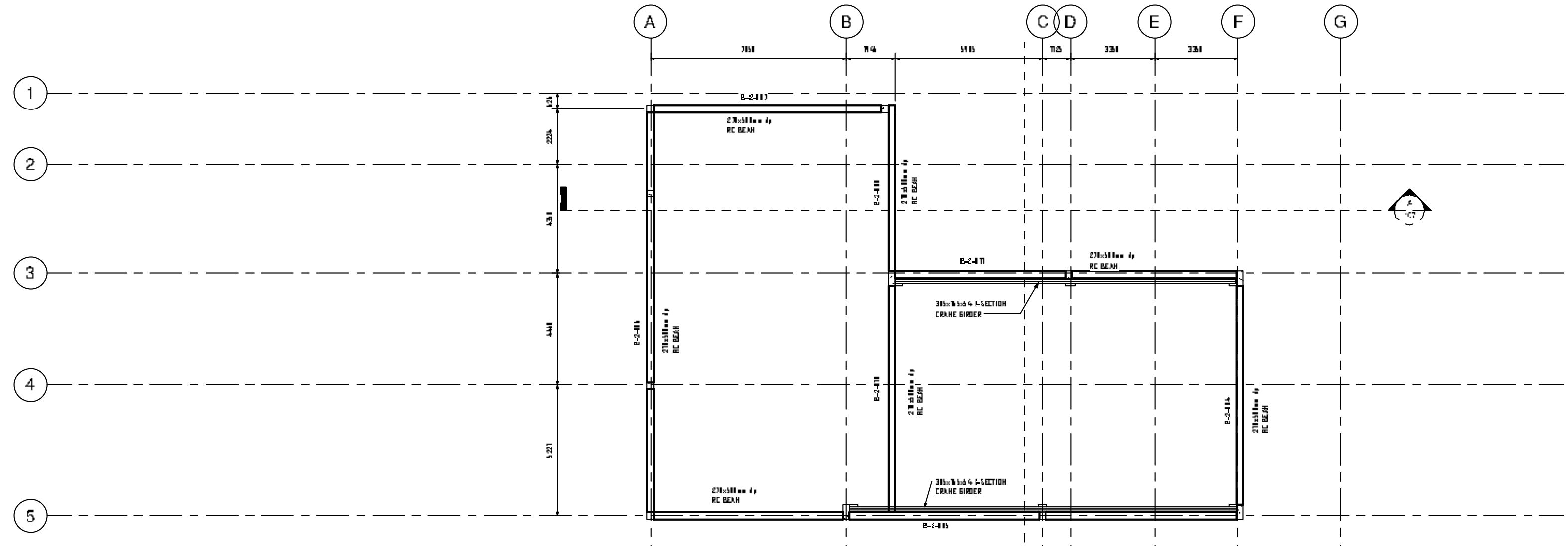
150 mm ON ORIGINAL

A1



LEVEL 1 BEAM LAYOUT

SCALE 1:100



LEVEL 3 BEAM LAYOUT

SCALE 1:100

NOTES:

1. REFER TO DRAWING C1924-1-DNS-001 TO 003 FOR GENERAL NOTES.
2. REFER TO DRAWING C1934-1-DCN-110 FOR TYPICAL CONCRETE DETAILS.
3. REFER TO DRAWING C1934-1-DMA-111 FOR TYPICAL MASONRY DETAILS.
4. REFER TO DRAWING C1934-1-DST-112 FOR TYPICAL STEEL DETAILS.
5. BRICKFORCE TO BE SUPPLIED IN EVERY 4TH BRICK COURSE FOR ALL MASONRY ELEMENTS ABOVE & BELOW SURFACE BED LEVEL.
6. BRICKWORK SETTING OUT AS PER LAYOUTS.
7. ALLOWABLE BEARING PRESSURE = 150KPa.
8. ALL BUILDING WORK AND MATERIALS ARE TO COMPLY WITH LOCAL AUTHORITY'S REQUIREMENTS AND ARE TO BE IN ACCORDANCE WITH SANS 10400 NATIONAL BUILDING REGULATIONS.

LEGEND

ELEMENT NOMENCLATURE

ELEMENT:	LEVEL:	ELEMENT No:
B-BEAM	B-BASEMENT	001-999
C-COLUMN	F-FOUNDATION	
F-FOOTING	G-GROUND	
P-PENETRATION	1-9 LEVELS OR	
S-STAIR	FLOORS HIGHER UP	
W-WALL		

[W] - [1] - [001]

PRELIMINARY

REV	DATE	AMENDMENT / REVISION DESCRIPTION	MVR No	APPROVAL
A	16.10.2023	PRELIMINARY	-	-

TITLE	NAME
DRAFTER	T. GUMEDE
DRAFTING CHECK	R. PIETERS
DESIGNER	T.GUMEDE
DESIGN CHECK	R. PIETERS
PROJECT MANAGER	T.CRONJE
PROJECT DIRECTOR	T.CRONJE

DRAWING APPROVED

ENGINEER: ....

PR ENG NR: ....

SIGNATURE: ....

SCALES AT A0 A1 SIZE DRAWING

SCALE 1:1

SCALE 1:50

SCALE 1:100

DESIGNER

SMEC South Africa

Member of the Surbana Jurong Group

SABS ISO 9001

CLIENT

GEORGE

THE CITY FOR ALL REASONS

GEORGE MUNICIPALITY

THEMBALETHU PUMP STATTION

STRUCTURAL DRAWING

BEAM LAYOUT

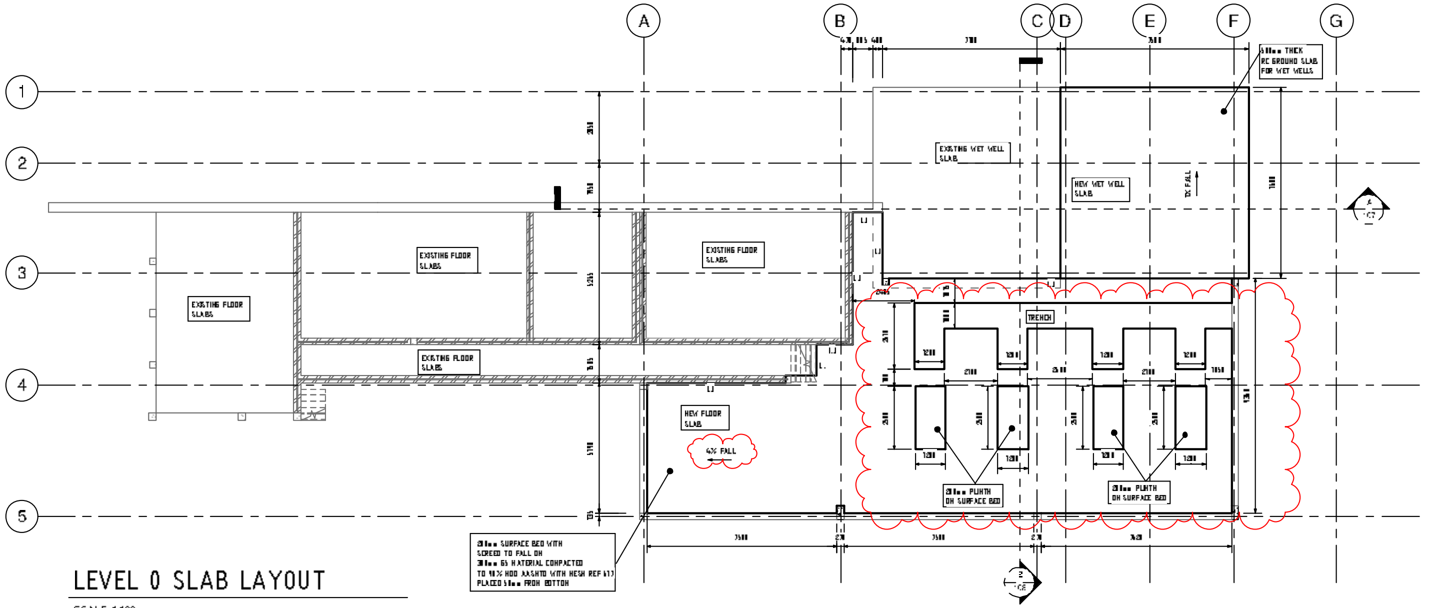
SCALE	DRAWING TYPE	DRAWING NUMBER	REVISION
1	DCN	106	A

PLOT DATE TIME 2023/10/17 18:14:12

DRAWING FILE LOCATION / NAME

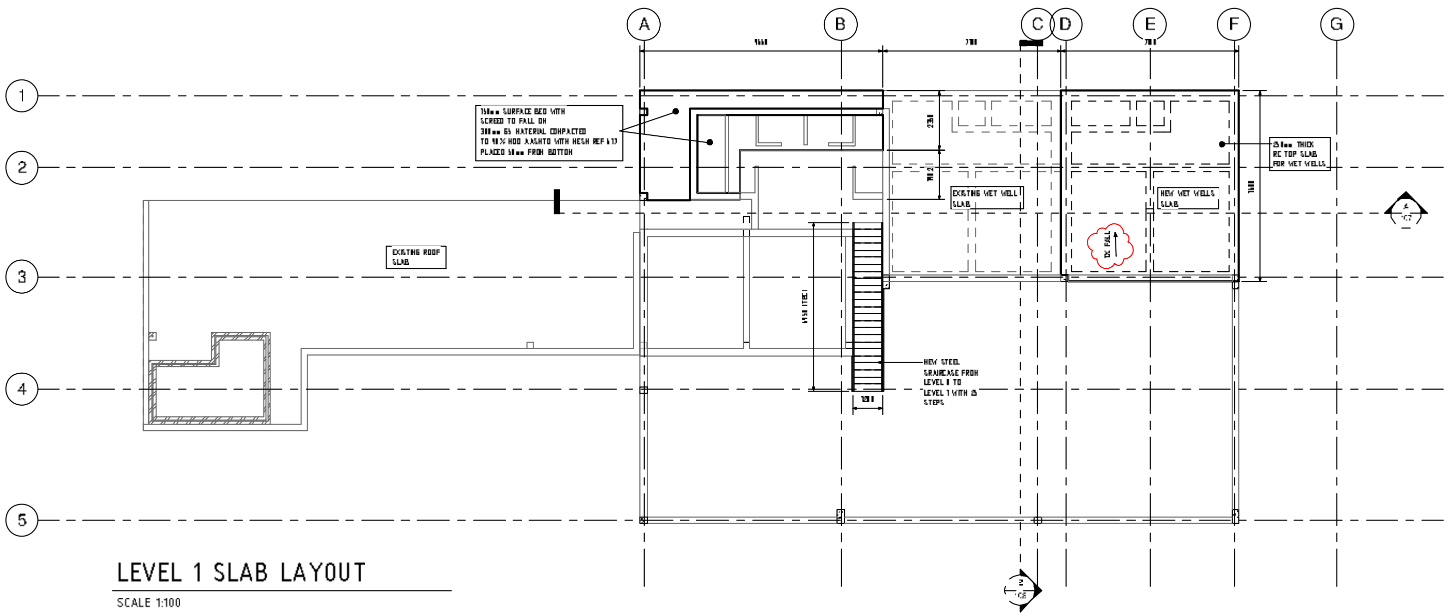
150 mm ON ORIGINAL

A1



LEVEL 0 SLAB LAYOUT

SCALE 1:100



LEVEL 1 SLAB LAYOUT

SCALE 1:100

NOTES:

1. REFER TO DRAWING C1924-1-DNS-001 TO 003 FOR GENERAL NOTES.
2. REFER TO DRAWING C1934-1-DCN-109 FOR TYPICAL CONCRETE DETAILS.
3. REFER TO DRAWING C1934-1-DMA-110 FOR TYPICAL MASONRY DETAILS.
4. REFER TO DRAWING C1934-1-DST-111 TO 112 FOR TYPICAL STEEL DETAILS.
5. BRICKFORCE TO BE SUPPLIED IN EVERY 4TH BRICK COURSE FOR ALL MASONRY ELEMENTS ABOVE & BELOW SURFACE BED LEVEL.
6. BRICKWORK SETTING OUT AS PER LAYOUTS.
7. ALLOWABLE BEARING PRESSURE = 150KPa.
8. ALL BUILDING WORK AND MATERIALS ARE TO COMPLY WITH LOCAL AUTHORITY'S REQUIREMENTS AND ARE TO BE IN ACCORDANCE WITH SANS 10400 NATIONAL BUILDING REGULATIONS.
9. ALL DIMENSIONS TO BE VERIFIED ON SITE PRIOR TO START OF CONSTRUCTION. ANY DESCRAPANCIES TO BE REPORTED TO THE ENGINEER.

LEGEND

ELEMENT NOMENCLATURE

ELEMENT:	LEVEL:	ELEMENT No:
B-BEAM	B-BASEMENT	001-999
C-COLUMN	F-FOUNDATION	
F-FOOTING	G-GROUND	
P-PENETRATION	1-9 LEVELS OR	
S-STAIR	FLOORS HIGHER UP	
W-WALL		

[W] - [1] - [001]

NOTE:

1. SAW-CUT JOINTS OR KEYED CONSTRUCTION JOINTS AT A MAXIMUM SPACING 30x SLAB THICKNESS OR 4500mm WHICHEVER IS LESSER (SEE TYPICAL DETAIL).
2. MESH DISCONTINUING OVER JOINTS. (SEE TYPICAL DETAIL)
3. RECTANGULAR SAW-CUT PANEL ASPECT RATIO TO BE NOT MORE THAN 1:1,25

PRELIMINARY

REV	DATE	AMENDMENT / REVISION DESCRIPTION	WVE No	APPROVAL
A	16.10.2023	PRELIMINARY	-	-
B	17.10.2023	PRELIMINARY	-	-
C	23.10.2023	PRELIMINARY	-	-

TITLE	NAME
DRAFTER	T. GUMEDE
DRAFTING CHECK	R. PIETERS
DESIGNER	T.GUMEDE
DESIGN CHECK	R. PIETERS
PROJECT MANAGER	T.CRONJE
PROJECT DIRECTOR	T.CRONJE

DRAWING APPROVED

ENGINEER: ....

PR ENG NR: ....

SIGNATURE: ....

SCALES AT A0 A1 SIZE DRAWING

SCALE 1:1

SCALE 1:50

SCALE 1:100

DESIGNER

SMEC South Africa
Member of the Surbana Jurong Group

SABS ISO 9001

CLIENT

GEORGE THE CITY FOR ALL REASONS

GEORGE MUNICIPALITY
THEMBALETHU PUMP STATTION
STRUCTURAL DRAWING
SLAB LAYOUT

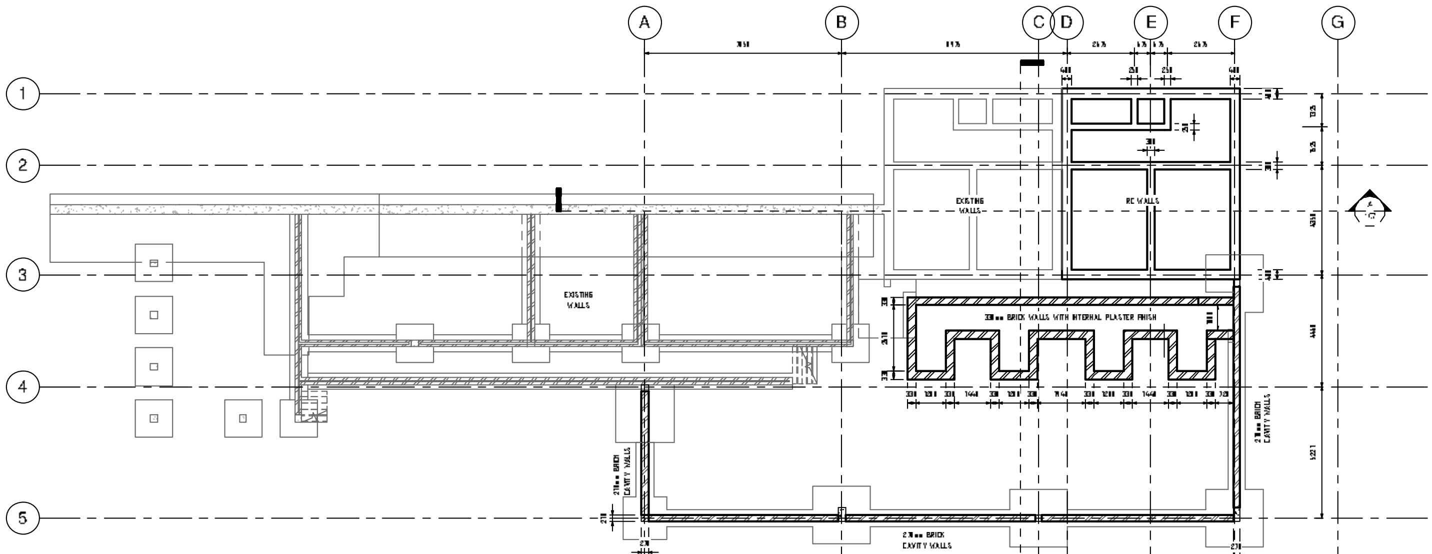
SCALE	DRAWING TYPE	DRAWING NUMBER	REVISION
1	DCN	105	C

PLOT DATE TIME 2023/10/23 10:53:24

DRAWING FILE LOCATION / NAME

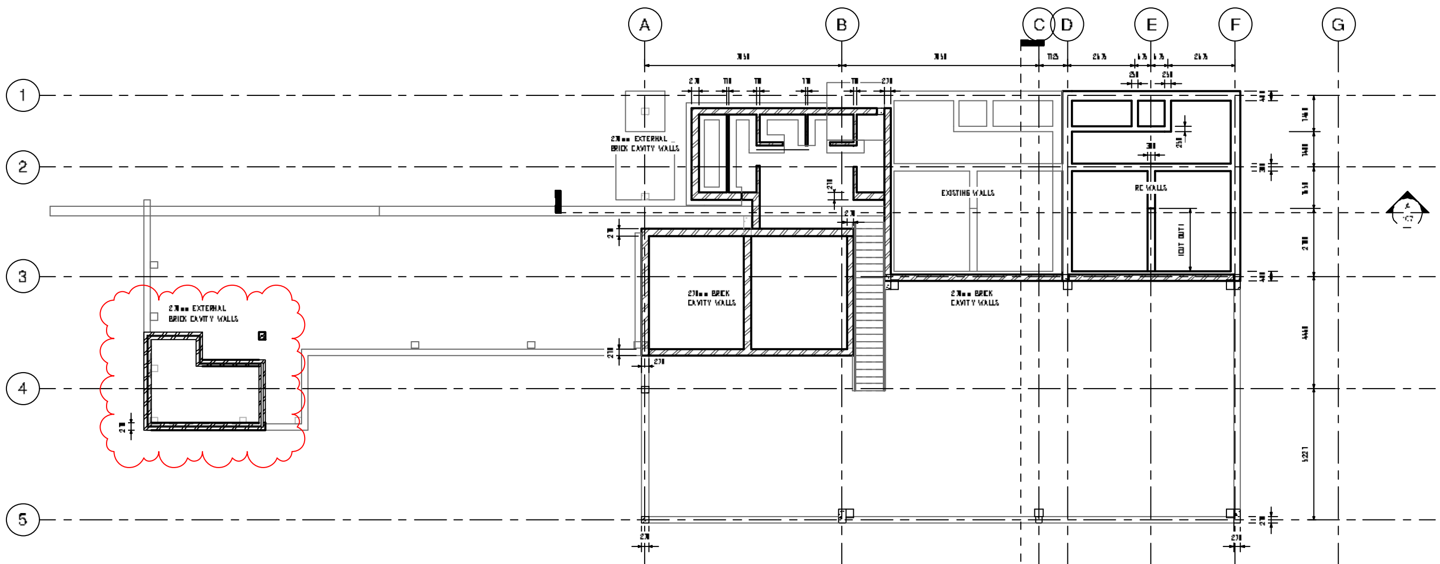
150 mm ON ORIGINAL

A1



LEVEL -1 WALL LAYOUT

SCALE 1:100



LEVEL 1 WALL LAYOUT

SCALE 1:100

NOTES:

1. REFER TO DRAWING C1924-1-DNS-001 TO 003 FOR GENERAL NOTES.
2. REFER TO DRAWING C1934-1-DCN-109 FOR TYPICAL CONCRETE DETAILS.
3. REFER TO DRAWING C1934-1-DMA-110 FOR TYPICAL MASONRY DETAILS.
4. REFER TO DRAWING C1934-1-DST-111 TO 112 FOR TYPICAL STEEL DETAILS.
5. BRICKFORCE TO BE SUPPLIED IN EVERY 4TH BRICK COURSE FOR ALL MASONRY ELEMENTS ABOVE & BELOW SURFACE BED LEVEL.
6. BRICKWORK SETTING OUT AS PER LAYOUTS.
7. ALLOWABLE BEARING PRESSURE = 150KPa.
8. ALL BUILDING WORK AND MATERIALS ARE TO COMPLY WITH LOCAL AUTHORITY'S REQUIREMENTS AND ARE TO BE IN ACCORDANCE WITH SANS 10400 NATIONAL BUILDING REGULATIONS.
9. ALL DIMENSIONS TO BE VERIFIED ON SITE PRIOR TO START OF CONSTRUCTION. ANY DESCRAPANCIES TO BE REPORTED TO THE ENGINEER.

