Contract JW14040RR

CONSTRUCTION OF A 2.25ML WATER TOWER IN ROBERTSVILLE

TENDER COVER PAGE **MBD 1**

YOU ARE HEREBY INVITED TO BID FOR REQUIREMENTS OF JOHANNESBURG WATER

BID NUMBER: JW14040RR **CLOSING DATE: 20 FEBRUARY 2026** **CLOSING TIME: 10:30 AM**

DESCRIPTION: CONSTRCUTION OF A 2.25ML WATER TOWER IN ROBERTSVILLE

CIDB REQUIREMENTS: TENDERERS SHOULD HAVE A CONTRACTOR CIDB GRADING OF 8CE OR HIGHER

BRIEFING SESSION	COMPULSORY
BRIEFING DETAILS	DATE AND TIME: 04 DECEMBER 2025 AT 10:00 AM ADDRESS: C/O NADINE AND ANVIL ROADS, ROBERTSVILLE, ROODEPOORT VENUE: SITE LOCATION (-26.192 0077 :27.920 08091) TENDERS RECEIVED FROM NON-ATTENDED BIDDERS OF A COMPULSORY BRIEFING SESSION WILL NOT BE ACCEPTED
TENDER SUBMISSION DETAILS	BID DOCUMENTS MUST BE DEPOSITED IN THE TENDER BOX SITUATED AT GROUND FLOOR IN JOHANNESBURG WATER ADDRESS: TURBINE HALL, 65 NTEMI PILISO STREET, NEWTOWN, JOHANNESBURG, 2001 PLEASE ALLOW SUFFICIENT TIME TO ACCESS JOHANNESBURG WATER OFFICES IN TURBINE HALL AND DEPOSIT YOUR TENDER DOCUMENT IN THE JOHANNESBURG WATER TENDER BOX SITUATED AT RECEPTION BEFORE TENDER CLOSING TIME. TIMES: THE BUILDING WILL OPEN 7 DAYS A WEEK FROM 06:00 UNTIL 18:00

BIDDER INFORMATION				
NAME OF BIDDER				
POSTAL ADDRESS				
PHYSICAL ADDRESS				
TELEPHONE NUMBER				
CELLPHONE NUMBER				
E-MAIL ADDRESS				
VAT REGISTRATION NUMBER				
TAX COMPLIANCE STATUS	TCS PIN		MAAA No	
OTHER STATUS	COIDA Registration No		CIDB No	

EMPLOYER INFORMATION			
DEPARTMENT	CAPEX	DEPARTMENT	SCM
CONTACT PERSON	Matodzi Ramuhulu	CONTACT PERSON	GCINA NDELA
TELEPHONE NUMBER	011 688 1539	TELEPHONE NUMBER	011 6881796
E-MAIL ADDRESS	Matodzi.ramuhulu@jwater.co.za	E-MAIL ADDRESS	gcina.ndela@jwater.co.za

NOTE:DOCUMENTS DOWNLOADED FROM THE ETENDER PORTAL IS AT NO COST BUT MUST COMPLY WITH SUBMISSION REQUIREMENTS.

WITHOUT LIMITATION, JOHANNESBURG WATER TAKES NO RESPONSIBILITY FOR ANY DELAYS IN ANY COURIER OR POSTAL SYSTEM OR ANY LOGISTICAL DELAYS WITHIN THE PREMISES OF JOHANNESBURG WATER. JOHANNESBURG WATER LIKEWISE TAKES NO RESPONSIBILITY FOR OFFERS DELIVERED TO A LOCATION OTHER THAN THE TENDER BOX AS PER THE TENDER SUBMISSION DETAILS STATED IN THE TENDER. PROOF OF POSTING OR OF COURIER DELIVERY WILL NOT BE TAKEN BY JOHANNESBURG WATER AS PROOF OF DELIVERY. TENDER SUBMISSION DOCUMENTS MUST BE IN THE BOX BEFORE TENDER CLOSURE.

The current Johannesburg Water Supply Chain policy is applicable which is available on the JW website www.johannesburgwater.co.za

THE TENDERER IS ENCOURAGED TO SIGN THE TENDER SUBMISSION REGISTER WHEN SUBMITTING THEIR TENDERS.

PLEASE ENSURE YOU SUBMIT 1 x ORIGINAL TENDER HARD DOCUMENT
(IF PRACTICAL, ALSO PROVIDE AN ELECTRONIC COPY IN A MEMORY STICK/USB TO ENSURE INFORMATION IS NOT MISSED WHEN TENDERS ARE BEING EVALUATED BY THE BID EVALUATION COMMITTEE – NON-SUBMISSION OF ELECTRONIC COPY AND MEMORY STICK/USB WILL NOT LEAD TO DISQUALIFICATION).

Any documents required that are not submitted in the tender box at the deadline will be considered late.

The tenderer accepts that Johannesburg Water will not take responsibility for the misplacement or premature opening of the tender if the outer package is not sealed and marked as stated.

NB: NO BIDS WILL BE CONSIDERED FROM PERSONS IN THE SERVICE OF THE STATE.

NAME OF CONTACT PERSON: ……..

SIGNATURE OF BIDDER: ……

CAPACITY UNDER WHICH THIS BID IS SIGNED: ……..

DATE: ……...

TERMS AND CONDITIONS FOR BIDDING

1. BID SUBMISSION:

1.1. BIDS MUST BE DELIVERED BY THE STIPULATED TIME TO THE CORRECT ADDRESS. LATE BIDS WILL NOT BE ACCEPTED FOR CONSIDERATION.

1.2. **ALL BIDS MUST BE SUBMITTED ON THE OFFICIAL FORMS PROVIDED (NOT TO BE RE-TYPED) OR ONLINE**

1.3. THIS BID IS SUBJECT TO THE PREFERENTIAL PROCUREMENT POLICY FRAMEWORK ACT AND THE PREFERENTIAL PROCUREMENT REGULATIONS, 2022, THE GENERAL CONDITIONS OF CONTRACT (GCC) AND, IF APPLICABLE, ANY OTHER SPECIAL CONDITIONS OF CONTRACT.

2. TAX COMPLIANCE REQUIREMENTS

2.1 BIDDERS MUST ENSURE COMPLIANCE WITH THEIR TAX OBLIGATIONS.

2.2 BIDDERS ARE REQUIRED TO SUBMIT THEIR UNIQUE PERSONAL IDENTIFICATION NUMBER (PIN) ISSUED BY SARS TO ENABLE THE ORGAN OF STATE TO VIEW THE TAXPAYER'S PROFILE AND TAX STATUS.

2.3 APPLICATION FOR THE TAX COMPLIANCE STATUS (TCS) CERTIFICATE OR PIN MAY ALSO BE MADE VIA E-FILING. IN ORDER TO USE THIS PROVISION, TAXPAYERS WILL NEED TO REGISTER WITH SARS AS E-FILERS THROUGH THE WEBSITE WWW.SARS.GOV.ZA.

2.4 FOREIGN SUPPLIERS MUST COMPLETE THE PRE-AWARD QUESTIONNAIRE IN PART B:3.

2.5 BIDDERS MAY ALSO SUBMIT A PRINTED TCS CERTIFICATE TOGETHER WITH THE BID.

2.6 IN BIDS WHERE CONSORTIA / JOINT VENTURES / SUB-CONTRACTORS ARE INVOLVED; EACH PARTY MUST SUBMIT A SEPARATE TCS CERTIFICATE / PIN / CSD NUMBER.

2.7 WHERE NO TCS IS AVAILABLE BUT THE BIDDER IS REGISTERED ON THE CENTRAL SUPPLIER DATABASE (CSD), A CSD NUMBER MUST BE PROVIDED.

3. QUESTIONNAIRE TO BIDDING FOREIGN SUPPLIERS

3.1.	IS THE ENTITY A RESIDENT OF THE REPUBLIC OF SOUTH AFRICA (RSA)?	☐ YES ☐ NO
3.2.	DOES THE ENTITY HAVE A BRANCH IN THE RSA?	☐ YES ☐ NO
3.3.	DOES THE ENTITY HAVE A PERMANENT ESTABLISHMENT IN THE RSA?	☐ YES ☐ NO
3.4.	DOES THE ENTITY HAVE ANY SOURCE OF INCOME IN THE RSA?	☐ YES ☐ NO
3.5.	IS THE ENTITY LIABLE IN THE RSA FOR ANY FORM OF TAXATION?	☐ YES ☐ NO

IF THE ANSWER IS "NO" TO ALL OF THE ABOVE, THEN IT IS NOT A REQUIREMENT TO REGISTER FOR A TAX COMPLIANCE STATUS SYSTEM PIN CODE FROM THE SOUTH AFRICAN REVENUE SERVICE (SARS) AND IF NOT REGISTER AS PER 2.3 ABOVE.

NB: FAILURE TO PROVIDE ANY OF THE ABOVE PARTICULARS MAY RENDER THE BID INVALID.

1. TENDER NOTICE AND INVITATION TO TENDER

Johannesburg Water (SOC) Ltd invites the tenderer for the following:

CONTRACT NO. JW14040RR: - CONSTRUCTION OF A 2.25 ML WATER TOWER IN ROBERTSVILLE.

The tender document will be available in the form of a download from the Johannesburg Water website (https://www.johannesburgwater.co.za/scm/supply-chain/tenders/all-open-tenders/) starting from 18 November 2025.

The Employer is Johannesburg Water.

All tenders and supporting documents must be submitted in a sealed envelope and be placed in the Tender box on the ground floor of Johannesburg Water by no later than 10:30 am on 20 February 2026.

Address is as follows:

TURBINE HALL, 65 NTEMI PILISO STREET, NEWTOWN, JOHANNESBURG, 2001

Johannesburg Water (SOC) Ltd is not obliged to accept the lowest or any tender and Johannesburg Water reserves to appoint:

a) in whole or in part.
b) to more than one tenderer.
c) to the highest points scoring bidder.
d) to the lowest acceptable tender or highest acceptable tender in terms of the point scoring system.
e) to a bidder not scoring the highest points (based on objective grounds in terms of section 2 (1) (f) of the PPPFA) (where applicable).
f) not to consider any bid with justifiable reasons.

A valid and binding contract with the successful tender/s will be concluded once Johannesburg Water has awarded the contract. Johannesburg Water (SOC) Ltd and the successful tenderer/s will sign the contract agreement forms.

Johannesburg Water SOC Ltd

CONTRACT NO: JW14040RR

CONSTRUCTION OF A 2.25 ML WATER TOWER IN ROBETSVILLE

VOLUME 1

TENDER AND CONTRACT

The Tenderer is to indicate in the "Submitted (Yes/No)" column in the below table that they have completed the required section of the tender document. Completion of this checklist will assist the Tenderer in ensuring that they have attended to all the required items for submission with this tender. Additionally, it is an absolute requirement that tenderers comply with National Treasury's CSD registration as well as SARS tax compliance requirements for contract award – refer T2.2.4. The below will form part of the tender document, the tenderers are therefore encouraged to submit the returnable and or documentation with their tender offer to avoid elimination especially with regards to what is stated in the Required for Tender Evaluation column or not obtaining points for Specific Goals. Tenderers are encouraged to ensure that their Tax status remains Tax Compliant on CSD throughout the process to avoid delaying the process or being eliminated at award stage. For infrastructure related projects. Tenderer must have a CIDB Active Status at the requested CIDB requirement at evaluation stage to avoid disqualification.

All documentation listed in the Checklist below shall form part of the Contract.

Table 1

Ref	Description of Returnable/s or Documentation that will form Part of Contract and must therefore to be Completed and / or Submitted by the Tenderer	Required for Tender Evaluation	Required for Tender Award	Required After Tender Award	Submitted (Yes/No)
1	**Tender Cover:**				
	Name of Tender	•			
	Contact Person	•			
	Telephone Number	•			
	Central Supplier Database Registration	•			
	CIDB Registration Number	•			
	COIDA Registration Number			•	
	Tax SARS PIN No.		•		
	MAAA No. for Tax Compliant Status		•		
2	**Mandatory Documents at Particular Stage:**				
	CIDB grading of 8CE higher. Active Status at the required CIDB grading or higher at the time of Evaluation	•			
T2.3.3	Mandatory Tender Briefing Meeting	•			
	Complete and sign the Form of Offer	•			

Ref	Description of Returnable/s or Documentation that will form Part of Contract and must therefore to be Completed and / or Submitted by the Tenderer	Required for Tender Evaluation	Required for Tender Award	Required After Tender Award	Submitted (Yes/No)
3	**Administrative Documentation:**				
T2.1.1	Record of Addenda to Tender Documents	•			
T2.1.2	Signed Certificate of Authority to Sign	•	•		
T2.1.3	Compulsory Enterprise Questionnaire	•			
	MBD 1 - Invitation to Bid - Completed and signed	•	•		
	Central Supplier Database Registration	•			
T2.1.4	MBD 4 - Declaration of interest - Completed and signed	•	•		
T2.1.4	MBD 5 - Declaration for procurement above R10 Million (all applicable taxes included) - Completed and signed.	•	•		
T2.1.4	MBD 6.1 - Preference Points Schedule – Specific Goals and Price Points - Completed and signed.	•			
T2.1.4	MBD 8 - Bidder's past supply chain management practices – Completed and signed.	•	•		
T2.1.4	MBD 9 - Certificate of Independent Bid Determination – Completed and signed.	•	•		
	Municipal Rates and Taxes for the Company - Current municipal rates for the **company** not older than 90 days (if leasing/renting, submitted proof such as lease agreement where premises are rented), OR Confirmation that suitable arrangements are in place for arrear municipal obligations with your local municipality. OR Current municipal rates which is not older than 90 days or valid lease agreement with affidavit from owner of property in cases stated in Proof of Good Standing with Regards to Municipal Accounts document in the Tender.	•	•		

Ref	Description of Returnable/s or Documentation that will form Part of Contract and must therefore to be Completed and / or Submitted by the Tenderer	Required for Tender Evaluation	Required for Tender Award	Required After Tender Award	Submitted (Yes/No)
	Municipal Rates and Taxes - Current municipal rates for the **directors** of the entity not older than 90 days (if leasing/renting, submitted proof such of lease agreement where premises are rented), OR Confirmation that suitable arrangements are in place for arrear municipal obligations with your local municipality. OR Current municipal rates which is not older than 90 days or valid lease agreement with affidavit from owner of property in cases stated in Proof of Good Standing with Regards to Municipal Accounts document in the Tender	•	•		
	3-year financial statements (audited where applicable)	•	•	•	
	Joint Venture Consortium or equivalent Agreement signed by all parties if applicable.	•	•		
	Any qualifications. If "Yes", reference to such qualification/s must be indicated on a cover letter. Please be aware that alterations on the tender document may result in your tender being **eliminated as the qualification may impede on the ability to evaluate like with like.**	•	•		
T2.1.5	Proposed Amendments and Qualifications	•			
T2.3.4	Imported Content Sheet: Forward Exchange Cover for Imported	•			
4.	**Functionality Documentation:**				
	Documentary Evidence Required for Criteria 1 **(Contactable Reference Letters and Completion / Final Approval Certificates)**	•			
	Documentary Evidence Required for Criteria 2 **(Site specific method statement)**	•		•	
	Documentary Evidence Required for Criteria 3 **(CV, qualifications, and valid registration)**	•		•	
	Documentary Evidence Required for Criteria 4 **(CV, qualifications, and valid registration)**	•		•	
	Documentary Evidence Required for Criteria 5 **(CV, qualifications)**	•		•	
	Documentary Evidence Required for Criteria 6	•		•	

Ref	Description of Returnable/s or Documentation that will form Part of Contract and must therefore to be Completed and / or Submitted by the Tenderer	Required for Tender Evaluation	Required for Tender Award	Required After Tender Award	Submitted (Yes/No)
	(CV, qualifications)				
	Documentary Evidence Required for Criteria 7 **(CV, qualifications)**	•		•	
	Documentary Evidence Required for Criteria 8 **(CV, qualifications, and valid registration)**	•		•	
5.	**Specific Goals:**				
	Documentary Evidence Required for Criteria 1 – **(Valid Construction Sector BBBEE Certificate issued by SANAS accredited verification agency or DTI/CIPC BBBEE Certificate for Exempted Micro Enterprises or Affidavit sworn under oath, OR CIPC registration document showing percentage of ownership and share certificate where applicable)**	•			
	Documentary Evidence Required for Criteria 2 – **(Proof of municipal account / valid lease agreement, letter from the Ward Council confirming the business address. Businesses that operate from personal properties are required to submit an affidavit)**	•			
	Documentary Evidence Required for Criteria 3 – **(Valid Construction Sector BBBEE Certificate issued by SANAS accredited verification agency or DTI/CIPC BBBEE Certificate for Exempted Micro Enterprises or Affidavit sworn under oath, OR CIPC registration document showing percentage of ownership and share certificate where applicable)**	•			
6.	**Scope of Work:**				
	Scope of Work and Specifications	•			
7.	**Pricing Schedule:**				
	Bill of Quantities/ Schedule of Quantities. completed	•			
	Alterations authenticated – Refer to Acknowledgment of Tender Conditions	•			
8.	**Site Information:**				
	Site Information	•			
9.	**Occupational Health, Safety and Environmental Specification**				

Ref	Description of Returnable/s or Documentation that will form Part of Contract and must therefore to be Completed and / or Submitted by the Tenderer	Required for Tender Evaluation	Required for Tender Award	Required After Tender Award	Submitted (Yes/No)
T2.3.1	Acknowledgement of SHE Specification & Annexures	•			
10.	**Tender Drawings:**				
T2.3.2	Acknowledgement of Project Tender Drawings	•			
11.	**Terms and Conditions:**				
	General Conditions of Contract	•			
	Tender Data	•			
	Pricing Data	•	•		
12.	**Other Documents**				
	Form of Acceptance (do not complete Form of Acceptance it will be completed by JW official)				
	Public Liability Insurance			•	
	Insurance of Works			•	
	Common Law Liability Insurance			•	
	Insurance of Construction Plant and Equipment			•	
	Valid Registration with Compensation for Occupation Injuries and Diseases Act			•	
	Performance Guarantee			•	
	Comprehensive Health and Safety Plan (compliance with OHSE Specification - if applicable			•	
	Bank Details Form			•	

Tenderers will be notified of any omitted, outstanding, missing and or incomplete administrative documents and will be offered a period of 3 days to complete or submit those pages i.e., Municipal Bidding Documents (MBD), authority to sign and other administrative documents that require completion and signatures. These exclude documentation on functionality, price, and preference points for specific goals. Tenders that are received contrary to the above requirements will be disqualified after three (3) days period has lapsed. If locality is a specific goal in MBD6.1 – the requested documentation may not be used to allocate points for specific goals.

Signature: _____ Date: _____

Johannesburg Water (SOC) Ltd

Johannesburg Water

CONTRACT NO: JW14040RR

CONSTRUCTION OF A 2.25 ML WATER TOWER IN ROBETSVILLE

VOLUME 1

PART 1: TENDERING PROCEDURES

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T1.1 TENDER DATA

T1.1.1 Conditions of Tender

The conditions of tender are the Standard Conditions of Tender as contained in Annex C of the CIDB Standard for Uniformity in Construction Procurement (August 2019). (See www.cidb.org.za).

The Standard Conditions of Tender make several references to the Tender Data for details that apply specifically to this tender. The Tender Data shall have precedence in the interpretation of any ambiguity or inconsistency between it and the Standard Conditions of Tender.

Each item of data given below is cross-referenced to the clause in the Standard Conditions of Tender to which it mainly applies.

T1.1.2 Tender Data

The clause numbers in the Tender Data refer to the corresponding clause numbers in the Conditions of Tender.

The additional Conditions of Tender are:

Clause Number	Tender Data
C.1.1	The Employer is, Johannesburg Water (SOC) Limited
C.1.2	The tender document issued by the Employer comprise: **Volume 1** **Tender Part 1: Tendering Procedures** T1.1: Tender Notice and Invitation to Tender T1.2: Tender Data **Tender Part 2: Returnable Documents** T2.1: List of Returnable Documents, including the Enterprise Declaration Affidavit which may be bound in a separate volume. T2.2: List of Other Returnable Documents T2.3: List of Other Returnable Schedules **Contract Part 1: Agreement and Contract Data** C1.1: Form of Offer and Acceptance C1.2: Contract Data C1.3: Forms of Securities **Contract Part 2: Pricing Data** C2.1: Pricing Instructions

Clause Number	Tender Data
	C2.2: Bill of Quantities **Volume 2A** **Contract Part 3: Scope of Work** C3.1: Scope of Work C3.2: Particular Specifications **Contract Part 4: Site Information** C4: Site Information **Volume 2B** Generic Specifications **Volume 3** Occupational Health, Safety and Environmental Specification Environmental Management Plan **Volume 4** Tender Drawings
C.1.4	The Employer's representative is: Contact Person: Matodzi Ramuhulu Telephone: 011 688 1539 E-mail address: Matodzi.ramuhulu@jwater.co.za The SCM representative is: Contact Person: Gcina Ndela Telephone: 011 688 1796 E-mail address: Gcina.ndela@jwater.co.za

Clause Number	Tender Data
C.2.1	**Eligibility criteria and requirements** **CIDB registration and grading:** 1) Only tenderers who are registered with the CIDB and were capable of being so prior to the evaluation of submissions, in a contractor grading designation equal to or higher than the contractor grading designation determined in accordance with the sum tendered for an **8CE** class of construction work, are eligible to submit tenders. Tenders must have an Active status at the required CIDB gradings at time of tender evaluation for the bidder to meet the eligibility criteria and requirement. 2) Joint ventures are eligible to submit tenders provided that: i) every member of the joint venture is registered with the CIDB; and ii) the combined contractor grading designation calculated in accordance with the CIDB Regulations is equal to or higher than a contractor grading designation determined in accordance with the sum tendered for an **8CE** class of construction work. **Failure to meet to Eligibility criteria and requirements will result in disqualification.**
C.2.8	Replace the contents of the clause with the following: "Request clarification of the tender documents, if necessary, by notifying the Employer's Officials indicated on the Tender Notice and Invitation to Tender in writing at least seven (7) working days before the closing time stated in the foregoing notice and clause C.2.15.1"
C.2.9	Add the following clause: "Accept that the submission of a Tender shall be construed as an acknowledgement by the Tenderer that they are satisfied with the insurance cover, the Employer will affect under the contract."
C.2.10.5	Add the following to the clause: " If no offer is made for an item, a line must be drawn through the space in pen. All prices and details must be legible / readable to ensure the tender will be considered for adjudication."

Clause Number	Tender Data
C.2.11	The evaluation on price alteration will be conducted as follows: Where the tender award strategy is to evaluate and award per item or category, the following must apply: • If there is an alteration on the rate but no alteration on the total for the item or category, the bidder will not be disqualified. • If there is an alteration on the total for the item/s without authentication, bidders will only be disqualified for alteration per item or category. Where the tender award strategy is to evaluate and award total bid offer, the following must apply: • If there is an alteration on the rate, total for the line item, sub-total/ sum brought/carried forward for the section but no alteration on the total bid offer, the bidder will not be disqualified. • If there is an alteration on the total bid offer on form of offer, then the amount in words must be considered or vice-versa. • If there is an unauthenticated alteration on the total bid offer and the amount in words is not authenticated, the bidders will be disqualified for the entire tender. Where the tender pricing schedule or bill of quantities is requesting rates/price from bidder/s without providing a total, the following will apply: • (i) If there is an unauthenticated alteration on the unit rate/price the bidder must be disqualified. **Please note: Corrections may not be made using correction fluid, correction tape or the like, bid received contrary to this will be disqualified.**
C.2.12.1	Replace Contents Alternative offers will **not** be permitted.
C.2.12.2	Failure to complete bid amount on the form of offer and sign full will result in the elimination of the tender.
C.2.13.3	Each tender offer shall be submitted as an original. Tenderers are also requested to submit a soft copy in a USB (Tenderers who do not submit a soft copy will not be disqualified)

Employer:		**Contractor:**	
Witness:		**Witness:**	

Clause Number	Tender Data
C.2.13.5	The Employer's address for delivery of tender offers and identification details to be shown on the Tenderer's offer package are: **Location of tender box:** Ground Floor Entrance **Physical address:** Johannesburg Water (SOC) Ltd Turbine Hall 65 Ntemi Piliso Street Newtown Johannesburg 2001 **Identification details:** Tender reference number, Title of Tender and the closing date and time of the tender, as well as the Tenderer's name, their Authorised Representative's name, postal address and telephonic contact numbers.
C.2.13.6 & C.3.5	A two-envelope procedure will **not** be followed.
C.2.15.1	The closing time for submission of tender offers is as stated in the Tender Notice and Invitation to Tender.
C.2.16	The tender offer validity period is 150 days.
C.2.16.1	Add the following to the clause: "If the tender validity expires on a Saturday, Sunday or public holiday, the Tender Offer shall remain valid and open for acceptance until the closure of business on the following working day."
C.2.19	The Tenderer must provide access during working hours to his premises for inspections on request.
C.2.23	The Tenderer is required to submit with his tender: 1) Valid SARS Compliance status Pin for Tenders issued by the South African Revenue Services. 2) Proof of CSD registration i.e. MA number 3) A Certificate of Contractor Registration issued by the CIDB. 4) where the tendered amount inclusive of VAT exceeds R 10 million: i. audited annual financial statement for 3 years, or for the period since establishment if established during the last 3 years, if required by law to prepare annual financial statements for auditing.

Employer:		**Contractor:**	
Witness:		**Witness:**	

Clause Number	Tender Data
	ii. if the bidder is not required by law to prepare financial statements, then the bidder is required to submit their unaudited financial statements prepared by an independent accounting professional. 5) Proof that the tenderer and directors of the tenderer are not in arrears for more than 90 days with municipal rates and taxes and municipal service charges, The latest municipal account is to be attached, or a signed copy of the valid lease agreement if the tenderer or director of the tenderer is currently leasing premises and not responsible for paying municipal accounts. i. Should the municipal statement that was submitted with the tender document before tender closing date and time be in arrears for more than 90 days at time of award, the tenderer will be requested to submit the latest municipal statement which shows that the tenderer is not in arrears for more than 90 days. If the statement at that time is in arrears for more than 90 days, the tenderer must submit before the stipulated deadline, the written proof of an approved arrangement with the municipality. ii. The proof may be a copy of the agreement or an updated municipal statement which reflects the arrangement. iii. Should this tender be considered for award of the contract, based on proof of submission and should proof of such submission be found to be invalid, erroneous or inaccurate, the tenderer will no longer be considered for the award of the contract. iv. Statement must not be older than 90 days from the closing date of this tender. Attach latest municipal account statement behind this page. v. In cases where the director of the tenderer resides with their spouse, parent, partner or sibling the owner of the property that confirm where the director of the tenderer resides must submit an affidavit stating such and explaining the relationship. This would happen in the case where the submitted municipal statement or lease agreement is not in the name of the director of the tenderer. Point (i) will be applicable. vi. In cases where the business address of the tenderer is also the official residence of the director of the tenderer, the director of the tenderer must submit an affidavit stating such. Proof that the municipal statement is not in arrears for more than 90 days or a valid lease agreement must be submitted. Point (i) will be applicable. 6) Particulars of any contracts awarded to the tenderer by an organ of state during the past five years, including particulars of any material non-compliance or dispute concerning the execution of such contract. 7) A statement indicating whether any portion of the goods or services are expected to be

Clause Number	Tender Data
	sourced from outside the Republic, and, if so, what portion and whether any portion of payment from the municipality or municipal entity is expected to be transferred out of the Republic. 8) Where a Tenderer satisfies CIDB contractor grading designation requirements through joint venture formation, such Tenderers must submit the Certificates of Contractor Registration in respect of each partner.
C.2.24	Add the following new clause: **"Canvassing and obtaining of additional information by tenderers.** Accept that: i) No Tenderer shall make any attempt either directly or indirectly to canvass any of the Employers officials or the Employer's agent in respect of his tender, after the opening of the tenders but prior to the Employer arriving at a decision thereon. ii) No Tenderer shall make any attempt to obtain particulars of any relevant information, other than that disclosed at the opening of tenders "
C.2.25	Add the following new clause: **Prohibitions on awards to persons in service of the state** Accept that the Employer is prohibited to award a tender to a person - a) who is in the service of the state; or b) if that person is not a natural person, of which any director, manager, principal shareholder or stakeholder is a person in the service of the state; or c) a person who is an advisor or consultant contracted with the municipality or municipal entity. "In the service of the state" means to be - i) a member of: - • any municipal council. • any provincial legislature; or • the National Assembly or the National Council of Provinces. ii) a member of the board of directors of any municipal entity. iii) an official of any municipality or municipal entity. iv) an employee of any national or provincial department. v) provincial public entity or constitutional institution within the meaning of the Public Finance Management Act, 1999 (Act No.1 of 1999). vi) a member of the accounting authority of any national or provincial public entity; or

Clause Number	Tender Data
	vii) an employee of Parliament or a provincial legislature." In order to give effect to the above, the questionnaire for the declaration of interests in the tender of persons in service of state in Section T2.1 must be completed.
C.2.26	Add the following new clause: **"Awards to close family members of persons in the service of the state** Accept that the notes to the Employer's annual financial statements must disclose particulars of any award of more than R 2 000 to a person who is a spouse, child or parent of a person in the service of the state (defined in clause C.2.25), or has been in the service of the state in the previous twelve months, including a) the name of that person; b) the capacity in which that person is in the service of the state; and c) the amount of the award. To give effect to the above, the questionnaire for the declaration of interests in the tender of persons in service of state in part T2 – Returnable Documents must be completed in full and signed."
C.2.27	Add the following new clause: **Tax Compliance** In the case of a Joint Venture/Consortium the tax Compliance status Pin must be submitted for each member of the Joint Venture/Consortium.
C.2.28	Add the following new clause: i) Tenderers will be notified of any omitted, outstanding, missing and or incomplete administrative documents and will be offered a period of 3 days to complete or submit those pages i.e., Municipal Bidding Documents (MBD), authority to sign and other administrative documents that require completion and signatures. These exclude documentation on functionality, price and preference points for specific goals. ii) Tenders that are received contrary to the above requirements will be disqualified after three (3) days period has lapsed. iii) In cases where locality is a specific goal and the bidder did not submit the required documentation, the tenderer upon submitting the municipal statement, lease agreement or letter from ward councilor confirming business address as per above, may not be eligible for points under specific goals if such documentation was not submitted with the tender document.

Clause Number	Tender Data
C.3.2	Replace the contents of the clause with the following: "If necessary, issue addenda that may amend or amplify the tender documents to each tenderer during the period from the date that tender documents are available until seven (7) calendar days before the tender closing time stated in the Tender Data. If, as a result a tenderer applies for an extension to the closing time stated in the Tender Data, the Employer may grant such extension and, shall then notify all tenderers who collected tender documents."
C.3.4.2	Tenders will be opened in public soon after closing time and recording of received documents but not later than 11:00 at the tender office located at Turbine Hall, 65 Ntemi Piliso, Newtown, 2001, Ground Floor. Tenderers' names and total prices, where practical, will be read out
C.3.9	Replace Existing Clause Arithmetic Errors **Construction related tenders** JW undertakes to check the highest scoring bid for arithmetical errors and correcting them as follows: JW shall check for arithmetic errors using the following sequence: (i) Check the amount in words against the amount in figures on the *Form of Offer*, (ii) Check the Form of Offer against the Summary Schedule Total, (iii) Check the Section Sub-Totals per section against the Summary Total for summation errors, (iv) Check the Section Sub-Totals in the Summary Schedule against Section Sub-Totals in the Bill of Quantities. (v) Check the Section Sub-Totals against the Item Totals for summation errors. (vi) Check the Item Totals against the product of the Item Rate and the Quantity Provided. If a bill of quantities or price schedule applies JW will request the bidder to correct the arithmetic errors as follows: (i) In respect of the Form of Offer, where there is a discrepancy between the amounts in figures and the amount in words, the amount in words shall govern. The bidder must be requested to adjust the amount in figures to correspond with the amount in words. JW will notify the tenderer of all errors or omissions that are identified in the tender offer and either request the tenderer to confirm the offer as tendered or JW will accept the corrected total of prices. Where the tenderer elects to confirm the tender offer as tendered, correct the errors as follows:

Clause Number	Tender Data
	(i) If bills of quantities or pricing schedules apply and there is an error in the line-item total resulting from the product of the unit rate and the quantity, the line-item total shall govern, and the rate shall be corrected. Where there is an obviously gross misplacement of the decimal point in the unit rate, the line-item total as quoted shall govern, and the unit rate shall be corrected. (ii) Where there is an error in the total of the prices either as a result of other corrections required by this checking process or in the tenderer's addition of prices, the total of the prices shall govern, and the tenderer will be requested to revise selected item prices (and their rates if bills of quantities apply) to achieve the tendered total of the prices. Clarification session(s) shall be held with Tenderer where there is pricing discrepancies, errors are highlighted and identified corrections are explained. Tenderer is afforded an opportunity to provide clarification, accept or reject identified corrections in writing. (i) In the event that the Tenderer accepts identified corrections, JW will proceed with evaluation. (ii) In the event that the Tenderer rejects the identified correction(s), JW must review the Tenderer's motivation and risks associated with the proposed change. This is not an opportunity for Tenderers to change the bid offer. A bidder that does not agree to the above will be disqualified. Risk related to the Arithmetic Corrections shall be assessed. Where risks are identified, tenderers shall provide JW with any other material or information that has a bearing on the tender offer, the tenderer's commercial position (including joint venture agreements), quotations preferencing arrangements or samples of materials considered necessary by JW for the purpose of a full and fair risk assessment. Should the tenderer not provide the material, or a satisfactory reason as to why it cannot be provided, by the time for submission stated in the JW request or fails to attend any meeting in which it has been formally invited to clarify any issue, the tender offer will be regarded as non-responsive.

Clause Number	Tender Data
C.3.11	Tenderer to complete, sign and return MBD6.1 with the tender submission. Tenderer to claim the points in the space provided and submit documentary evidence to support the points claimed for specific goals.

Stage	Description
Stage 1	Mandatory Evaluation
Stage 2	Administrative Evaluation
Stage 3	Technical Evaluation
Followed by	Preferential Procurement Goals and Pricing Evaluation

Stage 1: Mandatory Evaluation

Description		Complied	
No	**Description**	**Yes**	**No**
1	Attended compulsory briefing meeting		
2	CIBD grading 8CE or higher. Active Status at the required CIDB grading or higher at the time of Evaluation		
3	Completed and Signed Form of Offer		
4	Acknowledgement of Project Tender Drawings		
5	Acknowledgement of SHE Specification & Annexures		
6	Signed BoQ		

Tenderers who **FAIL** to meet the mandatory criteria or requirements of tender will result in disqualification.