LEGEND

ELEMENT NOMENCLATURE

ELEMENT:	LEVEL:	ELEMENT No:
B-BEAM	B-BASEMENT	001-999
C-COLUMN	F-FOUNDATION	
F-FOOTING	G-GROUND	
P-PENETRATION	1-9 LEVELS OR FLOORS HIGHER UP	
S-STAIR		
W-WALL		

[W] - [1] - [001]

PRELIMINARY

REV	DATE	AMENDMENT / REVISION DESCRIPTION
A	16.10.2023	PRELIMINARY
B	23.10.2023	PRELIMINARY
C	26.10.2023	PRELIMINARY

TITLE	NAME
DRAFTER	T. GUMEDE
DRAFTING CHECK	R. PIETERS
DESIGNER	T.GUMEDE
DESIGN CHECK	R. PIETERS
PROJECT MANAGER	T.CRONJE
PROJECT DIRECTOR	T.CRONJE

DRAWING APPROVED

ENGINEER: ....

PR ENG NR: ....

SIGNATURE: ....

SCALES AT A1 SIZE DRAWING

SCALE 1:1

SCALE 1:50

SCALE 1:100

DESIGNER

SMEC South Africa — Member of the Surbana Jurong Group

SABS ISO 9001

CLIENT

GEORGE — THE CITY FOR ALL REASONS

GEORGE MUNICIPALITY

THEMBALETHU PUMP STATTION

STRUCTURAL DRAWING

WALL LAYOUT

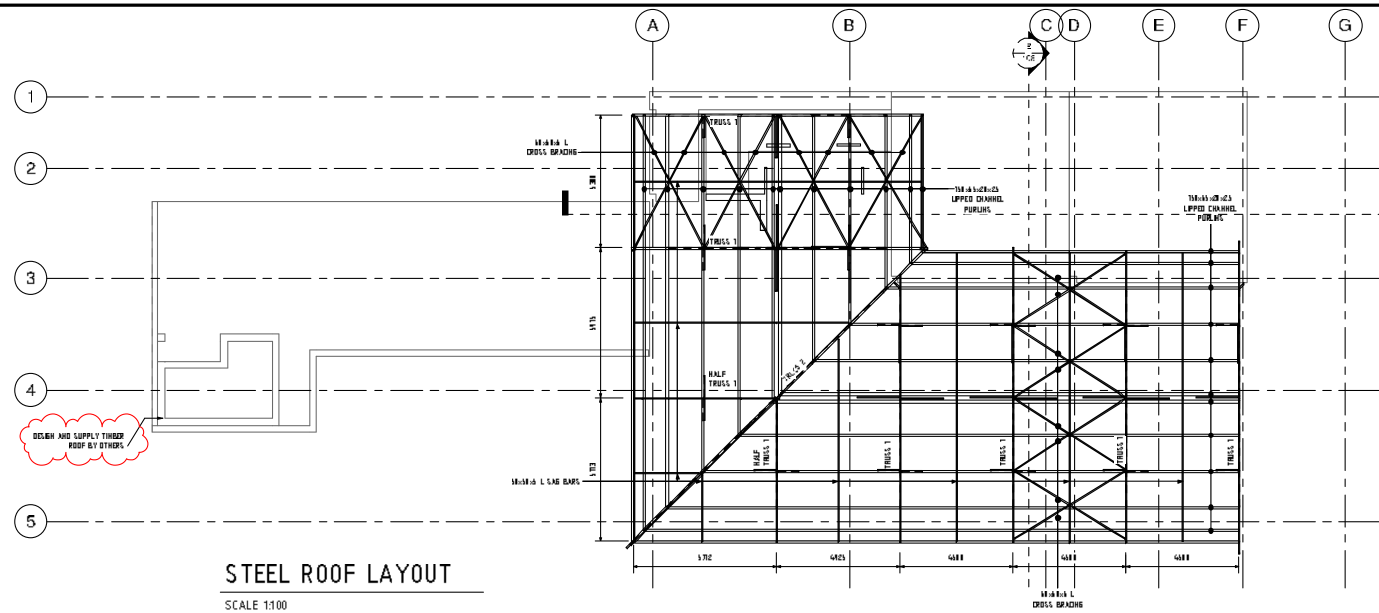
SCALE	DRAWING TYPE	DRAWING NUMBER	REVISION
1	DCN	106	C

PLOT DATE 2023/10/26 TIME 10:44:53

DRAWING FILE LOCATION / NAME

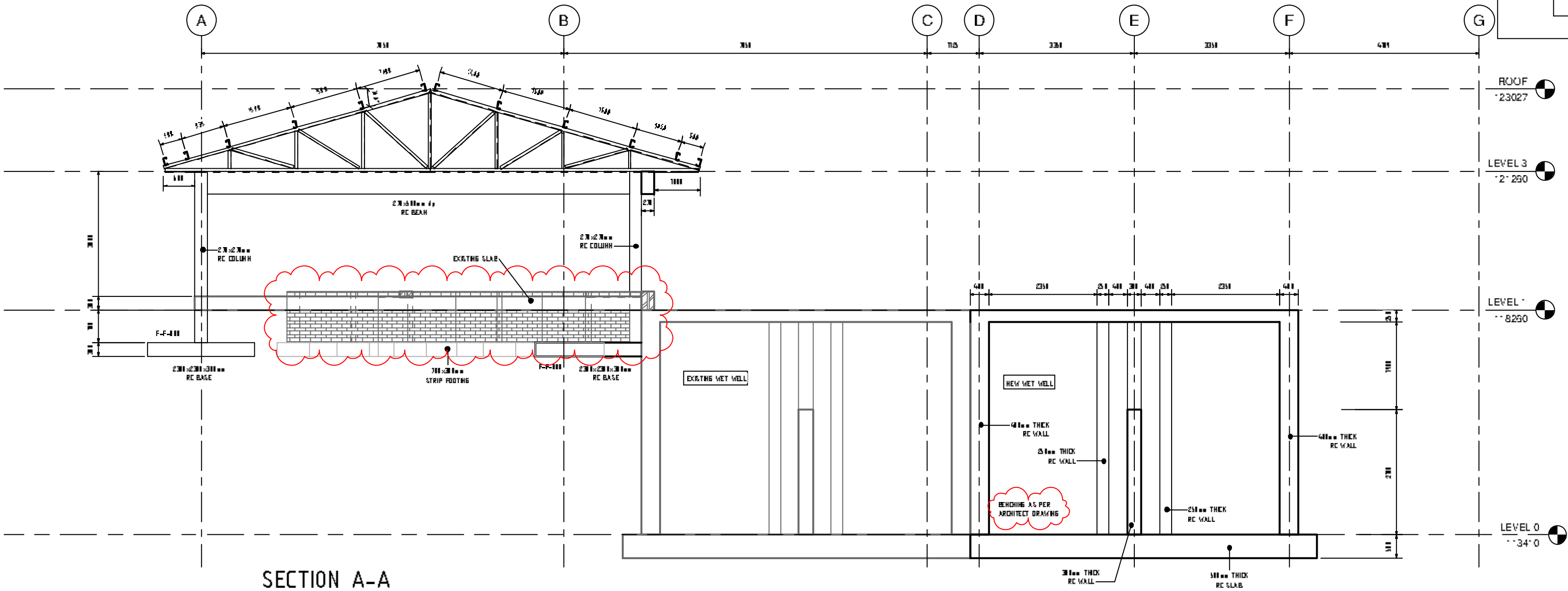
150 mm ON ORIGINAL

A1



STEEL ROOF LAYOUT

SCALE 1:100



SECTION A-A

SCALE 1:150

NOTES:

1. REFER TO DRAWING C1924-1-DNS-001 TO 003 FOR GENERAL NOTES.
2. REFER TO DRAWING C1934-1-DCN-109 FOR TYPICAL CONCRETE DETAILS.
3. REFER TO DRAWING C1934-1-DMA-110 FOR TYPICAL MASONRY DETAILS.
4. REFER TO DRAWING C1934-1-DST-111 TO 112 FOR TYPICAL STEEL DETAILS.
5. REFER TO DRAWING C1934-1-DST-112 FOR TYPICAL STEEL DETAILS.
6. BRICKFORCE TO BE SUPPLIED IN EVERY 4TH BRICK COURSE FOR ALL MASONRY ELEMENTS ABOVE & BELOW SURFACE BED LEVEL.
7. BRICKWORK SETTING OUT AS PER LAYOUTS.
8. ALLOWABLE BEARING PRESSURE = 150KPa.
9. ALL BUILDING WORK AND MATERIALS ARE TO COMPLY WITH LOCAL AUTHORITY'S REQUIREMENTS AND ARE TO BE IN ACCORDANCE WITH SANS 10400 NATIONAL BUILDING REGULATIONS.
10. ALL DIMENSIONS TO BE VERIFIED ON SITE PRIOR TO START OF CONSTRUCTION. ANY DESCRAPANCIES TO BE REPORTED TO THE ENGINEER.

LEGEND

ELEMENT NOMENCLATURE

ELEMENT:	LEVEL:	ELEMENT No:
B-BEAM	B-BASEMENT	001-999
C-COLUMN	F-FOUNDATION	
F-FOOTING	G-GROUND	
P-PENETRATION	1-9 LEVELS OR FLOORS HIGHER UP	
S-STAIR		
W-WALL		

W - 1 - 001

PRELIMINARY

REV	DATE	AMENDMENT / REVISION DESCRIPTION
A	16.10.2023	PRELIMINARY
B	17.10.2023	PRELIMINARY
C	23.10.2023	PRELIMINARY

TITLE	NAME
DRAFTER	T. GUMEDE
DRAFTING CHECK	R. PIETERS
DESIGNER	T.GUMEDE
DESIGN CHECK	R. PIETERS
PROJECT MANAGER	T.CRONJE
PROJECT DIRECTOR	T.CRONJE

DRAWING APPROVED

ENGINEER: ....

PR ENG NR: ....

SIGNATURE: ....

SCALES AT A1 AT SIZE DRAWING

SCALE 1:1

SCALE 1:50

SCALE 1:100

DESIGNER

SMEC South Africa

Member of the Surbana Jurong Group

SABS ISO 9001

CLIENT

GEORGE THE CITY FOR ALL REASONS

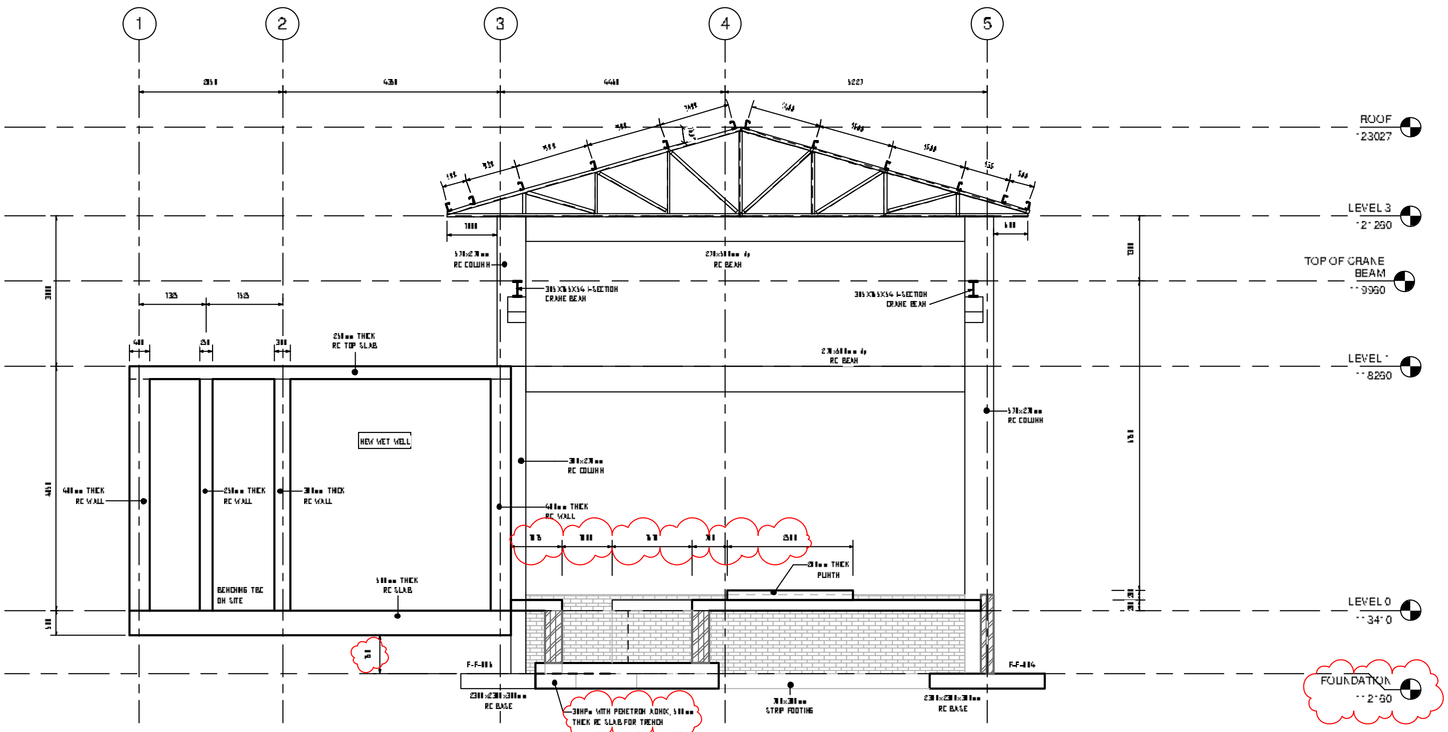
GEORGE MUNICIPALITY

THEMBALETHU PUMP STATTION

STRUCTURAL DRAWING

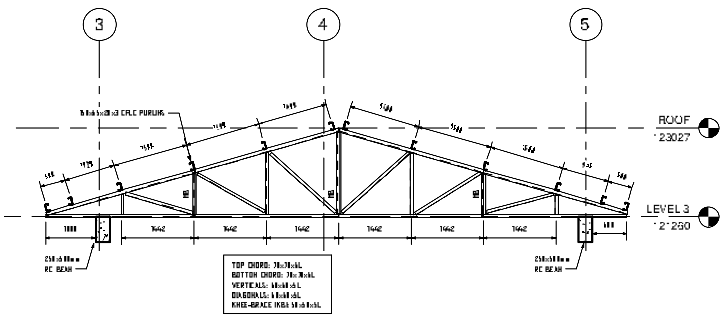
STEEL ROOF LAYOUT & SECTION

SCALE	DRAWING TYPE	DRAWING NUMBER	REVISION
1	DST	107	C



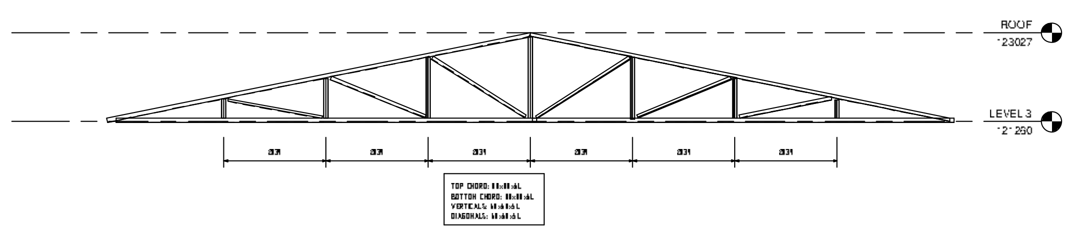
SECTION B-B

SCALE 1:50



TRUSS 1

SCALE 1:50



TRUSS 2

SCALE 1:50

NOTES:

1. REFER TO DRAWING C1924-1-DNS-001 TO 003 FOR GENERAL NOTES.
2. REFER TO DRAWING C1934-1-DCN-109 FOR TYPICAL CONCRETE DETAILS.
3. REFER TO DRAWING C1934-1-DMA-110 FOR TYPICAL MASONRY DETAILS.
4. REFER TO DRAWING C1934-1-DST-111 TO 112 FOR TYPICAL STEEL DETAILS.
5. BRICKFORCE TO BE SUPPLIED IN EVERY 4TH BRICK COURSE FOR ALL MASONRY ELEMENTS ABOVE & BELOW SURFACE BED LEVEL.
6. BRICKWORK SETTING OUT AS PER LAYOUTS.
7. ALLOWABLE BEARING PRESSURE = 150KPa.
8. ALL BUILDING WORK AND MATERIALS ARE TO COMPLY WITH LOCAL AUTHORITY'S REQUIREMENTS AND ARE TO BE IN ACCORDANCE WITH SANS 10400 NATIONAL BUILDING REGULATIONS.
9. ALL DIMENSIONS TO BE VERIFIED ON SITE PRIOR TO START OF CONSTRUCTION. ANY DESCRAPANCIES TO BE REPORTED TO THE ENGINEER.

LEGEND

ELEMENT NOMENCLATURE

ELEMENT:	LEVEL:	ELEMENT No:
B-BEAM	B-BASEMENT	001-999
C-COLUMN	F-FOUNDATION	
F-FOOTING	G-GROUND	
P-PENETRATION	1-9 LEVELS OR FLOORS HIGHER UP	
S-STAIR		
W-WALL		

[W] - [1] - [001]

PRELIMINARY

REV	DATE	AMENDMENT / REVISION DESCRIPTION
A	16.10.2023	PRELIMINARY
B	17.10.2023	PRELIMINARY
C	23.10.2023	PRELIMINARY

TITLE	NAME
DRAFTER	T. GUMEDE
DRAFTING CHECK	R. PIETERS
DESIGNER	T.GUMEDE
DESIGN CHECK	R. PIETERS
PROJECT MANAGER	T.CRONJE
PROJECT DIRECTOR	T.CRONJE

DRAWING APPROVED

ENGINEER:

PR ENG NR:

SIGNATURE:

DESIGNER: SMEC South Africa — Member of the Surbana Jurong Group

SABS ISO 9001

CLIENT: GEORGE — THE CITY FOR ALL REASONS

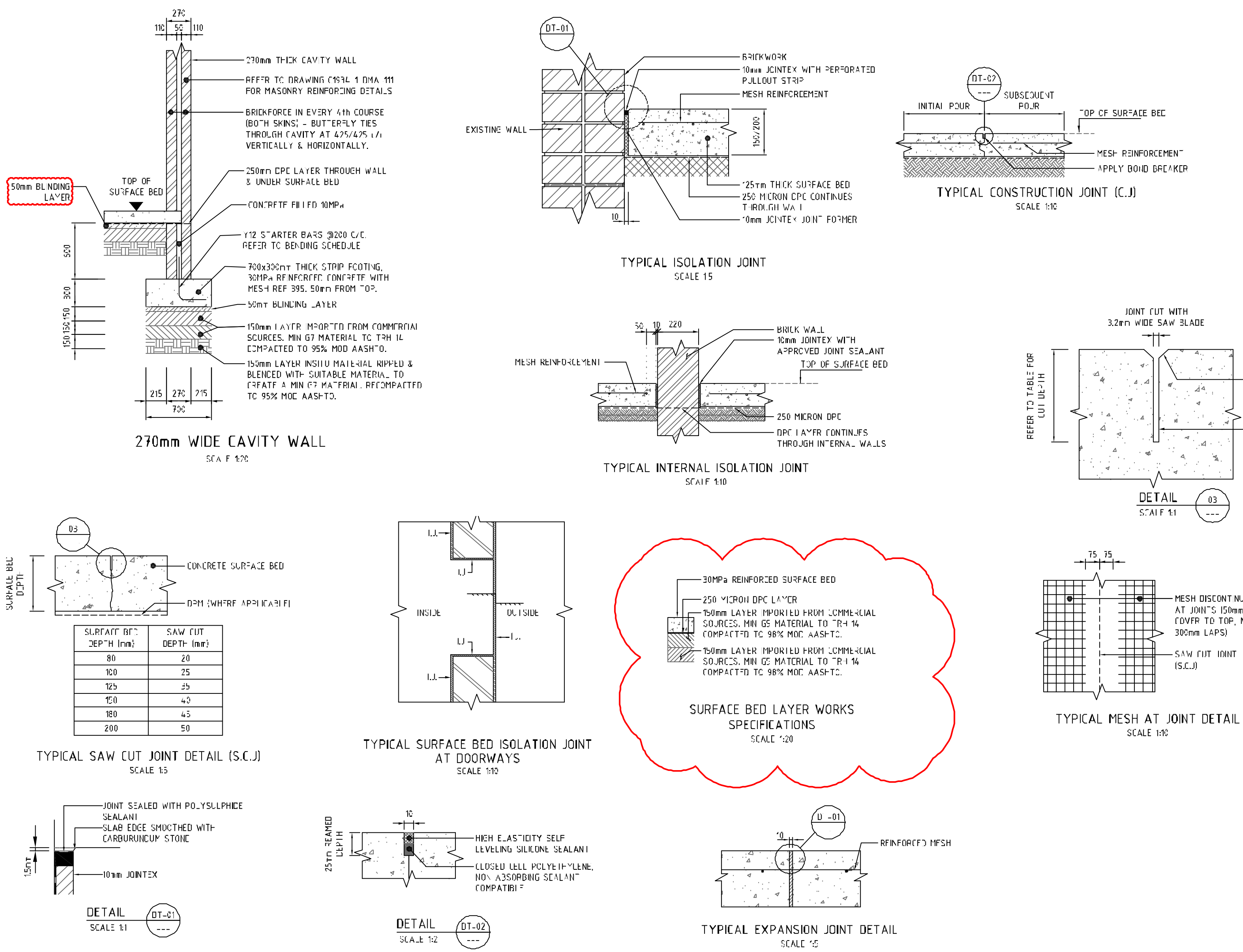
GEORGE MUNICIPALITY

THEMBALETHU PUMP STATTION

STRUCTURAL DRAWING

SECTIONS

PHASE	DRAWING TYPE	DRAWING NUMBER	REVISION
1	DCN	108	C



SURFACE BED DEPTH (mm)	SAW CUT DEPTH (mm)
80	20
100	25
125	35
150	40
180	45
200	50

TYPICAL SAW CUT JOINT DETAIL (S.C.J)
SCALE 1:5

NOTE:
1. REFER TO DRAWINGS C1924-1-DNS-001 TO 003 FOR GENERAL NOTES.
2. REFER TO DRAWINGS C1924-1-DCN-103 TO 105 FOR CONCRETE LAYOUTS.
3. REFER TO DRAWINGS C1924-1-DCN-106 FOR MASONARY LAYOUTS.
4. REFER TO DRAWING C1932-1-DST-107 & 108 FOR STEEL ELEVATIONS & SECTIONS.