Clause No.	Tender Data

Stage 2: Administrative Evaluation

Description			Complied	
Reference	**Description**	**Requirement**	**Yes**	**No**
Certificate of Authority	Certificate of Authority or Board Resolution granting authority to sign.	Completed and signed certificate of authority to sign or signed board resolution.		
MBD 1	Invitation to Bid	Complete and submit complete and signed MBD 1 Form		
CSD	Central Supplier Database Registration	Provide proof of CSD registration		
MBD 4	Declaration of interest	Complete and submit signed MBD 4 Form		
MBD 5	Declaration for procurement above 10 million (all applicable taxes included)	Complete and submit signed MBD 5 Form		
T2.3.1	Acknowledgement SHE Specification Annextures	Complete and submit signed T2.3.1 form.		
T2.3.2	Acknowledgement of Project Tender Drawings	Complete and submit signed T2.3.2 form.		
MBD 6.1	Preference Points Claim in Terms of The Preferential Procurement Regulations 2022	Complete and submit signed MBD 6.1 Form		
MBD 8	Declaration of bidder's past supply chain management practices	Complete and submit signed MBD 8 Form		
MBD 9	Certificate of Independent Bid Determination	Complete and submit signed MBD 9 Form		
Annexure – Proof of Specific Goals	Valid Construction Sector BBBEE Certificate issued by SANAS accredited verification agency or DTI/CIPC BBBEE Certificate for Exempted Micro Enterprises or Affidavit sworn under oath, OR	Submit applicable documentation with the tender submission		

Clause No.	Tender Data

	CIPC registration document showing percentage of ownership and share certificate where applicable			
Annexure – Proof of Specific Goals	Proof of municipal account / valid lease agreement, letter from the Ward Council confirming the business address	Submit applicable documentation with the tender submission		
Annexure	Municipal statement of account for Company (not older than three (03) months from the closing date of tender or a valid lease agreement at time of tender closure)	Submit applicable documentation with the tender submission		
Annexure	Municipal statement of account for Director/s (not older than three (03) months from the closing date of tender or a valid lease agreement at time of tender closure)	Submit applicable documentation with the tender submission		
Annexure	3-year financial statements (audited where applicable)	Submit applicable documentation with the tender submission		
Annexure	Joint Venture Consortium or equivalent Agreement signed by all parties, where applicable	Where applicable, submit applicable documentation with the tender submission		

Tenderers will be notified of any omitted, outstanding, missing and or incomplete administrative documents and will be offered a period of 3 days to complete or submit those pages i.e., Municipal Bidding Documents (MBD), authority to sign and other administrative documents that require completion and signatures. These exclude documentation on functionality, price and preference points for specific goals.

Tenders that are received contrary to the above requirements will be disqualified after three (3) days period has lapsed.

Any document or form submitted or completed upon request (was not included in the initial tender submission before the closing date) will not be used to claim points for specific goals.

Stage 3: Technical Evaluation

Tenderers who **FAIL** to meet the minimum required score or requirements of tender will be disqualified.

Employer:		**Contractor:**	
Witness:		**Witness:**	

Clause No.	**Tender Data**

The criteria maximum points in respect of each of criterion shall be as follows:

Criteria No #	Criteria	Evidence	Sub-Criteria/Clause		Max Score	Score
1.	Tenderers Experience with Respect to Construction of Elevated Reinforced Concrete water retaining structure (Tower) of 1ML capacity or more. Or Construction of Reinforced Concrete water retaining structure (Reservoir) of 6ML capacity	Supporting Documents Required include Appointment Letters, Reference Letters as per T2.1.7 (Or on Client Letter Head with all required Information) and Completion / Approval Certificates **Note**: *This reference letter must be completed by the referee/previous client of the tenderer and included in the tender submission. Appointment letters from the client outlining the scope of work for the contractor, either main contractor or sub-contractor. The quality of works must be certified by the client's Engineer. A separate form must be*	**Number of Elevated Reinforced Concrete Tower of 1ml or More Completed.** **OR** **Number of Reinforced Concrete Water Retaining Structure (Reservoir) of 6ml or More Completed**	Tenderer Has not Completed any Project	**30**	**0**
				Tenderer Has Completed at Least 1 Project. (Either reinforced concrete Tower or reinforced concrete Reservoir)		**25**
				Tenderer has completed two Reinforced concrete Tower and one Reinforced concrete Reservoir		**30**

Employer:		Contractor:	
Witness:		Witness:	

Clause No.	Tender Data							
			completed for each reference as a requirement in the evaluation criteria. Coordinates of Towers, Reservoirs and Pumpstation completed must be included and the information provided will be verified and if found to be false or misrepresented, punitive measures will be instituted against the respective party including blacklisting in participating in any future government tenders. All *Subcontracted work will be verified with the relevant client. If Tenderer was subcontracted reference letters submitted must be accompanied with reference letters and completion certificate from the main contractors.*		Or Tenderer has completed three Reinforced concrete Towers		

Employer:		**Contractor:**	
Witness:		**Witness:**	

Clause No.	Tender Data

Criteria No #	Criteria	Evidence	Sub-Criteria/Clause		Max Score	Score
2	Tenderers Experience with Respect to Construction of pump stations projects each with a minimum flow of 275 l/s or more.	Supporting Documents Required include Appointment Letters, Reference Letters as per T2.1.7 (Or on Client Letter Head with all required Information) and Completion / Approval Certificates. **Note**: *This reference letter must be completed by the referee/previous client of the tenderer and included in the tender submission. Alternatively, the Clients letterhead may be used provided it complies with the functional requirements. Appointment letters from the client outlining the scope of work for the contractor, either main contractor or*	**Number of Pump Stations Projects** **Each with a Minimum Flow Of 275 l/S.**	0 Completed Projects	**25**	**0**
				1 -3 Completed Projects		**23**
				>3 Completed Projects		**25**

Employer:		Contractor:	
Witness:		Witness:	

Clause No.	Tender Data

		sub-contractor. The quality of works must be certified by the client's Engineer. A separate form must be completed for each reference as a requirement in the evaluation criteria. The information provided will be verified and if found to be false or misrepresented, punitive measures will be instituted against the respective party including blacklisting in participating in any future government tenders. All Subcontracted work will be verified with the relevant client.				

Employer:		**Contractor:**	
Witness:		**Witness:**	

Clause No.	Tender Data

Criteria No #	Criteria	Evidence	Sub-Criteria/Clause		Max Score	Score
3.	Tenderers Experience with Respect to Construction of Steel Pipe Projects	Supporting Documents Required include Appointment Letters, Reference Letters as per T2.1.7 (Or on Client Letter Head with all required Information) and Completion / Approval Certificates. **Note**: *This reference letter must be completed by the referee/previous client of the tenderer and included in the tender submission. Alternatively, the Clients letterhead may be used provided it complies with the functional requirements. Appointment letters from the client outlining the scope of work for the contractor, either main contractor or sub-contractor. The quality of works must be certified by the client's Engineer. A separate form must be completed for each reference as a requirement in*	**Number of Completed Steel Pipe Projects of Diameter 450mm or More and Construction Cost of R15 Million or More and Inclusive of Cathodic Protection**	0 Completed Projects	**25**	**0**
				1 - 2 Completed Projects		**23**
				>2 Completed Projects		**25**

Employer:		Contractor:	
Witness:		Witness:	

Clause No.	Tender Data

		the evaluation criteria. The information provided will be verified and if found to be false or misrepresented, punitive measures will be instituted against the respective party including blacklisting in participating in any future government tenders. All Subcontracted work will be verified with the relevant client.				
Criteria No #	**Criteria**	**Evidence**	**Sub-Criteria/Clause**		**Max Score**	**Score**
4.	Post Qualification Experience of Contract Manager Only Contract Managers with qualifications of Bachelors' Degree (Civil Engineering / Construction Management) equivalent or higher. and Registration (Pr. Eng. / Pr. Technologist) or PrCPM / PrCM will be evaluated for experience of	Tender must Provide CV of Contract Manager in the format given on T2.1.9 Note: *Tenderers may provide their own CVs but information provided should contain all information in T2.1.9* *Note: certified Copy of qualifications to accompany the CVs*	**Number of Projects Involving construction of Water Retaining Structures (Elevated Reinforced Concrete Tower or Reinforced Concrete Reservoirs)** **And** **Construction Of Pump Station and Construction of Bulk Steel Pipe Work Completed)**	0 Completed Project	**5**	**0**
				1 - 3 Completed Projects		**2**
						5

Employer:		**Contractor:**	
Witness:		**Witness:**	

Clause No.	Tender Data

	a Contract Manager. However, the time of registration of Contract Manager will not impact post qualification number of projects.		***Note: A single project that includes the construction of a water retaining structure, together with the construction of a pump station and bulk steel pipework will be regarded as one project for evaluation purposes.***	>3 Completed Projects		
Criteria No #	**Criteria**	**Evidence**	**Sub-Criteria/Clause**		**Max Score**	**Score**
5.	Post Qualification Experience of Site Personnel Site Manager with qualifications of National Diploma (Civil or Structural) Engineering or more and Registered as a Candidate Professional in the Built Environment or more will be considered.	Tender must Provide CV of Site Manager in the format given on T2.1.9 Note: *Tenderers may provide their own CVs but information provided should contain all information in T2.1.9* *Note: Certified Copy of qualifications to accompany the CVs*	**Number of Projects Involving construction of Water Retaining Structures (Elevated Reinforced Concrete Tower or Reinforced Concrete Reservoirs).** **And** **Construction of Pump Station and Bulk Steel Pipe Work Completed as Site Agent / Site Manager)**	0 Completed Projects	**5**	**0**
				1 - 3 Completed Projects		**3**
				>3 Completed Projects		**5**

Employer:		**Contractor:**	
Witness:		**Witness:**	

Clause No.	Tender Data

			Note: A single project that includes the construction of a water retaining structure, together with the construction of a pump station and bulk steel pipework will be regarded as one project for evaluation purposes.			
Criteria No #	**Criteria**	**Evidence**	**Sub-Criteria/Clause**		**Max Score**	**Score**
6.	Foreman/ Supervisor with qualifications of National Diploma (Electrical/Mechanical) Engineering or more and Registered as a Candidate Professional in the Built Environment or more will be considered.	Tender must Provide CV of Site Foreman or Supervisor in the format given on T2.1.9 Note: *Tenderers may provide their own CVs but information provided should contain all information in T2.1.9* *Note: certified Copy of qualifications to accompany the CVs*	**Construction of Pump Station and As Foreman / Supervisor / Resident Engineer/ Site Engineer)**	0 Completed Projects	**5**	**0**
				1 - 3 Completed Projects		**2**
				>3 Completed Projects		**5**

Employer:		**Contractor:**	
Witness:		**Witness:**	

Clause No.	Tender Data

NO #	CRITERIA	EVIDENCE	SUB-CRITERIA/CLAUSE		MAX SCORE	SCORE
7	Post Qualification Experience of Safety Officer Only Safety Officers with qualifications of National Diploma (Safety Management)/ (Environmental Health/Environmental Science/	Tender must Provide CV of Safety Officer in the format given on T2.1.9 All Civil Related projects will be considered.	**Number Of Civil/Structural Engineering Projects Completed as Safety Officer**	1 Completed Project	**5**	**0**
				2 - 3 Completed Projects		**2**
	Environmental Management), SAMTRAC / SHEOMTRAC/ SHEMTRAC / MESHTRAC /NEBOSH / Safety Officers Course (NQF 5) or more and Registered with SACPCMP in the "Construction Health and Safety" Sector will be considered. However, the time of registration of Safety Officer will not impact post	*Note: certified Copy of qualifications to accompany the CVs*		>3 Completed Projects		**5**

Employer:		Contractor:	
Witness:		Witness:	

Clause No.	Tender Data

	qualification number of projects.					

	MINIMUM QUALIFYING SCORE	**80**
	TOTAL	**100**

Note: The tenderer must achieve the minimum required score of 80 to be evaluated further

NOTE 1: Where applicable, foreign qualifications MUST be accompanied by a SAQA verification certificate. Failure to submit SAQA verification certificate will lead to that qualification not being considered for allocation of points for that criterion.

NOTE 2: When an uncertified copy of professional registration is submitted, and the requirement was to submit a certified copy, JW will verify the validity of the registration on the issuing bodies or institution's website. If the verification is confirmed on the website, the bidder meets the criteria. This will only be applicable for the recommended bidders.

NOTE 3: The time of registration of Contract Manager, Site Manager and Safety Officer will not impact post qualification number of projects.

NOTE 4: The information provided by bidders will be verified and if found to be false, punitive measures will be affected.

Employer:		**Contractor:**	
Witness:		**Witness:**	

Clause No.	Tender Data
	Acronyms: **ECSA:** Engineering Council of South Africa **SACPCMP:** South African Council for the Project and Construction Management Professions **SAMTRAC:** Safety Management Training Course **NEBOSH:** National Examination Board in Occupational Safety and Health **SHEOMTRAC:** Safety Health Environmental Occupational Management Training Course **SHEMTRAC:** Safety Health Environmental Management Training Course **MESHTRAC:** Management Environmental Safety Health Training Course

Employer:		**Contractor:**	
Witness:		**Witness:**	

Clause number	Tender Data

4. STAGE FOR PRICE AND PREFERENCE POINTS EVALUATION:

4.1. Pricing

The following aspects will be considered in the financial offer:

(a) Costing for all items as described in the Pricing Schedule and applicable Strategies Review of financial offer and discrepancies between total and calculations.

(b) Identify any parameters that may have a bearing on the financial offer, e.g., contract period, price escalations or adjustments required and life cycle costs.

(c) The 90/10 preference point system will be applicable in this tender. Whereby 90 points will be allocated to price and 10 points will be allocated to the set specific goals per category as outlined on the pricing schedule. The bidder scoring the highest in terms of price and specific goal will be recommended for that specific category.

4.2. Award and Allocation Strategy:

AWARD STRATEGY	The tender will be awarded to the highest scoring bidder in terms of price and Specific Goals
ALLOCATION STRATEGY	The tender will be allocated to the highest scoring bidder in terms of price and Specific Goals

4.3. The maximum preference points for this bid are allocated as follows:

Description	Points	Points
PRICE	90	80
SPECIFIC GOALS	10	20
Total points for Price and Specific Goals	**100**	**100**

SPECIFIC GOALS

In terms of Regulation 4(2); 5(2); 6(2) and 7(2) of the Preferential Procurement Regulations 2022, preference points must be awarded for specific goals stated in the tender. For the purposes of this tender the tenderer will be allocated points based on the goals stated in table 1 below as must be supported by proof/ documentation stated in the conditions of this tender.

Specific goals may include contracting with persons, or categories of persons, historically disadvantaged by unfair discrimination on the basis of race, gender or disability.

Clause number	Tender Data
	Race: I. Ownership by black people II. Black Designated Group: Ownership by black people that are unemployed Ownership by black people who are youth Ownership by black people living in rural or underdeveloped areas or townships Ownership by black people with disabilities Ownership by black people who are military veterans Cooperative owned by black people **Gender:** I. Persons, or categories of persons, historically disadvantaged by unfair discrimination on the basis of gender are women. Ownership by persons that are classified as female or women according to the Department of Home Affairs of South African. **Disability:** I. Persons, or categories of persons, historically disadvantaged by unfair discrimination on the basis of disability are disabled persons. Reconstruction and Development Programme (RDP) objectives as published in Government Gazette No. 16085 dated 23 November 1994 i.e., **Local Manufacture:** I. Promotion of procurement of locally manufactured goods in South Africa to promote job creation in light of the high unemployment rate in South Africa which has a greater impact previously disadvantaged individuals and black youth. **Locality:** I. Promotion of procurement from local business in the geographical areas that JW operate in. This is also directed at creating employment in the areas JW operate in. The BSC may allocate points as follows: • Promotion of enterprises located in the Gauteng Province • Promotion of enterprises located in a specific region within COJ (the 7 regions. A to G) • Promotion of enterprises located in the City of Johannesburg municipality

Clause number	Tender Data
	• Promotion of enterprises located rural or underdeveloped areas or townships. **Qualifying Small Enterprises (QSE)** I. Promotion of procurement from QSE's that are black owned. **Exempted Micro Enterprises (EME):** I. Promotion of procurement from EME's that are black own. **SUB-CONTRACTING:** Promotion of sub-contracting a Historically Disadvantaged Individuals (HDI) company. Consider sub-contract only in cases where there are no company which can meet any of the specific goals. Check if the portion of the work cannot be subcontracted in terms of specific goals. One goal may be chosen, or a combination of goals may be decided upon including a sub-goal i.e., owned by black people that are disabled etc., **JOINT VENTURE, CONSORTIUM OR EQUIVALENT:** For Joint Venture Agreements, Consortiums or equivalent, the agreement must show percentages of ownership and work to be completed by each party. This agreement must form part of the tender submission. To determine the Joint Venture, Consortium or equivalent score for specific goals, JW will look at the consolidated BBBEE certificate to determine the points for specific goals that will be awarded to the tenderer. If a consolidated BBBEE certificate is not submitted, the parties to the joint venture, consortium or equivalent must submit their individual BBBEE certificates issued by a SANAS accredited verification agency or the documents listed below on 4.6 and the joint venture, consortium or equivalent agreement in order for JW to determine the proportional points for specific goals. Documentation to be provided: • JV, Consortium, or equivalent agreement • Consolidated BBBEE certificate issued by an SANAS accredited verification agency. Certificate must be valid

Clause number	Tender Data

Table 1:

The specific goals allocated points in terms of this tender	Number of points allocated (90/10 system)
Businesses located within the boundaries of COJ municipality	4
Business owned by 51% or more-Women	6
Total	**10**

The following verification documents must be submitted with the tender document:

Specific Goals – any one or a combination of any	Means of verification that may be selected or a combination thereof
Business owned by 51% or more-Women	Valid Construction Sector BBBEE Certificate issued by SANAS accredited verification agency or DTI/CIPC BBBEE Certificate for Exempted Micro Enterprises or Affidavit sworn under oath, OR CIPC registration document showing percentage of ownership and share certificate where applicable
Businesses located within the boundaries of COJ municipality	Proof of municipal account / valid lease agreement, letter from the Ward Council confirming the business address. Businesses that operate from personal properties are required to submit an affidavit

Note: The joint venture, consortium, or equivalent agreement in order for JW to determine the proportional points for specific goals.

Example, If there are two parties in a Joint Venture with a 50:50 ownership of the Joint Venture and one party is located within the boundaries of COJ and one is located in Tshwane, if one of the goals is locality and has total points of 4, the JV will only be entitled the proportional points of 2.

4.5 The following are the requirements for a valid Sworn Affidavit in terms of the BBBEE Sector Codes of Good Practise:

Affidavit Prescribed Formats	Category	Financial Threshold
Generic Enterprises		
	BO QSE	Between R10m and R50m
	BO EME	Less than R10m
Sector Specific Enterprises		
	BO QSE	Between R10m and R50m
	BO EME	Less than R10m
Construction Sector Code		
	EME Contractor	Less than R3m

Clause number	Tender Data

	BO EME BEP	Less than R1.8m	
Financial Sector Code			
	BO QSE	Between R10m and R50m	
	BO EME	Less than R10m	
Information Communication Technology Sector Code (ICT)			
	BO QSE	Between R10m and R50m	
	BO EME	Less than R10m	
Marketing, Advertising & Communication Sector Code (MAC)			
> Public Relations	BO QSE	Between R5m and R10m	
> Marketing, Advertising & Communications	BO EME	Less than R5m	
Property Sector Code			
> Service-based	BO QSE	Between R5m and R10m	
	EME	Less than R5m	
> Agency-based	BO QSE	Between R2.5m and R35m	
> Asset-based	EME	Less than R2.5m	
	BO QSE	Between R80m and R400m	
Tourism Sector Code			
	BO QSE	Between R5m and R45m	
	BO EME	Less than R5m	
Specialised Enterprises			
	BO QSE	Between R10m and R50m	
	BO EME	Less than R10m	

4.6 Requirements for a valid BBBEE Certificate are as follows:

a) Copy of a certified valid BBBEE certificate (Only Valid BBBEE accredited by SANAS), or a valid Sworn Affidavit issued by the DTIC or the CIPC or in a similar format complying with commissioner of oath Act.

b) Bidders who do NOT qualify as EME's and QSE's as outlined above must submit B-BBEE verification certificates that are issued by an Agency accredited by SANAS.

c) Bidders who fail to submit a certified copy of their valid B-BBEE certificate or valid sworn affidavit or valid DTI / CIPC B-BBEE certificate will score zero points for specific goals.

Valid Sworn Affidavits or certified copies of B-BBEE Certificate must comply with the requirements outlined in the Justices of the Peace and Commissioners of Oaths Act, no 16 of 1963 and its Regulations promulgated in Government Notice

Clause number	Tender Data

GNR 1258 of 21 July 1972 Justices of the Peace and Commissioners of Oaths Act, No. 16 of 1963. i.e.

(i) The deponent shall sign the declaration in the presence of the commissioner of oaths (COA).

(ii) Below the deponent's signature the COA shall certify that the deponent has acknowledged that he knows and understands the contents of the declaration and the COA shall state the manner, place, and date of taking the declaration.

(iii) The COA shall sign the declaration and print his full name and business address below his signature; and state his designation and the area for which he holds his appointment, or the office held by him if he holds his appointment ex officio.

(iv) Copy of certified copies will not be accepted.

Note: A tenderer failing to submit proof of specific goals claimed as per indicated above will not be disqualified but will be allocated zero points for specific goals and will be allocated points for pricing.

1. ADJUDICATION USING A POINT SYSTEM

a) The bidder obtaining the highest number of total points will be awarded the contract.

b) Preference points shall be calculated after prices have been brought to a comparative basis taking into account all factors of non-firm prices and all unconditional discounts;.

c) Points scored must be rounded off to the nearest 2 decimal places.

d) In the event that two or more bids have scored equal total points, the successful bid must be the one scoring the highest number of points for specific goals.

e) However, when functionality is part of the evaluation process and two or more bids have scored equal points including equal preference points for specific goals, the successful bid must be the one scoring the highest score for functionality.

f) Should two or more bids be equal in all respects, the award shall be decided by the drawing of lots.

2. POINTS AWARDED FOR PRICE THE 80/20 OR 90/10 PREFERENCE POINT SYSTEMS

Clause number	Tender Data
	A maximum of 90 points is allocated for price on the following basis: **90/10** $$Ps = 90\left(1 - \frac{Pt - Pmin}{Pmin}\right)$$ Where Ps = Points scored for comparative price of bid under consideration Pt = Comparative price of bid under consideration Pmin = Comparative price of lowest acceptable bid
C.3.12	Add the following to the clause: "Accept that the submission of a Tender shall be construed as an acknowledgement by the Tenderer that they are satisfied with the insurance cover, the Employer will affect under the contract."
C.3.13.1	Add to the existing clause: Tender offers will only be accepted if: a) the tenderer submits a valid SARS tax Compliance status Pin for tenders issued by the South African Revenue Services or has made arrangements to meet outstanding tax obligations; b) Proof of CSD registration i.e., MA xxxxx number; c) the tenderer submits a letter of intent from an approved insurer undertaking to provide the Demand Performance Guarantee to the format included in Part T2.2.22 of this procurement document d) the tenderer is registered with the Construction Industry Development Board in an appropriate contractor grading designation; e) the tenderer or any of its directors/shareholders is not listed on the Register of Tender Defaulters in terms of the Prevention and Combating of Corrupt Activities Act of 2004 as a person prohibited from doing business with the public sector; f) the tenderer has not: i) abused the Employer's Supply Chain Management System; or ii) failed to perform on any previous contract and has been given a written notice to this effect;

Clause number	Tender Data
	g) the tenderer has completed the Compulsory Enterprise Questionnaire and there are no conflicts of interest which may impact on the tenderer's ability to perform the contract in the best interests of the Employer or potentially compromise the tender process and persons in the employ of the state are permitted to submit tenders or participate in the contract; h) the tenderer is registered and in good standing with the compensation fund or with a licensed compensation insurer; i) the Employer is reasonably satisfied that the tenderer has in terms of the Construction Regulations, 2014, issued in terms of the Occupational Health and Safety Act, 1993, the necessary competencies and resources to carry out the work safely; and j) the tenderer: i) has sufficiently substantiated his experience in this type work; ii) has the required and experienced key personnel
C.3.17	The number of paper copies of the signed contract to be provided by the Employer is one.
	There are no additional conditions of tender.

-- END OF PART ---

Johannesburg Water SOC Ltd

CONTRACT NO: JW14040RR

CONSTRUCTION OF A 2.25 ML WATER TOWER IN ROBETSVILLE

VOLUME 1

RETURNABLE DOCUMENTS AND SCHEDULES

The tenderer must complete the following returnable documents:

T2.1 LIST OF RETURNABLE DOCUMENTS

Returnable Schedules required for tender evaluation purposes

Document		Page No.
T2.1.1	Record of Addenda to Tender Documents	RD.4
T2.1.2	Certificate of Authority	RD.5
T2.1.3	Compulsory Enterprise Questionnaire	RD.10
T2.1.4	Preferential Procurement	RD.12
MBD 6.1	Preference Points Claim Form in Terms of the Preferential Procurement Regulations 2022	RD.13
MBD 4	DECLARATION OF INTEREST	RD.20
MBD 8	DECLARATION OF BIDDER'S PAST SUPPLY CHAIN MANAGEMENT PRACTICES	RD.23
MBD 5	DECLARATION FOR PROCUREMENT ABOVE R10 MILLION (VAT INCLUDED)	RD.25
		RD.28
MBD 9	CERTIFICATE OF INDEPENDENT BID DETERMINATION	
T2.1.5	Proposed Amendments and Qualifications	RD.31
T2.1.6	Schedule of the Tenderer's Experience	RD.32
T2.1.7	Contactable Reference	RD.33
T2.1.8	Schedule of Key Personnel	RD.35
T2.1.9	Curriculum Vitae of Key Personnel	RD.43

T2.2 LIST OF OTHER RETURNABLE DOCUMENTS

Other documents required only for tender evaluation purposes

Document		Page No.
T2.2.1	Contractor's Certificate of Registration With CIDB	RD.60
T2.2.2	SARS Tax Compliance Status Pin and Proof of CSD registration	RD.61

T2.3 LIST OF RETURNABLE SCHEDULES

Other documents that will be incorporated into the contract

Document		Page No.
T2.3.1	Returnable Annexure A: Acknowledgement of SHE Specification	RD.63
& T2.3.2	Returnable Annexure B: Acknowledgment of Tender Drawings	RD.64

NOTE:

The Tenderer is required to complete each and every schedule listed above to the best of

his ability as the evaluation of tenders and the eventual contract will be based on the

information provided by the tenderer.

T2.1 LIST OF RETURNABLE DOCUMENTS

Returnable Schedules required for tender evaluation purposes:

Document		Page No.
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T2.1.8	Schedule of Key Personnel	RD.35
T2.1.9	Curriculum Vitae of Key Personnel	RD.43

T2.1.1 RECORD OF ADDENDA TO TENDER DOCUMENTS

We confirm that the following communications received from the Employer before the submission of this tender offer, amending the tender documents, have been taken into account in this tender offer:

	Date	Title or Details
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		

Attach additional pages if more space is required.

Signed: ..... Date: .....

Name: ..... Position: .....

Tenderer: .....

T2.1.2 CERTIFICATE OF AUTHORITY

Indicate the status of the Tenderer by ticking the appropriate box hereunder. The Tenderer must complete the certificate set out below for the relevant category.

(I) COMPANY	(II) CLOSE CORPORATION	(III) PARTNERSHIP	(IV) JOINT VENTURE	(V) SOLE PROPRIETOR

(I) Certificate For Company

I, ……, chairperson of the Board of Directors of ....., hereby confirm that by resolution of the Board (copy attached) taken on ....., Mr/Ms ....., acting in the capacity of ....., was authorized to sign all documents in connection with the tender for Contract No. JW14040RR and any contract resulting from it on behalf of the company.

Chairman: .....

As Witnesses: 1 .....

2 .....

Date: .....

(II) Certificate For Close Corporation

We, the undersigned, being the key members in the business trading as .....

..... hereby authorize Mr/Ms …….... , acting in the capacity of …….

....., to sign all documents in connection with the tender and any contract resulting from it on our behalf.

NAME	ADDRESS	SIGNATURE	DATE

Note : This certificate is to be completed and signed by all of the key members upon whom rests the direction of the affairs of the Close Corporation as a whole.

(III) Certificate For Partnership

We, the undersigned, being the key partners in the business trading as, ……

.....……, **hereby authorize Mr/Ms** .....……,

acting in the capacity of ……..., to sign all documents in connection with the tender and any contract resulting from it on our behalf.

NAME	ADDRESS	SIGNATURE	DATE

Note : This certificate is to be completed and signed by all of the key partners upon whom rests the direction of the affairs of the Partnership as a whole.

(IV) Certificate For Joint Venture

This Returnable Schedule is to be completed by joint ventures.

We, the undersigned, are submitting this tender offer in Joint Venture and hereby authorise Mr/Ms ……..…..., authorised signatory of the company…….. ……., acting in the capacity of lead partner, to sign all documents in connection with the tender offer and any contract resulting from it on our behalf.

NAME OF FIRM	ADDRESS	DULY AUTHORISED SIGNATORY
Lead partner		Signature: ..... Name: ..... Designation: .....
		Signature: ..... Name: ..... Designation: .....
		Signature: ..... Name: ..... Designation: .....
		Signature: ..... Name: ..... Designation: .....

Note : This certificate is to be completed and signed by all of the key partners upon whom rests the direction of the affairs of the Joint Venture as a whole.

(V) Certificate For Sole Proprietor

I, ..., hereby confirm that I am the sole owner of the Business

trading as …….....

Signature of Sole Owner: .....

As Witnesses: 1 .....

2 .....

Date: .....

T2.1.3 COMPULSORY ENTERPRISE QUESTIONNAIRE

The following particulars must be furnished. In the case of a joint venture, **separate** enterprise questionnaires in respect of each partner must be completed and submitted.

Section 1: Name of enterprise: . . . . . .

Section 2: VAT registration number, if any: . . . . . .

Section 3: CIDB registration number, if any: . . . . . .

Section 4: Particulars of sole proprietors and partners in partnerships

Name*	Identity number*	Personal income tax number*

***** Complete only if sole proprietor or partnership and attach separate page if more than 3 partners

Section 5: Particulars of companies and close corporations

Company registration number . . . . . .

Close corporation number . . . . . .

Proof of CSD registration i.e. MA xxxxxxxxx number. . . . . .

SARS Tax Compliance status Pin number . . . . . .

Section 6: Record in the service of the state

Indicate by marking the relevant boxes with a cross, if any sole proprietor, partner in a partnership or director, manager, principal shareholder or stakeholder in a company or close corporation is currently or has been within the last 12 months in the service of any of the following:

- ☐ a member of any municipal council
- ☐ a member of any provincial legislature
- ☐ a member of the National Assembly or the National Council of Province
- ☐ a member of the board of directors of any municipal entity
- ☐ an official of any municipality or municipal entity
- ☐ an employee of any provincial department, national or provincial public entity or constitutional institution within the meaning of the Public Finance Management Act, 1999 (Act 1 of 1999)
- ☐ a member of an accounting authority of any national or provincial public entity
- ☐ an employee of Parliament or a provincial legislature

If any of the above boxes are marked, disclose the following:

Name of sole proprietor, partner, director, manager, principal shareholder, or stakeholder	Name of institution, public office, board or organ of state and position held	Status of service (tick appropriate column)	
		Current	Within last 12 months

*insert separate page if necessary

Section 7: Record of spouses, children, and parents in the service of the state

Indicate by marking the relevant boxes with a cross, if any spouse, child or parent of a sole proprietor, partner in a partnership or director, manager, principal shareholder or stakeholder in a company or close corporation is currently or has been within the last 12 months been in the service of any of the following:

- ☐ a member of any municipal council
- ☐ a member of any provincial legislature
- ☐ a member of the National Assembly or the National Council of Province
- ☐ a member of the board of directors of any municipal entity
- ☐ an official of any municipality or municipal entity
- ☐ an employee of any provincial department, national or provincial public entity or constitutional institution within the meaning of the Public Finance Management Act, 1999 (Act 1 of 1999)
- ☐ a member of an accounting authority of any national or provincial public entity
- ☐ an employee of Parliament or a provincial legislature

Name of spouse, child or parent	Name of institution, public office, board or organ of state and position held	Status of service (tick appropriate column)	
		Current	Within last 12 months

*insert separate page if necessary

The undersigned, who warrants that he / she is duly authorised to do so on behalf of the enterprise:

i) authorizes the Employer to verify the tax compliance status from the South African Revenue Services that my / our tax matters are in order.

ii) confirms that the neither the name of the enterprise or the name of any partner, manager, director or other person, who wholly or partly exercises, or may exercise, control over the enterprise appears on the Register of Tender Defaulters established in terms of the Prevention and Combating of Corrupt Activities Act of 2004.

iii) confirms that no partner, member, director, or other person, who wholly or partly exercises, or may exercise, control over the enterprise appears, has within the last five years been convicted of fraud or corruption.

iv) iv) confirms that I / we are not associated, linked, or involved with any other tendering entities submitting tender offers and have no other relationship with any of the tenderers or those responsible for compiling the scope of work that could cause or be interpreted as a conflict of interest; and

v) iv) confirms that the contents of this questionnaire are within my personal knowledge and are to the best of my belief both true and correct.

Signed: ---------- Date: _____

Name: ---------- Position: _____

Enterprise name: ----------

T2.1.4 PREFERENTIAL PROCUREMENT

Forms for Completion by the Tenderer included in this section are:

Form No.	Form Title	Description	Page No.
MBD 6.1	Preference Points Claim Form in Terms of the Preferential Procurement Regulations 2022	Procedures and adjudication criteria for the information of the Tenderer	RD.13
MBD 4	DECLARATION OF INTEREST	Form to be completed by the Tenderer	RD.20
MBD 8	DECLARATION OF BIDDER'S PAST SUPPLY CHAIN MANAGEMENT PRACTICES	Form to be completed by the Tenderer	RD.23
MBD 5	DECLARATION FOR PROCUREMENT ABOVE R10 MILLION (VAT INCLUDED)	Form to be completed by the Tenderer	RD.25
MBD 9	CERTIFICATE OF INDEPENDENT BID DETERMINATION	Form to be completed by the Tenderer	RD.28

Note: All information supplied must be current and valid. Proposed or imminent changes to a Tenderer's status may be mentioned but the declarations must reflect current circumstances.