FOR APPROVAL

REV	DATE	AMENDMENT / REVISION DESCRIPTION
A		PRELIMINARY
B		PRELIMINARY

TITLE	NAME
DRAFTER	T. GUNTER
DRAWING CHECK	A. MEYERS
DESIGNER	T. GUNTER
DESIGN CHECK	A. MEYERS
PROJECT MANAGER	T. CRONJE
PROJECT DIRECTOR	T. CRONJE

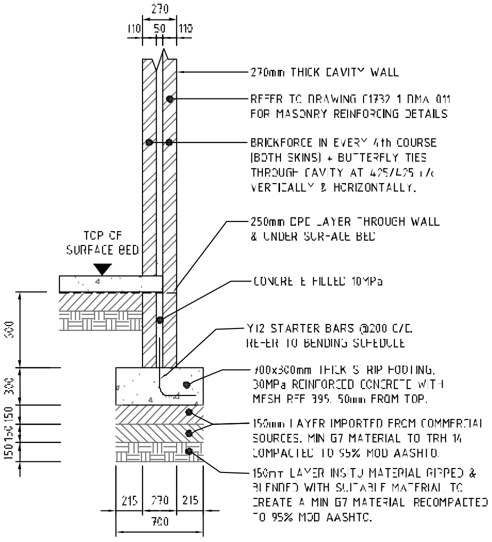
DRAWING APPROVED
ENGINEER: ....
PR ENG NR: ....
SIGNATURE: ....

SMEC PROJECT NO. 1924

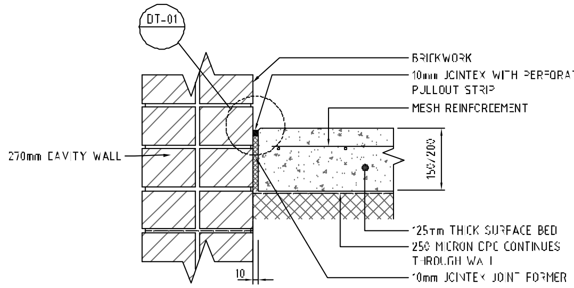
GEORGE MUNICIPALITY
THEMBALETHU PUMP STATION
STRUCTURAL DRAWING
CONCRETE TYPICAL DETAILS

PHASE	DRAWING TYPE	DRAWING NUMBER	REVISION
1	DCN	199	B

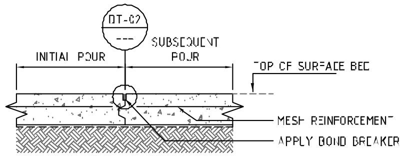
NOTE:
1. REFER TO DRAWINGS C1924-1-DNS-001 TO 003 FOR GENERAL NOTES.
2. REFER TO DRAWINGS C1924-1-DCN-103 TO 105 FOR CONCRETE LAYOUTS.
3. REFER TO DRAWINGS C1924-1-DCN-106 FOR MASONARY LAYOUTS.
4. REFER TO DRAWING C1732-1-DST-107 & 108 FOR STEEL ELEVATIONS & SECTIONS.



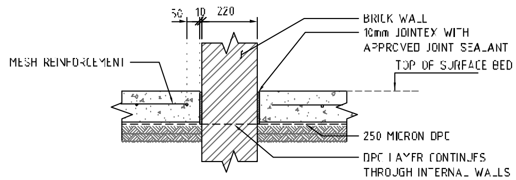
270mm WIDE CAVITY WALL
SCALE 1:20



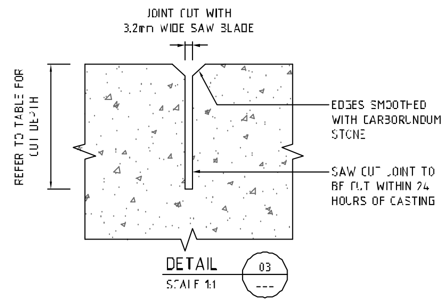
TYPICAL ISOLATION JOINT
SCALE 1:5



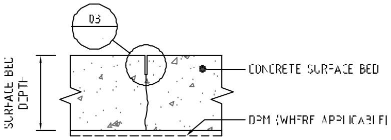
TYPICAL CONSTRUCTION JOINT (C.J)
SCALE 1:10



TYPICAL INTERNAL ISOLATION JOINT
SCALE 1:10

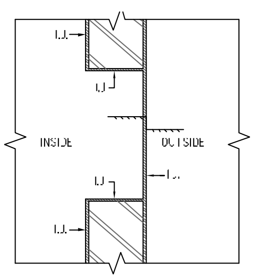


DETAIL 03
SCALE 1:1

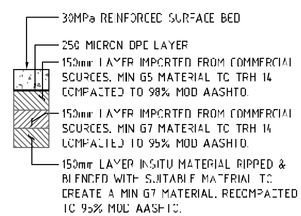


SURFACE BED DEPTH (mm)	SAW CUT DEPTH (mm)
80	20
100	25
125	35
150	40
180	45
200	50

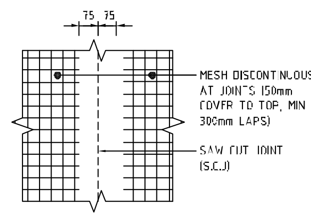
TYPICAL SAW CUT JOINT DETAIL (S.C.J)
SCALE 1:5



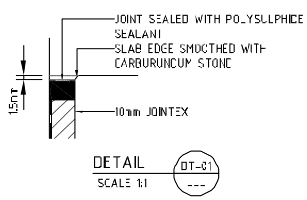
TYPICAL SURFACE BED ISOLATION JOINT AT DOORWAYS
SCALE 1:10



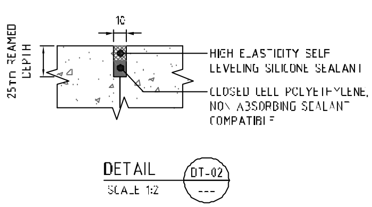
SURFACE BED LAYER WORKS SPECIFICATIONS
SCALE 1:20



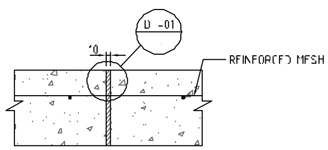
TYPICAL MESH AT JOINT DETAIL
SCALE 1:10



DETAIL DT-01
SCALE 1:1



DETAIL DT-02
SCALE 1:2



TYPICAL EXPANSION JOINT DETAIL
SCALE 1:5

FOR APPROVAL

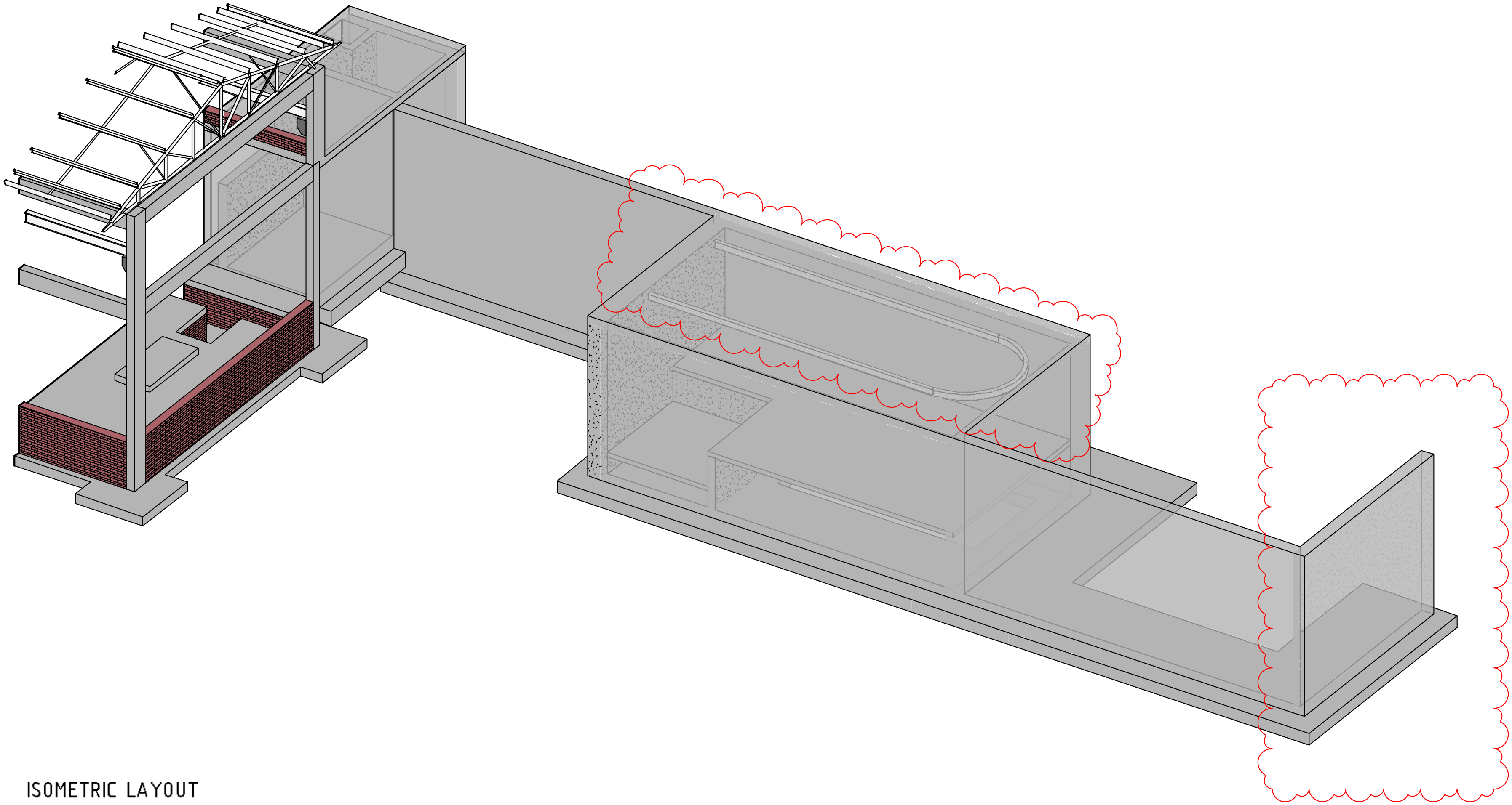
REV	DATE	AMENDMENT / REVISION DESCRIPTION
A	10.10.20	PRELIMINARY

TITLE	NAME
DRAFTER	T. GUNDIDE
DRAFTING CHECK	A. MEYERS
DESIGNER	T. GUNDIDE
DESIGN CHECK	A. MEYERS
PROJECT MANAGER	T. FONLE
PROJECT DIRECTOR	T. FONLE

SMEC PROJECT NO. 1924

GEORGE MUNICIPALITY
THEMBALETHU PUMP STATION
STRUCTURAL DRAWING
TYPICAL DETAILS

PHASE	DRAWING TYPE	DRAWING NUMBER	REVISION
1	DCN	109	A



ISOMETRIC LAYOUT

PRELIMINARY

REV	DATE	AMENDMENT / REVISION DESCRIPTION	MVR No	APPROVAL
A	17.10.2023	PRELIMINARY	-	-
B	23.10.2023	PRELIMINARY	-	-

TITLE	NAME
DRAFTER	T. GUMEDE
DRAFTING CHECK	R. PIETERS
DESIGNER	T.GUMEDE
DESIGN CHECK	R. PIETERS
PROJECT MANAGER	T.CRONJE
PROJECT DIRECTOR	T.CRONJE

DRAWING APPROVED
ENGINEER: ....
PR ENG NR: ....
SIGNATURE: ....

SCALES AT A0 A1 SIZE DRAWING
SCALE 1:1
SCALE 1:50
SCALE 1:100

DESIGNER
SMEC South Africa
Member of the Surbana Jurong Group
SABS ISO 9001

CLIENT
GEORGE THE CITY FOR ALL REASONS

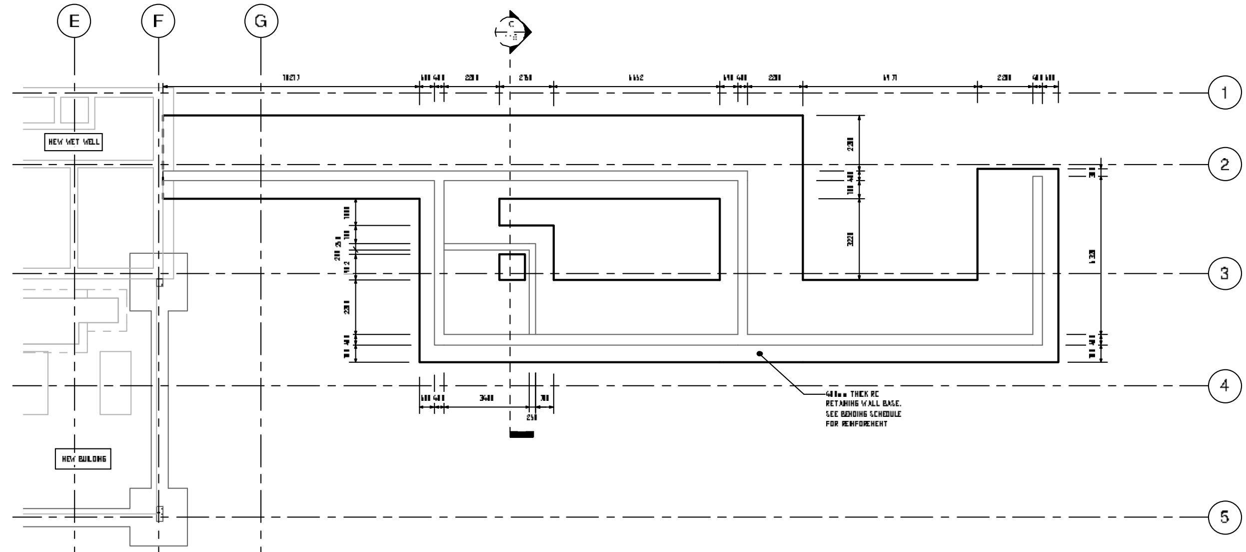
GEORGE MUNICIPALITY
THEMBALETHU PUMP STATTION
STRUCTURAL DRAWING
RETAINING WALL AND CHAMBER ISOMETRIC LAYOUT

PHASE	DRAWING TYPE	DRAWING NUMBER	REVISION
1	DCH	18	B

A1
150 mm ON ORIGINAL
DRAWING FILE LOCATION / NAME
PLOT DATE TIME 2023/10/23 11:13:34

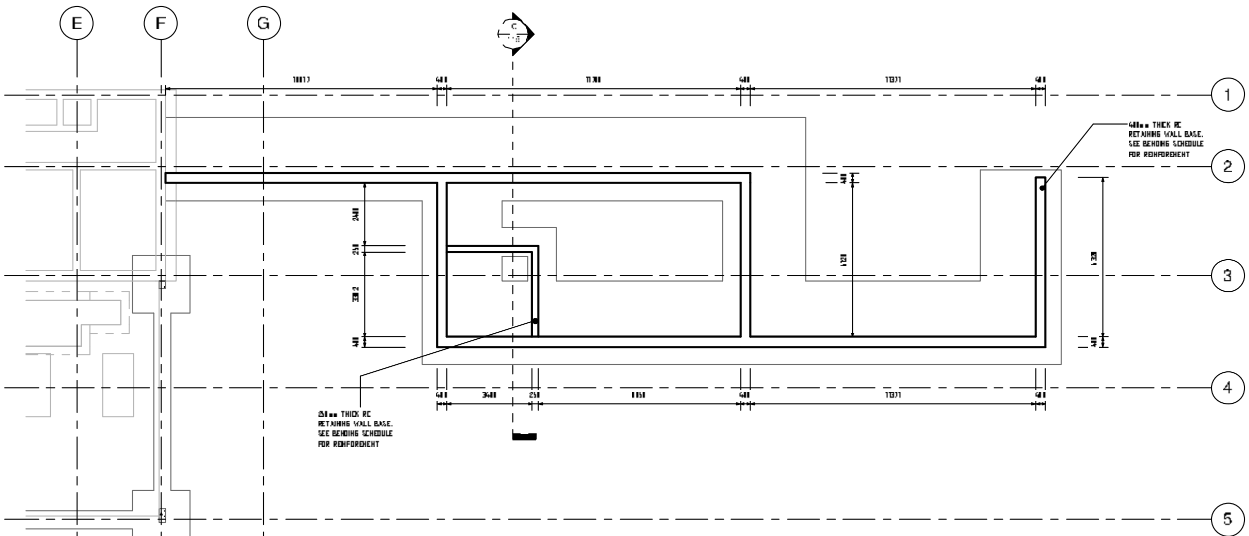
NOTES:

1. REFER TO DRAWING C1924-1-DNS-001 TO 003 FOR GENERAL NOTES.
2. REFER TO DRAWING C1934-1-DCN-113 TO 115 FOR CONCRETE LAYOUTS
3. REFER TO DRAWING C1934-1-DCN-109 FOR TYPICAL CONCRETE DETAILS.
4. REFER TO DRAWING C1934-1-DMA-110 FOR TYPICAL MASONRY DETAILS.
5. REFER TO DRAWING C1934-1-DST-111 TO 112 FOR TYPICAL STEEL DETAILS.
6. BRICKFORCE TO BE SUPPLIED IN EVERY 4TH BRICK COURSE FOR ALL MASONRY ELEMENTS ABOVE & BELOW SURFACE BED LEVEL.
7. BRICKWORK SETTING OUT AS PER LAYOUTS.
8. ALLOWABLE BEARING PRESSURE = 150KPa.
9. ALL BUILDING WORK AND MATERIALS ARE TO COMPLY WITH LOCAL AUTHORITY'S REQUIREMENTS AND ARE TO BE IN ACCORDANCE WITH SANS 10400 NATIONAL BUILDING REGULATIONS.