MBD 6.1

PREFERENCE POINTS CLAIM FORM IN TERMS OF THE PREFERENTIAL PROCUREMENT REGULATIONS 2022

This preference form must form part of all tenders invited. It contains general information and serves as a claim form for preference points for specific goals.

NB: BEFORE COMPLETING THIS FORM, TENDERERS MUST STUDY THE GENERAL CONDITIONS, DEFINITIONS AND DIRECTIVES APPLICABLE IN RESPECT OF THE TENDER AND PREFERENTIAL PROCUREMENT REGULATIONS, 2022

---

1. GENERAL CONDITIONS

1.1 The following preference point systems are applicable to invitations to tender:

- the 80/20 system for requirements with a Rand value of up to R50 000 000 (all applicable taxes included); and
- the 90/10 system for requirements with a Rand value above R50 000 000 (all applicable taxes included).

1.2 To be completed by the organ of state

a) The applicable preference point system for this tender is the 90/10 preference point system.

1.3 Points for this tender (even in the case of a tender for income-generating contracts) shall be awarded for:

a) Price; and
b) Specific Goals.

1.4 To be completed by the organ of state:

The maximum points for this tender are allocated as follows:

	POINTS
PRICE	90
SPECIFIC GOALS	10
Total points for Price and SPECIFIC GOALS	**100**

1.5 Failure on the part of a tenderer to submit proof or documentation required in terms of this tender to claim points for specific goals with the tender, will be interpreted to mean that preference points for specific goals are not claimed.

1.6 The organ of state reserves the right to require of a tenderer, either before a tender is adjudicated or at any time subsequently, to substantiate any claim in regard to preferences, in any manner required by the organ of state.

2. DEFINITIONS

a) **"tender"** means a written offer in the form determined by an organ of state in response to an invitation to provide goods or services through price quotations, competitive tendering process or any other method envisaged in legislation;

b) **"price"** means an amount of money tendered for goods or services, and includes all applicable taxes less all unconditional discounts;

c) **"rand value"** means the total estimated value of a contract in Rand, calculated at the time of bid invitation, and includes all applicable taxes;

d) **"tender for income-generating contracts"** means a written offer in the form determined by an organ of state in response to an invitation for the origination of income-generating contracts through any method envisaged in legislation that will result in a legal agreement between the organ of state and a third party that produces revenue for the organ of state, and includes, but is not limited to, leasing and disposal of assets and concession contracts, excluding direct sales and disposal of assets through public auctions; and

e) **"the Act"** means the Preferential Procurement Policy Framework Act, 2000 (Act No. 5 of 2000).

3. FORMULAE FOR PROCUREMENT OF GOODS AND SERVICES

3.1 Points Awarded For Price

3.1.1 The 90/10 Preference Point Systems

A maximum of 90 points is allocated for price on the following basis:

90/10

$$Ps = 90\left(1 + \frac{Pt - P\,min}{P\,min}\right)$$

Were

Ps = Points scored for price of tender under consideration

Pt = Comparative price of bid under consideration

Pmin = Comparative price of lowest acceptable bid

4. FORMULAE FOR DISPOSAL OR LEASING OF STATE ASSETS AND INCOME GENERATING PROCUREMENT

4.1 POINTS AWARDED FOR PRICE

A maximum of 90 points is allocated for price on the following basis:

90/10

$$Ps = 90\left(1 + \frac{Pt - P\,min}{Pmin}\right)$$

Were

Ps = Points scored for price of tender under consideration

Pt = Comparative price of bid under consideration

Pmin = Comparative price of lowest acceptable bid

5. POINTS AWARDED FOR SPECIFIC GOALS

5.1 In terms of Regulation 4(2); 5(2); 6(2) and 7(2) of the Preferential Procurement Regulations, preference points must be awarded for specific goals stated in the tender. For the purposes of this tender the tenderer will be allocated points based on the goals stated in Table 1 below as may be supported by proof/ documentation stated in the conditions of this tender:

5.2 In cases where organs of state intend to use Regulation 3(2) of the Regulations, which states that, if it is unclear whether the 80/20 or 90/10 preference point system applies, an organ of state must, in the tender documents, stipulate in the case of—

(a) an invitation for tender for income-generating contracts, that either the 80/20 or 90/10 preference point system will apply and that the highest acceptable tender will be used to determine the applicable preference point system; or

(b) any other invitation for tender, that either the 80/20 or 90/10 preference point system will apply and that the lowest acceptable tender will be used to determine the applicable preference point system,

then the organ of state must indicate the points allocated for specific goals for both the 90/10 and 80/20 preference point system.

Table 1: Specific goals for the tender and points claimed are indicated per the table below.

Note to tenderers: ***The tenderer must indicate how they claim points for each preference point system.*****)**

The specific goals allocated points in terms of this tender	Number of points allocated (90/10 system)	Number of points claimed (90/10 system) (To be completed by the tenderer)
Businesses located within the boundaries of COJ municipality	4	
Business owned by 51% or more-Women	3	
Business owned by 51% or more- by Black Youth	3	
Total	**10**	

6. DECLARATION WITH REGARD TO COMPANY/FIRM

6.1 Name of company/firm…….

6.2 Company registration number: ……...

6.3 TYPE OF COMPANY/ FIRM

☐ Partnership/Joint Venture / Consortium
☐ One-person business/sole propriety
☐ Close corporation
☐ Public Company
☐ Personal Liability Company
☐ (Pty) Limited
☐ Non-Profit Company
☐ State Owned Company

[TICK APPLICABLE BOX]

6.4 I, the undersigned, who is duly authorised to do so on behalf of the company/firm, certify that the points claimed, based on the specific goals as advised in the tender, qualifies the company/ firm for the preference(s) shown and I acknowledge that:

i) The information furnished is true and correct.

ii) The preference points claimed are in accordance with the General Conditions as indicated in paragraph 1 of this form.

iii) In the event of a contract being awarded as a result of points claimed as shown in paragraphs 1.4 and 4.2, the contractor may be required to furnish documentary proof to the satisfaction of the organ of state that the claims are correct.

iv) If the specific goals have been claimed or obtained on a fraudulent basis or any of the conditions of contract have not been fulfilled, the organ of state may, in addition to any other remedy it may have –

(a) disqualify the person from the tendering process.

(b) recover costs, losses or damages it has incurred or suffered as a result of that person's conduct.

(c) cancel the contract and claim any damages which it has suffered as a result of having to make less favourable arrangements due to such cancellation.

(d) recommend that the tenderer or contractor, its shareholders and directors, or only the shareholders and directors who acted on a fraudulent basis, be restricted from obtaining business from any organ of state for a period not exceeding 10 years, after the *audi alteram partem* (hear the other side) rule has been applied; and

(e) forward the matter for criminal prosecution, if deemed necessary.

……
SIGNATURE(S) OF TENDERER(S)

SURNAME AND NAME: …….
DATE: ……
ADDRESS: ……
……
……

6.5 SUB-CONTRACTING

6.5.1 Will any portion of the contract be sub-contracted?

(***Tick applicable box***)

YES		NO	

6.5.2 If yes, indicate:

i) What percentage of the contract will be subcontracted_____

ii) The name of the sub-contractor(s):

---

iii) The black sharehold of the sub-contractor(s):

---

iv) Whether the sub-contractor(s) is an EME or QSE

(Tick applicable box)

YES		NO	

v) Specify, by ticking the appropriate box, if subcontracting with an enterprise in terms of Preferential Procurement Regulations,2022:

Designated Group: An EME or QSE which is at last 51% owned by:	**EME** √	**QSE** √
Black people		
Black people who are youth		
People who are women		
Black people with disabilities		
Black people living in rural or underdeveloped areas or townships		
Cooperative owned by black people		
Black people who are military veterans		
OR		
Any EME		
Any QSE		

6.6 DECLARATION WITH REGARD TO COMPANY/FIRM

6.6.1 Name of company/firm: ……

6.6.2 VAT number registration number: ……

6.6.3 Company registration number: ……

6.7 TYPE OF COMPANY/ FIRM

☐ Partnership/Joint Venture / Consortium
☐ One person business/sole propriety
☐ Close corporation
☐ Company
☐ (Pty) Limited
[TICK APPLICABLE BOX]

6.8 DESCRIBE PRINCIPAL BUSINESS ACTIVITIES

……

……

……

……

6.9 COMPANY CLASSIFICATION

☐ Manufacturer
☐ Supplier
☐ Professional service provider
☐ Other service providers, e.g. transporter, etc.
[*TICK APPLICABLE BOX*]

6.10 MUNICIPAL INFORMATION

Municipality where business is situated: …….

Registered Account Number: ……

Stand Number: …….

6.11 Total number of years the company/firm has been in business: ……

6.12 I/we, the undersigned, who is / are duly authorised to do so on behalf of the company/firm, certify that the points claimed, based on the Specific Goals in MBD 6.1 qualifies the company/ firm for the preference(s) shown and I / we acknowledge that:

i) The information furnished is true and correct;

ii) In the event of a contract being awarded as a result of points claimed as shown in MBD 6.1, the contractor is required to furnish documentary proof as requested in the Tender Data to the satisfaction of the purchaser that the claims are correct;

iii) If the specific goals points have been claimed or obtained on a fraudulent basis or any of the conditions of contract have not been fulfilled, the purchaser may, in addition to any other remedy it may have –

(a) disqualify the person from the bidding process;

(b) recover costs, losses or damages it has incurred or suffered as a result of that person's conduct;

(c) cancel the contract and claim any damages which it has suffered as a result of having to make less favourable arrangements due to such cancellation;

(d) recommend that the bidder or contractor, its shareholders and directors, or only the shareholders and directors who acted on a fraudulent basis, be restricted by the National Treasury from obtaining business from any organ of state for a period not exceeding 10 years, after the *audi alteram partem* (hear the other side) rule has been applied; and

(e) forward the matter for criminal prosecution.

WITNESSES 1. …….. 2. ……..	…… SIGNATURE(S) OF BIDDERS(S) DATE: …….. ADDRESS …….. …….. ……..

MBD 4

DECLARATION OF INTEREST

1. No bid will be accepted from persons in the service of the state[1].

2. Any person, having a kinship with persons in the service of the state, including a blood relationship, may make an offer or offers in terms of this invitation to bid. In view of possible allegations of favouritism, should the resulting bid, or part thereof, be awarded to persons connected with or related to persons in service of the state, it is required that the bidder or their authorised representative declare their position in relation to the evaluating/adjudicating authority.

3 In order to give effect to the above, the following questionnaire must be completed and submitted with the bid.

3.1 Full Name of bidder or his or her representative: .....

3.2 Identity Number: .....

3.3 Position occupied in the Company (director, trustee, hareholder[2]): .....

3.4 Company Registration Number: .....

3.5 Tax Reference Number: .....

3.6 VAT Registration Number: .....

3.7 The names of all directors / trustees / shareholders members, their individual identity numbers and state employee numbers must be indicated in paragraph 4 below.

3.8 Are you presently in the service of the state?.....**YES / NO**

3.8.1 If yes, furnish particulars.....

.....

[1]MSCM Regulations: "in the service of the state" means to be –

(a) a member of –
  (i) any municipal council;
  (ii) any provincial legislature; or
  (iii) the national Assembly or the national Council of provinces;

(b) a member of the board of directors of any municipal entity;

(c) an official of any municipality or municipal entity;

(d) an employee of any national or provincial department, national or provincial public entity or constitutional institution within the meaning of the Public Finance Management Act, 1999 (Act No.1 of 1999);

(e) a member of the accounting authority of any national or provincial public entity; or

(f) an employee of Parliament or a provincial legislature.

[2] Shareholder" means a person who owns shares in the company and is actively involved in the management of the company or business and exercises control over the company.

3.9 Have you been in the service of the state for the past twelve months? .....**YES / NO**

3.9.1 If yes, furnish particulars.....

.....

3.10 Do you have any relationship (family, friend, other) with persons in the service of the state and who may be involved with the evaluation and or adjudication of this bid? .....**YES / NO**

3.10.1 If yes, furnish particulars.....

.....

3.11 Are you, aware of any relationship (family, friend, other) between any other bidder and any persons in the service of the state who may be involved with the evaluation and or adjudication of this bid? .....**YES / NO**

3.11.1 If yes, furnish particulars.....

.....

3.12 Are any of the company's directors, trustees, managers, principle shareholders or stakeholders in service of the state?.....**YES / NO**

3.12.1 If yes, furnish particulars.....

.....

3.13 Are any spouse, child or parent of the company's directors trustees, managers, principle shareholders or stakeholders in service of the state .....**YES / NO**

3.13.1 If yes, furnish particulars.....

.....

3.14 Do you or any of the directors, trustees, managers, principle shareholders, or stakeholders of this company have any interest in any other related companies or business whether or not they are bidding for this contract. .....**YES / NO**

3.14.1 If yes, furnish particulars: .....

.....

**Tenderers are encouraged to truthfully declare all other company interests they may have, with specific reference to Question 3.14, of which if not fully completed, might lead to disqualification. Tenderers are encouraged to utilise the CIPC bizportal (www.bizportal.gov.za) , free registration to check the companies for which a director is a director for. This can be done by inserting an ID number for the director tendering and the portal will show all companies, whether active or not.*

4. Full details of directors / trustees / members / shareholders.

Full Name	Identity Number	State Employee Number

....
Signature **Date**

....
Capacity **Name of Bidder**

MBD 8

DECLARATION OF BIDDER'S PAST SUPPLY CHAIN MANAGEMENT PRACTICES

1 The bid of any bidder may be disregarded if that bidder, or any of its directors have-

a. abused the institution's supply chain management system;

b. committed fraud or any other improper conduct in relation to such system; or

c. failed to perform on any previous contract.

2 In order to give effect to the above, the following questionnaire must be completed and submitted with the bid.

Item	Question	Yes	No
4.1	Is the bidder or any of its directors listed on the National Treasury's database as companies or persons prohibited from doing business with the public sector? (Companies or persons who are listed on this database were informed in writing of this restriction by the National Treasury after the *audi alteram partem* rule was applied).	Yes □	No □
4.1.1	If so, furnish particulars:		
4.2	Is the bidder or any of its directors listed on the Register for Tender Defaulters in terms of section 29 of the Prevention and Combating of Corrupt Activities Act (No 12 of 2004)? **To access this Register, enter the National Treasury's website, www.treasury.gov.za, click on the icon "Register for Tender Defaulters" or submit your written request for a hard copy of the Register to facsimile number (012) 3265445.**	Yes □	No □
4.2.1	If so, furnish particulars:		
4.3	Was the bidder or any of its directors convicted by a court of law (including a court outside of the Republic of South Africa) for fraud or corruption during the past five years?	Yes □	No □
4.3.1	If so, furnish particulars:		
4.4	Was any contract between the bidder and any organ of state terminated during the past five years on account of failure to perform on or comply with the contract?	Yes □	No □
4.4.1	If so, furnish particulars:		

CERTIFICATION

I, THE UNDERSIGNED (FULL NAME) …… CERTIFY THAT THE INFORMATION FURNISHED ON THIS DECLARATION FORM IS TRUE AND CORRECT.

I ACCEPT THAT, IN addition TO CANCELLATION OF A CONTRACT, ACTION MAY BE TAKEN AGAINST ME SHOULD THIS DECLARATION PROVE TO BE FALSE.

.....	.....
Signature	**Date**
.....	.....
Position	**Name of Bidder**

MBD 5

DECLARATION FOR PROCUREMENT ABOVE R10 MILLION (VAT INCLUDED)

For all procurement expected to exceed R10 million (VAT included), bidders must complete the following questionnaire:

1. Are you by law required to prepare annual financial statements for auditing?.....**YES / NO**

1.1 If yes, submit audited annual financial statements for the past three years or since the date of establishment if established during the past three years.

.....

.....

2. If the bidder is not required by law to prepare annual financial statements for auditing, they shall be required to furnish their Annual Financial Statements -

   i. for the past three years , or

   ii. since their establishment if established during the past three years

   Do you have any outstanding undisputed commitments for municipal services towards a municipality or any other service provider in respect of which payment is overdue for more than 30 days? .....**YES / NO**

2.1 If no, this serves to certify that the bidder has no undisputed commitments for municipal services towards a municipality or other service provider in respect of which payment is overdue for more than 30 days.

2.2 If yes, provide particulars.

.....

.....

3. Has any contract been awarded to you by an organ of state during the past five years, including particulars of any material non-compliance or dispute concerning the execution of such contract? .....**YES / NO**

3.1 If yes, furnish particulars

.....

.....

4 Will any portion of goods or services be sourced from outside the Republic, and, if so, what portion and whether any portion of payment from the municipality / municipal entity is expected to be transferred out of the Republic? .....**YES / NO**

4.1 If yes, furnish particulars

.....

.....

CERTIFICATION

I, THE UNDERSIGNED (FULL NAME) ……..
CERTIFY THAT THE INFORMATION FURNISHED ON THIS DECLARATION FORM IS TRUE AND CORRECT.

I ACCEPT THAT THE STATE MAY ACT AGAINST ME SHOULD THIS DECLARATION PROVE TO BE FALSE.

.....	.....
Signature	**Date**
.....	.....
Position	**Name of Bidder**

MBD 9

CERTIFICATE OF INDEPENDENT BID DETERMINATION

1. This Municipal Bidding Document (MBD) must form part of all bids[1] invited.

2. Section 4 (1) (b) (iii) of the Competition Act No. 89 of 1998, as amended, prohibits an agreement between, or concerted practice by, firms, or a decision by an association of firms, if it is between parties in a horizontal relationship and if it involves collusive bidding (or bid rigging)[2].Collusive bidding is a *pe se* prohibition meaning that it cannot be justified under any grounds.

3. Municipal Supply Regulation 38 (1) prescribes that a supply chain management policy must provide measures for the combating of abuse of the supply chain management system, and must enable the accounting officer, among others, to:

   a. take all reasonable steps to prevent such abuse;

   b. reject the bid of any bidder if that bidder or any of its directors has abused the supply chain management system of the municipality or municipal entity or has committed any improper conduct in relation to such system; and

   c. cancel a contract awarded to a person if the person committed any corrupt or fraudulent act during the bidding process or the execution of the contract.

4. This MBD serves as a certificate of declaration that would be used by institutions to ensure that, when bids are considered, reasonable steps are taken to prevent any form of bid-rigging.

5 In order to give effect to the above, the attached Certificate of Bid Determination (MBD9) must be completed and submitted with the bid:

[1] **Includes price quotations, advertised competitive bids, limited bids and proposals.**

[2] **Bid rigging (or collusive bidding) occurs when businesses, that would otherwise be expected to compete, secretly conspire to raise prices or lower the quality of goods and / or services for purchasers who wish to acquire goods and / or services through a bidding process. Bid rigging is, therefore, an agreement between competitors not to compete.**

Employer:		**Contractor:**	
Witness:		**Witness:**	

MBD 9

CERTIFICATE OF INDEPENDENT BID DETERMINATION

I, the undersigned, in submitting the accompanying bid:

_____
(Bid Number and Description) in response to the invitation for the bid made by:

_____
(Name of Municipality / Municipal Entity) do hereby make the following statements that I certify to be true and complete in every respect:

I certify, on behalf of _____that:
(Name of Bidder)

1. I have read, and I understand the contents of this Certificate;
2. I understand that the accompanying bid will be disqualified if this Certificate is found not to be true and complete in every respect;
3. I am authorized by the bidder to sign this Certificate, and to submit the accompanying bid, on behalf of the bidder;
4. Each person whose signature appears on the accompanying bid has been authorized by the bidder to determine the terms of, and to sign, the bid, on behalf of the bidder;
5. For the purposes of this Certificate and the accompanying bid, I understand that the word "competitor" shall include any individual or organization, other than the bidder, whether or not affiliated with the bidder, who:
   (a) has been requested to submit a bid in response to this bid invitation;
   (b) could potentially submit a bid in response to this bid invitation, based on their qualifications, abilities or experience; and
   (c) provides the same goods and services as the bidder and/or is in the same line of business as the bidder
6. The bidder has arrived at the accompanying bid independently from, and without consultation, communication, agreement or arrangement with any competitor. However, communication between partners in a joint venture or consortium[3] will not be construed as collusive bidding.
7. In particular, without limiting the generality of paragraphs 6 above, there has been no consultation, communication, agreement or arrangement with any competitor regarding:
   (a) prices;
   (b) geographical area where product or service will be rendered (market allocation)
   (c) methods, factors or formulas used to calculate prices;
   (d) the intention or decision to submit or not to submit, a bid;
   (e) the submission of a bid which does not meet the specifications and conditions of the bid; or
   (f) bidding with the intention not to win the bid.

[3] **Joint venture or Consortium means an association of persons for the purpose of combining their expertise, property, capital, efforts, skill and knowledge in an activity for the execution of a contract.**

8. In addition, there have been no consultations, communications, agreements or arrangements with any competitor regarding the quality, quantity, specifications and conditions or delivery particulars of the products or services to which this bid invitation relates.
9. The terms of the accompanying bid have not been, and will not be, disclosed by the bidder, directly or indirectly, to any competitor, prior to the date and time of the official bid opening or of the awarding of the contract.
10. I am aware that, in addition and without prejudice to any other remedy provided to combat any restrictive practices related to bids and contracts, bids that are suspicious will be reported to the Competition Commission for investigation and possible imposition of administrative penalties in terms of section 59 of the Competition Act No. 89 of 1998 and or may be reported to the National Prosecuting Authority (NPA) for criminal investigation and or may be restricted from conducting business with the public sector for a period not exceeding ten (10) years in terms of the Prevention and Combating of Corrupt Activities Act No. 12 of 2004 or any other applicable legislation.

....
Signature **Date**

....
Position **Name of Bidder**

T2.1.5 PROPOSED AMENDMENTS AND QUALIFICATIONS

The Tenderer should record any deviations or qualifications he may wish to make to the tender documents in this Returnable Schedule. Alternatively, a tenderer may state such qualifications in a covering letter to his tender and reference such letter in this schedule.

The Tenderer's attention is drawn to clause C.3.8 of the Standard Conditions of Tender referenced in the Tender Data regarding the employer's handling of material qualifications.

Page	Clause or item	Proposal

Signed: _____ Date: .....

Name: _____ Position: .....

Tenderer: .....

T2.1.6 SCHEDULE OF THE TENDERER'S EXPERIENCE

EMPLOYER: CONTACT PERSON AND TELEPHONE NUMBER	EMPLOYER'S AGENT OR REPRESENTATIVE: CONTACT PERSON AND TELEPHONE NUMBER	NATURE OF WORK	VALUE OF WORK (inclusive of VAT)	DATE COMPLETED OR EXPECTED TO BE COMPLETED

T2.1.7 CONTACTABLE REFERENCE

Criteria 1: Reinforced Concrete Reservoir/Tower

To Johannesburg Water (SOC) Ltd

I, the undersigned being duly authorised to do so, hereby furnish a reference to Johannesburg Water relative to tender Contract No**. JW14040RR** for **CONSTRUCTION OF A 2.25 ML WATER TOWER IN ROBETSVILLE**

Name of Tenderer: .....
Name of Project: .....
Construction dates (start and finish): .....

Description of Services Provided

.....

Material----------

Size----------

Infrastructure Co-ordinates:.....
Was their performance satisfactory? Yes / No*

Were the quality / specifications complied with Yes / No*

If No, please furnish details: .....

.....

.....
Will you recommend this supplier to anyone without reservations: Yes / No

Rate this supplier out of a possible score of 5 (5 being excellent and 1 being unacceptable) …

Name of authorised person: .....

Signature: ……..…… Date: ……

Telephone/Mobile: …… Email: ……..……

Completed on behalf (Name of Client): ……

NB: *This document must be completed by the referee and included in the tender submission. Alternatively, the client's letterhead may be used for this purpose provided it complies with the functional criteria requirements. A separate form must be completed for each reference as required in the evaluation criteria. Information provided will be verified and if found to be false or misrepresented, punitive measures will be instituted against the respective party including blacklisting and restriction from participating in any future government tender.*

Note: Coordinates are required for infrastructure projects to allow Johannesburg Water to verify the existence, location and completion of the projects claimed by the Tenderer. This information will be confirmed as part of the reference check process for the recommended bidder

T2.1.7 CONTACTABLE REFERENCE

Criteria 1: Reinforced Concrete Reservoir/Tower

To Johannesburg Water (SOC) Ltd

I, the undersigned being duly authorised to do so, hereby furnish a reference to Johannesburg Water relative to tender Contract No**. JW14040RR** for **CONSTRUCTION OF A 2.25 ML WATER TOWER IN ROBETSVILLE**

Name of Tenderer: .....
Name of Project: .....
Construction dates (start and finish): .....

Description of Services Provided

.....

Material----------

Size----------

Infrastructure Co-ordinates:.....
Was their performance satisfactory? Yes / No*

Were the quality / specifications complied with Yes / No*

If No, please furnish details: .....

.....

.....
Will you recommend this supplier to anyone without reservations: Yes / No

Rate this supplier out of a possible score of 5 (5 being excellent and 1 being unacceptable) …

Name of authorised person: .....

Signature: ……..…… Date: ……

Telephone/Mobile: …… Email: ……..……

Completed on behalf (Name of Client): ……

NB: This document must be completed by the referee and included in the tender submission. Alternatively, the client's letterhead may be used for this purpose provided it complies with the functional criteria requirements. A separate form must be completed for each reference as required in the evaluation criteria. Information provided will be verified and if found to be false or misrepresented, punitive measures will be instituted against the respective party including blacklisting and restriction from participating in any future government tender.

Note: Coordinates are required for infrastructure projects to allow Johannesburg Water to verify the existence, location and completion of the projects claimed by the Tenderer. This information will be confirmed as part of the reference check process for the recommended bidder

T2.1.7 CONTACTABLE REFERENCE

Criteria 2: Pumpstation with minimum flow of 275l/s

To Johannesburg Water (SOC) Ltd

I, the undersigned being duly authorised to do so, hereby furnish a reference to Johannesburg Water relative to tender Contract No**. JW14040RR** for **CONSTRUCTION OF A 2.25 ML WATER TOWER IN ROBETSVILLE**

Name of Tenderer: .....
Name of Project: .....
Description of Services Provided. .....

:.....

.infrastructure co-ordinates.....

Minimum flow----------
Was their performance satisfactory? Yes / No*

Were the quality / specifications complied with Yes / No*

If No, please furnish details: .....

.....

.....
Will you recommend this supplier to anyone without reservations: Yes / No

Rate this supplier out of a possible score of 5 (5 being excellent and 1 being unacceptable) …

Name of authorised person: .....

Signature: ……..…… Date: ……

Telephone/Mobile: …… Email: ……..……

Completed on behalf (Name of Client): ……

NB: This document must be completed by the referee and included in the tender submission. Alternatively, the client's letterhead may be used for this purpose provided it complies with the functional criteria requirements. A separate form must be completed for each reference as required in the

evaluation criteria. Information provided will be verified and if found to be false or misrepresented, punitive measures will be instituted against the respective party including blacklisting and restriction from participating in any future government tender.

Note: Coordinates are required for infrastructure projects to allow Johannesburg Water to verify the existence, location and completion of the projects claimed by the Tenderer. This information will be confirmed as part of the reference check process for the recommended bidder

T2.1.7 CONTACTABLE REFERENCE

Criteria 2: Pumpstation with minimum flow of 275 l/s

To Johannesburg Water (SOC) Ltd

I, the undersigned being duly authorised to do so, hereby furnish a reference to Johannesburg Water relative to tender Contract No**. JW14040RR** for **CONSTRUCTION OF A 2.25 ML WATER TOW ER IN ROBETSVILLE**

Name of Tenderer: .....
Name of Project: .....
Construction dates (start and finish): .....

Description of Services Provided

.....

Minimum Flow .....

Was their performance satisfactory? Yes / No*

Were the quality / specifications complied with Yes / No*

If No, please furnish details: .....

.....

.....

Will you recommend this supplier to anyone without reservations: Yes / No

Rate this supplier out of a possible score of 5 (5 being excellent and 1 being unacceptable) …

Name of authorised person: .....

Signature: ……..…… Date: ……

Telephone/Mobile: …… Email: ……..……

Completed on behalf (Name of Client): ……

NB: This document must be completed by the referee and included in the tender submission. Alternatively, the client's letterhead may be used for this purpose provided it complies with the functional criteria requirements. A separate form must be completed for each reference as required in the evaluation criteria. Information provided will be verified and if found to be false or misrepresented, punitive measures will be instituted against the respective party including blacklisting and restriction from participating in any future government tender. Returnable Documents

Note: Coordinates are required for infrastructure projects to allow Johannesburg Water to verify the existence, location and completion of the projects claimed by the Tenderer. This information will be confirmed as part of the reference check process for the recommended bidder

T2.1.7 CONTACTABLE REFERENCE

Criteria 3: Construction of Steel Pipes Projects

To Johannesburg Water (SOC) Ltd

I, the undersigned being duly authorised to do so, hereby furnish a reference to Johannesburg Water relative to tender Contract No**. JW14040RR** for **CONSTRUCTION OF A 2.25 ML WATER TOWER IN ROBERTSVILLE**

Name of Tenderer: .....
Name of Project: .....
Construction dates (start and finish): .....

Description of Services Provided

.....

Pipe Material and size.....

Value of Work .....

Coating ----------
Was their performance satisfactory? Yes / No*

Were the quality / specifications complied with Yes / No*

If No, please furnish details: .....

.....

.....

Will you recommend this supplier to anyone without reservations: Yes / No

Rate this supplier out of a possible score of 5 (5 being excellent and 1 being unacceptable) …

Name of authorised person: .....

Signature: ……..…… Date: ……

Telephone/Mobile: …… Email: ……..……

Completed on behalf (Name of Client): ……

NB: This document must be completed by the referee and included in the tender submission. Alternatively, the client's letterhead may be used for this purpose provided it complies with the functional

criteria requirements. A separate form must be completed for each reference as required in the evaluation criteria. Information provided will be verified and if found to be false or misrepresented, punitive measures will be instituted against the respective party including blacklisting and restriction from participating in any future government tender.

T2.1.7 CONTACTABLE REFERENCE

Criteria 3: Construction of Steel Pipes Projects

To Johannesburg Water (SOC) Ltd

I, the undersigned being duly authorised to do so, hereby furnish a reference to Johannesburg Water relative to tender Contract No**. JW14040RR** for **CONSTRUCTION OF A 2.25 ML WATER TOWER IN ROBETSVILLE**

Name of Tenderer: .....
Name of Project: .....
Construction dates (start and finish): .....

Description of Services Provided

.....

Pipe Material .....

Value of Work .....

Cathodic Protection----------

Was their performance satisfactory? Yes / No*

Were the quality / specifications complied with Yes / No*

If No, please furnish details: .....

Will you recommend this supplier to anyone without reservations: Yes / No

Rate this supplier out of a possible score of 5 (5 being excellent and 1 being unacceptable) …

Name of authorised person: .....

Signature: ……..…… Date: ……

Telephone/Mobile: …… Email: ……..……

Completed on behalf (Name of Client): ……

NB: This document must be completed by the referee and included in the tender submission. Alternatively, the client's letterhead may be used for this purpose provided it complies with the functional criteria requirements. A separate form must be completed for each reference as required in the evaluation criteria. Information provided will be verified and if found to be false or misrepresented, punitive measures will be instituted against the respective party including blacklisting and restriction from participating in any future government tender.

T2.1.8 SCHEDULE OF KEY PERSONNEL

In terms of the Project Specification and the Conditions of Tender, unskilled workers may only be brought in from outside the local community if such personnel are not available locally.

The Tenderer shall list below the personnel which they intend to utilize on the Works, including key personnel which may have to be brought in from outside if not available locally.

CATEGORY OF EMPLOYEE	NUMBER OF PERSONS					
	KEY PERSONNEL, PART OF THE CONTRACTOR'S ORGANISATION		KEY PERSONNEL TO BE IMPORTED IF NOT AVAILABLE LOCALLY		UNSKILLED PERSONNEL TO BE RECRUITED FROM LOCAL COMMUNITY	
	HDI	NON-HDI	HDI	NON-HDI	HDI	NON-HDI
Contracts Manager						
Site Manager						
Mechanical Engineering Foreman						
Civil Engineering Foreman						
Electrical and C&I Engineering Foreman						
Safety Officer						

Others: ……..... .....…. ……						

SIGNATURE: .....…… DATE: …….....

(of person authorized to sign on behalf of the Tenderer)

T2.1.9 CURRICULUM VITAE OF KEY PERSONNEL

ALL CVs MUST BE COMPLETED IN THE TEMPLATE LISTED BELOW. CVs THAT ARE PROVIDED IN ANY OTHER FORMAT WILLL NOT BE CONSIDERED.

Provide separate forms for each position listed in Form: Key Personnel

Proposed role in the project	**CONTRACTS MANAGER**

1. Surname	
2. First Name	
3. Date and place of birth	
4. Nationality	
5. Membership of Professional Bodies and Professional Registration	

6. Education (Submit certified copies of qualifications)

Institution (Date from – Date to)	Degree(s) or Diploma(s) obtained

7. Registration/Membership of Professional Bodies (Submit copies of registration certificates)

Institution/ Professional Body	Category of Registration	Registration Number

8. Post Qualification Experience

Company/ Organisation	(Date from – Date to)	Years of Employment	Position

9. Project-based Experience

Project Name and Locality	
Project Client	
Project Dates	
Project Value	
Project position (e.g. Contracts Manager, Site Agent, etc.)	
Description of Duties	
Description of Project Scope	

Project Name and Locality	
Project Client	
Project Dates	
Project Value	
Project position (e.g. Contracts Manager, Site Agent, etc.)	
Description of Duties	
Description of Project Scope	

Project Name and Locality	
Project Client	
Project Dates	
Project Value	
Project position (e.g. Contracts Manager, Site Agent, etc.)	
Description of Duties	
Description of Project Scope	

Project Name and Locality	
Project Client	
Project Dates	
Project Value	
Project position (e.g. Contracts Manager, Site Agent, etc.)	
Description of Duties	
Description of Project Scope	

Duplicate relevant section to add more information, if required.

Certification:

I, the undersigned, certify that, to the best of my knowledge and belief, this data correctly describes me, my qualifications and my experience.

…… ……

Signature of person named in the schedule *Date*

Proposed role in the project	**SITE** MANAGER

1. Surname	
2. First Name	
3. Date and place of birth	
4. Nationality	
5. Membership of Professional Bodies and Professional Registration	

6. Education (Submit certified copies of qualifications)

Institution (Date from – Date to)	Degree(s) or Diploma(s) obtained

7. Registration/Membership of Professional Bodies (Submit copies of registration certificates)

Institution/ Professional Body	Category of Registration	Registration Number

8. Post Qualification Experience

Company/ Organisation	(Date from – Date to)	Years of Employment	Position

9. Project-based Experience

Project Name and Locality	
Project Client	
Project Dates	
Project Value	
Project position (e.g. Contracts Manager, Site Agent, etc.)	
Description of Duties	
Description of Project Scope	

Project Name and Locality	
Project Client	
Project Dates	
Project Value	
Project position (e.g. Contracts Manager, Site Agent, etc.)	
Description of Duties	
Description of Project Scope	

Project Name and Locality	
Project Client	
Project Dates	
Project Value	
Project position (e.g. Contracts Manager, Site Agent, etc.)	
Description of Duties	
Description of Project Scope	

Project Name and Locality	
Project Client	
Project Dates	
Project Value	
Project position (e.g. Contracts Manager, Site Agent, etc.)	
Description of Duties	
Description of Project Scope	

Duplicate relevant section to add more information, if required.

Certification:

I, the undersigned, certify that, to the best of my knowledge and belief, this data correctly describes me, my qualifications and my experience.

…… ……

Signature of person named in the schedule *Date*

Proposed role in the project	FOREMAN / SUPERVISOR

1. Surname	
2. First Name	
3. Date and place of birth	
4. Nationality	
5. Membership of Professional Bodies and Professional Registration	

6. Education (Submit certified copies of qualifications)

Institution (Date from – Date to)	Degree(s) or Diploma(s) obtained

7. Registration/Membership of Professional Bodies (Submit copies of registration certificates)

Institution/ Professional Body	Category of Registration	Registration Number

8. Post Qualification Experience

Company/ Organisation	(Date from – Date to)	Years of Employment	Position

9. Project-based Experience

Project Name and Locality	
Project Client	
Project Dates	
Project Value	
Project Position (e.g. Project Manager, Engineer, etc.)	
Description of Duties	
Description of Project Scope	

Project Name and Locality	
Project Client	
Project Dates	
Project Value	
Project Position (e.g. Project Manager, Engineer, etc.)	
Description of Duties	
Description of Project Scope	

Project Name and Locality	
Project Client	
Project Dates	
Project Value	
Project Position (e.g. Project Manager, Engineer, etc.)	
Description of Duties	

Project Name and Locality	
Project Client	
Project Dates	
Project Value	
Project Position (e.g. Project Manager, Engineer, etc.)	
Description of Duties	
Description of Project Scope	

Duplicate relevant section to add more information, if required.

Certification:

I, the undersigned, certify that, to the best of my knowledge and belief, this data correctly describes me, my qualifications and my experience.

…… ……

Signature of person named in the schedule *Date*

Proposed role in the project	CIVIL ENGINEERING FOREMAN

1. Surname	
2. First Name	
3. Date and place of birth	
4. Nationality	
5. Membership of Professional Bodies and Professional Registration	

6. Education (Submit certified copies of qualifications)

Institution (Date from – Date to)	Degree(s) or Diploma(s) obtained

7. Registration/Membership of Professional Bodies (Submit copies of registration certificates)

Institution/ Professional Body	Category of Registration	Registration Number

8. Post Qualification Experience

Company/ Organisation	(Date from – Date to)	Years of Employment	Position

9. Project-based Experience

Project Name and Locality	
Project Client	
Project Dates	
Project Value	
Project Position (e.g. Project Manager, Engineer, etc.)	
Description of Duties	
Description of Project Scope	

Project Name and Locality	
Project Client	
Project Dates	
Project Value	
Project Position (e.g. Project Manager, Engineer, etc.)	
Description of Duties	
Description of Project Scope	

Project Name and Locality	
Project Client	
Project Dates	
Project Value	
Project Position (e.g. Project Manager, Engineer, etc.)	
Description of Duties	
Description of Project Scope	

Project Name and Locality	
Project Client	
Project Dates	
Project Value	
Project Position (e.g. Project Manager, Engineer, etc.)	
Description of Duties	
Description of Project Scope	

Duplicate relevant section to add more information, if required.

Certification:

I, the undersigned, certify that, to the best of my knowledge and belief, this data correctly describes me, my qualifications and my experience.

....
Signature of person named in the schedule *Date*

Proposed role in the project	**SAFETY OFFICER**

1. Surname	
2. First Name	
3. Date and place of birth	
4. Nationality	
5. Membership of Professional Bodies and Professional Registration	

6. Education (Submit certified copies of qualifications)

Institution (Date from – Date to)	Degree(s) or Diploma(s) obtained

7. Registration/Membership of Professional Bodies (Submit copies of registration certificates)

Institution/ Professional Body	Category of Registration	Registration Number

8. Post Qualification Experience

Company/ Organisation	(Date from – Date to)	Years of Employment	Position

9. Project-based Experience

Project Name and Locality	
Project Client	
Project Dates	
Project Value	
Project Position (e.g. Project Manager, Engineer, etc.)	
Description of Duties	
Description of Project Scope	

Project Name and Locality	
Project Client	
Project Dates	
Project Value	
Project Position (e.g. Project Manager, Engineer, etc.)	
Description of Duties	
Description of Project Scope	

Project Name and Locality	
Project Client	
Project Dates	
Project Value	
Project Position (e.g. Project Manager, Engineer, etc.)	

Description of Project Scope and Duties	Returnable Documents
Description of Project Scope	

Project Name and Locality	
Project Client	
Project Dates	
Project Value	
Project Position (e.g. Project Manager, Engineer, etc.)	
Description of Duties	
Description of Project Scope	

Duplicate relevant section to add more information, if required.

Certification:

I, the undersigned, certify that, to the best of my knowledge and belief, this data correctly describes me, my qualifications and my experience.

....
Signature of person named in the schedule *Date*

T2.2 LIST OF RETURNABLE DOCUMENTS

Other documents required only for tender evaluation purposes:

Document		Page No.
T2.2.1	Contractor's Certificate of Registration With CIDB	RD.60
T2.2.2	SARS Tax Compliance Status Pin and Proof of CSD registration	RD.61

T2.2.1 CONTRACTOR'S CERTIFICATE OF REGISTRATION WITH CIDB

NB: The Tenderer shall attach hereto the Contractor's Certificate of Registration with CIDB OR provide the CIDB registration number that JW can use to verify CIDB requirements for this tender. Failure to submit the certificate or CIDB registration number with the tender document will lead to the conclusion that the Tenderer is not registered with the CIDB and therefore not eligible to tender.

Tenderers who have made application to CIDB for registration and are capable of being so registered prior to the evaluation of submissions must attach a notification from CIDB that their application is being considered.

CIDB status to be active at the required CIDB grading at time of evaluation to avoid disqualification.

SIGNATURE:.....…… DATE: …….....

(of person authorized to sign on behalf of the Tenderer)

T2.2.2 SARS TAX COMPLIANCE STATUS PIN AND PROOF OF CSD REGISTRATION

The Tenderer must attach hereto a copy SARS Tax Compliance Status Pin and Proof of CSD registration i.e. MA xxxxxxxxxx number.

SIGNATURE:.....…… DATE: ….....

(of person authorized to sign on behalf of the Tenderer)

T2.3 LIST OF RETURNABLE SCHEDULES

3. Other documents that will be incorporated into the contract

Document	Page No.
T2.3.1 Returnable Annexure A: Acknowledgement of SHE Specification &	RD.60
T2.3.2 Returnable Annexure B: Acknowledgment of Tender Drawings	RD.61
Error! Reference source not found.	RD.62
Error! Reference source not found.	RD.63

T2.3.1 RETURNABLE ANNEXURE A: ACKNOWLEDGEMENT OF SHE SPECIFICATION & ANNEXURES

DECLARATION BY CONTRACTOR

I, the undersigned, and representing the tenderer as indicated hereby acknowledge that I have obtained copies of the following listed documentation and confirm that I fully understand the contents thereof and confirm compliance thereto in the event of being successful:

- OHS Specification (Volume 3)
- Annexure 1: Baseline Risk Assessment
- Annexure 2: Medical Screening Policy
- Annexure 3: Sign off form
- Annexure 4: Environmental Management Plan

We furthermore commit to:

- Comply with all applicable SHE related legal and other requirements.
- Inform all staff of their role in managing environmental impacts and safety hazards on site.

Signed at …… on this …….. Day of …… 20……...

Name of tenderer	
Name of Authorized person	
Authorized Signature*	

*Signature must be as per form T2.1.2 as applicable

T2.3.2 RETURNABLE ANNEXURE B: ACKNOWLEDGMENT OF TENDER DRAWINGS

DECLARATION BY CONTRACTOR

I, the undersigned, and representing the tenderer as indicated hereby acknowledge that I have obtained copies of the following listed documentation and confirm that I fully understand the contents thereof and confirm compliance thereto in the event of being successful:

The drawings that are issued for **TENDER PURPOSES** are those noted below:

TABLE OF DRAWING NUMBERS

Signed at …… on this …….. Day of …… 20……...

Name of tenderer	
Name of Authorized person	
Authorized Signature*	

*Signature must be as per form T2.1.2 as applicable

Employer:		**Contractor:**	
Witness:		**Witness:**	

Johannesburg Water (SOC) Ltd

Johannesburg Water

CONTRACT: JW14040RR

CONSTRUCTION OF A 2.25 ML WATER TOWER IN ROBETSVILLE

VOLUME 1

PART 1: AGREEMENT AND CONTRACT DATA

Employer:		**Contractor:**	
Witness:		**Witness:**	

TABLE OF CONTENTS

		Page No.
C1.1	**Form of Offer (Acceptance & Agreement)**	**C.3**
C1.1.1	Form of Offer	C.3
C1.1.2	FORM OF ACCEPTANCE	C.4
		C.5
C1.1.3	Schedule of **Deviations**	
C1.2	**Contract Data**	**C.7**
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Employer:		**Contractor:**	
Witness:		**Witness:**	

C1.1 FORM OF OFFER (ACCEPTANCE & AGREEMENT)

C1.1.1 Form of Offer

The Contractor is to complete and sign the Form of Offer

The Employer, identified in the Acceptance signature block, has solicited offers to enter into a contract in respect of the following works:

JW14040RR: CONSTRUCTION OF A 2.25 ML WATER TOWER IN ROBETSVILLE

The Tenderer, identified in the Offer signature block below, has examined the documents listed in the Tender Data and addenda thereto as listed in the Tender Schedules, and by submitting this Offer has accepted the Conditions of Tender.

By the representative of the Tenderer, deemed to be duly authorised, signing this part of this Form of Offer and Acceptance, the Contractor offers to perform all of the obligations and liabilities of the Contractor under the Contract including compliance with all its terms and conditions according to their true intent and meaning for an amount to be determined in accordance with the Conditions of Contract identified in the Contract Data.

THE OFFERED TOTAL OF THE PRICES INCLUSIVE OF VALUE ADDED TAX IS

_____

_____

Rand (in words); R_____ (in figures)

This offer may be accepted by the Employer by signing the Acceptance part of this Form of Offer and Acceptance and returning one copy of this document to the Contractor, whereupon the Contractor becomes the party named as the Contractor in the Conditions of Contract identified in the Contract Data.

Signature(s) _____ _____

Name(s) _____ _____

Capacity _____ _____

For the Contractor _____

(Name and address of organisation)

Name and signature of witness _____ _____

(Name) (Signature)

Date _____

Employer:		**Contractor:**	
Witness:		**Witness:**	

C1.1.2 FORM OF ACCEPTANCE

The Employer is to complete and sign the form of acceptance.

By signing this part of the Form of Offer and Acceptance, the Employer identified below accepts the Contractor's Offer. In consideration thereof, the Employer shall pay the Contractor the amount due in accordance with the Conditions of Contract identified in the Contract Data. Acceptance of the Contractor's Offer shall form an agreement between the Employer and the Contractor upon the terms and conditions contained in this Agreement and in the Contract that is the subject of this Agreement.

The terms of the contract are contained in:

Part 1 Agreement and Contract Data, (which includes this Agreement)
Part 2 Pricing Data
Part 3 Scope of Work
Part 4 Site Information

and drawings, pricing schedules (Bill of Quantities) and documents or parts thereof, which may be incorporated by reference into Parts 1 to 4 above.

Deviations from and amendments to the documents listed in the Tender Data and any addenda thereto listed in the Tender Schedules as well as any changes to the terms of the Offer agreed by the Contractor and the Employer during this process of offer and acceptance, are contained in the Schedule of Deviations attached to and forming part of this Agreement. No amendments to or deviations from said documents are valid unless contained in this Schedule, which must be duly signed by the authorised representative(s) of both parties.

The Contractor shall within twenty-eight **(28) days** after receiving a completed copy of this Agreement, including the Schedule of Deviations (if any), contact the employer's agent (whose details are given in the Contact Data) to arrange the delivery of any bonds, guarantees, proof of insurance and any other documentation to be provided in terms of the Conditions of Contract identified in the Contract Data at, or just after, the date of this Agreement comes into effect. Failure to fulfil any of these obligations in accordance with those terms shall constitute a repudiation of this Agreement.

Notwithstanding anything contained herein, this Agreement comes into effect on the date when the Contractor receives one fully completed copy of this document, including the Schedule of Deviations (if any). Unless the Contractor (now the Contractor) within five days after the date of such receipt notifies the Employer in writing of any reason why he cannot accept the contents of this Agreement, this Agreement shall constitute a binding contract between the parties.

Name(s) _____

Capacity _____

For the Employer **Johannesburg Water SOC (Ltd), Turbine Hall, 65 Ntemi Piliso Street, Newtown.**

(Name and address of organisation)

Name and signature of witness

_____ _____
(Name) (Signature)

Date _____

Employer:		**Contractor:**	
Witness:		**Witness:**	

C1.1.3 Schedule of Deviations

Notes:

1. The extent of deviations from the tender documents issued by the employer prior to the tender closing date is limited to those permitted in terms of the Conditions of Tender;
2. A Contractor's covering letter shall not be included in the final contract document. Should any matter in such letter, which constitutes a deviation as aforesaid become the subject of agreements reached during the process of offer and acceptance, the outcome of such agreement shall be recorded here;
3. Any other matter arising from the process of offer and acceptance either as a confirmation, clarification or change to the tender documents and which it is agreed by the Parties becomes an obligation of the contract shall also be recorded here; and
4. Any change or addition to the tender documents arising from the above arrangements and recorded here shall also be incorporated into the final draft of the Contract.

1	**Subject**	
	Details	
2	**Subject**	
	Details	
3	**Subject**	
	Details	
4	**Subject**	
	Details	
5	**Subject**	
	Details	
6	**Subject**	
	Details	
7	**Subject**	
	Details	

By the duly authorised representatives signing this Schedule of Deviations, the Employer and the Contractor agree to and accept the foregoing Schedule of deviations as the only deviations from and amendments to the documents listed in the Tender Data and addenda thereto as listed in the Tender Schedules, as well as any confirmation, clarification or change to the terms of the offer agreed by the Contractor and the Employer during the process of offer and acceptance.

Employer:		**Contractor:**	
Witness:		**Witness:**	

It is expressly agreed that no other matter whether in writing, oral communication or implied during the period between the issue of the tender documents and the receipt by the Contractor of a completed and signed copy of this Agreement shall have any meaning or effect in the contract between the parties arising from this Agreement.

For the Contractor:

Signature(s) _____ _____

Name(s) _____ _____

Capacity _____ _____

For the Contractor _____

(Name and address of organisation)

Name and signature of witness _____ _____

(Name) (Signature)

Date _____

For the Employer:

Name(s) _____ _____

Capacity _____ _____

For the Employer **Johannesburg Water SOC (Ltd), Turbine Hall, 65 Ntemi Piliso Street, Newtown**

(Name and address of organisation)

Name and signature of witness _____ _____

(Name) (Signature)

Date _____

Employer:		**Contractor:**	
Witness:		**Witness:**	

C1.2 CONTRACT DATA

C1.2.1 Part 1: Data Provided by the Employer

CONDITIONS OF CONTRACT

The General Conditions of Contract for Construction Works Third Edition (2015), published by the South African Institution of Civil Engineering, is applicable to this Contract.

Copies of these conditions of contract may be obtained from the South African Institution of Civil Engineering (Telephone number: 011-805 5947)

C1.2.1.1 Contract Specific Data

The following contract specific data are applicable to this Contract:

GCC Clause	Information
1.1.1.13	The Defects Liability Period is 52 weeks from the date of the Certificate of Completion.
1.1.1.14	Delete clause 1.1.1.14 and replace with: "Due Completion Date" means the date of expiry of the time stated in the Contract Data for achieving Practical Completion of the Works, calculated from the date on which the Employer's Agent instructs the commencement of Works and adjusted by such extensions of time or acceleration as may be allowed in terms of the Contract." The time for achieving Practical Completion is 16 months, inclusive of non-working and special non-working days.
1. 1.1.15	The name of the Employer is Johannesburg Water (SOC) Limited Contact person is Seemole Tleane
1.1.1.16	The name of the Employer's Agent is **TBA after Contract Award**.
1.1.1.26	The Pricing Strategy is a Re-measurement Contract.
1.2.1.2	The address of the Employer is: Physical: Turbine Hall, 65 Ntemi Piliso Street, Newtown Postal: P.O. Box 61542, Marshalltown, 2107 Tel: 011 688 1470 Fax: 011 688 1470 Email: Seemole.telane@jwater.co.za
1.2.1.2	The address of the Employer's Agent is **TBA after Contract Award**
3.2.3	Specific Approval – The Employer's Agent is required to obtain the Employer's approval for the following: • Approval of Variation Orders • The use of contingencies • Approval of Prov. Sum (3 Quotes system) • Approval to exceed the Contract Sum • Approval of Subcontracting Plan and work package breakdown

Employer:		**Contractor:**	
Witness:		**Witness:**	

GCC Clause	Information
	• Stoppage/ suspension of works
4.4.2	Add the following after this clause: Apart from sub-contractors identified by the Contractor for the execution of certain sections of the Works, subcontractors shall also include SMME's (Small Medium and Micro Enterprises), who are identified from the Local Community for the execution of certain sections of the Works. The appointment of subcontractors and the allocation of work to subcontractors shall, in addition to the provisions of the General Conditions of Contract, comply with, but not be limited to, the provisions of **C1.2.1.2.14** (see below). A minimum value of 10% of the Contract Price shall be subcontracted to SMME's.
4.10.1	Add the following to this clause: The Contractor shall employ labour from Local Communities (otherwise known as Local Labour), in accordance with the Tender Data, Scope of Work, Site Information, and Specifications. All Local Labour shall be recruited through the Community Liaison Officer (CLO) and/or Labour Desk Officer (LDO). The Contractor remains fully responsible for all Local Labour that are employed for the execution of the Works, as if they were the Contractor's own labour.
4.11.1	Add the following to this clause: Competent Employees shall include, amongst others, the following Key Personnel: • Contracts Manager • Site Manager • Safety Officer • Civil, Structural and Foremen The minimum requirements in terms of qualifications and experience of these Key Personnel are listed in **C1.2.1.2.15** (see below).

GCC Clause	Information

5.3.1	The documentation required before commencement with Works execution are:
	• Approved Health and Safety File (Clause 4.3)
	• Approval of the Environmental File (Clause 4.3)
	• Initial programme & cashflow projections (Clause 5.6)
	• Guarantee from Bank or Insurance Company (Clause 6.2)
	• Insurance of the Works, Plant, etc. (Clause 8.6), including but not limited to:
	  ○ SASRIA Policy
	  ○ Liability Insurance
	  ○ Insurance of Construction Machinery and Plant
	  ○ Insurance of Motor Vehicle Liability, etc.
	• Compliance Certificate in respect of COID
	• Signed Notification to the Department of Labour
	• Construction Permit (where applicable). The Employer will require Health and Safety documentation from the Contractor to acquire this permit.
	• Organogram of resources
	• Subcontract plan / proposal which includes a priced BoQ and a number of Subcontractors that meet requirements as per conditions of **C1.2.1.2.14**

5.3.2	The time to submit the documentation required before Commencement of the Works is 28 days.
5.3.3	**Time to instruct commencement of the Works** Delete Clause 5.3.3 and replace with the following: The Contractor shall commence with carrying out the Works upon written instruction from the Employer's Agent to commence with the Works.
5.8.1	Working days shall be Monday to Friday, between 07h00 to 17h00.
5.8.1	The non-working days are Saturdays and Sundays. The special non-working days are all Public Holidays in terms of the Public Holidays Act (as amended), and the annual "Builder's Break" as defined by SAFCEC on an annual basis.
5.11.1.2	Notwithstanding any other provision of this Contract, the Contractor agrees that there shall be no suspension of the Works due to non-payment by the Employer. The Contractor shall continue to perform the Works as scheduled, regardless of any delays or failures by the Employer to make payments when due.
5.13.1	The penalty for failing to complete the Works is the greater of: An amount equal to the daily Time Related P&G rate (as calculated from the Time Related P&G section in the Bill of Quantities) or R25,000.00 per day, whichever is greater.

Employer:		Contractor:	
Witness:		Witness:	

GCC Clause	Information
5.14.1	The requirements for achieving Practical Completion are: • Construction, testing & commissioning of the new 2.25Ml Robertsville Water Tower site with the 650mm diameter supply pipeline from the existing reservoir to the new Tower. The works will also include the following • Installation, testing & commissioning of Valve room at new tower site • Construction of Guard and Telemetry buildings (including all civil and electrical infrastructure) • Installation, testing & commissioning of Scour/Overflow structures • Perimeter fence at reservoir and tower sites • Paved access and parking areas • Construction, testing & commissioning of Sewer line to service guard house • Construction, testing & commissioning of 650mm diameter steel supply pipe with Cathodic protection from existing Reservoir to New Tower • Construction, testing & commissioning of 650 mm diameter steel delivery pipe from New Tower to Existing Network • All shutdown arrangements for tie-ins of the supply and delivery pipes to existing infrastructure • Installation, testing & commissioning of Telemetry for pump operations • Supply, Installation, testing & commissioning of pumps at Reservoir site • Supply,install, testing & commission generator at Reservoir site • Pipework with Cathodic protection at reservoir site and new tower site to connect new supply pipe
5.16.3	The latent defects period is 10 years
6.2.1	The time to deliver the Form of Guarantee is within 28 days from the Commencement Date. The security to be provided by the Contractor shall be in the form of Performance Guarantee and will comply with the requirements of Clause 6.2.3. The value of the Performance Guarantee shall be ten (10) % of the Contract Sum, which sum excludes VAT.
6.8.2	**The Contract Price Adjustment is applicable for this contract.** The contract rate shall be fixed for the first 12 months and thereafter the rates will be adjusted by change in CPA and will be fixed for the next 12 months he following formula will be applicable. In which the symbols have the following meaning as per GCC 2015: "x" is the proportion of "Ac" which is not subject to adjustment. "a", "b", "c" and "d" are the coefficients contained in the Contract Data, which are deemed, irrespective of the actual constituents of the work, to represent the

Employer:		Contractor:	
Witness:		Witness:	

GCC Clause	Information
	proportionate value of labour, contractors' equipment, material (other than "special materials" specified in the Contract Data) and fuel respectively. "L" is the "Labour Index" "P" is the "Plant Index" "M" is the "Materials Index" "F" is the "Fuel Index" The suffix "o" denotes the base indices applicable to the base month as stated in the Contract Data. The suffix "t" denotes the current indices applicable to the month in which the last day of the period falls to which the relevant monthly statement relates. If any index relevant to any particular certificate is not known at the time when the certificate is prepared, the Engineer shall estimate the value of such index. Any correction which may be necessary when the correct indices become known, shall be made by the Engineer in subsequent payment certificates. The value of the payment certificates issued shall be adjusted in accordance with the Contract Price Adjustment Schedule, with the following values: The value of "x" is 0,10 The values of the coefficients are: a = 0,32 Labour b = 0,25 Contractor's equipment c = 0,33 Material d = 0,10 Fuel The province where the Site is located is Gauteng and the urban area where the project is implemented is Johannesburg. The base month Prior to the month in which the tender closes. The Consumer Price Indices for Labour (L), Plant (P), Material (M) and Fuel (F) are as published by Statistics South Africa for the applicable time.
6.8.3	Price adjustments for variations in the costs of special materials are **NOT** allowed.
6.10.1.5	The percentage advance on materials not yet built into the Permanent Works is 80% The contractor to produce documentary evidence of ownership of material and material delivered on site.
6.10.3	The maximum percentage retention on the amounts due to the Contractor is 10% of the Contract Sum.
6.10.4	**Delivery, dissatisfaction with and payment of payment certificates** Delete Clause 6.10.4 and replace with the following: • Payment shall be made upon:The Contractor providing a payment certificate with all required supporting documents to the Employer's Agent on dates to be communicated to the Contractor upon award. The date of

Employer:		Contractor:	
Witness:		Witness:	

GCC Clause	Information
	the Original Tax Invoice must be the date the Employer's Agent approved the payment Certificate. • The payment certificate will then be ready for handing in to the Employer latest by the 25th of every month • The payment certificate being submitted with an original tax invoice. • No payment certificate will be processed if correct labour returns are not submitted. • Any failure to submit the required, Employer's Agent-approved payment certificate by the agreed date will result in the assessment by the Employer's Agent being held over until the assessment interval following the correct submission of the required information. Payment will be made within 30 days of receipt of the Contractor's statement. Payment shall be subject to the Contractor submitting an Original Tax Invoice compliant with SARS requirements for a Valid Tax Invoice to the Employer for the amount due. Any dissatisfaction in respect of such payment certificate shall be dealt with in terms of Clause 10.2.

Employer:		Contractor:	
Witness:		Witness:	

GCC Clause	Information
6.10.5	Payment of Retention Money Add to Clause 6.10.5 the following: When defects liability is specified, one half of the retention money shall be paid after the Employer's Agent has issued a Certificate of Completion in terms of Clause 5.14.4 as follows: • The Contractor will provide a statement for release of 5% retention to the Employer's Agent before or on the 20th of the month. • After the payment certificate has been approved by Employer's Agent, the Contractor must issue an Original Tax Invoice compliant with SARS requirements for Valid Tax Invoice. The date of the Original Tax Invoice must be the date the Employer's Agent approved the Payment Certificate. The certificate will then be ready for handing in to the Employer latest by the 25th of the month. • Payment will be on or before the last day of the month following the approval of the payment certificate by the Employer's Agent. The other half of the retention money shall be paid after the Employer's Agent has issued Final Approval Certificate at the end of the Defects Liability Period, which may be extended in term of Clauses 5.14.4 or 7.8.1, if necessary, as follows: • The Contractor will provide a statement for release of 5% retention to the Employer's Agent before or on the 20th of the month. • After the payment certificate has been approved by Employer's Agent, the Contractor must issue an Original Tax Invoice compliant with SARS requirements for Valid Tax Invoice. The date of the Original Tax Invoice must be the date the Employer's Agent approved the Payment Certificate. The certificate will then be ready for handing in to the Employer latest by the 25th of the month. • Payment will be on or before the last day of the month following the approval of the payment certificate by the Employer's Agent. Payment shall be subject to the Contractor submitting an Original Tax Invoice compliant with SARS requirements for Valid Tax Invoice to the Employer for the amount due.
6.10.6.2	Delete Clause 6.10.6.2
6.11	Delete Clause 6.11
7.8.2	**Cost of making good of defects** Amend Clause 7.8.2.1 as follows: In the first line, correct the spelling of 'therefore'.
8.1.1	Add to the end of Clause 8.1.1 the following text: "the Contractor shall remain solely responsible for the protection of the Works and the Site".
8.4.1.1	Add to the end of Clause 8.4.1.1 the following text: "indemnifies the Employer against any liability in respect of damage or physical loss of property of any person or injury or death of any person due to non-compliance with the Occupational Health and Safety Act (Act 85 of 1993).

Employer:		**Contractor:**	
Witness:		**Witness:**	

GCC Clause	Information
8.6	Add the following clause to 8.6 "In addition to any statutory obligations, or other requirements contained in the Conditions of Contract or in the Insurance Policy and Documents the Contractor shall report in writing to the Employer's Agent every accident within 48 hours of its occurrence, whether such accident is in respect of damage to persons or property. The report shall contain full details of the accident. The Employer's Agent shall have the right to make all and any enquiries either on the Site or elsewhere as to the cause and results of any such accident and the Contractor shall give the Employer's Agent full access and facilities for carrying out such enquiries. The Employer's Agent shall be given full and immediate access to all communication, reports, findings, assessments, etc. between the Contractor and its Insurance Broker (or Insurance Provider), particularly as it relates to the processing and outcomes of any and all claims. The Contractor shall further allow and authorise the Employer's Agent to communicate with its Insurance Broker (or Insurance Provider) to obtain any and all such information as the Employer's Agent deems necessary."
8.6.1.1.2	The value of plant and materials supplied by the Employer to be included in the insurance sum is R0.
8.6.1.1.3	The amount to cover professional fees for repairing damage and loss to be included in the insurance sum is an amount equal to 15% of the Contract Price.
8.6.1.3	The limit of indemnity for liability insurance is R20,000,000 (Twenty million Rand) for any single claim – the number of claims to be unlimited during the Construction and Defects Liability Periods
8.6.1.5	In addition to the insurances required in terms of General Conditions of Contract for Construction Works 2015 Clauses 8.6.1.1 to 8.6.1.4 the following insurance is also required: a. The Contractor shall insure all Works, Construction Machinery and Plant (including tools, offices and other temporary structures and content) and other items, other than those intended for incorporation into the works, owned, leased or hired and brought on to the Site against all risks of physical loss or damage for the period that such Plant shall be on the Site to the full value thereof. In respect of Machinery and Plant brought on to the Site by or on behalf of Sub-Contractors, the Contractor shall be deemed to have complied with the provisions of this Sub-Clause if it has ensured that such Sub-Contractors have similarly insured such Plant and Machinery. Such insurance shall be affected with an Insurer and in terms approved by the Employer (which approval shall not be unreasonably withheld) and the Contractor shall, when required, submit to the Employer's Insurance Brokers, via the Employer's Agent, the policy or policies of insurance and receipts for payment of the current premiums. b. The Contractor and the Sub-contractors shall affect and maintain at their cost, insurance under the provision of the Compensation for Occupational Injuries and Diseases Act (COID), 1993 (Act No. 130 of 1993) c. The Contractor and the Sub-Contractors shall affect and maintain at their own cost, motor vehicle liability insurance with at least indemnification

GCC Clause	Information
	for "balance of third party" risks, including passenger liability with a limit of indemnity of not less than R2,5 million. d. Where the contract involves manufacturing and/or fabrication of the works or part thereof at premises other than the Site, the Contractor shall satisfy the Employer that all materials and equipment for incorporation in the works are adequately insured during manufacture and/or fabrication. In the event of the Employer having an insurable interest in such works during manufacture or fabrication then such interest shall be noted by endorsement to the Contractor's Policies of Insurance. e. Any other Insurance cover that may be deemed necessary by the Contractor to ensure full and successful completion of the Works.
9.1.5.6	No loss of profit shall be paid by the Employer as a result of contract termination due to any circumstances.
10.4.2	Dispute resolution shall be by Amicable Settlement, failing which, any dispute shall be resolved by way of ad-hoc Adjudication.
10.5.3	The number of Adjudication Board Members to be appointed is one (1).
10.7.1	The determination of disputes shall be by arbitration.

C1.2.1.2 Additions

The additional Conditions of Contract are:

C1.2.1.2.1 Penalties

In addition to GCC clause 5.13, during the Contract Period should the Contractor:

a) Fail to report

- The Employer shall levy a penalty on the Contractor, should the latter fail to provide reporting Labor Stats and SMMEs Stats as required, with regard to content and frequency, whilst as per the Pricing Data section no payment for work completed shall be processed.
- The penalty value shall be R10,000.00 if the Contractors not complying with Environmental scorecards above 85% but below 93% for 2 successive months then the scorecard below 85% will be R10,000.00 per occasion.
- The penalty value shall be R10 000 if the contractors fail to comply with health and safety requirements and scoring above 85% but below 93% for successive 2 months and then the score below 85% contractors will be penalised for each month R10 000.00 Per occasion.
- If the Contractor fails to complete the latter for more than three incidents and should the Employer or his duly authorised representative find that the Contractor is hindering his (the Employer's) deliverables to senior management, he shall reserve the right to:
  i. perform the Works internally or through another Contractor; and
  ii. deduct additional costs incurred by the Employer from monies owed to the Contractor or from the Contractor's Guarantee. Additional costs incurred by the Employer shall include all claims from Contract affected parties, claims such as but not be limited to claims from customers, any

costs associated with the loss of water, and all costs associated with the procurement of an alternative Contractor.

iii. terminate the Contract

No liability in terms of this clause shall be attached to the Contractor if he can

No liability in terms of this clause shall be attached to the Contractor if he can prove to the satisfaction of the Employer that the nature of the failure is due to fire, war, riot, strikes, act of God, lockout, accident or other unforeseen occurrences or circumstances beyond the Contractor's control, provided, however, that in all cases the Contractor has notified the Employer in writing within 24 hours of it first coming to his notice, that delivery shall be delayed or become impossible for the above-mentioned reasons.

b) Fail to pay any labourer or SMME

- The Employer shall levy a penalty of R100 000.00 Per occurrence on Contractor, should the latter fail to provide payment to the SMME as required in the specification highlighted in the Scope of Work and specified in the appointment agreements with the Contractor and the SMME.
- The penalty value shall be R 50,000.00 per report per occasion; and
- If the Contractor fails to pay any labourer or SMME for more than three incidents the Employer shall reserve the right to terminate the Contract in terms of GCC 2015 Clause 9.2.

No liability in terms of this clause shall be attached to the Contractor if he can prove to the satisfaction of the Employer that the nature of the failure is due to fire, war, riot, strikes, act of God, lockout, accident or other unforeseen occurrences or circumstances beyond the Contractor's control, provided, however, that in all cases the Contractor has notified the Employer in writing within 24 hours of it first coming to his notice, that payment shall be delayed or become impossible for the above-mentioned reasons

c) Penalties irreversible

If the Contractor fails to achieve the monetary value of the target set by the Employer for contract participation by local SMME Contractors in terms of for Procurement and Particular Specifications in Scope of Works clause PS3.2.3, the Contractor shall be liable to the Employer for a sum calculated in accordance with the Contract Data and the aforementioned Scope of Works as a penalty for such underachievement."