RC BASE LAYOUT

SCALE 1:100



RC WALL LAYOUT

SCALE 1:100

LEGEND

ELEMENT NOMENCLATURE

ELEMENT:	LEVEL:	ELEMENT No:
B-BEAM	B-BASEMENT	001-999
C-COLUMN	F-FOUNDATION	
F-FOOTING	G-GROUND	
P-PENETRATION	1-9 LEVELS OR	
S-STAIR	FLOORS HIGHER UP	
W-WALL		

W - 1 - 001

NOTE:

1. SAW-CUT JOINTS OR KEYED CONSTRUCTION JOINTS AT A MAXIMUM SPACING 30x SLAB THICKNESS OR 4500mm WHICHEVER IS LESSER (SEE TYPICAL DETAIL).
2. MESH DISCONTINUING OVER JOINTS. (SEE TYPICAL DETAIL)
3. RECTANGULAR SAW-CUT PANEL ASPECT RATIO TO BE NOT MORE THAN 1:1,25

PRELIMINARY

REV	DATE	AMENDMENT / REVISION DESCRIPTION	MVR No	APPROVAL
A	17.10.2023	PRELIMINARY	-	-
B			-	-

TITLE	NAME
DRAFTER	T. GUMEDE
DRAFTING CHECK	R. PIETERS
DESIGNER	T.GUMEDE
DESIGN CHECK	R. PIETERS
PROJECT MANAGER	T.CRONJE
PROJECT DIRECTOR	T.CRONJE

DRAWING APPROVED

ENGINEER: ....

PR ENG NR: ....

SIGNATURE: ....

SCALES AT A0 A1 SIZE DRAWING

SCALE 1:1

SCALE 1:50

SCALE 1:100

DESIGNER: SMEC South Africa — Member of the Surbana Jurong Group

SABS ISO 9001

CLIENT: GEORGE — THE CITY FOR ALL REASONS

GEORGE MUNICIPALITY

THEMBALETHU PUMP STATTION

STRUCTURAL DRAWING

RETAINING WALL AND CHAMBER LAYOUTS

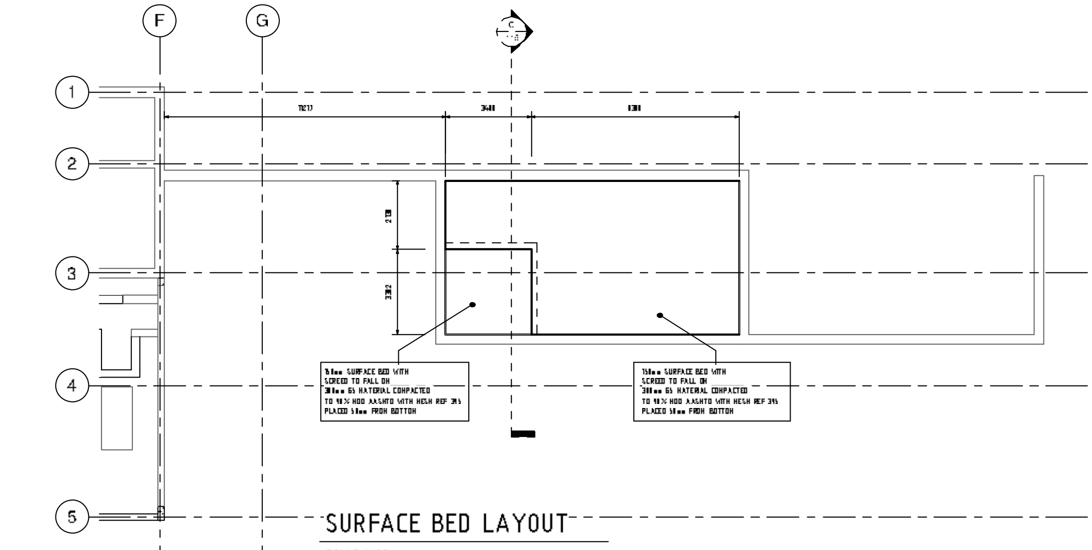
SCALE	DRAWING TYPE	DRAWING NUMBER	REVISION
1	DCN	116	A

PLOT DATE TIME 2023/10/20 10:53:24

DRAWING FILE LOCATION / NAME

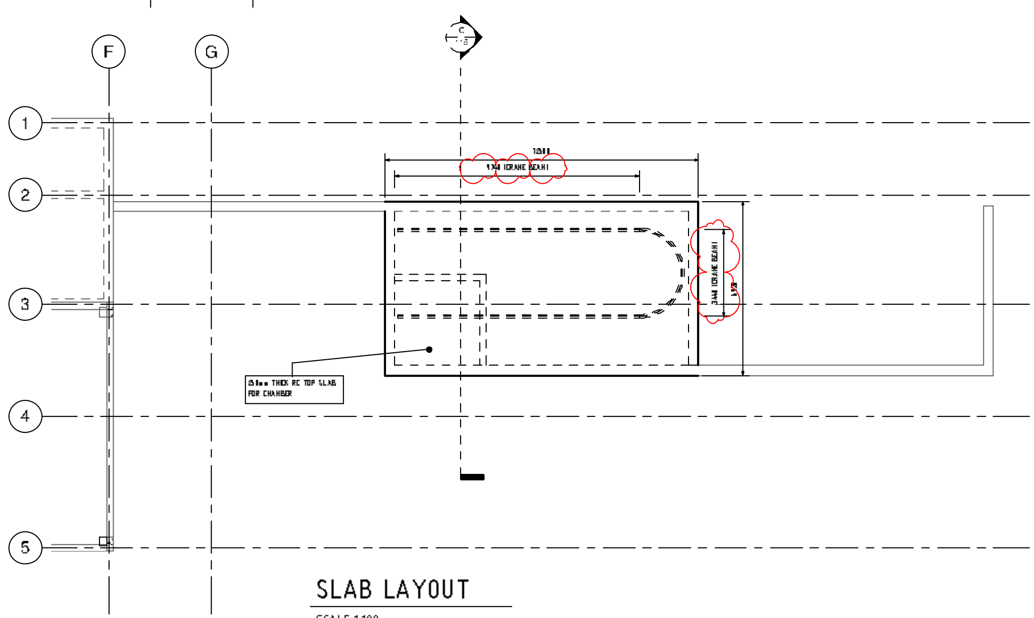
150 mm ON ORIGINAL

A1



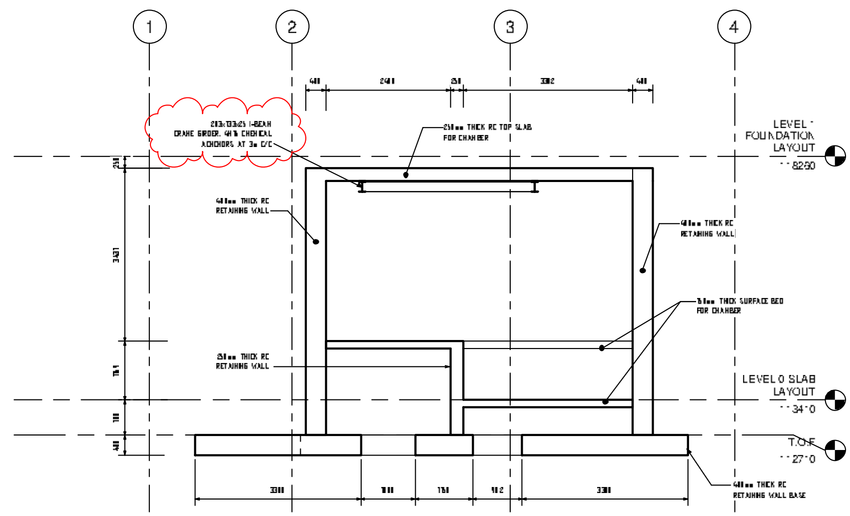
SURFACE BED LAYOUT

SCALE 1:100



SLAB LAYOUT

SCALE 1:100



SECTION C-C

SCALE 1:50

NOTE:
1. SAW-CUT JOINTS OR KEYED CONSTRUCTION JOINTS AT A MAXIMUM SPACING 30x SLAB THICKNESS OR 4500mm WHICHEVER IS LESSER (SEE TYPICAL DETAIL).
2. MESH DISCONTINUING OVER JOINTS. (SEE TYPICAL DETAIL)
3. RECTANGULAR SAW-CUT PANEL ASPECT RATIO TO BE NOT MORE THAN 1:1,25

NOTES:
1. REFER TO DRAWING C1924-1-DNS-001 TO 003 FOR GENERAL NOTES.
2. REFER TO DRAWING C1934-1-DCN-113 TO 115 FOR CONCRETE LAYOUTS
3. REFER TO DRAWING C1934-1-DCN-109 FOR TYPICAL CONCRETE DETAILS.
4. REFER TO DRAWING C1934-1-DMA-110 FOR TYPICAL MASONRY DETAILS.
5. REFER TO DRAWING C1934-1-DST-111 TO 112 FOR TYPICAL STEEL DETAILS.
6. BRICKFORCE TO BE SUPPLIED IN EVERY 4TH BRICK COURSE FOR ALL MASONRY ELEMENTS ABOVE & BELOW SURFACE BED LEVEL.
7. BRICKWORK SETTING OUT AS PER LAYOUTS.
8. ALLOWABLE BEARING PRESSURE = 150KPa.
9. ALL BUILDING WORK AND MATERIALS ARE TO COMPLY WITH LOCAL AUTHORITY'S REQUIREMENTS AND ARE TO BE IN ACCORDANCE WITH SANS 10400 NATIONAL BUILDING REGULATIONS.
10. ALL DIMENSIONS TO BE VERIFIED ON SITE PRIOR TO START OF CONSTRUCTION. ANY DESCRAPANCIES TO BE REPORTED TO THE ENGINEER.

PRELIMINARY

REV	DATE	AMENDMENT / REVISION DESCRIPTION
A	17.10.2023	PRELIMINARY
B	23.10.2023	PRELIMINARY

TITLE	NAME
DRAFTER	T. GUMEDE
DRAFTING CHECK	R. PIETERS
DESIGNER	T.GUMEDE
DESIGN CHECK	R. PIETERS
PROJECT MANAGER	T.CRONJE
PROJECT DIRECTOR	T.CRONJE

DRAWING APPROVED
ENGINEER: ....
PR ENG NR: ....
SIGNATURE: ....

DESIGNER: SMEC South Africa — Member of the Surbana Jurong Group

CLIENT: GEORGE — THE CITY FOR ALL REASONS

GEORGE MUNICIPALITY

THEMBALETHU PUMP STATTION

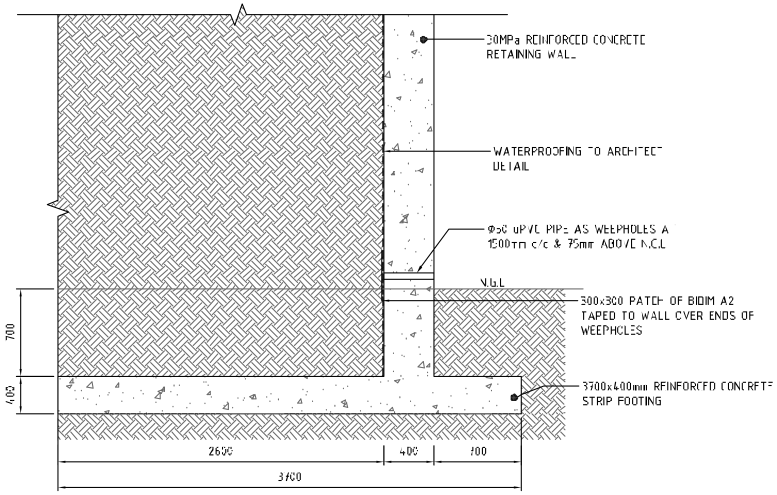
STRUCTURAL DRAWING

RETAINING WALL AND CHAMBER SECTIONS

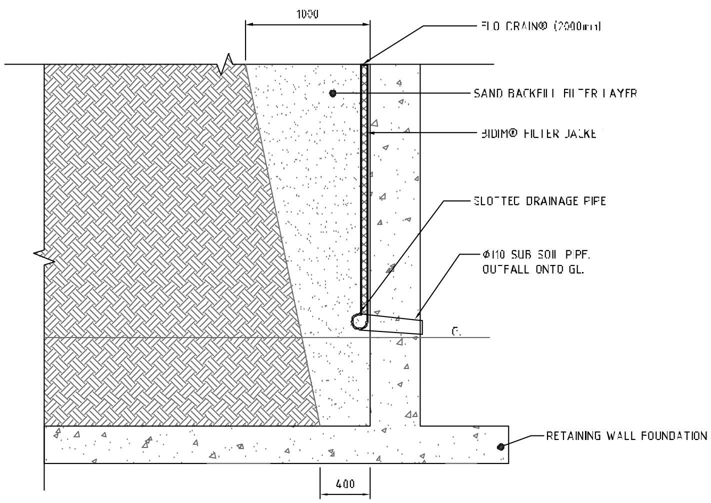
SCALE	DRAWING TYPE	DRAWING NUMBER	REVISION
1	DCN	115	B

A1 150 mm ON ORIGINAL

PLOT DATE TIME 2023/10/23 11:13:35



400mm WIDE REINFORCED CONCRETE RETAINING WALL
SCALE 1:20



TYPICAL SUBSOL DETAIL
SCALE 1:20

NOTE:
1. REFER TO DRAWING C1924-1-DNS-001 TO 003 FOR GENERAL NOTES.
2. REFER TO DRAWINGS C1924-1-DCN-103 TO 105 FOR CONCRETE LAYOUTS.
3. REFER TO DRAWINGS C1924-1-DCN-106 FOR MASONARY LAYOUTS.
4. REFER TO DRAWING C1332-1-DST-107 & 108 FOR STEEL ELEVATIONS & SECTIONS.

PRELIMINARY

REV	DATE	AMENDMENT / REVISION DESCRIPTION		
A		PRELIMINARY	-	-

TITLE	NAME
DRAFTER	T. GUNDE
DRAWING CHECK	A. PIETERS
DESIGNER	T. GUNDE
DESIGN CHECK	A. PIETERS
PROJECT MANAGER	T. CRONJE
PROJECT DIRECTOR	T. CRONJE

DRAWING APPROVED
ENGINEER: ....
PR ENG NR: ....
SIGNATURE: ....

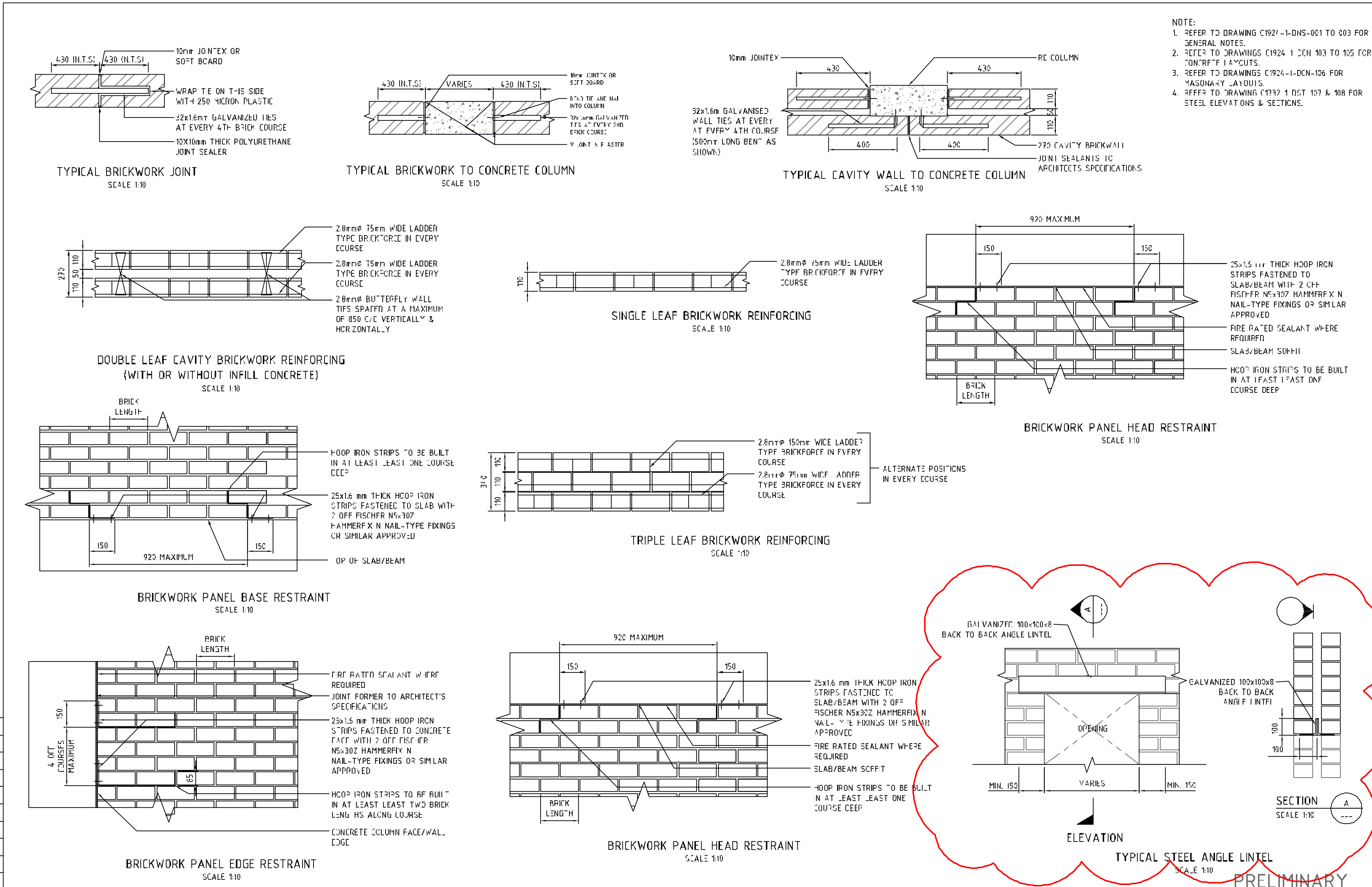
SCALE 1:1 · SCALE 1:5 · SCALE 1:10

SMEC South Africa
Member of the Surbana Jurong Group
SABS ISO 9001
SMEC PROJECT NO. 1924

GEORGE
THE CITY FOR ALL REASONS

GEORGE MUNICIPALITY
THEMBALETHU PUMP STATION
STRUCTURAL DRAWING
CONCRETE TYPICAL DETAILS

PHASE	DRAWING TYPE	DRAWING NUMBER	REVISION
1	DCN	116	A



REV	DATE	AMENDMENT / REVISION DESCRIPTION	WYS NO	APPROVAL
A	10.10.2023	PRELIMINARY	-	-
B	24.10.2023	PRELIMINARY		

TITLE	NAME
DRAFTER	[illegible]
DRAFTING CHECK	R. PIETERS
DESIGNER	[illegible]
DESIGN CHECK	R. PIETERS
PROJECT MANAGER	[illegible]
PROJECT DIRECTOR	T. CRONJE

DRAWING APPROVED:
ENGINEER: ....
PR ENG NR: ....
SIGNATURE: ....

SCALE 1:10

SMEC — Member of the Surbana Jurong Group
SABS ISO 9001
SMEC PROJECT NO. 1924

GEORGE — THE CITY FOR ALL REASONS

GEORGE MUNICIPALITY
THEMBALETHU PUMP STATION
STRUCTURAL DRAWING
MASONRY TYPICAL DETAILS

PHASE	DRAWING NO.	DRAWING NUMBER	REVISION
1	DMA	110	5

CONCRETE

1. ALL CONCRETE & CONCRETE WORK SHALL COMPLY WITH: SANS 0100-2, SABS 1200 E.
2. CONCRETE MIX DESIGN TO BE PROVIDED BY AN INDEPENDENT PROFESSIONAL ENGINEER.
3. COVER.
3.1 COVER BLOCKS
CONCRETE COVER TO REINFORCING IS AS FOLLOWS EXCEPT WHERE OTHERWISE NOTED ON BENDING SCHEDULES.
- BLINDING LAYER : 50mm
- STRIP FOUNDATION : 50mm
- BASES : 50mm
- SURFACE BED : 30mm
- COLUMNS : 30mm
- BEAMS : 30mm
- SLABS : 30mm

3.2 MINIMUM SAMPLE SIZES FOR STRENGTH CONCRETE (CONCRETE TEST CUBE RESULTS) TO BE ACCORDING TO LOLIC'S STANDARD SPECIFICATIONS TABLE 8305/4.
4. ADVERSE WEATHER REQUIREMENTS: SHALL COMPLY TO SABS 1200 G
5. READY MIX TO SITE SHALL COMPLY WITH SABS 1200 G.
6. PERMISSIBLE DEVIATIONS ACCORDING TO SABS 1200 G (6.2.3) - SEE TABLE BELOW.
6.1 DEGREE OF ACCURACY OF THE FOLLOWING ELEMENTS:

ELEMENT	DEGREE OF ACCURACY
• OFF SHUTTER CONCRETE	I
• FOUNDATIONS	II
• COLUMNS	II
• SLABS	II
• BEAMS	II

S.A.B.S. 1200 G (6.2.3)

6.2.3 SPECIFIED PERMISSIBLE DEVIATIONS	PERMISSIBLE DEVIATION		
	DEGREE OF ACCURACY		
	III	II	I
	mm	mm	mm
a) REINFORCEMENT.			
1) SPACING BETWEEN TWO ADJACENT BARS.	±25	±20	±15
2) LONGITUDINAL LOCATION OF BENDS AND ENDS OF BARS.	±40	±30	±20
3) COVER TO REINFORCEMENT (SEE (e) BELOW).	-0-20	-0-20	-0-10
b) FORMWORK. FORMWORK SHALL BE CONSTRUCTED AS TO ENSURE THAT THE POSITION OF THE FINISHED WORK WILL BE AS SPECIFIED, SUBJECT TO THE RELEVANT PERMISSIBLE DEVIATION GIVEN IN (c) OR (d) BELOW, AS APPLICABLE.			
c) FOUNDATIONS. MASS AND REINFORCED CONCRETE.			
1) POSITION ON PLAN OF ANY EDGE OR SURFACE MEASURED FROM THE NEAREST GRID LINE OR AGREED CENTER LINE.	±50	±35	±20
2) LINEAR DIMENSION ON PLAN CAST AGAINST EXCAVATED SIDES.	±60	±40	±20
3) LINEAR DIMENSION ON PLAN CAST AGAINST FORMWORK.	±30	±20	±10
4) LEVEL OF UNDERSIDE OF CONCRETE.	-40+20	-30+15	-20-10
5) SURFACE LEVEL (i.e. TOP OF FOUNDATION) (EXCLUDING FLOOR SLABS).	-30+15	-20+10	-10+5
d) ELEMENTS OR COMPONENTS ABOVE FOUNDATIONS. (INCLUDING FLOOR SLABS).			
1) POSITION ON PLAN OF ANY EDGE OR SURFACE MEASURED FROM THE NEAREST GRID LINE OR AGREED CENTER LINE.	±25	±15	±5
2) LINEAR (OTHER THAN CROSS-SECTION) DIMENSIONS.	±30	±20	±10
3) CROSS-SECTION DIMENSIONS.	-10+20	-5+15	±5
4) LEVEL (DEVIATION FROM DESIGNED LEVEL WITH REFERENCE TO THE NEAREST TRANSFERRED DATUM (TD) OF THE UPPER OR LOWER SURFACE, AS MAY BE SPECIFIED, OF ANY SLAB OR OTHER ELEMENT OR COMPONENT).	20+10	15-5	10+0
5) VERTICALITY, PER METER OF HEIGHT, SUBJECT TO A MAXIMUM OF.	5 70	5 50	2 30
6) OUT-OF-SQUARENESS OF A CORNER OR AN OPENING OR AN ELEMENT SUCH AS A COLUMN (SEE 6.1.2. (C)) FOR SHORT SIDE OF LENGTH.			
• UP TO AND INCLUDING 0.5 m.	±10	±5	±3
• OVER 0.5 m UP TO AND INCLUDING 2 m.	±20	±15	±10

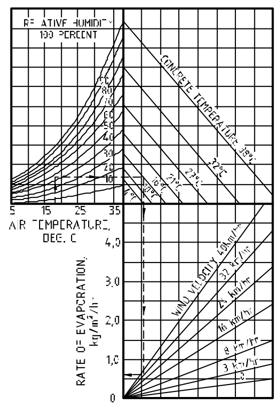
CONCRETE CONTINUED

• OVER 2 m, UP TO AND INCLUDING 4 m.	±25	±20	±15
7) EXPOSED CONCRETE SURFACE.			
• FLATNESS OF PLANE SURFACE.	10	5	3
• ABRUPT CHANGES IN A CONTINUOUS SURFACE.	10	5	2
8) EXPOSED CONCRETE SURFACE TO BE PLASTERED.			
• FLATNESS OF PLANE SURFACE.	15	10	5
• ABRUPT CHANGES IN A CONTINUOUS SURFACE.	10	5	3
e) COVER TO REINFORCEMENT. NO DEVIATION FORM THE MINIMUM COVER OF CONCRETE REINFORCEMENT SPECIFIED IN 5.1.3 (a) WILL BE PERMITTED.			
f) LOCATION OF HOLDING DOWN BOLTS.			
1) THE CENTER LINE OF A HOLDING-DOWN BOLT FROM ITS DESIGNATED LOCATION IN PLAN.	-3	-3	-3
2) THE TOP OF THE BOLT FROM ITS DESIGNATED ELEVATION.	-3+5	-3+5	-3 5
g) CONSTITUENTS IN CONCRETE MIX INCLUDING WATER; PERMISSIBLE DEVIATIONS OF QUANTITIES FROM APPROVED OR DESIGNATED OR PRESCRIBED MIX, AS APPLICABLE.			

7. CONCRETE STRENGTH OF MEMBERS UNLESS OTHERWISE SHOWN:
- BLINDING LAYER : 10MPa
- STRIP FOUNDATION : 25MPa
- BASES : 30MPa
- SURFACE BED : 30MPa
- COLUMNS : 30MPa
- BEAMS : 30MPa
- SLABS : 30MPa

8. 25mm CHAMFERS TO ALL EXPOSED CORNERS.
9. CONTRACTOR WILL BE RESPONSIBLE FOR ALL SETTING OUT OF WORKS FROM CONTROLLED BENCHMARKS ACCORDING TO SABS 1200 A (5.1).
10. 50mm BLINDING UNDER ALL PAD AND RETAINING WALL FOUNDATIONS.
11. ALL PILES TO BE ACCORDING TO SANS 1200 F
12. FACTORS AFFECTING CONCRETE SHRINKAGE CRACKS. IF THE RATE OF WATER EVAPORATION FROM THE CONCRETE EXCEEDS 1,0 kg/m² PER HOUR, PRECAUTIONS SHOULD BE TAKEN TO REDUCE EVAPORATION (SEE FIGURE BELOW)

TO USE THIS CHART:
1. ENTER WITH AIR TEMPERATURE, MOVE UP TO RELATIVE HUMIDITY.
2. MOVE RIGHT TO CONCRETE TEMPERATURE.
3. MOVE DOWN TO WIND VELOCITY.
4. MOVE LEFT, READ APPROX. RATE OF EVAPORATION.



(FIGURE 7.7) EFFECT OF CONCRETE AND AIR TEMPERATURES, RELATIVE HUMIDITY AND WIND VELOCITY ON THE RATE OF EVAPORATION OF SURFACE MOISTURE FROM CONCRETE. IF THE RATE OF WATER EVAPORATION FROM THE CONCRETE EXCEEDS 1,0 kg/m² PER HOUR, PRECAUTIONS SHOULD BE TAKEN TO REDUCE EVAPORATION (SEE FIGURE 7.7).

L.R. MARAIS, B.D. PERRIE (2009). CONCRETE INDUSTRIAL FLOORS ON THE GROUND. C&CI PUBLICATION. FIG. 7.7, PP 121

13. FORMWORK
13.1 ALL FORMWORK TO BE DESIGNED AND SIGNED OFF BY AN INDEPENDENT PROFESSIONAL ENGINEER APPOINTED BY THE CONTRACTOR.
13.2 REMOVAL OF FORMWORK ACCORDING TO SANS 10100:1992 PART 2 TABLE 7 (SEE NEXT PANEL).

CONCRETE CONTINUED

SANS 10100:1992 PART 2 TABLE 7

TYPE OF STRUCTURAL MEMBER OR FORMWORK	MINIMUM TIME								
	TYPE OF CEMENT USED								
	ORDINARY PORTLAND CEMENT AND PORTLAND CEMENT 15			RAPID-HARDENING PORTLAND CEMENT(2) AND RAPID-HARDENING PORTLAND CEMENT 15 (3)			CEMENTS CONTAINING MORE THAN 15% OF GGBS OR FA		
	WEATHER (SEE 3.2)								
	NORMAL	COOL	COLD	NORMAL	COOL	COLD	NORMAL	COOL	COLD
BEAM SIDES, WALLS AND UNLOADED COLUMNS	0.75	(4)	1.50	0.50	(4)	1	2	(4)	4
SLABS WITH PROPS LEFT IN PLACE	4	(4)	7	2	(4)	4	5	(4)	10
BEAM SOFFITS WITH PROPS LEFT IN PLACE, AND RIBS OF A RIBBED FLOOR CONSTRUCTION	7	(4)	12	3	(4)	5	10	(4)	17
SLAB PROPS	10	(4)	17	5	(4)	9	10	(4)	17
BEAM PROPS	14	(4)	21	7	(4)	12	14	(4)	21

(1) THE TIME OF REMOVAL OF FORMWORK ALLOWING FOR THE SURFACE FINISH IS TO BE DECIDED BY THE DESIGNER. THIS TABLE SHOULD BE REGARDED AS A GUIDE ONLY.

(2) SHORTER PERIODS MAY BE USED FOR SECTIONS HAVING A THICKNESS OF 300mm OR MORE.

(3) ONLY IF RAPID-HARDENING CEMENT IS USED AS A DIRECT REPLACEMENT FOR ORDINARY PORTLAND CEMENT. SHORTER REMOVAL TIMES FOR FORMWORK DO NOT APPLY IF MIXES ARE DESIGNED WITH RAPID HARDENING CEMENT TO ACHIEVE THE SAME 28-D STRENGTH

(4) IN COOL WEATHER, STRIPPING TIMES ARE TO BE DETERMINED BY INTERPOLATION BETWEEN THE PERIODS SPECIFIED FOR NORMAL AND COLD WEATHER.

14. CURING.
14.1 CONCRETE CURING SHALL BE CONTINUOUS FOR AT LEAST 7 DAYS FOR OPC CEMENT, AND AT LEAST 10 DAYS FOR BLAST FURNACE CEMENT OR A 50/50 MIXTURE OF OPC OR GGBFS.
14.2 CURING COMPOUNDS ARE APPLIED AS SOON AS BLEEDING HAS STOPPED AND BLEED WATER HAS EVAPORATED FROM THE SURFACE. THE CHOICE OF CURING COMPOUND IS ESPECIALLY IMPORTANT WHEN THE CONCRETE IS TO RECEIVE FURTHER TREATMENT SUCH AS PLASTERING OR PAINTING. SOME COMPOUNDS WILL PREVENT SUBSEQUENTLY APPLIED MATERIALS FROM ADHERING.
14.3 CONCRETE CURING SHALL BE IN ACCORDING TO BS 8001 TABLE 12.4 (BELOW).

BS 8001 TABLE 12.4

SUGGESTED MINIMUM MOIST CURING PERIODS	
WEATHER	MINIMUM MOIST CURING PERIOD, DAYS
NORMAL: 18 TO 22°C 65% RELATIVE HUMIDITY, LOW WIND SPEEDS	5
HOT: WITH DRYING WINDS	7
COLD: 5 TO 12°C	5

15. BACK PROPPING.
15.1 THE CONTRACTOR MUST GET THE MINIMUM STRENGTH ON WHICH THE CONCRETE CAN SUPPORT ITS OWN WEIGHT FROM THE DESIGNER.
15.2 IN CASES WHERE RAPID HARDENED CEMENT CONCRETE OR SIMILAR IS USED BY THE CONTRACTOR TO OBTAIN EARLY STRENGTH, THE CONTRACTOR MUST PROVE TO THE DESIGNER, COMPLIANCE TO MINIMUM STRENGTH REQUIREMENTS (THROUGH USE OF CONCRETE CUBE FROM SAME MIX).
15.3 DESIGN RESPONSIBILITY OF BACK PROPPING AND FORM WORK STRIPPING STAYS WITH THE CONTRACTOR'S FORM WORK DESIGNER.
15.4 BACK-PROPPING FOR A MULTI-STOREY BUILDING:
- FOR PRE-STRESSED AND POST-TENSIONED SLABS, THE CONTRACTOR MUST CONFIRM THE STRIPPING SEQUENCE WITH THE DESIGNER TO ENSURE COMPLIANCE PRIOR TO STRIPPING OF SUPPORT WORK ON.
- THE CONTRACTOR MUST AVOID CONSTRUCTION OF BRICKWORK ON TEMPORARILY PROPPED SLABS.
- BACK PROPPING FOR MULTI STOREY BUILDINGS IN ACCORDANCE WITH THE FOLLOWING TABLE:

CONCRETE CONTINUED

TABLE 1 BACK PROPPING REQUIREMENTS FOR MULTI STOREY BUILDINGS. FLOOR 1-6 / (LAST FLOOR) ARE IN SEQUENCE; WITH FLOOR 1 AT THE BOTTOM AND FLOOR 6 ON TOP.

FLOOR	% OF BACK-PROPPING AT 28 DAYS CONCRETE STRENGTH FOR:					
	FLOOR 1	FLOOR 2	FLOOR 3	FLOOR 4	FLOOR 5	FLOOR 6
FLOOR 1	100%	75%	50%	25%	0%	0%
FLOOR 2		100%	75%	50%	25%	0%
FLOOR 3			100%	75%	50%	25%
FLOOR 4				100%	75%	50%
FLOOR 5					100%	75%
FLOOR 6						100%

16. SURFACE BEDS.
16.1 MIX DESIGN TO YIELD A HIGH STRENGTH, DURABLE, LOW SHRINKAGE, ABRASION RESISTANT PRODUCT COMPLYING WITH THE FOLLOWING
- 28 DAY CONCRETE CUBE STRENGTH : 35 MPa
- AGGREGATES : NOMINAL SIZE OF COARSE AGGREGATE TO BE A MAXIMUM OF 25% OF SURFACE BED THICKNESS LIMITED TO 37.5 mm.
- AGGREGATES & SAND : PREFERABLY BOTH, WELL GRADED AND FROM A DOLOMITIC AND OR LIMESTONE SOURCE.

CEMENT : CEM II/A-V 32.5 (15/85 FLY ASH)

16.2 FLATNESS CRITERIA.
- FLOOR CLASSIFICATIONS TO BE ADHERED TO THROUGH USE OF THE FOLLOWING (SEE SURFACE BED DRAWING NOTES FOR CLASSIFICATION TYPE).

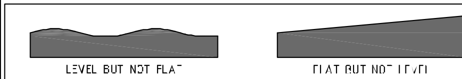


FIGURE 4.2: FLATNESS AND LEVELNESS

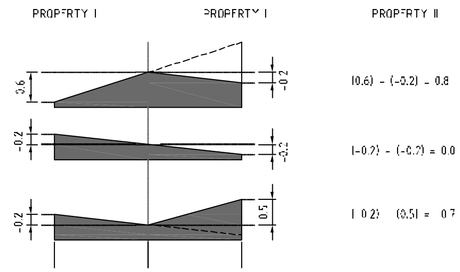


FIGURE 4.3: EXAMPLES OF MEASUREMENTS OF PROPERTY I OVER 300 mm AND THE RESULTANT DETERMINATION OF CHANGE IN ELEVATIONAL DIFFERENCE OVER A DISTANCE OF 300 mm (PROPERTY II). ALL DIMENSIONS IN mm

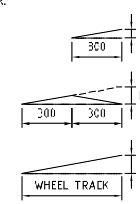
TABLE 4.1: DEFINITION OF SURFACE REGULARITY TERMS (PART OF TABLE)

PROPERTY
ELEVATIONAL DIFFERENCES OR MEASUREMENTS DERIVED FROM ELEVATIONAL DIFFERENCES THAT ARE LIMITED FOR EACH CLASS OF FLOOR.

PROPERTY I - THE ELEVATIONAL DIFFERENCE IN mm BETWEEN TWO POINTS 300 mm APART. SEE ALSO FIGURE 4.3

PROPERTY II - TO CONTROL FLATNESS, CHANGE IN ELEVATIONAL DIFFERENCE BETWEEN TWO CONSECUTIVE MEASUREMENTS OR ELEVATIONAL DIFFERENCES (PROPERTY I) EACH MEASURED OVER 300 mm, SEE ALSO FIGURE 4.3

PROPERTY III - THE ELEVATIONAL DIFFERENCE IN mm BETWEEN THE CENTRES OF THE FRONT LOAD WHEELS OF MATERIALS HANDLING EQUIPMENT



FOR INFORMATION

REV	DATE	AMENDMENT / REVISION DESCRIPTION	WRN No.	APPROVAL	DRAWING APPROVED		
A	13.10.2023	ISSUED FOR INFORMATION			ENGINEER :		
					PR ENG No. :		
					SIGNATURE :		

TITLE	NAME
DRAFTER	A.UYS
DRAFTING CHECK	R. PETERS
DESIGNER	A.UYS
DESIGN CHECK	R. PETERS
PROJECT MANAGER	L.NONI
PROJECT DIRECTOR	T. GROBLER

DESIGNER: SMEC South Africa — Member of the Surbana Jurong Group. SABS ISO 9001

SMEC PROJECT No. L1927

CLIENT: GEORGE — THE CITY FOR ALL REASONS

GEORGE MUNICIPALITY
THEMBALETHU PUMP STATION
STRUCTURAL DRAWING
NOTES & SPECIFICATIONS
SHEET 1 OF 3

SHEET	DRAWING TYPE	DRAWING NUMBER	REVISION
1	DNS	001	A

CONCRETE CONTINUED

16.3 DATA ANALYSIS AND PERMISSIBLE LIMITS A REPRESENTATIVE SAMPLE OF ELEVATIONS IS TO BE MEASURED, ANALYSED AND COMPARED WITH THE PERMISSIBLE LIMITS FOR PROPERTIES II AND IV GIVEN IN TABLE 4.2 (SEE NEXT PANEL) THE FLOOR IS NON-COMPLIANT IF:
- MORE THAN 5% OF THE TOTAL NUMBER OF MEASUREMENTS EXCEED THE 95% PROPERTY LIMIT.
- ANY MEASUREMENT EXCEEDS THE 100% PROPERTY LIMIT, AND ANY POINT ON THE PROPERTY IV SURVEY GRID IS OUTSIDE ±15 mm DATUM.

TABLE 4.2: PERMISSIBLE LIMITS ON PROPERTY II AND IV IN FREE-MOVEMENT AREAS

FLOOR CLASSIFICATION	TYPICAL FLOOR USE	PROPERTY II LIMIT (mm)		PROPERTY IV LIMIT (mm)	
		95%	100%	95%	100%
FM 1	WHERE VERY HIGH STANDARDS OF FLATNESS AND LEVELNESS ARE REQUIRED. FLOORS TO FM 1 CLASSIFICATION MAY NEED TO BE CONSTRUCTED USING LONG STRIP METHODS (SEE SECTION 2.2.3)	2.5	4.0	4.5	7.0
FM 2	BUILDINGS CONTAINING WIDE AISLE RACKING WITH STACKING OR RACKING OVER 8 m HIGH, FREE-MOVEMENT AREAS AND TRANSFER AREAS.	3.5	5.5	8.0	12.0
FM 3	BUILDINGS CONTAINING WIDE AISLE RACKING WITH STACKING OR RACKING UP TO 8 m HIGH RETAIL AND MANUFACTURING FACILITIES.	5.0	7.5	10.0	15.0
FOR ALL CLASSIFICATIONS, ALL POINTS MUST BE WITHIN 15 mm FROM DATUM.					

CONCRETE INDUSTRIAL GROUND FLOORS - A GUIDE TO DESIGN AND CONSTRUCTION. CONCRETE SOCIETY TECHNICAL REPORT No. 34 (3RD ED. 2003). FIGURES 4.2, 4.3 & TABLES 4.1, 4.2. PP. 19-22.

LOAD BEARING BRICKWORK

1. BRICKWORK.
1.1 MORTAR SHALL BE CLASS 2 MORTAR ACCORDING TO SABS 0400. THUS MIX 50kg PORTLAND CEMENT WITH 200 LITER BUILDING SAND.
1.2 BRICKS TO BE BURNT CLAY BRICKS THAT COMPLY TO SABS 227
1.3 SUPPLY BRICKFORCE IN EVERY FOURTH BRICK COURSE LAYER.
1.4 SAND GRADING ACCORDING TO SABS 1090.

TIMBER

1. STRUCTURAL TIMBER.
1.1 ALL TIMBER FOR STRUCTURAL USE SHALL BE GRADED IN ACCORDANCE WITH SANS 1783 AND SANS 1460.
- SANS 1783 FOR STRESS GRADED SOFTWOOD GENERAL STRUCTURAL TIMBER.
- SANS 1783 FOR STRESS GRADED SOFTWOOD ENGINEERING TIMBER.
- SANS 1460 FOR STRUCTURAL LAMINATED TIMBER.
- SANS 1783 FOR BATTENS AND BRANDERING.