The penalty for failing to achieve the monetary value of the target set by the Employer for contract participation by Targeted Enterprises and local SMME Contractors in terms of Small Contractor Development of Particular Specifications in PS3: Scope of Works, is 50% of the monetary value by which the achieved monetary value falls short of the target monetary value.

d) Penalties irreversible

Employer:		**Contractor:**	
Witness:		**Witness:**	

The Contractor shall note that all penalties once imposed shall be non-recoverable or reversible, even if the default is remedied.

C1.2.1.2.2 Source of Instructions

The Contractor shall neither seek nor accept instructions from any authority external to the Employer's Agent in connection with the performance of his services under this Contract. The Contractor shall refrain from any action which may adversely affect the Employer and shall fulfill his commitments with fullest regard for the interest of the Employer. The Contractor may only accept and comply with instructions from the Employer's Health and Safety Representative or the Employer's Environmental Representative with regards to matters regarding Health & Safety or Environmental Management respectively, but with further approval from the Employer's Agent.

C1.2.1.2.3 Officials not to Benefit

The Contractor warrants that no official of the Employer has been or shall be admitted by the Contractor to any direct or indirect benefit arising from this Contract or the award thereof. The Contractor agrees that breach of this provision is a breach of the Contract.

C1.2.1.2.4 Prevention of Corruption

The Employer shall be entitled to cancel the Contract and to recover from the Contractor the amount of any loss resulting from such cancellation, if the Contractor has offered or given any person any gift or consideration of any kind as an inducement or reward for doing or intending to do any action in relation to the obtaining or the execution of the Contract or any other contract with the Employer or for showing or intending to show favor or disfavor to any person in relation to the Contract or any other contract with the Employer. If similar acts have been done by any persons employed by the Contractor or acting on his behalf whether with or without the knowledge of the Contractor in relation to this or any other Contract with the Employer, the same consequences shall apply.

C1.2.1.2.5 Confidential Nature of Documents

All maps, drawings, photographs, mosaics, plans, reports, recommendations, estimates, documents and all other data compiled by or received by the Contractor under the Contract shall be the property of the Employer, shall be treated as confidential and shall be delivered only to the Employer's Agent or his duly authorized representative on completion of the Works; their contents shall not be made known by the Contractor to any person other than the personnel of the Contractor performing services under this Contract without the prior written consent of the Employer.

C1.2.1.2.6 Returns of Labour, SMME, Plant, Equipment and Material

The Contractor shall provide a return in detail in the form and at such intervals as the Employer's Agent or his duly authorized representative may prescribe showing the supervisory staff and the numbers of the several classes of labour from time to time employed by the Contractor on the Site and such information respecting construction plant, equipment and material as the Employer's Agent or his duly authorized representative may require. The supporting documents required for SMMEs include but are not limited to the following:

- A completed and signed sub-contracting agreement between the Contractor and the SMME

Employer:		**Contractor:**	
Witness:		**Witness:**	

- Valid CIPC registration (i.e. CK, COR)
- SA ID copies of owners
- Active CIDB membership: minimum grading 1CE
- Valid CSD compliance status
- Valid EME affidavit
- COIDA certificate
- Company Profile including similar experience and skilled personnel CVs
- Health and Safety Plan
- Proof of Payments

The supporting documents required for local labourers include but are not limited to the following

- A completed and signed employment contract between the Contractor and labourer
- Certified Copies of IDs
- Monthly Individual proof of payment
- Monthly timesheets
- Training returns
- UIF forms (proof of registration from Labour)

C1.2.1.2.7 Materials and Workmanship

All materials and workmanship shall be of the respective kinds described in the Contract and in accordance with the Employer's Agent's instructions and shall be subjected from time to time to such tests as the Employer's Agent may direct at the place of manufacture or fabrication, or on the Site or at all or any of such places. The Contractor shall provide such assistance, instruments, machines, labour and materials as are normally required for examining, measuring and testing any work and the quality, weight or quantity of any materials used and shall supply samples of materials before incorporation in the Works for testing as may be selected and required by the Employer's Agent. All testing equipment and instruments provided by the Contractor shall be used only by the Employer's Agent or by the Contractor in accordance with the instructions of the Employer's Agent.

a) No material not conforming with the Specifications in the Contract shall be used for the Works without prior written approval of the Employer and instruction of the Employer's Agent, provided always that if the use of such material results or may result in increasing the Contract Price, the procedure in GCC clause 6.3 (Variations) shall apply.

C1.2.1.2.8 Examination of the Work before Covering Up

No work shall be covered up or put out of view without the approval of the Employer's Agent or his duly authorized representative and the Contractor shall afford full opportunity for the Employer's Agent or his duly authorized representative to examine and measure any work which is about to be covered up or put out of view and to examine foundations before permanent work is placed thereon. The Contractor shall give due notice to the Employer's Agent whenever any such work or foundations is or are ready or about to be ready for examination. The Employer's Agent or his duly authorized representative shall without unreasonable delay, unless he considers it unnecessary and advises the

Employer:		**Contractor:**	
Witness:		**Witness:**	

Contractor, accordingly, attend for the purpose of examining and measuring such work or of examining such foundations.

C1.2.1.2.9 Employer's Agent's Power to Order Removal of Improper Work and Materials

The Employer's Agent or his duly authorized representative shall during the progress of the Works have power to order in writing from time to time, and the Contractor shall execute at his cost and expense, the following operations:

a) removal from the Site within such time or times as may be specified in the order of any materials which in the opinion of the Employer's Agent are not in accordance with the Contract.

b) substitution of proper and suitable materials; and

c) removal and proper re-execution (notwithstanding any previous test thereof or interim payment therefore) of any work which in respect of materials or workmanship is not in the opinion of the Employer's Agent or his duly authorized representative in accordance with the Contract.

C1.2.1.2.10 Default of Contractor in carrying out Employer's Agent's or his Duly Authorized Representative's Instructions

In case of default on the part of the Contractor in carrying out an instruction of the Employer's Agent or his duly authorized representative, the Employer shall be entitled to employ and pay other persons to carry out the same, and all expenses consequent thereon or incidental thereto shall be borne by the Contractor and shall be recoverable from him by the Employer and may be deducted by the Employer from any monies due or which may become due to the Contractor.

C1.2.1.2.11 Date Falling on Public Holiday or Weekend

Where under the terms of the Contract any act is to be done or any period is to expire upon a certain day and that day or that period fall on a day of rest or recognized public holiday or weekend, the Contract shall have effect as if the act were to be done or the period to expire upon the working day following such day.

C1.2.1.2.12 Ambiguities and Inconsistencies

The Employer or the Contractor shall notify the other as soon as either becomes aware of an ambiguity or inconsistency in or between the documents, which are part of this Contract. Governed by the spirit and intention of the Contract, the Employer shall give a binding instruction resolving the ambiguity or inconsistency.

C1.2.1.2.13 False Claims by the Contractor

a. Failure, by the Contractor, to demonstrate or present any feature declared during the procurement stage shall constitute grounds for Contract termination or the market related equivalent price discount, if no market related value is available, the Employer shall give a final ruling on the amount. This shall be at the discretion of the Employer based on the implication of such omission. Should the Contractor refuse to accept the Employer's price, the Contract shall be terminated.

Employer:		**Contractor:**	
Witness:		**Witness:**	

b. Any false claims by the Contractor or his staff (with or without his knowledge), based on Works to be performed or completed per site stage shall constitute grounds for Contract termination and result in blacklisting on the Employer's database.

The Contractor shall note that any of the above shall constitute non-performance on the part of the Contractor, further resulting in him forfeiting his full Contract Guarantee.

C1.2.1.2.14 Continuation of Works During Dispute Resolution

Notwithstanding any dispute or disagreement between the Client and Contractor, the Contractor shall continue to perform the Works as scheduled. Both parties agree that the resolution of any disputes shall proceed in parallel with the ongoing performance of the works, ensuring that the project timeline is maintained without interruption.

C1.2.1.2.14 Special Conditions

The successful Contractor must subcontract a minimum of 10% of the value of this Contract to an entity(s) described below. The value of the Contract for the purposes of this calculation shall be equal to the Contract Price (excluding VAT) as described in the General Conditions of Contract.

The subcontractor/s chosen for this purpose must be registered on National Treasury's Central Supplier Database (CSD) and must be from one of the following designated groups:

- An EME or QSE which is at least 51% owned by black people.
- An EME or QSE which is at least 51% owned by black people who are youth.
- An EME or QSE which is at least 51% owned by black women.
- An EME or QSE which is at least 51% owned by black people with disabilities.
- An EME or QSE which is 51% owned by black people living in rural or underdeveloped areas or townships.
- A cooperative which is at least 51% owned by black people.
- An EME or QSE which is at least 51% owned by black people who are military veterans.
- an EME or QSE.

1. Subcontractors must be chosen from National Treasury's Central Supplier Database which can be accessed on National Treasury's website.

2. The Contractor will identify subcontracting items or tasks that will meet the subcontracting minimum of 10% of the value of this Contract. In complying with this condition, the following shall be adhered with:
    - The Contractor shall develop a Subcontracting Plan that sets out the details of the proposed Subcontracting arrangements including, but not limited to, competitive bidding process to be used for the appointment of SMME's, scope of work to be allocated, criteria for the selection of Subcontractor(s), Subcontractor agreements, cost of the work to be Subcontracted, etc.
    - The Subcontracting Plan shall be issued to the Employer's Agent for approval, prior to the engagement of any Subcontractor(s) by the Contractor. The activities, time periods, linkages, etc. associated with the development and approval of the Subcontracting Plan shall be included in the Project Programme, which Programme is subject to the approval of the Employer's Agent.
    - The Employers Agent may assist with identified items for subcontracting but where these do not form 3% of the Contract Price, the Contractor shall identify additional works that will be subcontracted to ensure compliance with the minimum subcontracting percentage.

Employer:		**Contractor:**	
Witness:		**Witness:**	

- In the event that a rate supplied by the Contractor for a specific BoQ work item is not sufficient to cover Subcontractor costs/rates for that specific item, the Contractor shall provide a detailed rate breakdown for that specific BoQ item (and each and every subsequent BoQ work item where the rate is not sufficient to cover Subcontractor cost); and shall indicate costs (amongst others) for labour, material, handling, mark-ups, etc. to prove that the rate that was submitted during tender stage was in fact market related; and in balance with other rates that were submitted for work items that will not be undertaken by Subcontractors.
- Should any delays be experienced during the period of the Contract due to the appointment of subcontractors by the Contractor, work stoppages by subcontractors, industrial action by subcontractors, etc. such delays shall be assigned to the Contractor, and no claims for Extension of Time will be entertained by the Employer.
- The Contractor will be liable to pay a penalty if the Subcontracting target of 10% has not been met by the end of the Contract. The Employer will deduct this penalty amount through the Payment Certificate process. The Employer will have full discretion as to when the penalty will be applied (i.e. the month in which the penalty amount will be deducted). In calculating the total amount that has been (will be) paid to SMME's, all amounts that have actually been reimbursed to SMME's will be taken into account including P&G's, amounts for actual work done, etc.
- The penalty amount described above shall be equal to 50% (fifty percent) of the difference between the target Subcontract amount (i.e 10% of the Contract Price) and the actual amount that has been spent on Subcontractors/SMME's by the end of the Contract.

3. A Subcontracting agreement between the Main Contractor and the Subcontractor shall be submitted to JW upon appointment and must include the following minimum information:
   - Name of Subcontractor and BBBEE status
   - Subcontractor domicilium and registered address of business, as well as status of compliance with all applicable legal requirements.
   - Area and location of project
   - Scope of Work issued to the Subcontractor
   - Value of the Work issued including P&G's (this information must be submitted in a format that is readily auditable).
   - Assistance provided/to be provided to the Subcontractor by the Contractor, e.g. acquisition of materials, machinery, tools, etc.
   - Indicate the remuneration rate of all local labourers (the latest Gazetted labour rates)

Employer:		**Contractor:**	
Witness:		**Witness:**	

- A Skills Transfer Plan which will indicate, amongst others, the proposed skills that will be transferred to the Subcontractor, individuals that will be identified for skills transfer, the amount that will be spent by the Contractor on skills transfer, evidence that will be produced by the Contractor (such as training certificates, training registers, etc.), etc.
- A specific provision that enables the Contractor to pay the Subcontractor's suppliers, labour (skilled, local, etc.) or any other service provider of the Subcontractor, should the Subcontractor fail to do so. This provision shall include (but not be limited to) the following conditions/proviso's: Invoices that are due for payment from suppliers and the like must be invoices that have been approved for payment and be based on work or services that have actually been completed or delivered. Payments that are due to labour will be based on approved timesheets.
    - The Contractor is to ensure that any invoice presented for payment is indeed an approved invoice, and that the necessary work or services have been delivered or completed. The approved invoice shall be settled (paid) by the Contractor (on behalf of the Subcontractor) by the due date for payment.
    - The Contractor will be entitled to deduct payments made to any third party, on behalf of the Subcontractor, from subsequent payments that may become due to the Subcontractor.
    - The Contractor will be entitled to bill the Subcontractor a mark-up on the payments made on behalf of the sub-contractor. The mark-up shall not be more than 10% (ten percent) of the amount actually paid (i.e. the amount (excluding VAT) reflected on the invoice that has been settled). The mark-up amount shall be deducted from subsequent payments that may become due to the Subcontractor.
    - Proof of any such payments made on behalf of the Subcontractor shall be issued to the Employer's Agent, on request, with all necessary supporting information that the Employer's Agent may request
    - Payments made on behalf of the Subcontractor are not subject to the Contractor first being paid by the Employer. Therefore, the Contractor shall pay approved invoices, on behalf of the Subcontractor, irrespective of whether the Contractor has first been paid by the Employer. The Contractor will be entitled to levy interest on all payments that have been made in this regard, in accordance with the necessary interest payment provisions contained in the General and Special Conditions of Contract.

4. The successful Contractor shall submit periodic SMME/Subcontractor reports to the Employer's Agent as follows:
    - Status of progress against the Subcontracting Plan (described above), to the approval of the Employer's Agent
    - Subcontractor domicilium and registered address of business, as well as ongoing status of compliance with all applicable legal requirements.
    - Name of Subcontractor and BBBEE status
    - Area and location of project
    - Scope of work issued to the Subcontractor

Employer:		**Contractor:**	
Witness:		**Witness:**	

- Value of the work issued (this information must be submitted in a format that is readily auditable)
- Monthly payments made to the subcontractor (this information must be submitted in a format that is readily auditable)
- Assistance provided to the Subcontractor e.g. advance payments, acquisition of materials, machinery, tools, etc.
- Performance of the Subcontractor, with evidence to support this performance assessment.

5. Upon completion of the project, the Contractor is required to provide a final report to JW on skills transferred to / acquired by the Subcontractor(s) engaged on the Project, description and value of work performed, as well as their overall performance.

6. The Contractor shall also indicate whether the experience gained by the Subcontractor is sufficient to assist the Subcontractor to improve their CIDB grading, with full details of supporting information.

C1.2.1.2.15 Competent Employees

Competent Employees	Qualifications	Experience
Contracts Manager	Post Qualification Experience of Contract Manager Only Contract Managers with qualifications of Bachelors' Degree (Civil Engineering / Construction Management) equivalent or higher. and Registration (Pr. Eng. / Pr. Technologist) or PrCPM / PrCM will obtain a score for experience of a Contract Manager. However, the time of registration of Contract Manager will not impact post qualification number of projects.	Minimum 8 years' (All Projects) post qualification. Experience on at least two Reinforced Concrete reservoir/Tower and steel pipes with construction value of R40m ex VAT
Site Agent /Manager	Post Qualification Experience of Site Personnel Site Manager with qualifications of National Diploma (Civil or Structural) Engineering or more and Registered as a Candidate Professional in the Built Environment or more will be considered	Minimum 5 years' (All Projects) post qualification. Experience on at least two Reinforced Concrete reservoir/Tower and stell pipes with construction value of R40m ex VAT
Civil, Mechanical Foremen /Supervisor	Foreman/ Supervisor with qualifications of National Diploma (Civil/Mechanical) Engineering or more.	Minimum 4 years' (All Projects) post qualification. Experience on at least two Reinforced Concrete works and steel pipes with construction value of R30m ex VAT

Employer:		**Contractor:**	
Witness:		**Witness:**	

Safety Officer	Post Qualification Experience of Safety Officer Only Safety Officers with qualifications of National Diploma (Safety Management)/ (Environmental Health/Environmental Science/ Environmental Management), SAMTRAC / SHEOMTRAC/ SHEMTRAC / MESHTRAC /NEBOSH / Safety Officers Course (NQF 5) or more and Registered with SACPCMP in the "Construction Health and Safety" Sector will be considered. However, the time of registration of Safety Officer will not impact post qualification number of projects.	Minimum 4 years in any related projects (post-graduation) will be considered.

C1.2.1.2.16 Tie-in Limitations

The connection of new infrastructure to the existing infrastructure is limited to low-flow periods and subject to prior arrangement and approval by the Works.

C1.2.1.3 Variations to General Conditions of Contract

Add the following Table:

3.2.4	**Employer's Agent for Health and Safety** Replace Clause 3.2.4 with the following: 'In terms of Clause 1.3.2, all parties to the Contract shall be subject to the relevant requirements of the Construction Regulations 2014 (as amended) of the Occupational Health and Safety Act, Act 85 of 1993 (as amended).' Add the following at the end of the above new replacement Clause 3.2.4: 'Where the Employer is obliged to appoint an Employer's Agent for Health and Safety in terms of the Construction Regulations 2014 (as amended) of the Occupational Health and Safety Act (Act 85 of 1993 as amended), and where such Employer's Agent for Health and Safety has complied with the registration requirements of a Construction Health and Safety Agent as a specified category in terms of section 18 (1) (c) of the Project and Construction Management Professions Act (Act 48 of 2000), the applicable clauses of the latest edition of the "Standard Scope of Services for Construction Health and Safety Agents Registered In Terms Of Section 18(1)(c) of the Project And Construction Management Professions Act (Act No. 48 Of 2000)", including Clauses 2.2.5 "STAGE 5 - CONSTRUCTION DOCUMENTATION AND MANAGEMENT", and 2.2.6 "STAGE 6 - PROJECT CLOSE – OUT", and 2.2.7 "ADDITIONAL RELATED SERVICES", as published in "Registration Rules for Construction Health and Safety Agents in Terms of Section 18 (1) (c) of the Project and Construction Management Professions Act, 2000 (Act No. 48 of 2000)" by the South African Council for Construction and Project Management Professionals in terms of the Project and Construction Management Professions Act (Act 48 of 2000 as amended), shall also apply.'

Employer:		**Contractor:**	
Witness:		**Witness:**	

5.1.1.2	**Time Calculations** SEPARATE THE PHRASE “shall be excluded from the calculation of the time-span concerned.” BY MOVING IT ONTO A NEW LINE AS A NEW PARAGRAPH, AND PROMOTE THAT PARAGRAPH BY ONE PARAGRAPH LEVEL TO A POSITION WHERE IT FORMS THE LAST PART OF SUB-CLAUSE 5.1.1, SO THAT SUB-CLAUSE 5.1.1.2 READS AS FOLLOWS: 5.1.1.2 The day on which the timespan commences shall be excluded from the calculation of the timespan concerned.”
5.7.1	**Rate of progress** ON PAGE 25, IN THE TOP PARAGRAPH, FOR THE SENTENCE COMMENCING WITH “Such steps shall…” REPLACE THE SENTENCE “Such steps shall be approved by the Employer's Agent, which approval shall not be unreasonably withheld.” WITH “Such steps shall be subject to the approval of the Employer's Agent, which approval shall not be unreasonably withheld.”
6.5.1.3	**Basis of payment for dayworks** ON PAGE 40, IN THE LAST LINE OF THE SUB-CLAUSE, REPLACE THE PHRASE “ruling plant hire rates” WITH “ruling construction equipment hire rates”

C1.2.2 PART 2: DATA PROVIDED BY THE CONTRACTOR

<table>
<tr><th>GCC Clause</th><th>Information</th></tr>
<tr><td>Clause 1.1.9</td><td>The name of the Contractor is……...

The Contact person is……</td></tr>
<tr><td>Clause 1.2.1.2</td><td>The address of the Contractor is:
<table>
<tr><th>Physical Address:</th><th>Postal Address:</th></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>Tel:</td><td>Fax:</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Email</td><td></td></tr>
</table></td></tr>
<tr><td>Clause 6.2.1</td><td>The security to be provided by the Contractor shall be one of the following:

The Performance Guarantee shall be irrevocable, On-Demand Performance Guarantee, to be issued exactly in the form of the proforma document provided in favour of the Employer by a Bank or Recognised Financial Institution or Cash in lieu of bond will apply.</td></tr>
<tr><td>Clause 6.8.3</td><td>The variation in cost of special materials is

Type Unit Rate

NOT APPLICABLE</td></tr>
</table>

Johannesburg Water (SOC) Ltd

CONTRACT NO: JW14040RR

CONSTRUCTION OF A 2.25 ML WATER TOWER IN ROBETSVILLE

VOLUME 1

PART 1.3: FORMS AND SECURITIES

Employer:		**Contractor:**	
Witness:		**Witness:**	

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C1.3 FORMS AND SECURITIES

FORMS FOR COMPLETION BY THE CONTRACTOR

THE FOLLOWING FORMS ARE TO BE COMPLETED BY THE CONTRACTOR AFTER THE TENDER HAS BEEN AWARDED TO THE SUCCESSFUL TENDERER

a) Form of Guarantee
b) Blasting Indemnity
c) Agreement in terms of the Occupational Health and Safety Act
d) Occupational Health And Safety Indemnity Undertaking

The forms will be completed by the Contractor who will be instructed to do so in the Form of Acceptance. The completed forms will become part of the Contract.

The Form of Guarantee is a pro forma document. The Contractor will provide an original document, from a financial institution, with the same text within the time stated in the Contract Data. Only a Bank or approved Insurance Company or Guarantee Corporation is acceptable as Guarantor.

TO BE PRINTED ON THE OFFICIAL LETTERHEAD 0F THE GUARANTOR.

PERFORMANCE GURANTEE

For use with the General Conditions of Contract for Construction Works, ……. Edition, ….

C1.3.1 GUARANTEE REFERENCE NUMBER

Whereas [insert the full name of the Employer], registration number: [insert registration number], of [insert full physical address] (the "Employer") has awarded a contract for [insert a detailed description of the contract], under contract number: [insert details] (the "Contract"), to [insert full names of the Contractor], registration number [insert details], of [insert full physical address] (the "Contractor").

And whereas the Contract requires the Contractor to provide to the Employer an on-demand performance guarantee for the due and proper performance by the Contractor of its obligations in terms of the Contract.

Now therefore:

[insert full names of the Guarantor], registration number [Insert details], of [insert the full physical address] (the "Guarantor"), duly represented by the undersigned: [insert the full names of the signatory], and [insert the full names of the signatory], acting herein in their respective capacities as: [insert full title] and [insert full title] respectively, of the Guarantor, and being duly authorized to sign this on demand performance guarantee (this "Guarantee") and to incur obligations in relation thereto, in the name, and on behalf, of the Guarantor under, and in terms of, a Resolution of the Board of Directors or other written authority of the Guarantor, hereby irrevocably and unconditionally guarantees and undertakes:

1. To pay the Employer the sum or sums not exceeding the following aggregate amount: R [insert the amount] (the "Guaranteed Amount") upon receipt of the documents identified in clauses 1.1 to 1.3 below

1.1. A copy of a first written demand issued by the Employer to the Contractor stating that payment of a sum certified by the Engineer in an Interim or Final Payment Certificate has not been made in terms of the Contract and failing such payment within seven (7) calendar days, the Employer intends to call upon the Guarantor to make payment in terms of 1.2.

1.2. A first written demand issued by the Employer to the Guarantor e-mailed to ……with a copy to the Contractor stating that a period of seven (7) days has elapsed since the first written demand in terms of 1.1 above and the sum certified has still not been paid.

1.3. A copy of the aforesaid payment certificate which entitles the Employer to receive payment in terms of the Contract of the sum.

2. To pay to the Employer the Guaranteed Amount or the full outstanding balance upon receipt of a first written demand from the Employer to the Guarantor emailed to ……. calling up this Performance Guarantee, such demand stating that:

2.1. The Contract has been terminated due to the Contractor's default and that this Performance Guarantee is called up in terms o 2; or

2.2. A provisional or final sequestration or liquidation court order has been granted against the Contractor and that the Performance Guarantee is called up in terms of 2; and

2.3. The aforesaid written demand is accompanied by a copy of the notice of termination and/or the

provisional/final sequestration and/or the provisional liquidation court order.

3. To pay to the Employer on demand any sum or sums not exceeding the Guaranteed Amount on presentation of a written demand signed by the Employer (the "Demand"), supported by a written statement signed by the Employer certifying that the Contractor, in the opinion of the Employer as at the date of issue of such Demand, is in breach of its obligations under the Contract or that a defect had occurred following the performance by the Contractor of its obligations under the Contract, and without being required to prove or set out the nature of any such breach or defect.

4. Payment by the Guarantor in terms of 1 to 3 shall be made within seven (7) calendar days upon receipt of the first written demand to the Guarantor.

5. The Guarantor hereby acknowledges that:

5.1. Any reference in this Performance Guarantee to the Contract is made for the purpose of convenience and shall not be construed as any intention whatsoever to create an accessory obligation or any intention whatsoever to create a suretyship.

5.2. Its obligation under this Performance Guarantee is restricted to the payment of money.

6. The Employer shall have the absolute right to arrange his affairs with the Contractor in any manner which the Employer may deem fit and the Guarantor shall not have the right to claim his release from this Performance Guarantee on account of any conduct alleged to be prejudicial to the Guarantor.

7. Neither the failure of the Employer to enforce strict or substantial compliance by the Contractor with its obligations under the Contract nor any act, conduct or omission by the Employer prejudicial to the interests of the Guarantor will discharge the Guarantor from liability under this Guarantee.

8. This Performance Guarantee, with the required demand notices in terms of 1 to 3, shall be regarded as a liquid document for the purpose of obtaining a court order.

9. This Performance Guarantee is neither negotiable nor transferable.

10. The Guarantor's period of liability shall be from and including the date of issue of this Performance Guarantee and up to and including the date on which the Certificate of Completion of the Works has been issued or payment in full of the Guaranteed Sum, whichever occurs first. The Engineer and/or the Employer shall advise the Guarantor in writing of the date on which the Certificate of Completion of the Works has been issued.

11. The Guarantor chooses the physical address [insert the full physical address] care of [insert the full names], as well as the e-mail address ……., for the service of all notices for all purposes in connection herewith.

12. This Guarantor is governed by the laws of the Republic of South Africa and any dispute arising hereunder shall be subject to the jurisdiction of the South African courts. In respect of such proceedings, each of the Parties specifically consents to the non-exclusive jurisdiction of the High Court of South Africa (Gauteng Local Division, Johannesburg).

Signed at …… for and on behalf of ……..

Employer:		**Contractor:**	
Witness:		**Witness:**	

Guarantor's signatory (1)

Name: ……

Designation: ……..… …….

Guarantor's signatory (2)

Name: ……..

Designation: ……..……. ……

Employer:		**Contractor:**	
Witness:		**Witness:**	

C1.3.2 Blasting Indemnity

Given by _____

*Company Registration No._____

Address _____

a *Company incorporated with limited liability according to the company laws of the Republic of South Africa, *Partnership, *Close Corporation, *Public Company (hereinafter called the Contractor), represented herein by _____ in his capacity as the Contractor's _____ duly authorised hereto by a resolution of the Contractor dated _____ a certified copy of which resolution is attached to this Indemnity.WHEREAS the Contractor has entered into a Contract with the Johannesburg Water (SOC) Ltd (hereinafter called the Employer) for,

_____
and the Company requires this Indemnity from the Contractor

NOW THEREFORE THIS DEED WITNESSETH that the Contractor does hereby indemnify and hold harmless the Company in respect of all loss or damage that may be incurred or sustained by the Employer by reason of or in any way arising out of or caused by blasting operations that may be carried out by the Contractor in connection with the aforementioned Contract and also in respect of all claims that may be made against the Employer in consequence of such blasting operations, by reason of or in any way arising out of any accidents or damage to persons, life or properly or any other cause whatsoever, and also in respect of all legal or other expenses that may be incurred by the Employer in examining, resisting or settling any such claims; for the due performance of which the Contractor binds itself according to law.

THUS, DONE AND SIGNED for and on behalf of the Contractor at _____

on the _____ day of _____ 20_____ in the presence of the subscribing witnesses.

As witnesses:

1. _____ _____
Name & Surname Signature

2. _____ _____

Employer:		**Contractor:**	
Witness:		**Witness:**	

Name & Surname _____ Signature _____

Duly authorised to sign on behalf of: _____

Address: _____

_____

Employer:		**Contractor:**	
Witness:		**Witness:**	

C1.3.3 Health and Safety Contract Between Employer and Contractor in Terms of Section 37(2) of the Occupational Health and Safety Act No 85 Of 1993

Written agreement between Johannesburg Water ((Proprietary) Limited (hereinafter referred to as "the Employer) and _____ (hereinafter referred to as "the mandatary") as envisaged by Section 37(2) of the Occupational Health and Safety Act, No. 85, of 1993 as amended.

I _____ representing _____ (mandatary) do hereby acknowledge that _____ (mandatary) is an employer in its own right and shall be regarded as the employer for purposes of the contract work specified in the body of the principal agreement with duties as prescribed in the Occupational Health and Safety Act, No. 85 of 1993 as amended so as to ensure that all work will be performed or machinery and plant used in accordance with the provisions of the said Act. I furthermore agree to comply with the requirements of the Employer as contained in the Occupational Health and Safety Specification included with the principal agreement and to liaise with the employer should I, for whatever reason, be unable to perform in terms of this agreement.

Signed this _____ day of _____ at _____

Signature on behalf of mandatary _____

Signature on behalf of Employer _____

Compensation Fund Registration No. of mandatary _____

Good Standing Certificate : ☐ yes ☐ no (tick one box)

Employer:		**Contractor:**	
Witness:		**Witness:**	

C1.3.4 Health and Safety Contract: General Information

1. The Occupational Health and Safety Act comprises Sections 1 to 50 and all un-repealed regulations promulgated in terms of the former Machinery and Occupational Safety Act No 6 of 1983 as amended, as well as other regulations which may be promulgated in terms of the OHS Act.

2. 'Mandatary' is defined as including an agent, a contractor or a subcontractor for work, but without derogating from his status in his own right as an employer or user of plant and machinery

3. Section 37 of the Occupational Health and Safety Act potentially punishes employers (principals) for the unlawful acts or omissions of mandataries (contractors) save where a written agreement between the parties has been concluded containing arrangements and procedures to ensure compliance with the said Aid by the mandatary.

4. All documents attached or referred to in the above agreement from an integral part of the agreement.

5. To perform in terms of this agreement mandataries must be familiar with the relevant provisions of the Act.

6. Mandataries who utilise the services of their own mandataries (subcontractors) are advised to conclude a similar written agreement.

7. Be advised that this agreement places the onus on the mandatary to contact the Employer in the event of inability to perform as per this agreement. The Employer, however, reserves the right to unilaterally take any steps as may be necessary to enforce this agreement.

8. The contractor shall be responsible for the full and proper implementation of the terms and provisions of the Act and its regulations in the area in which the work is to be undertaken by the Contractor.

9. The Contractor shall be responsible for the well-being, in relation to health and safety, of all persons coming upon or into such area in accordance with that legislation, including the implementation of any directives issued by management of the Employer in this respect.

10. The work to be done is **JW14040RR:** CONSTRUCTION OF A 2.25 ML WATER TOWER IN ROBETSVILLE

11. The area in which the work is to be conducted is _____

12. The Contractor shall familiarise himself with such area and all risks existing thereon and undertakes to report to the representative of the Employer any hazard or risk to health and safety which arises during the contract work in the area concerned and over which the Contractor may have no control. All necessary and appropriate safety / health equipment shall be issued by the Contractor to all persons working on or coming into the area.

Employer:		**Contractor:**	
Witness:		**Witness:**	

C1.3.4.1 Occupational Health and Safety Indemnity Undertaking

I, the undersigned _____

in my capacity as _____

of the firm _____

1. Hereby undertake to ensure that I/my firm and/or employees and/or subcontractors and/or his employees -
   - 1.1 comply strictly with the provisions of the Occupational Health and Safety Act of 1993 (as amended) and/or the regulations promulgated in terms thereof, with specific reference to section 37(2) of the said act, as well as any relevant legislation, in the course of the performance/execution of any service and/or work in, to or on any of the Employer's buildings, construction sites and/or premises;
   - 1.2 ensure that consultants and/or visitors comply with any instructions and measures relating to occupational health and safety, as prescribed by the Employer; and
   - 1.3 comply strictly with the statutorily prescribed work systems, operational equipment, machinery and occupational health and safety conditions;

2. And as an independent employer and contractor, hereby indemnify, in terms of the above undertakings, the Employer -
   - 2.1 in respect of any costs that I/my firm and/or employees and/or subcontractors and their employees may incur of necessity in compliance with the above undertakings; and
   - 2.2 against any claims that may be instituted against the Employer and/or any liability that the Employer may incur, whether instituted and/or caused by me/my firm's employees, agents, consultants, subcontractors and/or their employees and visitors or the Employer's clients or neighbours in respect of any incidents related to my/my firm's activities and as a result of which the occupational health and safety of the persons involved have been detrimentally affected; and
   - 2.3 against similar claims that I, managers or directors of my firm may have against the Employer and any damages for which I, managers or directors of my firm hold the Employer liable.

3. My firm's compensation commissioner number is _____ and I confirm that my firm and its subcontractors' fees have been paid up and obligations in respect of the compensation commissioner have been complied with and further that I shall furnish proof thereof in writing on request.

4. I hereby confirm that I have the authority to sign this indemnity undertaking and that the Employer is not obliged to confirm such confirmation.