1.2 TIMBER STRUCTURES - PRODUCT REQUIREMENTS FOR PREFABRICATED STRUCTURAL MEMBERS ASSEMBLED WITH PUNCHED METAL PLATE FASTENERS SHALL COMPLY TO SANS 51 250:2009 OR EN 14250:2004
1.3 TIMBER STRUCTURE CONNECTOR REQUIREMENTS SHALL COMPLY WITH SANS 54545:2009 OR EN14545:2008 AND SHALL COMPLY WITH CORROSION PROTECTION IN ACCORDANCE WITH.
1.4 THE STRUCTURAL TIMBER DESIGN AND FABRICATION SHALL BE IN ACCORDANCE WITH SANS 10160 BASIS OF STRUCTURAL DESIGN AND ACTIONS FOR BUILDINGS AND INDUSTRIAL STRUCTURES, SANS10163 THE STRUCTURAL USE OF TIMBER, SANS 10243 THE MANUFACTURE AND ERECTION OF TIMBER ROOF TRUSSES.
1.5 THE STORAGE, HANDLING, ERECTION AND BRACING SHALL BE IN ACCORDANCE WITH THE LATEST EDITION OF SANS 10243.
1.6 SOFTWOOD BATTENS AND BRANDERING TO COMPLY WITH SANS 653.
1.7 TIMBER ROOF STRUCTURES SHALL COMPLY WITH SANS 10400 THE APPLICATION OF THE NATIONAL BUILDING REGULATIONS - PART L.
1.8 THE TIMBER STRUCTURE SHALL FORM PART OF A RATIONAL DESIGN ACCORDING TO REGULATION A19 OF THE NATIONAL BUILDING REGULATIONS SANS 10400 1900 PROMULGATED UNDER BUILDING STANDARDS ACT 103/1977 WHERE A RATIONAL DESIGN IS REQUIRED FOR THE STRUCTURAL SYSTEM OF A BUILDING.
1.9 ALL EXPOSED TIMBER COMPONENTS TO BE TREATED AND SEALED AGAINST THE ELEMENTS, TREATMENT SHALL BE IN ACCORDANCE TO SAWPA AND SANS 10005 PRESERVATIVE TREATMENT OF TIMBER. THE MAIN CHEMICALS USED IN THIS COUNTRY ARE CCA (COPPER CHROME ARSENATE) AND CREOSOTE. CCA GIVES THE TIMBER A GREENISH LOOK WHILST CREOSOTE LEAVES THE TIMBER BLACK. OTHER CHEMICALS USED ARE BORON AND TBTOL (TRIBUTYLTINOXIDE LINDANE). PCP SHALL NOT BE USED AND HAS BEEN REMOVED FROM THE MARKET PLACE BECAUSE OF ITS DAMAGING ENVIRONMENTAL PROPERTIES.
1.10 ALL STRUCTURAL TIMBER SHALL HAVE MOISTURE CONTENT NOT EXCEEDING 17% (17G/KG) AT THE TIME OF INSTALLATION.
1.11 ALL STRUCTURAL TIMBER FRAMES SHALL COMPLY WITH SANS 10082: 2007 TIMBER FRAME BUILDINGS.

TIMBER CONTINUED

1.12 ASTM C7033:2005 OSB BOARD STRUCTURAL CLADDING OF GABLE TRUSSED AS AN OPTION.
1.13 SANS ISO 3575/4998 GALVANIZED BOLTS AND NUTS SHEETING Z275 MILD ENVIR - TRUSS MEMBER CONNECTORS.
1.14 SANS 9364 BRACKETS AND WASHERS FROM ALUMINIUM ZINC COATED.
1.15 NAILS FOR TIMBER STRUCTURES SHALL BE IN ACCORDANCE WITH SANS 820 AND POSITIONED IN ACCORDANCE WITH SANS 10163.
1.16 EURO CODE 5: TIMBER.
- MONOPLANAR PREFABRICATED TIMBER ROOF TRUSSES (NAIL-PLATED) SHALL BE IN ACCORDANCE WITH SANS 1900:2004.
- CONSTRUCTION WORKS OF STRUCTURAL TIMBER WORK (ROOFING) SHALL BE IN ACCORDANCE WITH SANS 2001-CT2:2009 PART CT2; AND PART CT1 FOR FLOORING.
- EUCALYPTUS POLES, CROSS-ARMS AND SPACERS FOR POWER DISTRIBUTION AND TELEPHONE SYSTEMS SHALL BE IN ACCORDANCE WITH SANS 754:2007.
- WOODEN POLES, DROPPERS, GUARDRAIL POSTS AND SPACER BLOCKS (HARDWOOD AND SOFTWOOD (SPECIES) SHALL BE IN ACCORDANCE WITH SPECIFICATION SANS 457 PART 1 TO 3.

FIRE PROTECTION FOR STRUCTURAL STEEL

1. FIRE PROTECTION (2HRS FIRE RATING FOR STRUCTURAL STEEL WORK) INTUMESCENT PAINT SPECIFICATIONS.
1.1 SURFACE PREPARATION - REMOVE OIL OR GREASE FROM SURFACE PRIOR TO ABRASIVE BLAST CLEANING.
1.2 ABRASIVE BLAST TO A COMMERCIAL FINISH IN ACCORDANCE WITH ISO 8501 SA 2 TO OBTAIN A 25 TO 75 MICRON BLAST PROFILE.
1.3 APPLY 50 MICRON DFT CARBOLINE CARBOZINC 17A SELF CURING INORGANIC ZINC PRIMER, IN ACCORDANCE WITH THE SUPPLIERS SPECIFICATIONS.
1.4 APPLY INTUMESCENT PAINT (MICON INTUSYF OR SIMILAR) WITH A TWO HOUR FIRE RATING ACCORDING TO THE SUPPLIER'S SPECIFICATION.
1.5 APPLY 2 X 40 MICRON DFT CARBOLINE CARBOTHANE 134 ZA ALIPHATIC ACRYLIC POLYURETHANE, IN ACCORDANCE WITH THE SUPPLIER'S SPECIFICATION.

STRUCTURAL STEEL

1. GENERAL.
1.1 ALL DIMENSIONS ARE IN MILLIMETERS.
1.2 ALL STRUCTURAL STEEL WORK SHALL COMPLY TO SANS 1200H.
1.3 ALL STRUCTURAL STEELWORKS CONSTRUCTION SHALL COMPLY TO SANS 2001-CS1:2001.
1.4 RESPONSIBILITIES OF PARTIES ACCORDING TO SANS 1921-3, RESPONSIBILITIES STRATEGY: B - CONTRACTOR SUPPLIES FABRICATION DRAWINGS STEELWORK STRUCTURAL ENGINEER - SMEC SOUTH AFRICA (PTY) LTD.
1.5 ADDITIONAL HOLES MAY NOT BE MADE IN ANY STRUCTURAL MEMBER WITHOUT THE PRIOR CONSENT OF THE SUPERVISING ENGINEER.
1.6 ADEQUATE TEMPORARY BRACING MUST BE PROVIDED TO STRUCTURAL STEELWORK UNTIL ERECTION IS COMPLETE.
1.7 WORKSHOP DRAWINGS TO BE APPROVED BEFORE FABRICATION. DRAWINGS TO BE CHECKED FOR DESIGN INTENT ONLY.
2. MATERIALS.
2.1 ALL STEEL SHALL CONFORM TO SANS 1431 MINIMUM STEEL GRADE FOR THE FOLLOWING STEEL PROFILE:
- HOT FORMED SECTIONS : GRADES S-355 JR
- FABRICATED SECTIONS : GRADES S-355 JR
- NON- STRESSED RELIEVED HOLLOW SECTIONS : GRADES S-355 JR
- ALL PLATES : GRADES S-355 JR
- COLD FORMED OPEN SECTIONS : GRADES S 235 JR

2.2 DIMENSIONAL TOLERANCE FOR THE FOLLOWING MEMBERS SHALL COMPLY TO: SPECIFICATIONS FOR HOLLOW SECTIONS. HOLLOW SECTIONS ARE PRODUCED TO SANS 657: PART 1.
- UNIVERSAL BEAMS AND COLUMNS : EN 10034
- TAPER FLANGE I- SECTION : EN 10024
- IPE SECTIONS : EN 10034
- IPE AA SECTIONS : INTERNAL SPECIFICATIONS SPE 230
- DIN METRIC CHANNELS : DIN 1026 : 1963
- IMPERIAL CHANNELS : BS 4 : PART 1 : 1993
- SA PARALLEL FLANGE CHANNELS : EN 10279
- ANGLES : EN 10056-2

STRUCTURAL STEEL CONTINUED

2.3 SPECIFICATIONS FOR OPEN COLD FORMED SECTIONS. THE PROFILE DIMENSIONS AND ANGULAR ACCURACY OF A COLD FORMED SECTION, SHOULD BE MEASURED AT A POINT NOT LESS THAN 150MM FROM THE END OF THE SECTION. THE STRAIGHTNESS OF ANY LENGTH SHALL BE SUCH THAT THE OFFSET DOES NOT EXCEED 1/500 OF THAT LENGTH. THE DEVIATION OF ANY PROFILE DIMENSION SHALL NOT EXCEED ± 2MM OR 1.5%, WHICHEVER IS THE GREATER. THE DEVIATION FROM THE ANGLE OF 90% SHALL NOT EXCEED ± 1°AT ANY CORNER.
2.4 THE ENGINEER SHALL AT ALL REASONABLE TIMES HAVE FREE ACCESS TO INSPECT THE WORKS WHERE STEEL IS BEING FABRICATED THE FABRICATOR SHALL PROVIDE ALL MATERIAL CERTIFICATES.
3. WORKMANSHIP.
3.1 THE EDGES OF ALL ROLLED SECTIONS SHALL BE TRUE, FAIR AND FULL TO PROFILE THROUGHOUT. THE WHOLE BOLTED CONTACT SURFACE SHALL BE IN CLOSED CONTACT. CONTACT SURFACES SHALL BE CLEAN AND FREE FROM BURRS, RUST, GREASE, PAINT OR OTHER IRREGULARITIES.
4. HOLDING DOWN BOLTS AND BOLTS.
4.1 HOLDING DOWN BOLTS SHALL BE FABRICATED FROM THE FOLLOWING GRADE STEEL UNLESS OTHERWISE SPECIFIED ALL : GRADE S-235 JR.
5. BOLTS.
5.1 ALL BOLTS SHALL COMPLY TO THE REQUIREMENTS OF 1504014, 1504016, 1501417, 151418. ALL BOLTS TO BE GRADE 4.8 UNLESS OTHERWISE SPECIFIED.
5.2 CLASS 8 NUTS TO 1504032 TO BE USED FOR CLASS 4.8 AND 8.8 BOLTS.
5.3 WASHERS TO 1507091 TO BE USED FOR ALL GRADES OF BOLTS
5.4 BOLTS SHALL HAVE WELL - FORMED HEADS FORGED FROM THE SOLID. NUTS SHALL CLOSELY FIT THE BOLTS TO BE TURNED BY HAND. AT LEAST ONE CLEAR THREAD SHALL PROJECT BEYOND THE RUN WHEN FULLY TIGHTENED. ALL BOLTS SHALL HAVE AT LEAST ONE WASHERS UNDER THE NUT AND SHALL BE SO TIGHTENED THAT THE TREADED PORTION DOES NOT BEAR ON THE MEMBERS CONNECTED. WHERE BOLT HEADS OR NUTS BEAR UPON BEVELLED SURFACES, 5mm TAPERED WASHERS SHALL BE PROVIDED.
5.5 BOLTS TO BE PROPERLY LUBRICATED BY SUPPLIER.
5.6 TURN OF NUT METHOD FOR H.S.F.G. AS APPROVED BY SANS 10094:
- SNUG TIGHT FIT - HAND TIGHTEN BY THE FULL-EFFORT OF AN IRON-WORKER USING A STANDARD SPANNER (OR PODGER/SPUD SPANNER)
- MARK THE NUT AND BOLT AS REFERENCE POINT
- ROTATE THE NUT RELATIVE TO THE BOLT BY THE FOLLOWING PART TURN:
  a. BOLT LENGTH UP TO 4D : ⅓ TURN WITH +/- 30° TOLERANCE
  b. BOLT LENGTH BETWEEN 4D & 8D : ½ TURN WITH +/- 30° TOLERANCE
  c. BOLT LENGTH BETWEEN 8D & 12D : ⅔ TURN WITH +/- 45° TOLERANCE

6. HOLES.
6.1 HOLES SHALL BE ACCURATELY DRILLED TO TEMPLATE. BURRS AND ARRISSES SHALL BE REMOVED BEFORE ASSEMBLY.
6.2 THE HOLE DIAMETER SHALL NOT EXCEED THE BOLTS DIAMETER BY MORE THAN 2mm UP TO M24, M30=+3mm.
6.3 THE ALLOWABLE HOLE POSITION TOLERANCE FOR ASSEMBLY - 1mm.
7. WELDING.
7.1 THE LENGTH AND SIZE OF ALL WELDS SHALL BE IN ACCORDANCE WITH THE DRAWINGS OR AS SPECIFIED BY THE ENGINEER. WELDS SHOWN ON DRAWINGS ARE FINAL MINIMUM SIZES.
7.2 ALL WELDING SHALL COMPLY TO THE LATEST REQUIREMENTS OF AWS D1.1. AND VISUALLY CONFORM TO AWS SECTION 6, TABLE 6.1.
7.3 ALL WELDING SHALL BE PERFORMED IN STRICT ADHERENCE TO A WRITTEN WELDING PROCEDURE SPECIFICATION (WPS) AS PER AWS D1.1. UNLESS OTHERWISE APPROVED ALL WELDING PARAMETERS SHALL BE WITHIN THE ELECTRODE MANUFACTURERS RECOMMENDATIONS.
7.4 ONLY CODED WELDERS SHALL BE EMPLOYED, CERTIFICATION SHALL BE FORWARDED TO THE ENGINEER AND WELD TEST SAMPLES SHALL BE SUBMITTED ON REQUEST.
7.5 ALL WELDS TO BE CONTINUOUS 5mm FILLET WELDS ALL AROUND UNLESS OTHERWISE SPECIFIED.
7.6 ALL ELECTRODES TO BE OF E70XX STRENGTH AND APPROPRIATE FOR THE PROCESS SELECTED.
7.7 SMAW ELECTRODES TO BE STORED IN DRY WEATHERPROOF CONTAINER. BAKING OF ELECTRODES AFTER OPENING LIMITED TO ONCE ONLY. ANY ELECTRODE THAT HAS BEEN WET SHALL NOT BE USED.
8. PAINTING.
8.1 THE PAINT SUPPLIER TO SPECIFY THE PROTECTIVE PAINT SYSTEM ACCORDING TO ISO 12944-5 BASED ON THE FOLLOWING DESIGN PARAMETERS.
8.1.1 CLASSIFICATION OF CORROSION ENVIRONMENT ACCORDING TO ISO 12944-5 AS: C3 MEDIUM.
8.1.2 SUBSTRATE: LOW ALLOY CARBON STEEL.
8.1.3 EXPECTED DURABILITY: MEDIUM
8.1.4 EXPOSURE: INDOOR AND OUTDOOR
8.2 THE PAINT SUPPLIER TO FORWARD THE THE PAINT SPECIFICATION TO THE ENGINEER FOR REVIEW TO ISO 12944-5 FOR APPROVAL IN PRINCIPLE. THE COATING DESIGN PERFORMANCE RESPONSIBILITY STAY WITH THE SUPPLIER.
8.3 SURFACE PREPARATION TO BE DONE ACCORDING TO GRADE SA 2.5.
8.4 ALL SHARP CORNERS TO BE STRIPE COATED 20mm BEYOND EACH CORNER.

STRUCTURAL STEEL CONTINUED

8.5 CONTRACTOR PAINT SPECIFICATION AND PROCESS TO BE SUBMITTED TO ENGINEER FOR APPROVAL.
8.6 SAMPLE SECTIONS CAN BE REQUESTED BY THE ENGINEER FOR APPROVAL.

ABBREVIATIONS

ALT	ALTERNATE
APPROX	APPROXIMATELY
B1	BOTTOM 1 LAYER (REINFORCING)
CHS	CIRCULAR HOLLOW SECTION (STEEL SECTION)
CJ	CONSTRUCTION JOINT
CL	CENTER LINE OR COVER LEVEL (CIVIL'S)
DIA / Ø	DIAMETER
DPC	DAMP PROOF COURSE
DWG	DRAWING
FF	FAR FACE (REINFORCING)
EJ	EXPANSION JOINT
ELA	EQUAL LEGGED ANGLE (STEEL SECTION)
ENG	ENGINEER
EQ	EQUAL
FF	FAR FACE (REINFORCING)
FFL	FINISHED FLOOR LEVEL
HD	HOLDING DOWN (BOLT)
ID	INSIDE DIAMETER
IF	INSIDE FACE (REINFORCING)
IJ	ISOLATION JOINT
IL	INVERT LEVEL
kPa	KILO-PASCALS
m	METERS
mm	MILLIMETERS
MAX	MAXIMUM
MECH	MECHANICAL
MEZZ	MEZZANINE
MIN	MINIMUM
MPa	MEGA PASCALS
NGL	NOMINAL GROUND LEVEL
NF	NEAR FACE (REINFORCING)
No.	NUMBER OFF
NOM	NOMINAL
NTS	NOT TO SCALE
OD	OUTSIDE DIAMETER
OF	OUTSIDE FACE (REINFORCING)
PT	POST TENSIONED
QTY	QUANTITY
RC	REINFORCED CONCRETE
REV	REVISION
RHS	RECTANGULAR HOLLOW SECTION (STEEL SECTION)
SCJ	SAW CUT JOINT
SHS	SQUARE HOLLOW SECTION (STEEL SECTION)
SIM	SIMILAR
SMAW	SHIELDED METAL ARC WELDING
SSL	STRUCTURAL SERVICE LEVEL
SYM	SYMMETRICAL
T1	TOP 1 LAYER (REINFORCING)
TBC	TO BE CONFIRMED
THK	THICK (THICKNESS)
TOB	TOP OF BASE/BEAM
TOC	TOP OF CONCRETE
TYP	TYPICAL
ULA	UNEQUAL LEGGED ANGLE (STEEL SECTION)
ULT	ULTIMATE
UNO	UNLESS NOTED OTHERWISE
WPS	WELDING PROCEDURE SPECIFICATION

FOR INFORMATION

REV	DATE	AMENDMENT / REVISION DESCRIPTION	WTN No.	APPROVAL	DRAWING APPROVED
A	13.10.2022	ISSUE FOR INFORMATION			

ENGINEER : ....

PR ENG No. : ....

SIGNATURE : ....

DRAFTED	
DRAFTING CHECK	R. PETERS
DESIGN	
DESIGN CHECK	R. PETERS
PROJECT MANAGER	
PROJECT DIRECTOR	T. GROVE

SMEC South Africa — Member of the Surbana Jurong Group

SABS ISO 9001

SMEC PROJECT No. 1192?

GEORGE — THE CITY FOR ALL REASONS

GEORGE MUNICIPALITY

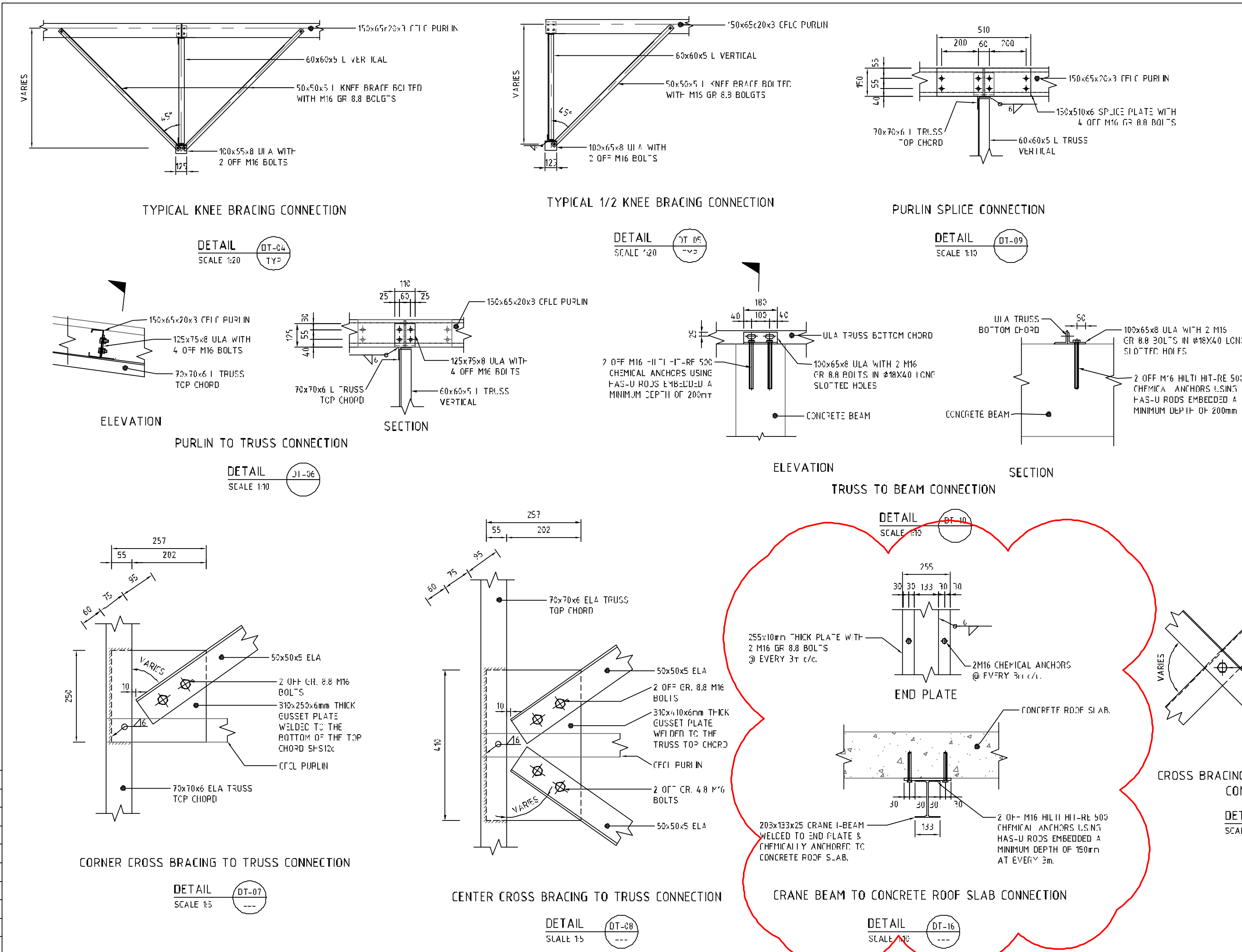
THEMBALETHU PUMP STATION

STRUCTURAL DRAWING

NOTES & SPECIFICATIONS

SHEET 2 OF 3

STAGE	DRAWN TYPE	DRAWING NUMBER	REVISION
1	DNS	002	A



NOTE:
1. REFER TO DRAWING C1924-1-DNS-001 TO 003 FOR GENERAL NOTES.
2. REFER TO DRAWINGS C1924-1-DCN-103 TO 105 FOR CONCRETE LAYOUTS.
3. REFER TO DRAWINGS C1924-1-DCN-106 FOR MASONARY LAYOUTS.
4. REFER TO DRAWING C1132-1-DST-107 & 108 FOR STEEL ELEVATIONS & SECTIONS.

PRELIMINARY

REV	DATE	AMENDMENT / REVISION DESCRIPTION
A	10.11.2023	PRELIMINARY
B	26.10.2023	PRELIMINARY

TITLE	NAME
DRAFTER	
DRAWING CHECK	
DESIGNER	
DESIGN CHECK	
PROJECT MANAGER	
PROJECT DIRECTOR	

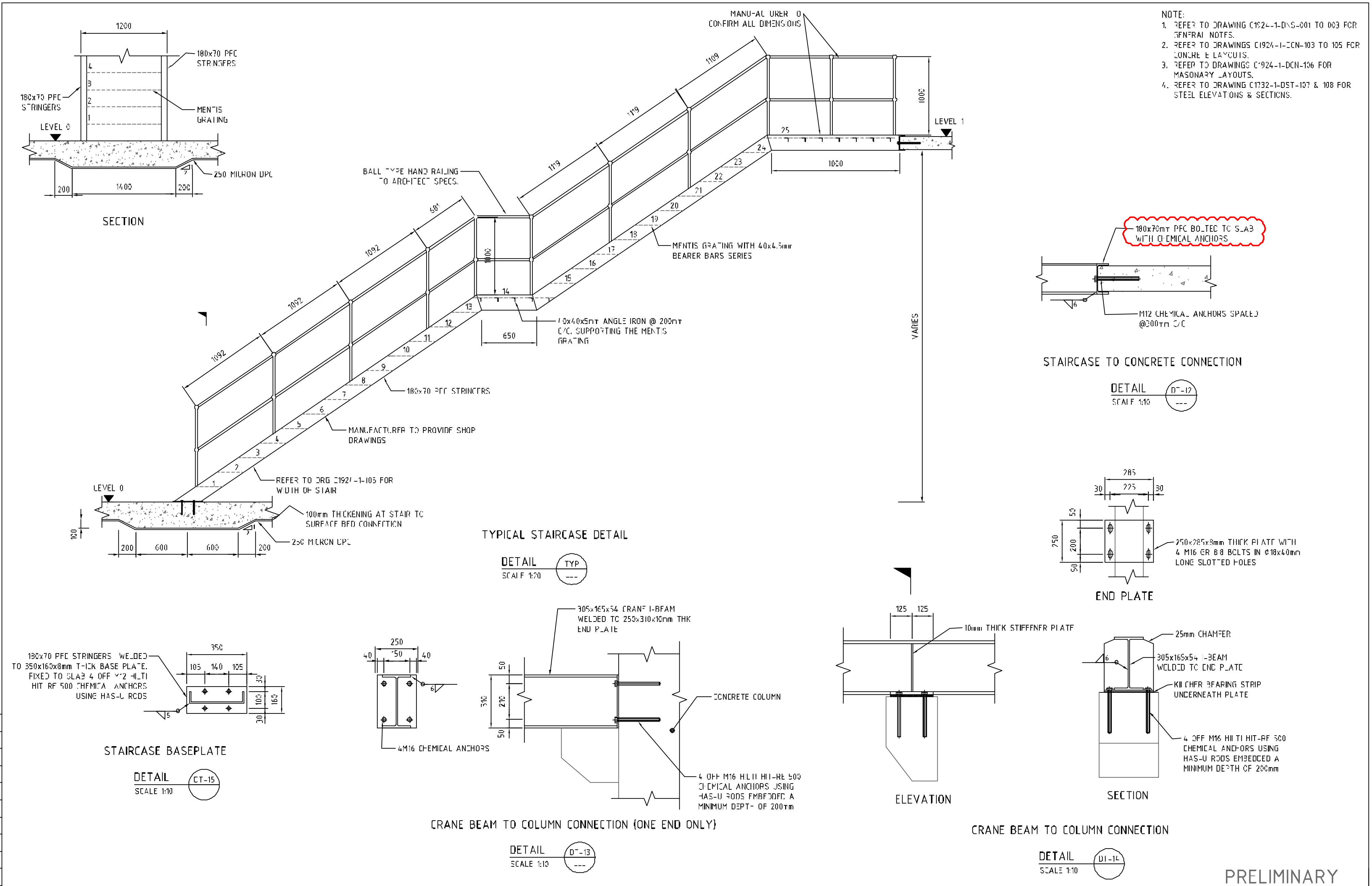
DRAWING APPROVED:
ENGINEER: ....
PR ENG NR: ....
SIGNATURE: ....

SMEC PROJECT NO. 1924

GEORGE MUNICIPALITY
THEMBALETHU PUMP STATION
STRUCTURAL DRAWING
STEEL TYPICAL DETAILS

PHASE	DRAWING TYPE	DRAWING NUMBER	REVISION
1	DST	111	B

NOTE:
1. REFER TO DRAWING C1924-1-DNS-001 TO 003 FOR GENERAL NOTES.
2. REFER TO DRAWINGS C1924-1-DCN-103 TO 105 FOR CONCRETE LAYOUTS.
3. REFER TO DRAWINGS C1924-1-DCN-106 FOR MASONARY LAYOUTS.
4. REFER TO DRAWING C1732-1-DST-107 & 108 FOR STEEL ELEVATIONS & SECTIONS.



PRELIMINARY

REV	DATE	AMENDMENT / REVISION DESCRIPTION
A	19.10.2023	PRELIMINARY
B	23.10.2023	PRELIMINARY

TITLE	NAME
DRAFTER	I. DUPLOE
DRAWING CHECK	E. PETERS
DESIGNER	I. DUPLOE
DESIGN CHECK	E. PETERS
PROJECT MANAGER	T. DEONUS
PROJECT DIRECTOR	T. DEONUS

DRAWING APPROVED
ENGINEER: ....
PR ENG NR: ....
SIGNATURE: ....

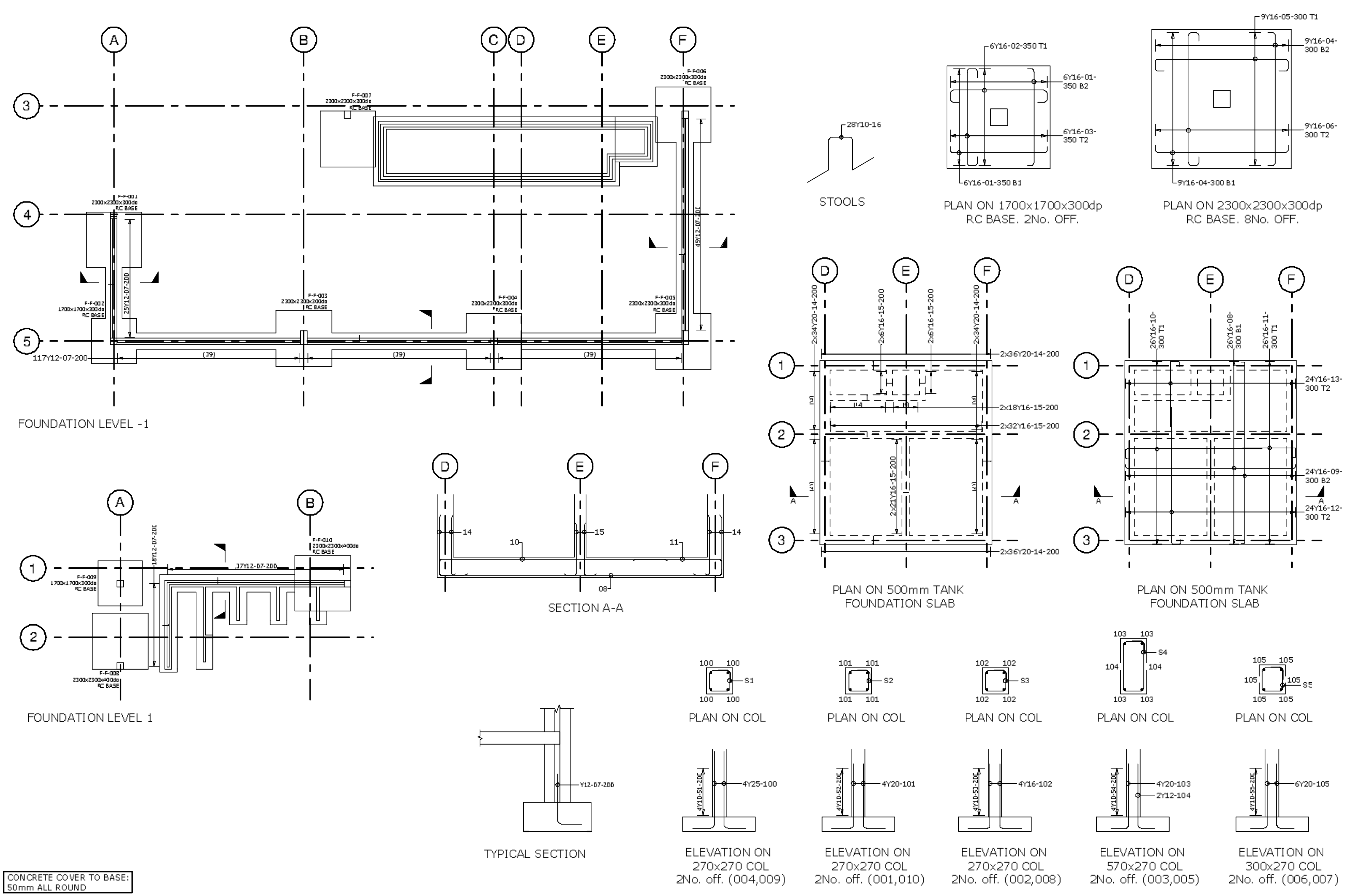
SCALES AT ORIGINAL SIZE DRAWING
SCALE 1:5
SCALE 1:10
SCALE 1:20

SMEC South Africa
Member of the Surbana Jurong Group
SABS ISO 9001
SMEC PROJECT NO. 1924

GEORGE THE CITY FOR ALL REASONS

GEORGE MUNICIPALITY
THEMBALETHU PUMP STATION
STRUCTURAL DRAWING
STEEL TYPICAL DETAILS

PHASE	DRAWING TYPE	DRAWING NUMBER	REVISION
1	DST	112	B



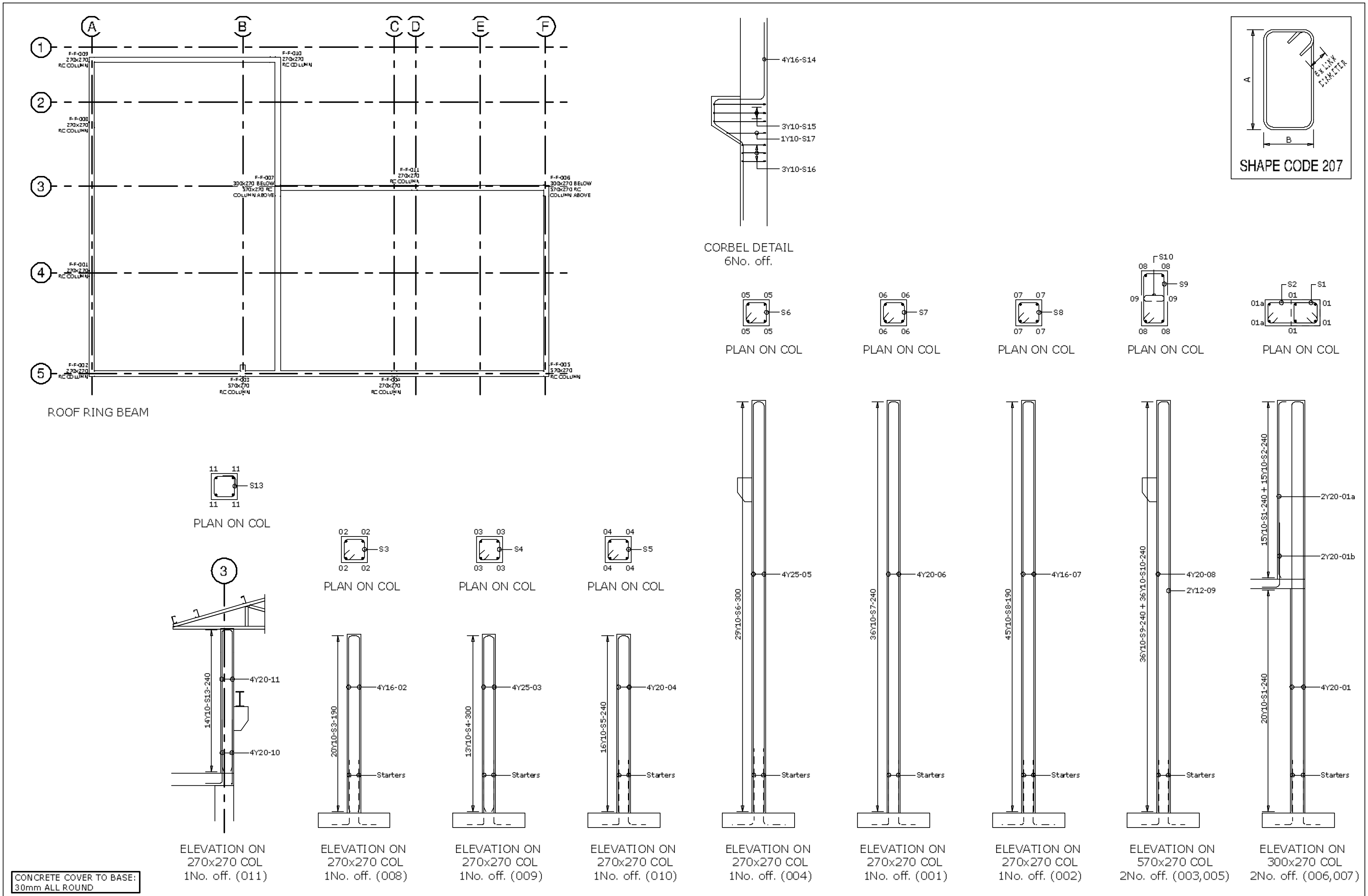
CONCRETE COVER TO BASE:
50mm ALL ROUND

SMEC PROJECT NO. C1324

65 Riebeek Street
Cape Town 8001
South Africa
PO Box 8022
Roggebaai 8012
South Africa
T +27 21 417 2900
F +27 21 417 2999
www.smec.com