Signed at _____ This _____ day of _____

_____ _____

Signature Capacity

As witnesses:

1 _____

2 _____

Employer:		**Contractor:**	
Witness:		**Witness:**	

Johannesburg Water SOC Ltd

CONTRACT NO: JW14040RR

CONSTRUCTION OF A 2.25 ML WATER TOWER IN ROBETSVILLE

VOLUME 1

PART 2: PRICING DATA

Employer:		Contractor:	
Witness:		Witness:	

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Employer:		**Contractor:**	
Witness:		**Witness:**	

C2 PRICING DATA

C2.1 Pricing Instructions

C2.1.1 General preamble to the bill of quantities (Engineering works)

a) All items in the Bill of Quantities, except where otherwise specified in Clause 8 of a Standardised Specification or in the Project Specification, shall be measured and shall cover operations as recommended in the standard system of measurement of civil engineering quantities, published under the title “Civil Engineering Quantities”, by the South African Institution of Civil Engineering.

b) The basis and principles of measurement and payment are described in this section (Pricing Instructions) and Clause 8 of each of the Standardised Specifications for Civil Engineering Construction. The applicable SANS 1200 Standardised Specifications are listed in the Scope of Work, Portion 1: Project Specifications. Variations and amendments to the Project Standard Specifications are contained in the Scope of Work, Portion 2: Variations and/or Additions to the Project Standard Specifications.

c) Descriptions in the Bill of Quantities are abbreviated and comply generally with those in the Standardised Specifications. Clause 8 of each Standardised Specification, read together with the relevant clauses of the Scope of Work, set out what ancillary or associated activities are included in the rates for the operations specified. Should any requirements of the measurement and payment clause of the applicable Standardised Specification or the Scope of Work, conflict with the terms of the Bill of Quantities, the requirements of the Standardised Specification or Scope of Work, as applicable, shall prevail.

d) The clauses in a specification in which further information regarding the Schedule item may be found are listed in the “Payment Refers” column in the Schedule. The reference clauses indicated are not necessarily the only sources of information in respect of listed items. Further information and specifications may be found elsewhere in the Contract Documents. Standardised Specifications are identified by the letter or letters which follow SANS in the SANS 1200 series of specifications, e.g. G for SANS 1200G.

e) Unless otherwise stated, items are measured net in accordance with the drawings, and no allowance is made for waste.

f) The quantities set out in the Bill of Quantities are the estimated quantities of the Contract Works, but the Contractor shall be required to undertake whatever quantities may be directed by the Employer’s Agent from time to time. The Contract Price for the completed Works shall be computed from the actual quantities of work done, valued at the relevant unit rates and/or prices. The Contractor must not order the quantities of materials stated in the Bill of Quantities until he has confirmed from the Construction Drawings or measurement on Site that such quantities are in fact the correct quantities.

g) The rates and/or prices to be inserted in the Bill of Quantities are to be the full inclusive prices for the work described under the several items. Such rates and/or prices shall cover all costs and expenses that may be required in and for the execution of the work described, and shall cover the cost of all general risks, liabilities, and obligations set forth or implied in the documents, as well as overhead charges and profit. Reasonable charges shall be inserted as these shall be used as a basis for assessment of payment for additional work that may have to be carried out.

h) A price or rate is to be entered against each item in the Bill of Quantities, whether the quantities are stated or not. An item against which no price is entered will be considered to be covered by the other prices or rates in the Schedule.

i) The units of measurement described in the Bill of Quantities are metric units. Alternatives used are as follows:

mm	=	millimetre		=	hour
m	=	metre	kg	=	kilogram
km	=	kilometre	t	=	ton (1000kg)
m2	=	square metre	No.	=	number
m2 pass	=	square metre pass	sum	=	lump sum
ha	=	hectare	MN	=	mega-newton
m3	=	cubic metre	MN.m	=	mega-newton-metre
m3km	=	cubic metre-kilometre	PC sum	=	Prime Cost sum
l	=	litre	Prov sum	=	Provisional sum
kl	=	kilolitre	%	=	percent
MPa	=	megapascal	kW	=	kilowatt
W/day	=	Workday	R/only	=	Rate only

j) For the purpose of this Bill of Quantities, where applicable, the following words shall have the meanings hereby assigned to them:

Unit	:	The unit of measurement for each item of work as defined in the SANS 1200.
Quantity	:	The number of units of work for each item.
Rate	:	The agreed payment per unit of measurement.
Amount	:	The product of the quantity and the agreed rate for an item.
Lump sum	:	An agreed amount for an item, the extent of which is described in the Bills of Quantities but the quantity of work of which is not measured in any units.

k) Arithmetical errors in the Bill of Quantities shall be corrected in accordance with Clause C3.9 of the Conditions of Tender. Should there be any discrepancy between rates and/or prices written in the Assessment Schedule and the Bill of Quantities, the latter shall govern.

l) While the Employer has every intent to complete the full scope of works, the Employer reserves the right to reduce or increase the scope of works according to the budget, or to terminate this contract, with adjustment to the agreed rates, sums or fees and without payment of any penalty in this regard. The Service Provider shall however be entitled to pro-rata payment for all services carried out in terms of any adjustment to the Scope of Work or, in the case of termination, remuneration and/or reimbursement.

m) The Bill of Quantities shall be completed by hand in INK or TYPED. The Bill of Quantities in the tender document may be replaced with the typed electronic Bill of Quantities, without changing the quantities, items and description.

Employer:		**Contractor:**	
Witness:		**Witness:**	

C2.1.2 Sufficiency of tender

The Contractor shall be deemed to have satisfied himself before tendering as to the correctness and sufficiency of his Tender for the construction of the Works and of the rates and prices, which rates and prices shall, except in so far as it is otherwise provided in the Contract, cover all his obligations under the Contract and all matters and things necessary for the proper execution and completion of the Works.

C2.1.3 Special payment conditions

This clause shall be read in conjunction with the 'Penalties' clause(s). Where the penalty clause shall always receive precedence over this clause, should it be found that duplicative financial corrective measures exist.

C2.1.3.1 Applicability of payment items

All payment items forming part of this Contract shall not apply to ordered Works completed by the Contractor under this Contract, where completed Works:

- are not completed to acceptable quality;
- are not issued by the Employer's Agent;
- are still within the defects and liability period; or
- are not accepted by the Employer's Agent or his duly authorised representative.

C2.1.3.2 Provided previously

The Contractor shall not re-execute works under this Contract where he has successfully executed works for the Employer under a previous contract(s) that comply with the requirements of this Contract. However, where applicable the Contractor shall:

1. clearly state this in his qualifications; and

2. still provide the associated rates and prices in the schedule in the associated line item, but not calculate an associated amount.

The Employer shall at his sole discretion decide to re-execute such works.

C2.1.3.3 Working outside normal hours

The additional costs, if any, to perform works outside normal working hours shall be deemed to have been allowed for in the provided activity pricing rates and/or prices.

C2.1.3.4 Materials and equipment

C2.1.3.4.1 Materials

The Employer shall not provide any materials, as this shall be provided by the Contractor and deemed to have been included in the various provided rates and prices.

Employer:		**Contractor:**	
Witness:		**Witness:**	

C2.1.3.4.2 Equipment

The Employer shall not provide any works equipment, as this shall be provided by the Contractor and deemed to have been included in the various provided activity rates and prices.

C2.1.3.4.3 Damage to materials provided by the Employer

Where the Contractor or public damage any materials, provided by the Employer, whilst in the care of the Contractor, he shall immediately report such damage, arrange for the replacement and all replacement costs shall be at his expense.

C2.1.3.5 Permits and wayleaves

All associated costs to obtain permits and way-leaves as required for the execution of the works, where such affect other services, shall be deemed to have been included in the scheduled rates for SANS 1200A or SANS 1200AA or SANS 1200AB where pricing provision for such items have been allowed for in the pricing schedules, alternatively it shall be deemed to be included in the various scheduled activity rates or prices provided by the Contractor.

C2.1.3.6 Locating existing services

The cost to locate existing services shall be included in the various works activity pricing rates and/or prices, including any excavations required and the provision and use of service detection personnel and equipment. Identified existing services shall be suitably marked at regular intervals for reference purposes.

C2.1.3.7 Confined space

The Contractor shall note that a portion of the work will be executed within confined spaces, and it shall be deemed that allowance has been made in all provided activity pricing rates and/or prices.

C2.1.3.8 Concrete

Descriptions (prices) of concrete work shall be deemed to include the design of concrete mixes and all testing of concrete and materials other than compressive strength testing of concrete samples from concrete being placed in the works (the Contractor shall only be entitled to payment for those samples and compressive strength tests called for by the Employer's Agent or his duly authorized representative and which pass the test requirements), handling and depositing (by hoisting or lowering) concrete in the forms, working and packing concrete around reinforcement, all "construction joints" other than "designated joints" as defined in SANS 1200G which are given separately, shaping tops of components as required and striking off and curing.

Descriptions (prices) of concrete in surface beds cast in panels shall be deemed to include formwork, fillets and the like in forming the panels.

C2.1.3.9 Formwork

Formwork is measured to the net surfaces of concrete to be supported, except at intersections of beams with beams, columns, walls, etc. and tops of columns with slabs, beams, etc. where no deductions have been made and descriptions (prices) shall be deemed to include use and waste, except where the formwork is of a permanent nature or is to be left in, fitting together to all required shapes, all cutting, intersections, cambering where required, holes for rods, bolts, pipes and the like, propping, maintaining, keeping damp whilst the concrete is being deposited and removing of formwork.
Formwork "left in" and permanent formwork shall be deemed to include leaving in formwork, props, etc.

Descriptions (prices) of formwork to soffits shall be deemed to include propping not exceeding 3.5m high unless otherwise described. Descriptions (prices) of formwork to walls and columns shall be deemed to be not exceeding 3.5m high above bearing level unless otherwise described.

Descriptions (prices) of formwork to soffits of solid slabs shall be deemed to be to slabs not exceeding 300mm thick unless otherwise described.

C2.1.3.10 Smooth formwork

Descriptions (prices) shall be deemed to include for rubbing off all projections at seams etc. after removal of the formwork, making good any defects with 2:1 cement mortar and leaving a smooth surface with all arises slightly rounded, all to the satisfaction of the Employer's Agent or his duly authorized representative.

C2.1.3.11 Reinforcement

Descriptions (prices) for all steel reinforcement to concrete shall be deemed to include cutting and waste, bending, hooked ends, binding at lappings and intersections with annealed wire, all as above described, hoisting or lowering and maintaining in position whilst the concrete is being deposited and cover blocks and spacers in accordance with the relevant SANS Codes of Practice.

C2.1.3.12 Precast concrete

Descriptions (prices) of precast concrete shall be deemed to include reinforcement required for manufacturing, handling and erection purposes, steel rod or wire loop hooks and/or mortices for Lewis bolts required for handling and transporting, any necessary temporary propping and strutting, bedding, jointing and pointing.

C2.1.3.13 Testing

The cost of testing of the ordered Works shall be included in the various applicable Works items. In particular those: • clearly intended by or provided for in the specifications. • involving testing or tests to ensure that the design of the whole of the Works or any part of the Works is appropriate for the purpose which it was intended to fulfil. No additional or separate payment for testing shall be entertained by the Employer.

C2.1.3.14 Cost of samples

All samples shall be supplied by the Contractor at his own cost unless the supply thereof is clearly intended in the specifications or Bill of Quantities to be at the cost of the Employer. Payment shall not be made for samples which do not comply with the specifications.

C2.1.3.15 Failure to submit reports and associated visual media

The Contractor's payment certificate shall be accompanied by confirmation from the Employer's Agent or his duly authorised representative then at items listed for payment have been successfully executed and/or delivered as required. Failure to obtain such confirmation from the Employer's Agent or his duly authorised representative shall result in non-payment of the Contractor's payment certificate until the default has been corrected or the deemed incomplete items are excluded from the payment certificate.

C2.1.3.16 Payment ONLY for works completed

The Contractor shall note that payment shall only be made for Work activities successfully (delivering the end result) executed, complying with the quality requirements and provided to the Employer's Agent or his duly authorized representative.

C2.1.3.17 Training

The Contractor is required to provide training on all equipment installed during the installation and commissioning periods of the contract. Pricing shall make adequate provision for the training of the Employer's delegated staff members.

C2.1.3.18 Maintenance

Pricing shall include for attendance to maintenance items in accordance with the requirements of the contract conditions and specifications.

C2.1.3.19 Disposal of existing equipment

Pricing shall provide allowance for the successful disposal of all redundant and obsolete equipment indicated for removal from the facility.

C2.1.3.20 Certificate of Compliance

Pricing shall provide allowance for the issuing of the relevant Certificates of Compliance for the installation(s) at the facility. One certificate of compliance is required per electrical distribution board completed, and the certificate shall cover all downstream works.

C2.1.4 SMME Portion of the Works

A portion of the works must be allocated for completion by appointed SMMEs.

The Main Contractor shall retain liability and responsibility for the management, scheduling, and quality control of all works performed by the sub-contractors. After appointment of the Main Contractor, Johannesburg Water will supply the Main Contractor with a list of SMMEs which the Main Contractor can approach to provide rates for the items envisaged for subcontracting. The Main Contractor will be expected to conduct a competitive process to recommend a Sub-Contractor or Sub-Contractors to Johannesburg Water. Johannesburg Water will then evaluate all rates provided by the Sub-Contractor for fairness. Johannesburg Water will then either a) approve the appointment of the Sub-Contractor or Sub-Contractors or b) enter into negotiations with the Main Contractor and Sub-Contractor / s or c) request that the Contractor recommend a different Sub-Contractor.

Further an allowance has been made for the Contractor to complete the following tasks:

- The Contractor shall ensure that the Sub-Contractor(s) complies with paying all amounts due in respect of his employees and himself in terms of all relevant legislation and regulations including, but not confined to, the
    - Income Tax Act, the
    - Compensation for Occupational Injuries and Diseases Act,
    - Unemployment Insurance Act,
    - Basic Conditions of Employment Act
- Monitoring of the Quality of Work completed by the Sub-contractor/SMME
- Skills transfer during the execution of the project
- Compliance with all aspects of the Scope of Work
- Assistance with sourcing of applicable material in line with the technical data sheets

Further an allowance has been made for "Training" – this is related to CETA accredited training which is to be agreed with the Employer during project execution. No amount can be claimed under this item for on-site or on-the-job training, only for accredited training which the SMME receives.

Employer:		**Contractor:**	
Witness:		**Witness:**	

BILL OF QUANTITIES

Employer:		Contractor:	
Witness:		Witness:	

SUMMARY OF BILL OF QUANTITIES	
Description	**Amount**
SECTION A: PRELIMINARY AND GENERAL	R
SECTION C: SITE CLEARAMCE	R
SECTION DB EARTHWORK (PIPE TRENCHES)	R
SECTION G: CONCRETE	R
SECTION HA: STRUCTURAL STEELWORK	R
SECTION HC: CORROSION PROTECTION OF STRUCTURAL STEEL	R
SECTION L: WATERMAINS	R
SECTION: LB BEDDING FOR PIPES	R
SECTION LD: SEWER	R
SECTION LG: PIPE JACKING	R
SECTION ME: SUBBASE	R
SECTION MJ: SEGMENTED PAVING	R
SECTION MK: KERBING AND CHANNELING	R
SECTION PLB: MISCELLANEOUS WORKS FOR TANKS	R
SECTION PLG: ELECTICAL WORKS	R
TOTAL FOR SCHEDULE OF QUANTITIES	R
ADD CONTINGENCIES (10%)	R

Employer:		**Contractor:**	
Witness:		**Witness:**	

ADD ESCALATION (5%)	R
SUBTOTAL (EXC VAT)	R
ADD 15% VAT	R
TOTAL FOR TENDER (FORWARD TO THE FORM OF OFFER)	R

SUMMARY OF SCHEDULE OF QUANTITIES

SECTION	DESCRIPTION	TOTAL
SECTION A:	PRELIMINARY AND GENERAL	R
SECTION C:	SITE CLEARANCE	R
SECTION D:	EARTHWORKS	R
SECTION DB:	EARTHWORK (PIPE TRENCHES)	R
SECTION G:	CONCRETE	R
SECTION HA:	STRUCTURAL STEELWORK	R
SECTION HC:	CORROSION PROTECTION OF STRUCTURAL STEEL	R
SECTION L:	WATER MAINS	R
SECTION LB:	BEDDING FOR PIPES	R
SECTION LD:	SEWER	R
SECTION LG:	PIPE JACKING	R
SECTION ME:	SUBBASE	R
SECTION MJ:	SEGMENTED PAVING	R
SECTION MK:	KERBING AND CHANNELLING	R
SECTION PLB:	MISCELLANEOUS WORKS FOR TANKS	R
SECTION PLG:	ELECTRICAL WORKS	R
TOTAL FOR SCHEDULE OF QUANTITIES		R
ADD CONTINGENCIES (10%)		R
ADD ESCALATION (5%)		R
SUBTOTAL		**R**
ADD 15 % VAT		R
TOTAL FOR TENDER (FORWARD TO THE FORM OF TENDER)		R

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	ADJUSTED RATE	AMOUNT
	SANS 1200 A	**SECTION 1 : GENERAL**				
A1	8.3	**Scheduled fixed-charge and value- related items**				
A1.1	8.3.1	Contractual requirements for the provision of all sureties, Insurance of the works and Plant, Third Party Liability Insurance, Unemployment Insurance and any other statutory requirements	Sum	1.0		
A1.2	PSA 8.3.1	Fixed preliminary and general charges	Sum	1.0		
	8.3.2	Establishment of Facilities on Site (Only on the written instruction of the Engineer)				
A1.3		Facilities for the Engineer (See Clause C3.4.2.2)				
		(a) Furnished offices (1 No.)	Sum	1.0		
		(b) Telephone (1 Cellphone with Simcard)	P. Sum	1.0	12 500.00	12 500.00
		(c) Percentage mark-up on (a+b) above	%	12 500.0		
		(d) Nameboards (No.)	Sum	1.0		
		(e) PPE for Engineer and assistants	Sum	1.0		
		(f) Survey instruments, etc.	Sum	1.0		
A1.4	8.3.2.2	Facilities for the Contractor				
		All facilities as scheduled in Clause 8.3.2.2 of SABS 1200A				
		(a) Offices and storage sheds	Sum	1.0		
		(b) Workshops	Sum	1.0		
		(c) Laboratories	Sum	1.0		
		(d) Living accommodation	Sum	1.0		
		(e) Ablution and toilet facilities	Sum	1.0		
		(f) Tools and equipment	Sum	1.0		
		(g) Water supplies, electric power and communications	Sum	1.0		
		(h) Protection against water and storms (see PSA 5.5)	Sum	1.0		
		(i) Access	Sum	1.0		
		(j) Plant	Sum	1.0		
		(k) PPE for Contractors staff, suppliers, subcontractors and visitors	Sum	1.0		
A1.5	8.3.3	Other fixed-charge obligations	Sum	1.0		
A1.5.1		Removal of Site Establishment (On Instruction by Engineer)	Sum	1.0		
A1.5.2	PS7.1	Provision of a Safety Plan in terms of OHS Act and Safety Regulations	Sum	1.0		
A2	**8.4**	**Scheduled Time-related items**				
A2.1	PSA 8.4.1	Time-related preliminary and general items	Month	16.0		
A2.2	8.4.2	Operation and maintenance of facilities for the duration of construction				
TOTAL CARRIED FORWARD					R	

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	ADJUSTED RATE	AMOUNT
BROUGHT FORWARD					R	
A2.3	8.4.2.1	Facilities for the Engineer				
		(a) Furnished offices (1 No.)	Month	16.0		
		(b) Telephone (R900 per month airtime for celphone)	Month	16.0		
		(c) Nameboards (2 No.)	Month	16.0		
		(d) Survey instruments, etc.	Month	16.0		
		(e) PPE for Engineer and assistants	Month	16.0		
A2.4	8.4.2.2	Facilities for the Contractor				
		All facilities as scheduled in Clause 8.4.2.2 of SABS 1200A				
		(a) Offices and storage	Month	16.0		
		(b) Workshops	Month	16.0		
		(c) Laboratories	Month	16.0		
		(d) Living accommodation	Month	16.0		
		(e) Ablution and toilet	Month	16.0		
		(f) Tools and equipment	Month	16.0		
		(g) Water supplies, electric power and communications	Month	16.0		
		(h) Dealing with water (Sub-clause5.8)	Month	16.0		
		(i) Access (Sub-clause 5.8)	Month	16.0		
		(j) Plant	Month	16.0		
A2.5	8.4.3	Supervision for duration of construction	Month	16.0		
A2.6	8.4.4	Company and head office overhead costs for the duration of the contract	Month	16.0		
A2.7	8.4.5	Other time-related obligations	Month	16.0		
A2.8	PSA 8.9	Compliance with OHS act and Construction Regulations	Month	16.0		
A2.9		Compliance with Record of Decision issued by GDARD	Month	16.0		
A3	**8.5**	**<u>SUMS STATED PROVISIONALLY BY ENGINEER</u>**				
A3.1		Supply and Install lightning protection according to latest applicable SANS codes	SUM	1.0		
A3.2		Supply and install VSD, displays, DC chokes, telemetry cabinet, fibre cable, SD4 data radio, instrumentation, c/w antenna and mast	SUM	1.0		
A3.3		CLO's Payment for CLO (i) Remuneration of CLO (based on R10500/month incl. traveling allowance)	Month	16.0		
		(ii) Cell phone allowance (R150 airtime per month)	Month	16.0		
		(iii) Contractors mark-up on items (i) and (ii) above for Contractor's overheads, liaison, making payments and supplying office space and associated facilities within his establishment	%	45 600.0		
A3.4	PSA 5.5	Protection against water and storms	Sum	1.0		
TOTAL CARRIED FORWARD					R	

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	ADJUSTED RATE	AMOUNT
BROUGHT FORWARD					R	
A3.5		Quality assurance and management plan	SUM	1.0		
A3.6		Provisional sum for Independent OHS, EMP and Electrical practitioners	Prov. SUM	1.0	250 000.00	250 000.00
A3.7		Provide Security guard (armed response) for duration of the construction works after hours, and on instruction by the Engineer	Month	16.0		
A4	**8.7**	**DAYWORK** Note: Executed on Instruction of the Engineer Only	Days	20.0		
A4.1		Labour				
		(i) Un-skilled	hr.	10.0		
		(ii) Semi-skilled	hr.	10.0		
		(iii) Skilled (artisan - welder plumber etc.)	hr.	10.0		
		(iv) Engineer	hr.	5.0		
		(v) Technician	hr.	5.0		
		(vi) Foreman	hr.	10.0		
		(vii) Driver (LDV,machine, trucks, etc.)	hr.	10.0		
		(viii) Certified Blaster	hr.	10.0		
		(ix) Steel fixer	hr.	10.0		
		(x) Concretor	hr.	10.0		
		(xi) Charge hand	hr.	10.0		
		(xii) Security guard	hr.	10.0		
A4.2		Plant and equipment				
		(a) Tractor loader backhoe (TLB)				
		(i) Tractor Loader Backhoe (Bigger than 45kW but smaller than 70kW)	hr.	10.0		
		(b) Crawler Excavators				
		(i) Smaller than 93kW (small)	hr.	10.0		
		(ii) Bigger than 93kW but smaller than 200kW (Medium)	hr.	10.0		
		(c) Tipper Trucks				
		(i) Tipper trucks (3m³) Small	hr.	10.0		
		(ii) Tipper trucks (5m³) Medium	hr.	10.0		
		(iii) Tipper trucks (10m³) Large	hr.	10.0		
		(d) Flat Bed Trucks				
		(i) Flat bed 5t capacity	hr.	8.0		
		(ii) Flat bed 7t capacity	hr.	8.0		
		(e) LDV				
		(i) 1t Pick-up	hr.	10.0		
		(f) Mobile Crane 5t at 3m radius	hr.	10.0		
		(g) Walk behind vibrating rollers				
		(i) Model - Bomag 60 or similar (small)	hr.	10.0		
		(ii) Model - Bomag 76 or similar (medium)	hr.	10.0		
		(iii) Model - Bomag 90 or similar	hr.	10.0		
TOTAL CARRIED FORWARD					R	

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	ADJUSTED RATE	AMOUNT
BROUGHT FORWARD					R	
		(h) Plate compactors				
		(i) Vipac or similar	hr.	10.0		
		(i) Rammers				
		(i) Model - Wacker or similar	hr.	10.0		
		(j) Concrete mixers				
		(i) Volume 100 litre wet (small, towable)	hr.	8.0		
		(ii) Volume 175 litre wet (medium)	hr.	8.0		
		(iii) Volume 250 litre wet (large)	hr.	8.0		
		(k) Diesel compressors including hoses and tools	hr	10.0		
		(i) Capacity smaller than 200 cfm (small)	hr.	10.0		
		(ii) Capacity bigger than 200 cfm smaller than 400 cfm (medium)	hr.	10.0		
		(iii) Capacity bigger than 400 cfm (large)	hr.	10.0		
		(l) Waterpump				
		(i) Capacity smaller than 400 litre/min (medium)	hr	10.0		
		(ii) Capacity bigger than 400 but smaller than 600 litre/min (medium)	hr	10.0		
		(iii) Capacity bigger than 600 but smaller then 1 100 litre/sec (large)	hr	10.0		
A5	**8.8**	**TEMPORARY WORKS**				
A5.1		Provide and maintain access roads and adjacent streets including reinstatement of roads on completion of Works (or accommodation of traffic)	Sum	1.0		
		Existing services				
A5.2		Temporarily protection of existing services	P. SUM	1.0	12 500.00	12 500.00
A5.3		Contractor's mark-up on 108 above	%	12 500.0		
A5.4		Cast insitu class 20/19 concrete for encasing of existing services	m³	10.0		
A5.5		Welded steel reinforcing mesh (Ref 395)	m²	100.0		
A5.6		Relocation of existing services	P. SUM	1.0	93 750.00	93 750.00
A5.7		Contractor's mark-up on A5.6 above	%	93 750.0		
A6		Sub-Contractor P&G's for all packages		1.0		
		Contractor's mark-up on A6 above	%	10%		
	TOTAL FOR SECTION A CARRIED FORWARD TO SUMMARY				**R**	

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	ADJUSTED RATE	AMOUNT
	SABS 1200 C	**SECTION C: SITE CLEARANCE**				
C1		CLEAR SITE				
C1.1	8.2.1	**Clear and grub site and remove any obstruction that may occur and spoil to designated site. Only areas indicated in writing by Engineer must be cleared:**				
		Clear and grub including all vegetation for Site footprint	m²	2 255		
C1.2	PSC 5.1	Clear and grub including all vegetation for pipe route 3m wide.	m	1 154		
C1.3	PSC 3.1	Transport spoil material to unspecified sites and dump (provisional)	m³.km	7 662		
		SITE PREPARATION				
C1.4	8.2.10	Remove top soil to nominal depth 75 mm, stockpile and maintain	m³	187		
	TOTAL FOR SECTION C CARRIED FORWARD TO SUMMARY				**R**	

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	ADJUSTED RATE	AMOUNT
	SABS 1200 D	**SECTION D: EARTHWORKS**				
D1 SC	PSD 8.3.2	EXCAVATION				
	8.3.2a	**Excavate in all materials and use for backfill, or dispose as ordered:**				
		(a) Tower Foundation (measured under Work Packages)	m³	228		
		(b) Valve Chamber	m³	353		
D1.2	8.3.2b	**Excavate in all materials to spoil:**				
		(a) Tower Foundation	m³	491		
		(b) Valve Chamber	m³	141		
D1.3	8.3.2c	**Extra over items D1.1 to D1.4 for excavation in:**				
		(a) Intermediate material	m³	182		
		(b) Hard rock material	m³	61		
D1.4	8.3.2d	**Extra over items D1.1 to D1.4 for excavation in:**				
		Hand excavation or other method (excluding blasting) to remove rock outcrops or rock underbreak after bulk excavation to form level site (alternative for soilcrete backfilling in rock overbreak)	m³	20		
D2		EXISTING SERVICES				
D2.1	PSD8.3.8.1	**Hand excavation for locationg and exposing existing services in:**				
		(a) Roadways	m³	30		
		(b) All other areas	m³	30		
D3		**Topsoiling from stockpile 75 mm layer:**				
	PSD 8.3.10	Level on Site	m³	114		
D4 SC		**Extra over items PSD 8.3.2. for**				
	PSD 8.3.14	(a) Temporary stockpiling	m³	353		
	PSD 8.3.15	(b) Disposing of spoil material on a site provided by The Contractor (measured under Work Packages)	m³	632		
D5 SC		**Grassing**				
	PGENRD 8	Grassing (Kikuyu instant lawn) (measured under Work Packages)	m³	1 517		
	TOTAL FOR SECTION D CARRIED FORWARD TO SUMMARY				**R**	

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	ADJUSTED RATE	AMOUNT
	SABS 1200 DB	**SECTION DB: PIPE TRENCHES**				
DB1		EXCAVATION				
DB1.1	PSDB8.3.2a	**Excavate by machine in all materials for trenches, backfill, compact and dispose of surplus or unsuitable material for pipes up to 650 mm diameter for dephts:**				
		Over and up to				
		(a) 0,0 m 1,0 m	m	66		
		(b) 1,0 m 2,0 m	m	1 022		
		(c) 2,0 m 3,0 m	m	289		
DB1.2	8.3.2b	**Extra-over items DB1.1 to DB1.3 for excavation in (provisional):**				
		(a) Intermediate material	m³	492		
		(b) Hard rock material	m³	164		
DB1.3	8.3.2c	Excavate unsuitable material from trench bottom and dispose of it	m³	65		
DB2	8.3.3	EXCAVATION ANCILLARIES				
DB2.1	8.3.3.1a	**Imported backfill materials from trench excavation or stockpiles on site:** Acquire, deliver, place and compact imported selected backfill to fill over-excavation under pipe bedding where unsuitable material under item DB1.5 is removed	m³	65		
DB2.2	PSDB8.3.2(4)	Backfill stabilized with 5% cement where directed by the Engineer	m³	10		
DB2.3	PSDB8.3.2(5)	Soilcrete backfill where directed by the Engineer	m³	15		
		TOTAL FOR SECTION DB CARRIED FORWARD TO SUMMARY			**R**	

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	ADJUSTED RATE	AMOUNT
	SABS 1200 G	**SECTION G: CONCRETE (STRUCTURAL)**				
G1	8.2	FORMWORK				
	8.2.2	**Smooth vertical plane to:**				
G1.1		Tower Foundation	m²	123		
G1.2		Chambers and thrust blocks	m²	164		
	8.2	FORMWORK				
	8.2.2	**Special smooth vertical plane to:**				
G1.3		Internal and External Shaft Walls	m²	1 240		
G1.4		Internal and External Tank Walls	m²	828		
	8.2.2	**Smooth horizontal to:**				
G1.5		Circular landing at top of internal tank walls	m²	13		
G1.6		Chamber soffits	m²	70		
	8.2.2	**Smooth inclined formwork:**				
G1.7		Inclined portion of tank walls	m²	789		
	8.2.4	**Smooth domed formwork:**				
G1.8		Domed Roof	m²	178		
	8.2.5	**Narrow Widths**				
G1.9		Chamber Bases	m	49		
G1.10		Tower Dome Roof	m	62		
G1.11		Chamber Roofs	m	49		
		BOX OUT HOLES/FORM VOIDS				
	PSG 8.10	**Small circular holes of diameter up to 0.35m sealed with a bentonite strip when grouted.**				
G1.12		Scour and overflow pipes	No	5		
	PSG 8.10	**Small circular holes of diameter 0.35m up to 0.65m sealed with a bentonite strip when grouted.**				
G1.13		Inflow and Outflow pipes	No	8		
G2	8.3	REINFORCEMENT				
G2.1	8.3.1	**Mild steel bars:**				
		Diameters 8 mm to 40 mm: average price for manholes	t	22		
G2.2	8.3.1	**High-tensile steel bars average price:**				
		Diameters 10 mm to 40 mm: average price as indicated on schedules	t	223		
G3	8.4	CONCRETE				
G3.1	8.4.2	**Blinding layer in 15 MPa/19 mm concrete:**				
		50 mm minimum thickness	m²	650		
G3.2	8.4.3	**Mass concrete: 15MPa/19 mm:**				
		Below tower foundation	m³	12		
		TOTAL CARRIED FORWARD			R	

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	ADJUSTED RATE	AMOUNT
		TOTAL BROUGHT FORWARD			R	
	8.4.3	**Strength concrete: 20 MPa/19 mm:**				
G3.3		Concrete for Scour tank base	m³	2		
	8.4.3	**Strength concrete: 30 MPa/19 mm:**				
G3.4		Tower Base	m³	478		
G3.5		Chamber Base and Thrust blocks	m³	19		
	8.4.3	**Strength concrete: 35 MPa/19 mm:**				
G3.6		Shaft Walls	m³	179		
G3.7		Chamber and scour Walls	m³	24		
G3.8		Dome Roof	m³	54		
G3.9		Chamber Roof	m³	18		
	8.4.3	**Strength concrete: 40 MPa/19 mm:**				
G3.10		Tank Walls	m³	290		
G4	8.4.4	UNFORMED SURFACE FINISHINGS				
		Wood floated finishings:				
G4.1		Top of Tower base	m²	195		
G4.2		Top of dome roof and ringbeam	m²	194		
G4.3		Chamber Base and Overflow tank	m²	77		
G4.4		Chamber roof	m²	70		
G5	PSG8.9	CONCRETE CUBE-TESTING MACHINE				
G5.1		Testing of concrete cubes	No	179		
G5.2		Supply cube-testing machine on site with recent calibration certificate and water trough	Sum	1		
		TOTAL FOR SECTION G CARRIED TO SUMMARY			**R**	