GEORGE MUNICIPALITY
THEMBALETHU PUMP STATTION
RC FOUNDATION REINFORCEMENT

A2 Scale	AS SHOWN
Drawing type	DRB
Drawing no.	110
Revision	A



CONCRETE COVER TO BASE:
30mm ALL ROUND

SMEC PROJECT NO. C1324

65 Riebeek Street
Cape Town 8001
South Africa

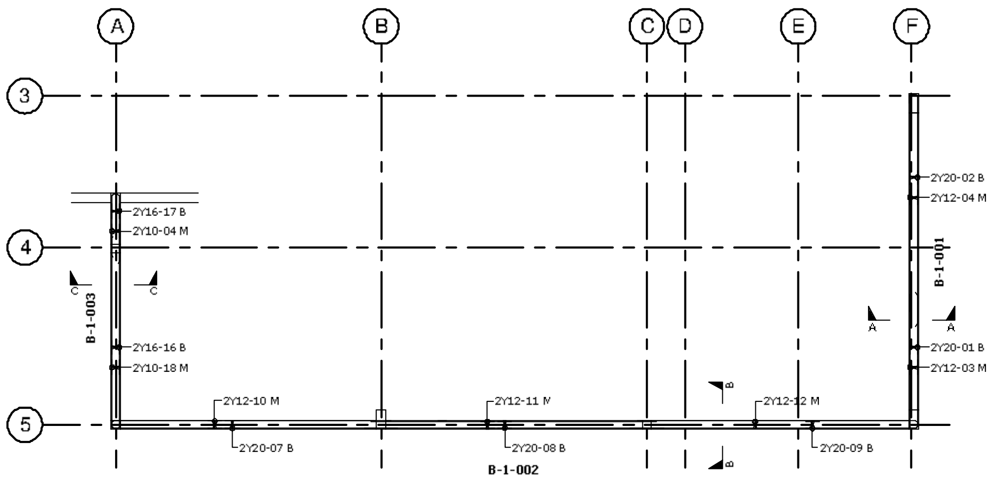
PO Box 8022
Roggebaai 8012
South Africa

T +27 21 417 2900
F +27 21 417 2999
www.smec.com

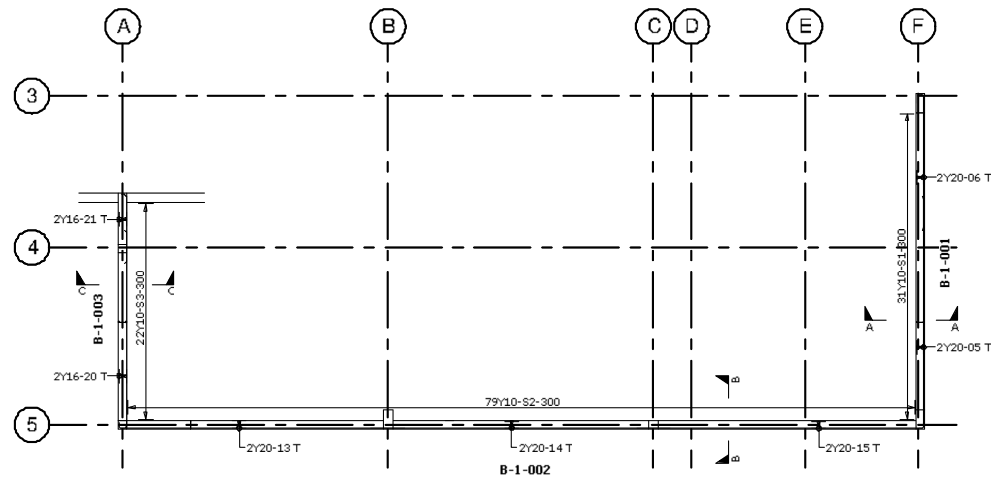
GEORGE MUNICIPALITY
THEMBALETHU PUMP STATTION

RC COLUMN REINFORCEMENT

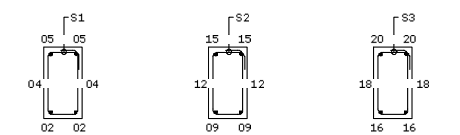
A2	AS SHOWN
	DRB
	112
	A



LEVEL 1 RING BEAM - BOTTOM & MIDDLE REINFORCEMENT



LEVEL 1 RING BEAM - TOP REINFORCEMENT



SECTION A-A SECTION B-B SECTION C-C

CONCRETE COVER TO BEAM:
30mm ALL ROUND

SMEC PROJECT NO. C1924

65 Riebeek Street
Cape Town 8001
South Africa

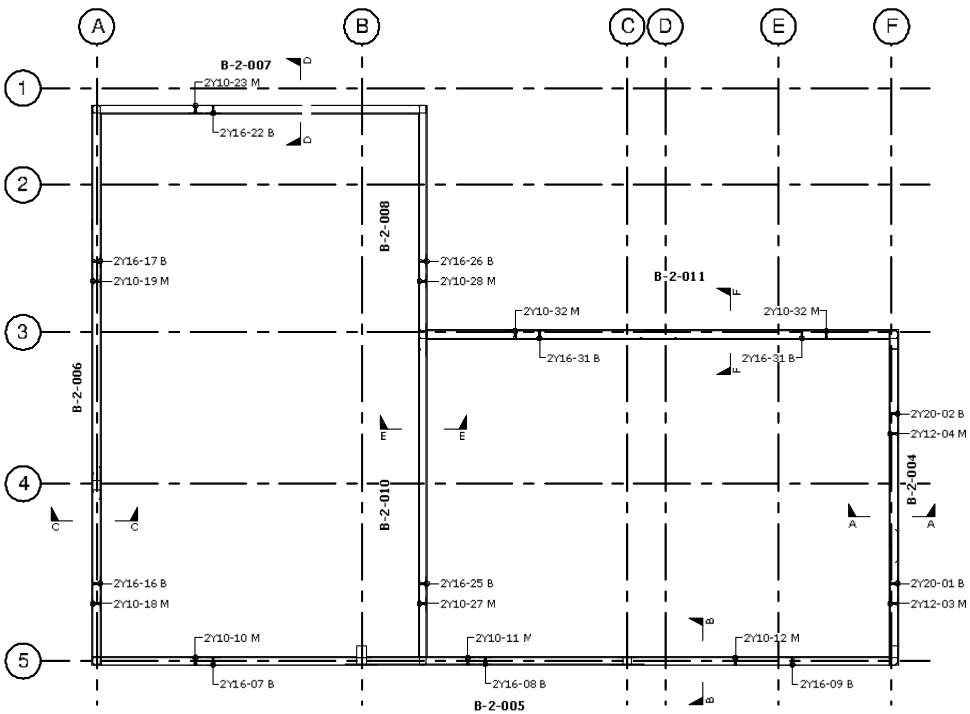
PRO Box 8022
Roggebaai 8012
South Africa

T +27 21 417 2900
F +27 21 417 2999
www.smec.com

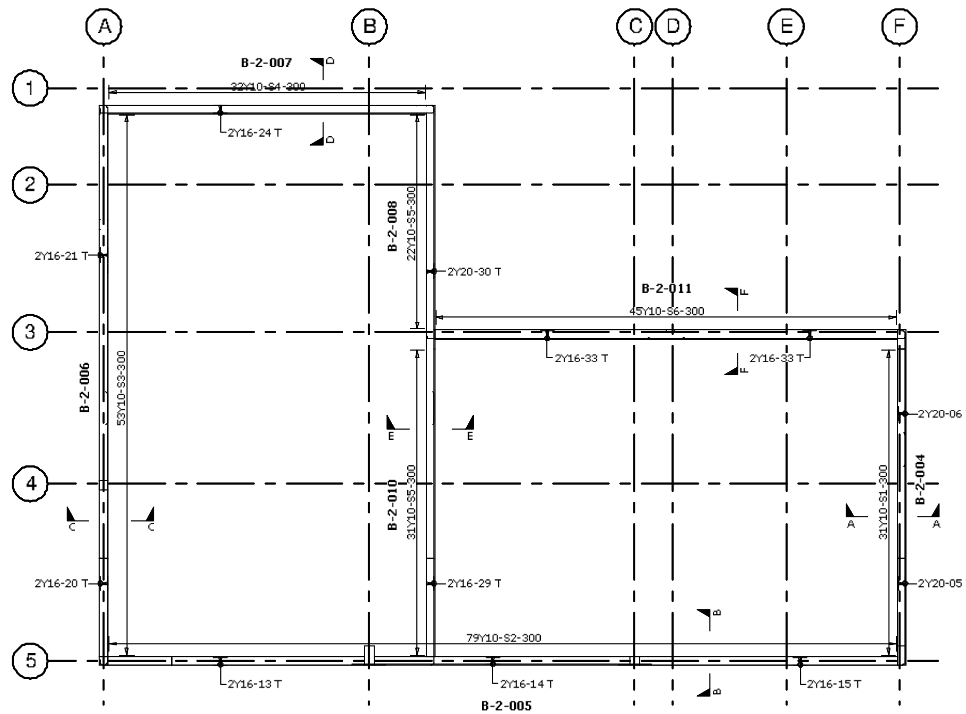
GEORGE MUNICIPALITY
THEMBALETHU PUMP STATTION

LEVEL 1 RC RING BEAM REINFORCEMENT

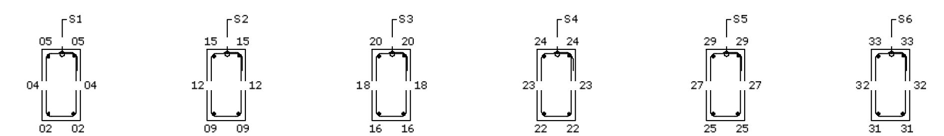
A2 Scale	AS SHOWN
Drawing type	DRB
SMEC drawing no.	114
Revision No.	A



ROOF RING BEAM - BOTTOM & MIDDLE REINFORCEMENT



ROOF RING BEAM - TOP REINFORCEMENT



SECTION A-A SECTION B-B SECTION C-C SECTION D-D SECTION E-E SECTION F-F

CONCRETE COVER TO BEAM:
30mm ALL ROUND

No	Date	Description	Initial
A			

SMEC PROJECT NO. C1924

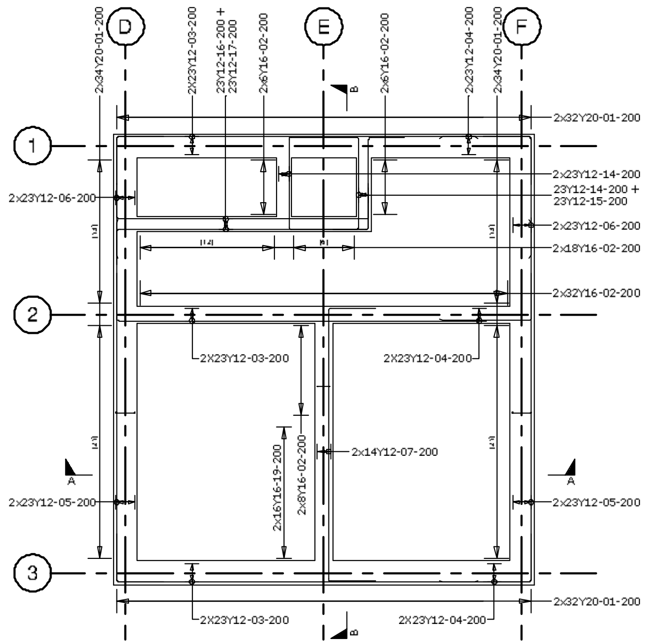
65 Riebeek Street
Cape Town 8001
South Africa
PRO Box 8022
Roggebaai 8012
South Africa
T +27 21 417 2900
F +27 21 417 2999
www.smec.com

GEORGE
THE CITY FOR ALL REASONS

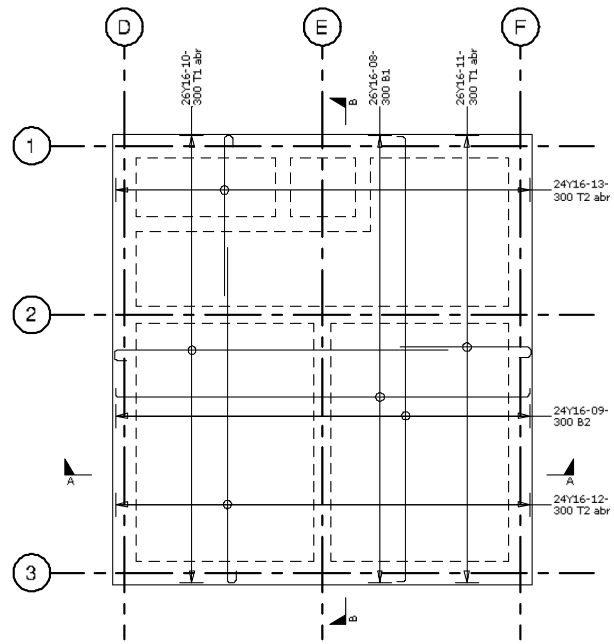
GEORGE MUNICIPALITY
THEMBALETHU PUMP STATTION

RC ROOF RING BEAM REINFORCEMENT

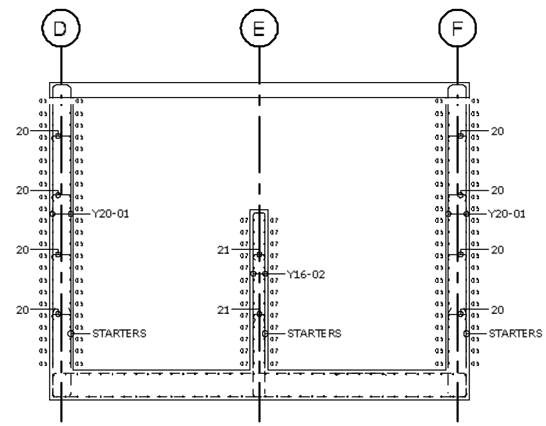
A2 Scale	AS SHOWN
Drawing type	DRB
Drawing no.	116
Revision	A



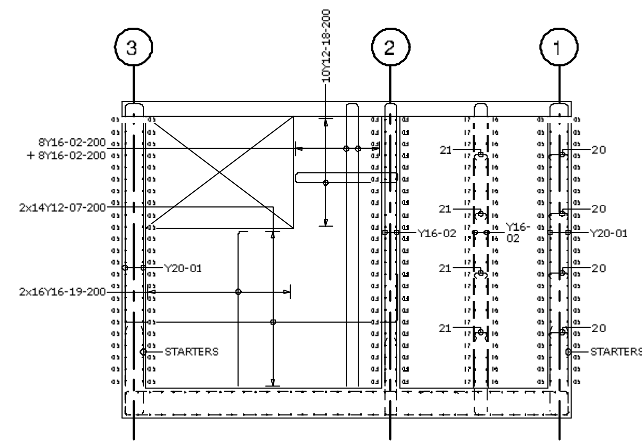
PLAN ON RC WALLS



PLAN ON 250mm TANK ROOF SLAB



SECTION A-A



SECTION B-B

CONCRETE COVER TO TANK WALLS:
50mm SOIL SIDE, 40mm INTERNAL.

CONCRETE COVER TO BASE:
50mm ALL ROUND

SMEC
Member of the Surbana Jurong Group
SMEC PROJECT NO. C1924

SABS
ISO 9001

65 Riebeek Street
Cape Town 8001
South Africa

PPO Box 8022
Roggebaai 8012
South Africa

T +27 21 417 2900
F +27 21 417 2999
www.smec.com

GEORGE
THE CITY FOR ALL REASONS

GEORGE MUNICIPALITY
THEMBALETHU PUMP STATTION

RC TANK WALL REINFORCEMENT

A2 Scale	AS SHOWN
Drawing type	DRB
Drawing no.	118
Revision	A

DEEL MEMBER	AANTAL NO OFF	PER DEEL/ MEMB.	DIA	LENGTE LENGTH	TOT.	MERK MARK	KODE CODE	BUIGING VOLGENS - SANS 282 BENDING TO - SANS 282 A	B	C	D	E/r
300x270/	2	4	Y20	8600	8	01	37	140	(8490)			
570x270		2	Y20	3750	4	01a	37	140	(3640)			
006,007		2	Y20	1650	4	01b	37	350	(1330)			
		35	Y10	1150	70	S1	207	240	210			
		15	Y10	400	30	S2	207	210	510			
270x270	1	4	Y16	3750	4	02	37	140	(3640)			
008		20	Y10	1100	20	S3	207	210	210			
270x270	1	4	Y25	3750	4	03	37	140	(3640)			
009		13	Y10	1100	13	S4	207	210	210			
270x270	1	4	Y20	3750	4	04	37	140	(3640)			
010		16	Y10	1100	16	S5	207	210	210			
270x270	1	4	Y25	8600	4	05	37	140	(8490)			
004		29	Y10	1100	29	S6	207	210	210			
270x270	1	4	Y20	8600	4	06	37	140	(8490)			
001		36	Y10	1100	36	S7	207	210	210			
270x270	1	4	Y16	8600	4	07	37	140	(8490)			
002		45	Y10	1100	45	S8	207	210	210			
570x270	2	4	Y20	8600	8	08	37	140	(8490)			
003,005		2	Y12	8650	4	09	37	160	(8490)			
		36	Y10	1700	72	S9	207	510	210			
		36	Y10	400	72	S10	36	80	60	210	60	(80)
270x270	1	4	Y20	1650	4	10	37	350	(1330)			
011		4	Y20	3000	4	11	37	140	(2920)			
		14	Y10	1100	14	S13	207	210	210			
CORBEL	6	4	Y16	2750	24	S14	188	800	520	250	200	360
		3	Y10	1700	18	S15	207	210	520			
		1	Y10	1400	6	S17	207	210	380			
		3	Y10	1100	18	S16	207	210	225			

	8	10	12	16	20	25	32	40	TOT
R									
Y		304	31	182	560	190			1267
TOT		304	31	182	560	190			1267

Datum/Date	2023/10/23
Geteken/Drawn	R du P
Tek.Nr/Drg.No	C1924-DCN-103
Werk Nr/Job No	C1924

SABS

SMEC South Africa
Member of the Surbana Jurong Group

65 Riebeek Street
Cape Town 8001
South Africa

PPO Box 8022
Roggebaai 8012
South Africa

T +27 21 417 2900
F +27 21 417 2999
www.smec.com

THEMBALETHU PUMP STATTION
RC COLUMN REINFORCEMENT

Wysiging/Revision	A
Skedule Nr/Shedule No	113

DEEL MEMBER	AANTAL NO OFF	PER DEEL/ MEMB.	DIA	LENGTE LENGTH	TOT.	MERK MARK	KODE CODE	BUIGING VOLGENS - SANS 282 BENDING TO - SANS 282 A	B	C	D	E/r
B-1-001	1	2	Y20	4100	2	01	37	150	(4000)			
		2	Y20	6950	2	02	37	150	(6840)			
		2	Y12	4100	2	03	37	100	(4000)			
		2	Y12	6500	2	04	37	100	(6440)			
		2	Y20	6950	2	05	37	150	(6840)			
		2	Y20	4100	2	06	37	150	(4000)			
		31	Y10	1450	31	S1	60	440	210			
B-1-002		2	Y20	8550	2	07	37	150	(8450)			
		2	Y20	8850	2	08	20	(8850)				
		2	Y20	8600	2	09	37	150	(8490)			
		2	Y12	8350	2	10	37	100	(8250)			
		2	Y12	8450	2	11	20	(8440)				
		2	Y12	8350	2	12	37	100	(8290)			
		2	Y20	8550	2	13	37	150	(8450)			
		2	Y20	8850	2	14	20	(8850)				
		2	Y20	8600	2	15	37	150	(8490)			
		79	Y10	1450	79	S2	60	440	210			
B-1-003		2	Y16	5950	2	16	37	150	(5850)			
		2	Y16	2150	2	17	37	150	(2030)			
		2	Y10	5750	2	18	37	100	(5650)			
		2	Y10	1900	2	19	37	100	(1830)			
		2	Y16	5950	2	20	37	150	(5850)			
		2	Y16	2150	2	21	37	150	(2030)			
		22	Y10	1450	22	S3	60	440	210			

	8	10	12	16	20	25	32	40	TOT
R									
Y		127	63	51	365				608
TOT		127	63	51	365				608

Datum/Date	2023/10/23
Geteken/Drawn	R du P
Tek.Nr/Drg.No	C1924-DCN-104
Werk Nr/Job No	C1924
Wysiging/Revision	A
Skedule Nr/Shedule No	115

SMEC South Africa
Member of the Surbana Jurong Group
65 Riebeek Street
Cape Town 8001
South Africa
PPO Box 8022
Roggebaai 8012
South Africa
T +27 21 417 2900
F +27 21 417 2999
www.smec.com

THEMBALETHU PUMP STATTION
LEVEL 1 RC RING BEAM
REINFORCEMENT

DEEL MEMBER	AANTAL NO OFF	PER DEEL/ MEMB.	DIA	LENGTE LENGTH	TOT.	MERK MARK	KODE CODE	BUIGING VOLGENS - SANS 282 BENDING TO - SANS 282				
								A	B	C	D	E/r
B-2-004	1	2	Y20	4100	2	01	37	150	(4000)			
		2	Y20	6950	2	02	37	150	(6840)			
		2	Y12	4100	2	03	37	100	(4000)			
		2	Y12	6500	2	04	37	100	(6440)			
		2	Y20	6950	2	05	37	150	(6840)			
		2	Y20	4100	2	06	37	150	(4000)			
		31	Y10	1450	31	S1	60	440	210			
B-2-005	1	2	Y16	8550	2	07	37	150	(8450)			
		2	Y16	8850	2	08	20	(8850)				
		2	Y16	8600	2	09	37	150	(8490)			
		2	Y10	8350	2	10	37	100	(8250)			
		2	Y10	8450	2	11	20	(8440)				
		2	Y10	8400	2	12	37	100	(8290)			
		2	Y16	8550	2	13	37	150	(8450)			
		2	Y16	8850	2	14	20	(8850)				
		2	Y16	8600	2	15	37	150	(8490)			
		79	Y10	1450	79	S2	60	440	210			
B-2-006	1	2	Y16	5950	2	16	37	150	(5850)			
		2	Y16	11650	2	17	37	100	(11600)			
		2	Y10	5750	2	18	37	100	(5650)			
		2	Y10	11500	2	19	37	100	(11400)			
		2	Y16	8150	2	20	37	100	(8060)			
		2	Y16	9500	2	21	37	100	(9410)			
		53	Y10	1450	53	S3	60	440	210			
B-2-007	1	2	Y16	10050	2	22	38	120	9870	(120)		
		2	Y10	10050	2	23	38	100	9870	(100)		
		2	Y16	10050	2	24	38	120	9870	(120)		
		32	Y10	1450	32	S4	60	440	210			
B-2-008	1	2	Y16	10150	2	25	37	120	(10080)			
B-2-010		2	Y16	7500	2	26	37	120	(7390)			
		2	Y10	9950	2	27	37	100	(9880)			
		2	Y10	7300	2	28	37	100	(7190)			
		2	Y16	8150	2	29	37	100	(8060)			
		2	Y16	9500	2	30	37	100	(9410)			
		53	Y10	1450	53	S5	60	440	210			
B-2-011	1	4	Y16	7700	4	31	37	120	(7600)			
		4	Y10	7600	4	32	37	100	(7500)			
		4	Y16	7700	4	33	37	120	(7600)			
		45	Y10	1450	45	S6	60	440	210			

	8	10	12	16	20	25	32	40	TOT
R									
Y		367	19	548	109				1042
TOT		367	19	548	109				1042

Datum/Date	2023/10/23
Geteken/Drawn	R du P
Tek.Nr/Drg.No	C1924-DCN-104
Werk Nr/Job No	C1924

SMEC South Africa
Member of the Surbana Jurong Group
65 Riebeek Street
Cape Town 8001
South Africa
PO Box 8022
Roggebaai 8012
South Africa
T +27 21 417 2900
F +27 21 417 2999
www.smec.com

THEMBALETHU PUMP STATTION
RC ROOF RING BEAM
REINFORCEMENT

Wysiging/Revision	A
Skedule Nr/Shedule No	117