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	ADJUSTED RATE	AMOUNT
	SABS 1200 HA	**SECTION HA : STRUCTURAL STEELWORK**				
H1	8.3.1	SUPPLY AND FABRICATION				
H1.1 SC	8.3.1.1	Preparation and submission to the Engineer for approval of shop detail drawings. (measured under Work Packages)	t	11.5		
H2		Supply and fabrication of steelwork ***A. Hot rolled steel*** **(a) PFC Sections for platforms**				
H2.1 SC		1. 230 x 90 mm (measured under Work Packages)	t	11.5		
H2.2		Trial assembly of platforms (measured under Work Packages)	No	8.0		
H3	8.3.2	DELIVERY				
H3.1 SC	8.3.2.1	Delivery of steelwork to site of all items under 8.3.1 above (measured under Work Packages)	t	11.5		
H4	8.3.3	ERECTION				
H4.1 SC		Offloading of steel, stacking on site, and erection of steelwork of all items under 8.3.1 above (measured under Work Packages)	t	11.5		
H5	8.3.4	ERECTION BOLTS Supply, deliver and storage of bolts, washer and nuts as indicated on drawing 1440a/WA/DET09				
H5.1 SC		(a) M16 (measured under Work Packages)	t	1.2		
H6	8.3.7	HANDRAILS Handrails assembly complete as per drawing 1440a/WA/DET09				
H6.1 SC		a) Horisontal (measured under Work Packages)	m	63		
H6.2 SC		b) Sloping on stairs at 45 deg angle (measured under Work Packages)	m	66		
H7	8.3.8	LADDERS				
H7.1 SC		Supply and install Hot dip galvanized mild steel Catladders as detailed on drawing 1440aWA/DET03 (measured under Work Packages)	m	27		
H8	8.3.9	FLOORING				
H8.1 SC		Hot dip galvanized open grid flooring complete and installed with frames for floors and stairs (measured under Work Packages)	m²	175		
H9	8.3.10	NON-DESTRUCTIVE TESTING				
H9.1 SC		Testing of welding as indicated by the engineer including supply of test certificates. (measured under Work Packages)	No.	120		
H10	8.3.12	SECURITY DOOR				
H10.1 SC		Supply and Install "TDL" type door from STRONG DOOR or similar approved. (measured under Work Packages)	No	2		
	TOTAL FOR SECTION HA CARRIED TO SUMMARY				**R**	

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	ADJUSTED RATE	AMOUNT
	SABS 1200 HC	**SECTION HC: CORROSION PROTECTION OF STRUCTURAL STEELWORK**				
HC1	8.2.3	SURFACE PREPARATION AND COATING APPLICATION				
		Shopwork:				
HC1.1		Surface preparation (acid bath) and cleaning	t	11.5		
HC1.2		Hot dip Galvanzied coating	t	11.5		
	TOTAL FOR SECTION HC CARRIED TO SUMMARY					**143 893.75**

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	ADJUSTED RATE	AMOUNT
	SABS 1200 L	**SECTION L: WATER MAINS**				
L1	8.2.2	PIPE LINE				
		Supplying, laying, and jointing of water pipes SAW to API 5L Grade X42, 6mm thick with 6mm CML and Rigid Polyurethane coating.				
		(a) 650mm Steel	m	1 100		
		(b) 550mm Steel	m	30		
		(c) 450mm Steel	m	30		
		(d) 200mm Steel	m	7		
L2		**Supplying, laying, and jointing of water pipes, Grade 316 Stainless Steel, according to SABS719, irrespective of depth.**				
		(a) 650mm Stainless Steel	m	42		
		(b) 550mm Stainless Steel	m	36		
		(c) 250mm Stainless Steel	m	48		
		(d) 200mm Stainless Steel	m	36		
L3		CONNECTION INTO EXISTING				
		Connection to existing pipeline complete as shown on drawings including excavation				
L3.1		Connection to existing pipe junctions including	No	2		
L3.2		Connection to existing pipe junction at Reservoir site including excavation, breaking through walls and making good.	No	1		
L4		**Bends**				
		(a) Item 1.1: S.S 90 deg 650mm dia	No	2		
		(b) Item 1.2: S.S 45 deg 650mm dia	No	2		
		(c) Item 1.3: S.S 43.5 deg 550mm dia	No	1		
		(d) Item 1.4: S.S 90 deg 550mm dia	No	1		
		(e) Item 1.5: S.S. 45 deg 250mm dia	No	2		
		(f) Item 1.6: S.S. 90 deg 250mm dia	No	2		
		(g) Item 1.8: S.S. 45 deg 200mm dia	No	4		
		(h) Item 1.9 M.S. 90 deg 650mm dia fully	No	1		
			No	2		
		(j) Item 1.11: M.S. 55 deg 550mm dia bevel edged bend	No	1		
		(k) Item 1.12: M.S. 90 deg 250mm dia Bevel edged bend	No	1		
L5		**Valves**				
		(a) Item 2.1: 200mm dia, cast iron, gate valve (See SANS1123 Table 1600)	No	1		
		(b) Item 2.2: 400mm dia, cast iron, gate valve (See SANS1123 Table 1600)	No	9		
		(c) Item 2.3: 400mm dia, cast iron, Combination control Valve	No	1		
		(d) Item 2.4: 250mm dia, cast iron, Combination control Valve	No	6		
		(e) Item 2.5: 250mm dia, cast iron, NRV	No	3		
L6		**Cut Lengths**				
L6.1		Item 4.1: SS 650mm dia pipe (l=2000) One End Flanged.	No	2		
		TOTAL CARRIED FORWARD			R	

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	ADJUSTED RATE	AMOUNT
		TOTAL BROUGHT FORWARD			R	
L6.2		Item 4.2: SS 650mm dia pipe (l=6000) Flanged Both Ends	No	4		
L6.3		Item 4.3: SS 650mm dia pipe (l=1260) No Flanges	No	1		
L6.4		Item 4.4: SS 650mm dia pipe (l=400) Flange one end	No	1		
L6.5		Item 4.5: SS 650mm dia pipe (l=2075) One End Flanged	No	1		
L6.6		Item 4.6: SS 650mm dia pipe (l=2520) One End Flanged	No	1		
L6.7		Item 4.7: SS 550mm dia pipe (l=300) One End Flanged	No	1		
L6.8		Item 4.8: SS 550mm dia pipe (l=6000) Flanged Both Ends	No	4		
L6.9		Item 4.9: SS 550mm dia pipe (l=2660) One End Flanged	No	1		
L6.10		Item 4.10: SS 550mm dia pipe (l=1350) Flanged One End	No	1		
L6.11		Item 4.11: SS 750mm dia pipe (l=300) No Flanges	No	1		
L6.12		Item 4.12: SS 250mm dia pipe (l=350) One End Flanged	No	1		
L6.13		Item 4.13: SS 250mm dia pipe (l=6000) Flanged Both Ends	No	3		
L6.14		Item 4.14: SS 250mm dia pipe (l=2260) One End Flanged	No	1		
L6.15		Item 4.15: SS 250mm dia pipe (l=350) One end flanged	No	1		
L6.16		Item 4.16: SS 250mm dia pipe (l=3900) One End Flanged	No	1		
L6.17		Item 4.17: SS 250mm dia pipe (l=980) One End Flanged	No	1		
L6.18		Item 4.18: SS 200mm dia pipe (l=300) One End Flanged	No	3		
L6.19		Item 4.19: SS 200mm dia pipe (l=415) Flanged Both Ends	No	1		
L6.20		Item 4.20: SS 200mm dia pipe (l=6000) Both Ends Flanged	No	3		
L6.21		Item 4.21: SS 200mm dia pipe (l=1875) Flanged Both Ends	No	1		
L6.22		Item 4.22: SS 200mm dia pipe (l=350) One End Flanged	No	1		
L6.23		Item 4.26: MS 650mm dia pipe (l=19100) One End Flanged, one edge bevelled	No	1		
L6.24		Item 4.27: MS 650mm dia pipe (l=1744) Bevel edged	No	1		
L6.25		Item 4.28: MS 650mm dia pipe (l=510) One end Flanged other bevelled	No	1		
L6.26		Item 4.29: MS 400mm dia pipe (l=500) bevel edged	No	1		
L6.27		Item 4.30: MS 550mm dia pipe (l=10910) Flanged Both Ends	No	1		
L6.28		Item 4.31: MS 550mm dia pipe (l=4481) Flanged Both Ends	No	1		
L6.29		Item 4.32: SS 250mm dia pipe (l=495) Flanged One End	No	1		
		TOTAL CARRIED FORWARD			R	

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	ADJUSTED RATE	AMOUNT
		TOTAL BROUGHT FORWARD			R	
L6.29		Item 4.33: MS 550mm dia pipe (l=586) Both ends flanged	No	1		
L6.30		Item 4.34: MS 550mm dia pipe (l=2187) One end Flanged	No	1		
L6.31		Item 4.35: MS 550mm dia pipe (l=12631) Bevelled edges	No	1		
L6.32		Item 4.36: MS 400mm dia pipe (l=3955) Both ends flanged	No	1		
L6.33		Item 4.37: MS 400mm dia pipe (l=2293) Both ends flanged	No	1		
L6.34		Item 4.38: MS 350mm dia pipe (l=4895) Both ends flanged	No	1		
L6.35		Item 4.39: MS 250mm dia pipe (l=958) Both ends flanged	No	1		
L6.36		Item 4.40: MS 250mm dia pipe (l=1053) Both ends flanged	No	1		
L6.37		Item 4.41: MS 250mm dia pipe (l=2508) Both ends flanged	No	1		
L6.38		Item 4.42: MS 250mm dia pipe (l=1377) Both ends flanged	No	1		
L6.39		Item 4.43: MS 250mm dia pipe (l=150) Both ends flanged	No	3		
L5		**Reducers**				
L5.1		Item 5.1: SS 1000 x 750mm dia Eccentric reducer	No	1		
L5.2		Item 5.2: SS 750 x 500mm dia Eccentric reducer	No	1		
L5.3		Item 5.3: SS 500 x 300mm dia Eccentric reducer	No	1		
L5.4		Item 5.4: SS 300 x 250mm dia Eccentric reducer	No	1		
L5.5		Item 5.5: MS 650 x 400mm dia Concentric reducer	No	3		
L5.6		Item 5.6: MS 550 x 400mm dia Concentric reducer	No	7		
L5.7		Item 5.7: MS 400 x 350mm dia Concentric reducer	No	1		
L5.8		Item 5.8: MS 400 x 250mm dia Concentric reducer	No	1		
L5.9		Item 5.9: MS 350 x 250mm dia Concentric reducer	No	1		
L6		**General**				
L6.1		Item 1.7: SS 250mm by 200mm Reducing Tee	No	1		
L6.2		Item 3.1: SS 650mm dia pipe (l=1255) with puddle flange	No	1		
L6.3		Item 3.2: SS 650mm dia pipe (l=1085), one end flanged with puddle flange	No	1		
		Item 3.3: SS 250mm dia pipe (l=995), Paddle flange only	No	1		
L6.4		Item 3.4: SS 200mm dia pipe (l=1000), One end flanged with paddle flange	No	1		
L6.7		Item 3.9: MS 650mm dia pipe (l=1045) fully flanged with puddle flange	No	3		
L6.8		Item 3.10: MS 550mm dia pipe (l=1655) fully flanged with puddle flange	No	2		
L6.9		Item 3.11: MS 400mm dia Equal tee, fuly flanged with 505mm spool piece	No	4		
		TOTAL CARRIED FORWARD			R	

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	ADJUSTED RATE	AMOUNT
		TOTAL BROUGHT FORWARD				R
L6.10		Item 3.12 MS 650mm dia S-Bend pipe both ends flanged	No	1		
L6.11		Item 3.13 MS 550mm dia S-Bend pipe both ends flanged	No	1		
L6.12		Item 3.14 MS 650mm Blind flange	No	1		
L6.13		Item 3.15: MS 550mm dia pipe (l=1045) fully flanged with puddle flange	No	3		
L6.14		Item 3.16: MS 550 x 300mm dia tee with 300mm spool piece fully flanged	No	1		
L6.15		Item 3.17: MS 550mm Blind flange	No	2		
L6.16		Item 3.18: MS 300mm Blind flange	No	1		
L6.17		Item 3.19: MS 650mm dia 37.65 deg long radius bend with spool piece fully flanged	No	1		
L6.18		Item 3.20: MS 500mm dia Tee with 505 spool piece fully flanged	No	2		
L6.19		Item 3.21: MS 400mm dia Tee with 505 spool piece fully flanged	No	2		
L6.20		Item 3.22: MS 250mm dia Tee with 505 spool piece fully flanged	No	1		
L6.21		Item 3.23: MS 400mm dia Sweeping Tee with 505 spool piece fully flanged	No	3		
L7		**Expansion Joints**				
L7.1		Item 6.1: SS 650mm dia Expansion Joint	No	1		
L7.2		Item 6.2: SS 550mm dia Expansion Joint	No	1		
L7.3		Item 6.3: SS 250mm dia Expansion Joint	No	1		
L8		**Supply, install and commission Pumps**				
L8.1		KSB SA OMEGA 250-480A (423 impeller) with a WEG 250kW 380v 355 M/L 4p motor or similar approved including base plate, supply and delivery pipe modifications to ensure fit, capable of following duty: 275l/s at 51.5m with range from 43.5 to 57	Item	3		
L8.2		Provisional sum to change pipe work to suit selected pump in and outlets	Sum	1		
L8.3		Provisional sum MCC and electrical controls	Sum	1		
L8.4		Provisional sum for lighting, socket outlets, cables, earthing and bonding, ups and lightning protection.	Sum	1		
L9		**Pipeline route markers**				
L9.1	PSL 8.2.18	Route markers are to be constructed with a 100mm pvc sleeve filled with 20MPa concrete, as per drawing 1440b/WA/Lay01 & 02	No	10		
L10	PL GD	**Standby Generator**				
L10.1		Design and other documentation	Item	1		
L10.2		Procurement/Fabrication/Installation, Testing ar	Item	1		
L10.3		Installation/Testing and comssioning	Item	1		
		TOTAL FOR SECTION L CARRIED FORWARD TO SUMMARY				**R**

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	ADJUSTED RATE	AMOUNT
	SABS 1200 LB	**SECTION LB: BEDDING FOR PIPES**				
LB1	8.2.1	PROVISION OF BEDDING **Available from trench excavation without the need for screening or treatment:**				
		Steel pipes (non flexible pipe bedding)				
LB1.1		(a) Selected granular material	m³	326		
LB1.2		(b) Selected fill material	m³	975		
		Including screening and/or other treatment:				
		Steel pipes (non flexible pipe bedding)				
LB1.3		(a) Selected granular material	m³	66		
LB1.4		(b) Selected fill material	m³	195		
LB2	8.2.2 8.2.2.2 & 8.2.2.3	**Supply of imported bedding material from:** Borrow pits or commercial sources (Provisional)				
LB2.1		(a) Selected granular material	m³	33		
LB2.2		(b) Selected fill material	m³	98		
LB2.3		Supply and place 6-20 mm graded stone as directed by the Engineer	m³	75		
LB2.4	PSLB 8.2.6	Extra over items 8.2.1 and 8.2.2 for bedding stabilized with 5% cement	m³	15		
	TOTAL FOR SECTION LB CARRIED FORWARD TO SUMMARY				**R**	

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	TENDER	ADJUSTED RATE	AMOUNT
	SANS 1200 LD	**SECTION LD : SEWERS**				
LD1		PIPE WORK **Supply, handle, lay, join (butt-fusion) bed in specified class, test and disinfect HDPE pipe PE100, PN12,5, SDR 13,6 (SANS 4427):**				
LD1.1 SC		(a) 110 mm dia (measured under Work Packages)	m	157		
LD2	8.2.3	MANHOLES **Manholes (1000mm inside diameter) to complete with concrete cover and frame, for depths :** Over and up to :				
LD2.1 SC		(a) 3.0 m 4,0 m (measured under Work Packages)	No	4		
LD2.2 SC		Extra-over items LD2.1 to LD2.3 for "Heavy Duty" cover and frame in road areas (measured under Work Packages)	No	4		
LD2.3 SC	8.2.7	Encasing 110mm dia pipes in 15 MPA concrete (measured under Work Packages)	m^3	6		
LD2.4 SC	8.2.11	Break into existing manhole, connect new network and make good (measured under Work Packages)	No	1		
	TOTAL FOR SECTION LD CARRIED TO SUMMARY				**R**	

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	ADJUSTED RATE	AMOUNT
	SANS 1200LG	**SECTION LG: PIPE JACKING**				
		PIPE JACKING AT ROAD CROSSINGS				
LG1	8.2.1	**Jacking Establishment for 2 positions:**				
LG1.1		Fixed charges	Sum	2		
LG1.2		Time related charges	Sum	2		
LG2	8.2.2	**Supply and delivery of pipes to be jacked:**				
LG2.1		900 mm ø Class 100-D with In-the-wall rubber ring joint.	m	55		
LG3	8.2.3	**Jacking of pipes:**				
LG3.1		900 mm ø Class 100-D with In-the-wall rubber ring joint.	m	55		
LG4	8.2.4	**Excavation for jacking using hand held pneumatic tools:**				
LG4.1		Soft excavation-with clay spade attachments	m^3	53		
LG4.2		Intermediate	m^3	13		
LG4.3		Extra over LG4.1 for unforseen rock or boulders in the Jacking pit	m^3	13		
LG6	8.2.9	**Stabilization of unstable areas and grouting of voids where necessary**				
LG6.1		Provision and establishment of equipment on site and removal on completion	No	2		
LG6.2		Operation of equipment	Day	2		
LG6.3		Material used based on 10:1 sand cement mix	m^3	33		
		TOTAL FOR SECTION LG CARRIED TO SUMMARY			**R**	

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	ADJUSTED RATE	AMOUNT
	SABS 1200 ME	**SECTION ME: SUBBASE**				
ME1	8.3.2	SUBBASE				
ME1.1 SC		Construct gravel subbase with material from commercial source and compact to 97% Mod AASHTO for paved areas (measured under Work Packages)	m³	130.00		
ME2	8.3.5	**Process material by means of:**				
ME2.1 SC		(a) Stabilization (measured under Work Packages)	m³	130.00		
ME3	8.3.8	STABILIZING AGENT				
ME3.1 SC		Portland cement (measured under Work Packages)	t	11.96		
		TOTAL FOR SECTION ME CARRIED TO SUMMARY			**R**	**0.00**

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	ADJUSTED RATE	AMOUNT
		SECTION MJ : SEGMENTED PAVING				
MJ1		CONSTRUCT PRECAST CONCRETE SEGMENTED PAVING				
MJ1.1 SC	PSMJ 8.2.2	**Provide and construct segmented paving lain in Herringbone pattern 60 mm thick, 25 Mpa Type S-A concrete paving blocks. Price must include bedding, sand layer, compaction and finishing (Colour to suit Client) (measured under Work Packages)**	m²	738		
MJ1.2 SC	8.2.3	Cut units to fit edge restraints (measured under Work Packages)	m	258		
MJ1.3 SC	8.2.4	Roll to Locked-up Condition as Specified in clause 5.6.2 (provisional) (measured under Work Packages)	m²	738		
		TOTAL FOR SECTION MJ CARRIED FORWARD TO SUMMARY			**R**	

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	ADJUSTED RATE	AMOUNT
		SECTION MK : KERBING AND CHANNELLING				
MK1 SC	8.2.1	**CONCRETE KERBING**				
		Figure 8 b precast kerbs for new construction				
MK1.1 SC		Radius over 20m (measured under Work Packages)	m	215		
MK1.2 SC		Radius less than 20m (measured under Work Packages)	m	43		
MK1.3 SC		Figure 13 precast edge beam for new construction (measured under Work Packages)	m	258		
MK2 SC		**TRANSITIONS**				
		From mountable kerb to vertical kerb (measured under Work Packages)	No	2		
MK3 SC		**TRIMMING**				
		Trimming of excavations for mountable kerbs :				
		(a) Soft (measured under Work Packages)	m²	60		
		(b) Intermediate (measured under Work Packages)	m²	10		
		TOTAL FOR SECTION MK CARRIED FORWARD TO SUMMARY			**R**	

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	ADJUSTED RATE	AMOUNT
	PART SPEC PLB	**SECTION PB: MISCELLANEOUS WORK FOR TANKS**				
PLB1	PLB 8.1	STERILIZATION				
PLB1.1		Reservoir and internal pipes	Sum	1		
PB1.2		Supply pipeline	Sum	1		
PB2	PLB 8.2	WATER TIGHTNESS				
PB2.1		Test for reservoir and pipes for water tightness	Sum	1		
PB3		PROTECTION SYSTEMS				
PB3.2		Aircraft warning light	Prov. Sum	1	112 500.00	112 500.00
PLB3.3		CP and DC Mitigation - Professional services and Installation	Prov. Sum	1	2 850 000.00	2 850 000.00
PLB3.4		Contractors mark-up on PB3.3 above	%	2 850 000		
PLB4	PGENR B1	FENCING				
PLB4.1 SC		2.4m high concrete fence as per drawing 1440a/WT/DET08 (measured under Work Packages)	m	302		
PLB4.2 SC	PGENR B1	Supply and install double sliding gate to match security fencing as per drawing 1440a/WT/DET08 (measured under Work Packages)	No	1		
PLB5		GUARD HOUSE				
PLB5.1 SC	PSTRU E	Construct guard house complete as per drawing 1440a/WT/DET06 (measured under Work Packages)	Sum	1		
PLB6		VALVE ROOM				
PLB6.1 SC	PSTRU E	Construct Valve Room as per drawing 1440a/WT/DET07 (measured under Work Packages)	Sum	1		
PLB6.2 SC		Supply and Install overhead Gantry beams complete with 3 ton Block and Tackle (measured under Work Packages)	Sum	1		
PLB7		GENERATOR ROOM				
PLB7.1 SC	PSTRU E	Modify existing Pump station to accommodate new generator (measured under Work Packages)	Prov. Sum	1	125 000.00	125 000.00
	TOTAL FOR SECTION PLB CARRIED TO SUMMARY				**R**	

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	ADJUSTED RATE	AMOUNT
	PART SPEC	**SECTION PLG: ELECTRICAL WORKS**				
PLG1		**LV Network and power supplies**				
PLG1.1 SC		Provisional amount for a 40A, Single phase ESKOM connection fee to the tower site in a position to be indicated on site. (measured under Work Packages)	P. Sum	1	43 750.00	43 750.00
PLG1.2 SC		Contractor's overhead, surcharge and profit on item PA1.1 (measured under Work Packages)	%	43 750		
PLG1.3 SC		Supply and install a single phase metering kisok to Eskom specification complete with meter and circuit breaker (measured under Work Packages)	No	1		
PLG2		**Conduit and Wiring**				
PLG2.1 SC		Conduit installed in ceiling void, masonry walls, floors, etc complete with all fixing accessories, couplings, bushes, locknuts, end boxes (50 x 100mm or 100 x 100mm as the case may be), terminations and male adapters				
		Supply, deliver and Install				
		(a) 25mm Ø galvanized steel (measured under Work Packages)	m	200		
		(b) 25mm Ø u-PVC (measured under Work Packages)	m	50		
PLG2.2 SC		Supply, deliver and install insulated stranded copper conductors				
		(a) 4 mm² (measured under Work Packages)	m	150		
		(b) 6 mm² (measured under Work Packages)	m	100		
		(c) 16mm² 4-core PVC/SWA/PVC (measured under Work Packages)	m	50		
PLG2.3 SC		Supply deliver and install insulated copper earth conductors				
		(a) 4 mm² (measured under Work Packages)	m	150		
		(b) 6 mm² (measured under Work Packages)	m	100		
		(c) 6mm² BCEW (measured under Work Packages)	m	30		
PA3		**Distribution Boards**				
PA3.1 SC		Design and manufacture new factory wired distribution board complete as per schematic diagram and specification. Delivery, offloading, installation and commissioning of new factory wired distribution board				
		(a) DB-Main at Guard House (measured under Work Packages)	No	1		
		(b) Sub DB for Valve room (measured under Work	No	1		
PA4		**Luminaires**				
PA4.1 SC		Light fittings complete with lamps and fixing accessories with 5Amp plugs and boxes				
		(a) Supply, deliver and install Type 1 luminaire (2x54W Open channel) (measured under Work Packages)	No	10		
		(b) Supply, deliver and install Beka Dart, spotlight with 70W MH lamp (or similar approved). (measured under Work Packages)	No	8		
PA5		**Socket Outlets**				
PA5.1 SC		Supply, deliver and install 16A normal surface mounted outdoor water proof single socket outlet complete. (measured under Work Packages)	No	4		
PA5.2 SC		Supply, deliver and install 16A normal embedded in the wal single socket outlet complete. (measured under Work Packages)	No	6		
		TOTAL CARRIED FORWARD			R	

ITEM NO	PAYMENT REFERS	SHORT DESCRIPTION	UNIT	QUANTITY	ADJUSTED RATE	AMOUNT
		TOTAL BROUGHT FORWARD			R	
PA6 SC		**Light switches complete as specified** Supply, deliver and install 16A single lever one-way light switch (measured under Work Packages)	No	6		
		Provisional Sum for Solar Led Flood Lightining as per below specifications	Prov sum	1	500 000.00	500 000.00
		Solar LED High Masts Floodlights complete as per and in accordance Clause **PSW1,PSW2,PSW3,PSW4,PSW5,PSW6,PSW7,PSW8 of portion C: Particular Project Specification.**				
		TOTAL FOR SECTION PLG CARRIED TO SUMMARY			**R**	

Johannesburg Water SOC Ltd

Johannesburg Water

Construction of a 2.25Ml Water Tower in Robertsville (With Associated Works)

VOLUME 2

PART 3: SCOPE OF WORK

PREAMBLE TO SCOPE OF WORK

General

The Standard Specification for all associated civil work shall be the SANS 1200 – Standardized Specification for Civil Engineering Construction.

The Standardized Specifications applicable to this Contract are listed in the Project Specification.

These Specifications are not issued with this volume but are available at the Contractor's expense from: SA Bureau of Standards, Private Bag X191, Pretoria, 0001.

Scope

This Project Specification is set out in two portions:

Portion 1: PROJECT SPECIFICATION covers a general description of the project, the facilities available and the requirements to be met.

Portion 2: VARIATIONS AND ADDITIONS TO THE STANDARDISED SPECIFICATIONS covers variations to the standardized specifications and particular specifications which are applicable to the contract.

Status

Should any requirement of the Project Specification conflict with any requirement of the standardized or particular specifications, the requirements of the Project Specifications shall prevail.

C3.1 DESCRIPTION OF THE WORKS

C3.1.1 JW OBJECTIVES

The employer's objective is to augment the deficient storage capacity, to improve residual pressures and to reduce the number of RW directly fed zones to improve the level of service to the consumers.

C3.1.2 OVERVIEW OF THE WORKS

This Contract comprises inter alia of the construction of the Robertville 2.25Ml Water Tower site with the 650mm diameter supply pipeline from the existing reservoir approximately 1km away.

The work is broadly described, but not limited to deliver:

- 2.25Ml concrete water tower, with associated piping
- Valve room at new tower site
- Guard and Telemetry buildings
- Scour/Overflow structures
- Perimeter fence at reservoir and tower sites
- Paved access and parking areas
- Sewer line to service guard house
- 650mm diameter steel supply pipe from existing Reservoir to New Tower
- 650mm diameter steel delivery pipe from New Tower to Existing Network
- All shutdown arrangements for tie-ins of the supply and delivery pipes to existing infrastructure
- Cathodic protection for new pipeline
- Telemetry for pump operations
- Supply and install pumps at Reservoir site
- Supply and install generator at Reservoir site
- Pipework at reservoir site and new tower site to connect new supply pipe

This description of the Works is not necessarily complete and shall not limit the work to be carried out by the Contractor under this Contract. Approximate quantities of each type of work are given in the Bill of Quantities.

C3.1.3 LOCATION OF THE WORKS

The proposed tower site is located on open land in Robertsville on the corner of Anvil and Nadine streets. The existing reservoir site is located on the corner of Dikbas and Robert streets and the tower is located on the corner of Anvil and Nadine streets, as shown on the locality plan below. The site is fairly level and is sparsely covered by veld grass. The site area will have to be fenced, and the contractor must provide a security guard 24 hours a day. A temporary entrance and access must be created.

Locality Plan

C3.1.4 TEMPORARY WORKS

The Contractor shall construct all temporary works as required by the contractors Construction method. The tendered rates shall include full compensation for all temporary works.

C3.2 ENGINEERING

C3.2.1 DESIGN

(a) The Employer is responsible for the design of the permanent Works as reflected in the Contract Documents unless otherwise stated.
(b) The Contractor is responsible for the design of the temporary Works and their compatibility with the permanent Works.
(c) The Contractor shall supply all details necessary to assist the Engineer in the compilation of the as-built drawings.

C3.2.2 JW's DESIGN

The employer's design is as detailed in the documentation and on the drawings.

C3.2.3 CONTRACTOR'S DESIGN

Where contractor is to supply the design of designated parts of the permanent Works or temporary Works he shall supply full working drawings supported by a professional engineer's design certificate.

C3.2.4 DRAWINGS

The Contractor shall use only the dimensions stated in figures on the Drawings in setting out the Works, and dimensions shall not be scaled from the Drawings, unless required by the Engineer. A list of the tender drawings is shown in the table below. The Engineer will, on the request of the Contractor in accordance with the provisions of the Conditions of Contract, provide such dimensions as may have been omitted from the Drawings.

The Contractor shall ensure that accurate as-built records are kept of all infrastructure installed or relocated during the contract. The position of pipe bends, junction boxes, duct ends, and all other underground infrastructure shall be given by either co-ordinates, or stake value and offset. Where necessary, levels shall also be given. A marked-up set of drawings shall also be kept and updated by the Contractor. This information shall be supplied to the Engineer's Representative on a regular basis.

PLAN No	DESCRIPTION
1440A/WA/KEY01R	Key Plan and list of Drawings
1440A/WA/LAY01R	Tower Site Plan
1440A/WT/LAY01R	Tower Site and Earthworks Plan
1440A/WT/DET01R	Tower Foundation and Roof Plan
1440A/WT/DET02R	Tower Section and Elevation
1440A/WT/DET03R	Staircase and Grating Details
1440A/WT/DET04R	Access Ladder details – sheet 1 of 2
1440A/WT/DET05R	Access Ladder details – sheet 2 of 2
1440A/WT/DET06R	Guardhouse Detail
1440A/WT/DET07R	Valve Room Details
1440A/WT/DET08R	Fence Details
1440A/WT/PIPE01R	Tower Pipework Layout – sheet 1 of 4
1440A/WT/PIPE02R	Tower Pipework Layout – sheet 2 of 4
1440A/WT/PIPE03R	Tower Pipework Layout – sheet 3 of 4
1440A/WT/PIPE04R	Tower Pipework Layout – sheet 4 of 4
1440A/WT/PIPE05R	Pipes on Tower Site – sheet 1 of 2
1440A/WT/PIPE06R	Pipes on Tower Site – sheet 2 of 2
1440A/ST/DET01R	Manhole Details
1440A/ST/DET02R	Valve Room Building Details
1440A/ST/DET03R	Tower Reinforcement Details – sheet 1 of 2
1440A/ST/DET04R	Tower Reinforcement Details – sheet 2 of 2
1440A/SE/LAY01R	Guard house sewer
1440b/RE/LAY01R	Reservoir Site and Pipe Layout Plan
1440b/RE/PIPE01R	Reservoir site pipe layout and details
1440b/WA/LAY01R	Supply Pipe Longitudinal Section: 0 to 600m
1440b/WA/LAY02R	Supply Pipe Longitudinal Section: 600 to 980m

All information in possession of the Contractor, required by the Engineer and/or the Engineer's Representative to complete the as-built/record drawings, must be submitted to the Engineer's Representative before a Certificate of Completion will be issued. The Drawings prepared by the Employed for the permanent Works are listed and bound at the back of this volume. The Employer reserves the right to issue amended and/or additional drawings during the Contract.

C3.2.5 DESIGN PROCEDURES

All design and modifications thereto shall be communicated in writing and the contractor and engineer shall maintain lists to record and track all transactions.

C3.3 PROCUREMENT

C3.3.1 PREFERENTIAL PROCUREMENT

C3.3.1.1 Requirements

The Contractor shall comply with the requirements as specified in the documentation.

C3.3.2 SUBCONTRACTING

C3.3.2.1 Scope of mandatory subcontract works

All matters pertaining to sub-contractors (including nominated sub-contractors) and the works executed by them shall be dealt with directly between the engineer and the Contractor in the context of all sub-contractors' work being an integral part of the works for which the Contractor is responsible. The engineer will neither liaise directly with any subcontractors nor issue instructions concerning the sub-contractors' works directly to any sub-contractor. All matters arising out of the sub-contractor agreements shall be dealt between the contractor and the sub-contractor and the engineer will not become involved.

C3.3.2.2 Preferred subcontractors/suppliers

Preferably City of Johannesburg based (COJ) based.

C3.3.2.3 Subcontracting procedures

As per JW 6.3

C3.3.2.4 Attendance on subcontractors

Not applicable.

C3.4 CONSTRUCTION

C3.4.1 WORKS SPECIFICATIONS

C3.4.1.1 Applicable SABS 1200 Standardized Specifications

Although not bound in or issued with this document, the SANS 1200 Standardized Specification for Civil Engineering Construction as approved by the Council of the South African Bureau of Standards shall apply to this Contract. The Contractor shall be in possession of these Standardized Specifications and their related SANS 0120 Code of Practice which apply equally and shall keep a copy of each on site for reference by him and the Engineer for the duration of the Contract.
For "Workmen's Compensation Act" read "Compensation for Occupational Injuries and Diseases Act, 1993 (Act No.130 of 1993)" wherever it appears. For "Machinery and Occupational Safety Act" and "Mines and Works Act" read "Occupational Health and Safety Act, 1993 (Act 85 of 1993)" wherever they appear. For “maintenance period” read “Defects Liability Period” in terms of Clause 5.16.3 of the General Conditions of Contract for Construction Works 2015, wherever it appears.
The Construction Sections of the Works shall be executed in accordance with the Specifications listed below and other such pertinent Specifications and / or instructions as may be issued from time to time.

The following SABS 1200 Standardized Specifications for civil engineering construction are applicable:

SABS 1200 A	:	Preliminary and General
SABS 1200 C	:	Site clearance
SABS 1200 D	:	Earthworks
SABS 1200 DB	:	Earthworks (pipe trenches)
SABS 1200 G	:	Concrete (Structural)
SABS 1200 HA	:	Structural Steelwork
SABS 1200 HC	:	Corrosion protection of Structural Steelwork
SABS 1200 L	:	Medium-pressure pipelines
SABS 1200 LB	:	Bedding (pipes)
SABS 1200 LD	:	Sewer
SABS 1200 LG	:	Pipe Jacking
SABS 1200 ME	:	Subbase
SABS 1200 MJ	:	Segmented paving
SABS 1200 MK	:	Kerbing and channelling

C3.4.1.2 Particular Specifications

The following Particular Specifications for work not covered by the SABS 1200 Standardized Specifications are also included hereunder:

PG G	:	Specification for alternative designs of structures or structural elements
PGENR B1	:	General Fencing
PH A	:	Structural Steel
PL A	:	Specification for low pressure valves
PL B	:	Disinfecting, testing for water tightness and compliance with specifications
PL C	:	Join med press steel pipes
PL E	:	Corrosion protection steel pipes
PL F	:	Manufacture med press steel pipe
PL G	:	Electrical specification
PL GA	:	Telemetry

PL GB : Pumps
PL GC : Variable speed drives
PL GD : Standby Diesel Generator
PL HA : Cement Mortar Lining
PSTRU E : Building work

The above engineering specifications shall take precedence over any other SABS specification for the project.

C3.4.1.3 Variations and Additions to the SABS 1200 Standardized Specifications

Variations and additions to the following SABS 1200 Standardized Specifications were made.

SABS 1200 A : General
SABS 1200 C : Site clearance
SABS 1200 D : Earthworks
SABS 1200 DB : Earthworks (pipe trenches)
SABS 1200 G : Concrete (Structural)
SABS 1200 L : Medium-pressure pipelines
SABS 1200 LB : Bedding (pipes)
SABS 1200 LD : Sewer
SABS 1200 ME : Subbase
SABS 1200 MJ : Segmented paving
SABS 1200 MK : Kerbing and channelling

The following variations and additions to the SABS 1200 Standardized Specifications referred to above apply to this Contract. The prefix PS indicates an amendment to SABS 1200. The letters and numbers following these prefixes respectively indicate the relevant Standardized Specification and clause numbers in SABS 1200 to which the variation or addition thereto applies.

C3.4.2 CONSTRUCTION PROGRAMMING

C3.4.2.1 Programmes and reports required
In addition to the requirements of Clause 5.6.2 of the Conditions of Contract, the following requirements shall prevail:

Contractual programme
A contractual programme, meaning: a chart showing the different sections of construction making up the Works and the order, resourcing and sequence in which the work is to be carried out in order to achieve completion on the prescribed dates shall be submitted with the Contractor's tender. This programme shall, upon the Engineer's agreement in writing become binding on the parties to the contract. Such program shall include for possible delays for inclement weather. The Contractual program shall in addition clearly indicate any Contractor's float as may be applicable.

Construction programme
A construction programme, meaning: an agreed chart which shall be used to monitor the progress of the works shall be submitted within 28 days of agreement of the contractual programme by the Engineer. This chart shall, as far as is practical, be based upon the agreed contractual programme, but shall not in any way relieve either party of their obligations or rights in terms of the contractual programme or the contract. The chart shall show the different sections of the Works suitably divided into elements and activities, clearly indicating the start and completion dates of each activity and element against which the progress shall be monitored. The Contractor is advised to determine the programming requirements of section 5.6 of GCC 2015 described below.

Reports required
The Contractor shall provide the Engineer a fortnightly report detailing the following:
a) Date of report
b) Working days elapsed from start
c) Working days left to contractual completion and/or key dates and forecast of any slippage envisaged
d) Percentage of work complete per activities on construction programme and forecast remaining time and resources required
e) Supervisory staff and labour force on site
g) List of constructional plant
h) Delays encountered
i) Information required

j) Variation Orders and site instructions received
k) Claims status (if any)
l) Weather delays
m) Signature of site agent

The Contractor shall in addition provide the Employer with weekly returns showing the number and grade of Employees employed and the number and type of Constructional Plant on site.

C3.4.2 SITE ESTABLISHMENT

C3.4.2.1 Services and facilities provided by the Employer

(a) Water sources

A reticulated potable water supply is available in the vicinity of the Site. The responsible water supply authority in the area of the Site is Johannesburg Water. Should the Contractor wish to utilise such water supply, he shall himself be responsible for making his own arrangements with the responsible water supply authority for the supply of all water that he may require from such reticulation network for construction purposes as well as for domestic consumption. If so required by the responsible water supply authority, the Contractor shall further be responsible, at his own cost, for making or otherwise providing metered connections to the available services at the positions specified by the water authority, as well as for the removal of such connections on completion of the Contract. No warranty is offered or given by the Employer that the existing available reticulated water supply will necessarily be adequate for the Contractor's purposes nor that such supply is in any way guaranteed.

All charges as may be levied by the responsible water supply authority in respect of water consumed by the Contractor shall be for the Contractor's account and payment to the Contractor in respect thereof shall, be deemed to be included in the sums bid by the Contractor for the various Preliminary and General items listed in the Bill of Quantities, as well as in the rates bid by the Contractor for the various other items listed in the Bill of Quantities which require the consumption of water.

The Contractor shall, when reasonably required by the Engineer, produce documentary proof that all amounts as may have become due and payable by the Contractor to the responsible water authority have been promptly paid in full.

(b) Electricity supply

A reticulated electrical power supply is available in the vicinity of the Site. The responsible electricity supply authority in the area of the Site is Citi Power. Should the Contractor, wish to avail himself of such supply, he shall, at his own cost, be responsible for making his own arrangements with the responsible electricity supply authority for the supply of all electrical power he may require from such reticulation network for construction purposes as well as for domestic consumption. If so required by the responsible electricity supply authority, the Contractor shall, at his own cost, be responsible for making metered connections to the available services at the positions specified by the electricity supply authority, as well as for the removal of such connections on completion of the Contract. No warranty is offered or given by the Employer that the existing available reticulated electrical power supply will necessarily be adequate for the Contractor's purposes nor that its supply is in any way guaranteed.

All charges as may be levied by the responsible electricity supply authority in respect of electrical power consumed by the Contractor shall be for the Contractor's account and payment to the Contractor in respect thereof shall, be deemed to be included in the sums bid by the Contractor for the various Preliminary and General items listed in the Bill of Quantities, as well as in the rates bid by the Contractor for the various other items listed in the Bill of Quantities which require the consumption of electricity.

The Contractor shall, when reasonably required by the Engineer, produce documentary proof that all amounts as may have become due and payable by the Contractor to the responsible electricity supply authority have been promptly paid in full.

(c) Excrement disposal

The Contractor shall make use of Chemical Toilets. All costs for the maintenance and cleaning of the facilities shall be borne by the Contractor and shall be deemed to be included in the sums bid by the Contractor for the Various Preliminary and General items listed in the Bill of Quantities.

(d) Area for Contractor's site establishment

A specific area in close proximity to or on the Site of the Works will be made available by the Employer to the Contractor for the Contractor's site establishment. The specific area for the Contractor's site establishment will be identified to the Contractor by the Engineer and the Contractor shall have sole use of such area, free of charge, for the duration of the Contract. The Contractor shall use this area only for the purposes of erecting his site offices, workshops, stores and other facilities required for the execution of the Contract. The Contractor shall not use the area nor allow it to be used for any purposes not directly associated with the execution of the Contract. The Contractor shall be responsible for arranging, at his own cost, for the provision of all services he may require in the area, as well as elsewhere on the Site.

Should the Contractor deem the area made available by the Employer to be inadequate or unsuitable for the Contractor's particular needs, then the Contractor shall be at liberty to make his own arrangements with the owners of other sites which he considers are better suited to his needs; provided always that the use by the Contractor of any area other than that made available to him by the Employer shall be subject to the prior written approval of the Engineer, which approval shall not be unreasonably withheld; and provided further that the Contractor shall have no claim against the Employer in respect of any costs incurred by him, either directly or indirectly in consequence of utilising any area other than that made available to him by the Employer, and which costs exceed those costs allowed for by the Contractor in his Bid.

C3.4.2.2 Facilities provided by the Contractor

(a) Facilities for the Engineer

The Contractor shall provide on the Site, for the duration of the Contract and for the exclusive use of the Engineer and/or his Representative (as applicable), the various facilities described hereunder. All such facilities shall be provided promptly on the commencement of the Contract and failure on the part of the Contractor to provide any facility required in terms of this specification shall constitute grounds for the Engineer to withhold payment of the Contractor's bidded Preliminary and General items until the facility has been provided or restored as the case may be.

(i) Office accommodation

The Contractor shall provide on the Site one (1) office for the exclusive use of the Engineer. Such office shall comply with and be furnished in accordance with the requirements of subclause 3.2 of SABS 1200 AB. The Contractor shall maintain the office(s) in accordance with the requirements of subclause 5.2 of SABS 1200 AB. Such office accommodation shall be provided within the Contractor's site establishment facilities.

(ii) Carports

The Contractor shall provide on Site for the duration of the Contract, three (3) carports for the sole use of the Client, the Engineer and his staff. Each carport shall be constructed so that the vehicle parked under it is always protected against the direct rays of the sun. The carport area shall be at least 20 m² and the floor shall be covered with a layer of crushed stone to alleviate dusty and muddy conditions. The carport(s) shall be positioned to provide easy and convenient access to the Engineer's office.

(iii) Site meeting venue

The Contractor shall provide within his own site establishment facilities, a suitably furnished office or other venue capable of comfortably accommodating a minimum of **ten** (10) persons at site meetings. The Engineer shall be allowed free use of such venue for conducting any other meetings concerning the Contract at all reasonable times.

(iv) Contract nameboards

The Contractor shall provide, erect and maintain two (2) contract nameboards at such positions and locations directed by the Engineer, which nameboards shall, unless otherwise specified elsewhere in the Contract, comply with the recommendations for the standard board of the South African Association of Consulting Engineers, with regard to size, painting, decorating and detail, and the requirements described hereunder.

Each nameboard shall be made of tempered hardboard with a thickness of at least 12 mm, so braced on the reverse side as to prevent warping and shall be mounted on two or more, as necessary, firmly planted poles. The painting of the boards shall comply with the relevant requirements of CKS 193 and the colours of the paints shall be an acceptable match to the applicable colours given in SABS 1091. The Contractor

shall keep the contract nameboards in good state of repair for the duration of the Contract and shall remove them on completion of the Contract.

(v) Survey equipment and assistants

Survey equipment
The Contractor shall, for the duration of the Contract, provide the following survey equipment for the exclusive use of the Engineer and his staff:

- 1 upright reading automatic level with tripod;
- 1 metric levelling staff with protective cover bag;
- 6 ranging rods;
- 1 100 metre Stilon tape measure;
- 1 ± 2 kg hammer.

Whenever reasonably required by the Engineer, the Contractor shall make available to the Engineer or his representative, the following additional survey equipment:

- 1 tacheometer with tripod;
- 1 survey staff for tacheometer;
- 1 Distomat, complete with tripod and fully charged battery.

All such survey equipment provided by the Contractor shall be in good condition, properly calibrated and fit for the purpose and shall be kept fully serviceable at all times by the Contractor at his own cost. The Contractor shall have any defective equipment repaired or replaced at his own cost within 12 hours after notification by the Engineer's staff. Where required by the Engineer, the Contractor shall at his own cost, promptly arrange for the recalibration of survey equipment provided.

(vi) Telephone facilities
Cellphones
The Contractor shall pay the Engineer the fixed cost items scheduled in the bill to provide these services.

(ix) Electricity supply for the Engineer
All electricity supply to the Engineer's office(s) and laboratory (if applicable), whether provided by the Contractor by way of a reticulated supply from a local authority or other authorised electricity supply, or by way of on-site generators, shall be regulated by the Contractor to within limits such as to prevent damage due to fluctuations in the electrical current supply that may occur to any electrical plant and equipment provided by the Contractor or the Engineer.

The Contractor shall be liable for and pay to the Engineer on demand, all costs that the Engineer may incur in the repair or replacement of any electrical equipment provided by the Engineer on the Site. Reliance by the Contractor on the regulation of the electrical supply by the supplier or on current regulators fitted to generators shall not absolve the Contractor of his liabilities in terms of this Subclause and, where appropriate, the Contractor shall provide and install at his own cost, all such electrical current-regulating equipment as is necessary to prevent damage to the said equipment.

(x) Site instruction book
The Contractor shall keep a triplicate book for site instructions on the Site at all times.

(b) Water

The Contractor shall, at his own expense, be responsible for obtaining and providing all water as may be required for the purposes of executing the Contract, including water for both construction purposes and domestic use, as well as for making all arrangements in connection therewith. The Contractor shall further, at his own expense, be responsible for providing all necessaries for procuring, storing, transporting and applying water required for the execution of the Contract, including but not limited to all piping, valves, tanks, pumps, meters and other plant and equipment, as well as for all work and superintendence associated therewith. The sources of all water utilised for the purposes of the Contract shall be subject to the prior approval of the Engineer, which approval shall not be unreasonably withheld. The Contractor shall comply with all prevailing legislation in respect of drawing water from natural and other sources and shall, when required by the Engineer, produce proof of such compliance. The distribution of water shall be carried out by the Contractor strictly in accordance with the applicable laws and regulations.

All water provided by the Contractor for construction purposes shall be clean, free from undesirable concentrations of deleterious salts and other materials and shall comply with any further relevant specifications of the Contract. The Contractor shall, whenever reasonably required by the Engineer, produce test results demonstrating such compliance. Water provided by the Contractor for human consumption shall be healthy and potable to the satisfaction of the health authorities in the area of the Site.

No separate payment will be made to the Contractor for the obtainment, providing and consumption of water, the costs of which will be deemed to be included in the Contractor's bid rates.

(c) Electricity

The Contractor shall, at his own expense, be responsible for obtaining and providing all electricity as he may require for the purposes of executing the Contract, including electricity for both construction purposes and domestic use, as well as for making all arrangements in connection therewith. The distribution of electricity shall be carried out by the Contractor strictly in accordance with the applicable laws and regulations. No separate payment will be made to the Contractor for the obtainment, providing and consumption of electricity, the costs of which will be deemed to be in the Contractor's bidded rates and prices.

(d) Excrement disposal

The Contractor shall, at his own expense, be responsible for safely and hygienically dealing with and disposing of all human excrement and similar matter generated on the Site during the course of the Contract, to the satisfaction of the responsible health authorities in the area of the Site and the Engineer. All such excrement shall be removed from the Site and shall not be disposed of by the Contractor on the Site. The Contractor shall further comply with any other requirements in this regard as may be stated in the Contract.

No separate payment will be made to the Contractor in respect of discharging his obligations in terms of this subclause and the costs thereof shall be deemed to be included within the Contractor's bidded Preliminary and General items.

C3.4.2.3 Site usage

The site shall only be used for the construction of the works.

C3.4.2.4 Permits and wayleaves

The Employer shall be responsible to obtain all the wayleaves required for this Contract.

C3.4.2.5 Features requiring special attention

(a) Site maintenance

During progress of the work and upon completion thereof, the Site of the Works shall be kept and left in a clean and orderly condition. The Contractor shall store materials and equipment for which he is responsible in an orderly manner and shall keep the Site free from debris and obstructions.

b) Testing and quality control

(I) CONTRACTOR TO ENGAGE SERVICES OF AN INDEPENDENT LABORATORY

Notwithstanding the requirements of the Specifications pertaining to testing and quality control, the Contractor shall engage the services of an approved independent laboratory to undertake all testing of materials, the results of which are specified in, or may reasonably be inferred from, the Contract. These results will be taken into consideration by the Engineer in deciding whether the quality of materials utilised, and workmanship achieved by the Contractor comply with the requirements of the Specifications. The a foregoing shall apply irrespective of whether the specifications indicate that the said testing is to be carried out by the Engineer or by the Contractor. The Contractor shall be responsible for arranging with the independent testing laboratory for the timeous carrying out of all such testing specified in the Contract, at not less than the frequencies and in the manner specified. The Contractor shall promptly provide the Engineer with copies of the results of all such testing carried out by the independent laboratory. For the purposes of this clause, an "independent laboratory" shall mean an "approved laboratory" (as defined in subclause PSA 7.2) which is not under the management or control of the Contractor and in which the Contractor has no financial interest, nor which has any control or financial interest in the Contractor.

The Engineer shall be entitled at times during the Contract to require that the Contractor arrange with the independent laboratory to carry out any tests, at such times and at such locations in the Works as the Engineer shall prescribe. The Contractor shall promptly and without delay arrange with the independent laboratory for carrying out all such additional testing as required by the Engineer, and copies of the test results shall be promptly submitted to the Engineer.

(III) COSTS OF TESTING

(a) Tests

The costs of all testing carried out by the independent laboratory, above shall be borne by the Contractor and shall be deemed to be included in the bidded rates and prices for the respective items of work as listed in the Schedule of Quantities and which require testing in terms of the Specifications. No separate payments will be made by the Employer to the Contractor in respect of any testing.

Where, as a result of the consistency of the materials varying or as a result of failure to meet the required specifications for the work, it becomes necessary to carry out additional tests (eg re-tests on rectified work and/or replacement materials), the costs of such additional testing shall be for the Contractor's account.

(b) Additional tests required by the Engineer

The costs of any additional tests required by the Engineer shall be reimbursed to the Contractor against substitution of the Provisional Sum allowed therefore in the Schedule of Quantities; provided always that the costs of any such additional tests ordered by the Engineer, the results of which indicate that the quality of the materials utilised and/or the standard of workmanship achieved are/is not in accordance with the specifications, shall not be reimbursable to the Contractor.

(c) Subcontractors

All matters pertaining to subcontractors (including Nominated Subcontractors) and the work executed by them shall be dealt with directly between the Engineer and the Contractor in the context of all subcontract work being an integral part of the Works for which the Contractor is responsible. The Engineer will not liaise directly with any subcontractors nor will he issue instructions concerning the subcontract works directly to any subcontractor. All matters arising from the subcontract agreements shall be dealt with directly between the Contractor and the subcontractors and the Engineer will not become involved.

(d) Access to properties

The Contractor shall organise the work to cause the least possible inconvenience to the public and to the property owners adjacent to or affected by the work, and except as hereunder provided, shall at all times provide and allow pedestrian and vehicular access to properties within or adjoining or affected by the area in which he is working.

(e) Existing residential areas

Electricity and water supply interruptions in existing residential areas shall be kept to a minimum. The Engineer's approval shall be obtained prior to such interruptions and residents shall be notified in writing at least 24 hours but not more than 48 hours in advance. Supplies shall be normalised by 16:00 on the same day.

(f) Labour-intensive competencies of supervisory and management staff

Contractor having a CIDB contractor grading designation of 8CE and higher shall only engage supervisory and management staff in labour intensive works who have either completed, or for the period 1 July 2021 to 30 September 2021, are registered for training towards, the skills programme outlined in Table 1.

The managing principal of the contractor, namely, a sole proprietor, the senior partner, the managing director or managing member of a close corporation, as relevant, having a contractor grading designation of 1CE, 2CE, 3CE and 4CE shall have personally completed, or for the period 1 July 2016 to 30 June 2018 be registered on a skills programme for the NQF level 2. All other site supervisory staff in the employ of such contractors must have completed, or for the period 1 July 2018 to 30 March 2019 be registered on a skills programme, for the NQF level 2-unit standards or NQF level 4-unit standards.

Table 1: Skills programme for supervisory and management staff

Personnel	NQF level	Unit standard titles	Skills programme description
Team leader / supervisor	2	Apply Labour-intensive Construction systems and Techniques to Work Activities	This unit standard must be completed, **and**
		Use Labour-intensive Construction Methods to Construct and Maintain roads and Stormwater Drainage	one of these 3 unit standards be used
		Use Labour -intensive Construction Methods to Construct and Maintain Water and Sanitation Services	
		Use Labour-intensive Construction methods to Construct, Repair and Maintain Structures	
Foreman / supervisor	4	Implement Labour-intensive Construction systems and Techniques	This unit standard must be completed, **and**
		Use Labour-intensive Construction Methods to Construct and Maintain Roads and Stormwater Drainage	any one of these 3 unit standards be used
		Use Labour-intensive Construction Methods to Construct and Maintain Water and Sanitation Services	
		Use Labour-Intensive Construction Methods to Construct, Repair and Maintain Structures	
Site Agent / Manager (ie the contractor's most senior representative who is resident on the site)	5	Manage Labour-intensive Construction Processes	Skills Programme against this single unit standard

(a) Employment of unskilled and semi-skilled workers in labour-intensive works

(I) REQUIREMENTS FOR THE SOURCING AND ENGAGEMENT OF LABOUR

(1) Unskilled and semi-skilled labour required for the execution of all labour-intensive works shall be engaged strictly in accordance with prevailing legislation and SANS 1914-5, Participation of Targeted Labour.

(2) The rate of pay shall be as per sectoral guidelines.

(3) Tasks established by the contractor must be such that:

(aa) the average worker completes 5 tasks per week in 40 hours or less; and

(bb) the weakest worker completes 5 tasks per week in 55 hours or less.

(4) The Contractor must revise the time taken to complete a task whenever it is established that the time taken to complete a weekly task is not within the requirements of 1.1.3.

(5) The Contractor shall, through all available community structures, inform the local community of the labour-intensive works and the employment opportunities presented thereby. Preference must be given to people with previous practical experience in construction and/or who come from households:

(aa) where the head of the household has less than a primary school education;

(bb) that have less than one full-time person earning an income;

(cc) where subsistence agriculture is the source of income;

(dd) those who are not in receipt of any social security pension income.

(6) The contractor must provide monthly statistics to the Johannesburg Water indicating the number of new jobs created through this contract. This statistic must be provided with each monthly payment certificate using Councils electronic prescribed format, which will be provided by the Project Manager of this project to the successful bidder. Failure to provide the required statistics Council may withhold payment.

(II) SPECIFIC PROVISIONS PERTAINING TO SANS 1914-5

(1) Definition

Targeted labour: Unemployed persons who are employed as local labour on the project.

(2) Contract participation goals

(aa) There is no specified contract participation goal for the contract. The contract participation goal shall be measured in the performance of the contract to enable the employment provided to targeted labour to be quantified.

(bb) The wages and allowances used to calculate the contract participation goal shall, with respect to both time-rated and task-rated workers, comprise all wages paid and any training allowance paid in respect of agreed training programmes.

(3) Terms and conditions for the engagement of targeted labour

Further to the provisions of clause 3.3.2 of SANS 1914-5, written contracts shall be entered into with targeted labour.

(4) Variations to SANS 1914-5

(aa) The definition for net amount shall be amended as follows:

Financial value of the contract upon completion, exclusive of any value-added tax or sales tax which the law requires the employer to pay the contractor.

(bb) The schedule referred to in 5.2 shall in addition reflect the status of targeted labour as women, youth and persons with disabilities and the number of days of formal training provided to targeted labour.

(III) TRAINING OF TARGETED LABOUR

(1) The Contractor shall provide all the necessary on-the-job training to targeted labour to enable such labour to master the basic work techniques required to undertake the work in accordance with the requirements of the contract in a manner that does not compromise worker health and safety.

(2) The cost of the formal training of targeted labour, will be funded by the provincial office of the Department of Labour. This training will take place as close to the project site as practically possible. The Contractor must access this training by informing the relevant provincial office of the Department of Labour in writing, within 14 days of being awarded the contract, of the likely number of persons that will undergo training and when such training is required. The Employer must be furnished with a copy of this request.

(3) The contractor shall be responsible for scheduling the training of workers and shall take all reasonable steps to ensure that each beneficiary is provided with a minimum of six (6) days of formal training if he/she is employed for 3 months or less and a minimum of ten (10) days if he/she is employed for 4 months or more.

(4) The Contractor shall do nothing to dissuade targeted labour from participating in training programmes.

(5) An allowance equal to 100% of the task rate or daily rate shall be paid by the Contractor to workers who attend formal training, in terms of 1.3.4 above.

(6) Proof of compliance with the requirements of 1.3.2 to 1.3.6 must be provided by the Contractor to the Employer prior to submission of the final payment certificate.

(i) Employment of local labour

It is the intention that this Contract should make maximum use of the local labour force that is presently underemployed. To this end the Contractor shall limit the utilisation on the Contract of non-local employees to that of key personnel only and to employ and train local labour to the extent necessary for the execution and completion

of this Contract. The Contractor shall fill in the form entitled Key Personnel in the Forms to be completed by the Bidder. The data stated on the above-mentioned form will be strictly monitored during the Contract period and any deviations therefrom shall be subject to the prior approval of the Engineer, which approval shall not be unreasonably withheld.

The employment of casual labour will be done in co-operation with community leaders and local structures. The bidder shall ensure that all remuneration paid to employees is in line with the relevant sectorial determination in terms of the Basic Conditions of Employment Act, No 75 of 1997, as determined by the Department of Labour.

(j) Monthly statements and payment certificates

The statement to be submitted by the Contractor in terms of Clause 49 of the Conditions of Contract shall be prepared by the Contractor at his own cost, strictly in accordance with the standard payment certificate prescribed by the Engineer, in digital electronic computer format. The Contractor shall, together with a copy of the digital electronic computer file of the statement, submit two (2) A4 size paper copies of the statement.

For the purposes of the Engineer's payment certificate, the Contractor shall subsequently be responsible, at his own cost, for making such adjustments to his statement as may be required by the Engineer for the purposes of accurately reflecting the actual quantities and amounts which the Engineer deems to be due and payable to the Contractor in the payment certificate.

The Contractor shall, at his own cost, make the said adjustments to the statement and return it to the Engineer within three (3) normal workings days from the date on which the Engineer communicated to the Contractor the adjustments required. The Contractor shall submit to the Engineer five (5) sets of A4 size paper copies of such adjusted statement, together with a copy of the electronic digital computer file thereof.

Any delay by the Contractor in making the said adjustments and submitting to the Engineer the requisite copies of the adjusted statement for the purposes of the Engineer's payment certificate will be added to the times allowed to the Engineer in terms of Subclause 49.4 of the Conditions of Contract to submit the signed payment certificate to the Employer and the Contractor. Any such delay will also be added to the period in which the Employer is required to make payment to the Contractor.

(k) Construction in restricted areas

Working space is sometimes restricted. The construction method used in these restricted areas largely depends on the Contractor's Plant. Notwithstanding, measurement and payment will be strictly according to the specified cross-sections and dimensions irrespective of the method used, and the rates and prices bidded will be deemed to include full compensation for any difficulties encountered by the Contractor while working in restricted areas. Neither extra payment nor any claim for payment due to these difficulties will be considered.

(l) Notices, signs, barricades and advertisements

All notices, signs and barricades, as well as advertisements, may be used only if approved by the Engineer. The Contractor shall be responsible for their supply, erection, maintenance and ultimate removal and shall make provision for this in his bidded rates.

The Engineer shall have the right to instruct the Contractor to move any sign, notice or advertisement to another position, or to remove it from the Site of the Works if in his opinion it is unsatisfactory, inconvenient or dangerous.

(m) Workmanship and quality control

The onus to produce work that conforms in quality and accuracy of detail to the requirements of the Specifications and Drawings rests with the Contractor, and the Contractor shall, at his own expense, institute a quality control system and provide suitably qualified and experienced engineers, foremen, surveyors, materials technicians, other technicians and technical staff, together with all transport, instruments and equipment to ensure adequate supervision and positive control of the Works at all times. The cost of supervision and process control, including testing carried out by the Contractor, will be deemed to be included in the rates bidded for the related items of work.

The Contractor's attention is drawn to the provisions of the various Standardized Specifications regarding the minimum frequency of testing required. The Contractor shall, at his own discretion, increase this frequency where necessary to ensure adequate control.

On completion and submission of every part of the work to the Engineer for examination and measurement, the Contractor shall furnish the Engineer with the results of the relevant tests, measurements and levels to demonstrate the achievement of compliance with the Specifications.

C3.4.2.6 Extension of time due to abnormal rainfall

(a) Extension of time in respect of delays resulting from wet climatic conditions on the Site will only be considered in respect of abnormally wet climatic conditions and shall be determined for each calendar month or part thereof, in accordance with the formula given below:

$$V = (Nw - Nn) + (Rw - Rn)/X$$

in which formula the symbols shall have the following meanings:

V = Potential extension of time in calendar days for the calendar month under consideration:
If V is negative and its absolute value exceeds Nn, then V shall be taken as equal to minus Nn.
When the value of V for any month exceeds the number of days in the particular month, V will be the number of days in the month.

Nw = Actual number of days in the calendar month under consideration on which a rainfall of Y mm or more was recorded on the Site

Nn = Average number of days, derived from existing records of rainfall in the region of the Site, on which a rainfall of Y mm or more was recorded for the calendar month

Rw = Actual rainfall in mm recorded on the Site in an approved rain gauge for the calendar month under consideration

Rn = Average rainfall in mm for the calendar month, derived from existing records of rainfall in the region of the Site

The factor (Nw - Nn) shall be deemed to be a fair allowance for variations from the average number of days during which the rainfall exceeds Y mm.

The factor (Rw - Rn)/X shall be deemed to be a fair allowance for variations from the average number of days during which the rainfall did not exceed Y mm but wet conditions prevented or disrupted work.

(b) The rainfall records at rainfall station number [0476/339] Johannesburg International Airport for the period January 2010 to December 2014 are reproduced in the accompanying table, and the monthly averages (Rn and Nn) for this period shall, for the purposes of this Contract be taken as normal and as the values to be substituted for Rn and Nn in the formula above. The values of X and Y shall be 20 and 10 respectively.

The potential extension of time V has been calculated for each month and year of the period concerned to indicate the possible effect of the rainfall formula. The values of V were obtained by applying the rainfall formula and using the actual rainfall figures and the calculated values of Rn and Nn indicated in the table.

(c) The Contractor shall, at his own cost, provide and erect on the Site at a location approved by the Engineer, an approved rain gauge, which shall be fenced off in a manner which will prevent any undue interference by workmen and others. The Contractor shall, at his own cost, arrange for the reading of the rain gauge on a daily basis for the duration of the Contract. The gauge readings, as well as the date and time at which the reading was taken shall be recorded in a separate record book provided by the Contractor for this purpose. All entries in the rainfall record books shall be signed by the person taking the reading and the gauge shall be properly emptied immediately after each reading has been taken. If required by the Engineer, the Engineer shall be entitled to witness the reading of the gauge.

(d) The Contractor's claims in terms of Subclause 5.12 of the Conditions of Contract for extension of time in respect of delays resulting from wet climatic conditions on the Site during each month, shall be submitted in writing to the Engineer monthly;
provided always that

(i) the period allowed to the Contractor in terms of Clause 10.1 of the Conditions of Contract in which to submit his claim for each month shall be reduced to seven (7) days, calculated from the last day of the month to which the claim applies; and

(ii) the 28-day period allowed to the Engineer in terms of Subclause 10.1.5 of the Conditions of Contract in which to give his ruling on the claim, shall be reduced to fourteen (14) days.

The Contractor's monthly claim shall be accompanied by a copy of the signed daily rainfall readings for the applicable month.

(e) The extent of any extension of time which may be granted to the Contractor in respect of wet climatic conditions (whether normal or abnormal) shall be determined as the algebraic sum of the "V" values for each month between the Commencement Date and the Due Completion Date of the Contract, calculated in accordance with subclause C3.4.2.6(a) above;

provided always that

(i) rainfall occurring within the period of the Contractor's Christmas shut-down period (referred to in Subclause 1.6 of the Conditions of Contract) shall not be taken into account in the calculation of the monthly "V" values;

(ii) rainfall occurring during any period during which the Contractor was delayed due to reasons other than wet climatic conditions on the Site, and for which delay an extension of time is granted by the Engineer, shall not be taken into account in the calculation of the monthly "V" values;

(iii) if the algebraic sum of the "V" values for each month is negative, the time for completion will not be reduced on account of subnormal rainfall, and

(iv) where rainfall is recorded only for part of a month, the "V" value shall be calculated for that part of the month using pro rata values for Nn and Rn.

(f) The Engineer shall, simultaneous with granting any extension of time in terms of this clause, revise the Due Completion Date of the Contract to reflect an extension of time having been granted in respect of wet climatic conditions, to the extent of the algebraic sum of all the "V" values for all the preceding months of the Contract, less the aggregate of the "Nn" values for the remaining (unexpired) months of the Contract (viz less aggregate of the potential maximum negative "V" values for the remaining Contract Period). Thus, provided that where such period is negative, the Due Completion Date shall not be revised.

(g) Any extension of time in respect of wet climatic conditions granted in terms of this clause shall not be deemed to take into account delays experienced by the Contractor in repairing or reinstating damage to or physical loss of the Works arising from the occurrence of abnormal climatic conditions. Extension of time in respect of any such repairs or reinstatement regarding damage shall be the subject of a separate application for extension of time in accordance with the provisions of Clause 42 and Clause 48 of the Conditions of Contract.

RAINFALL TABLE

STATICAL INFORMATION:OR TAMBO AIRPORT 2010-2014		
	Percipitation	
Month	**Average Number of days with >= 1mm, Nn**	**Average Monthly (mm), Rn**
January	5.2	142.26
February	1.6	84.38
March	1.8	88.58
April	1.6	63.44
May	3.2	12.32
June	0.4	4.92
July	0	0
August	0	3.14
September	0.6	21.3
October	1.6	54.02
November	3	102.66
December	5.8	182.54
Total	**24.8**	**759.56**

C3.4.3 PLANT AND MATERIALS

C3.4.3.1 Plant and materials supplied by the employer

The Employer shall not supply any plant or materials.

C3.4.3.2 Materials, samples and shop drawings

(a) Samples
Materials or work which do not conform to the approved samples submitted, will be rejected. The Engineer reserves the right to submit samples to tests to ensure that the material represented by the sample meets the specification requirements. The costs of any such tests conducted by or on behalf of the Engineer, the results of which indicate that the samples provided by the Contractor do not conform to the requirements of the Contract, shall be for the Contractor's account.

C3.4.4 CONSTRUCTION EQUIPMENT

C3.4.4.1 Requirements for equipment

The Contractor's equipment shall be adequate to construct the works.

C3.4.4.2 Equipment provided by the employer

The Employer will not provide any equipment.

C3.4.5 EXISTING SERVICES

C3.4.5.1 Known services

All known services are indicated on the drawings. Exact positions cannot be guaranteed.

C3.4.5.2 Treatment of existing services

The Contractor shall ascertain and observe all conditions laid down by the relevant authorities for the execution of the work in the vicinity of their services.

C3.4.5.4 Damage to services

If any services are damaged during excavations, the relevant service provider and the Engineer shall be notified immediately. The Contractor shall be responsible for all costs to repair damaged services.

C3.4.5.5 Reinstatement of services and structures damaged during construction

When the service provider does the permanent reinstatement, the cost involved shall be payable by the Contractor. When the contractor does the permanent reinstatement, the method of reinstatement shall be approved by the services provider.

PSA GENERAL

PSA 1 SCOPE

REPLACE THE CONTENTS OF SUBCLAUSE 1.1, INCLUDING THE NOTES, WITH THE FOLLOWING:
"1.1 This specification covers requirements, principles and responsibilities of a general nature which are generally applicable to civil engineering construction and building works contracts, as well as the requirements for the Contractor's establishment on the Site."

PSA 2 INTERPRETATIONS

PSA 2.3 DEFINITIONS

IN THE OPENING PHRASE BETWEEN THE WORDS "specification" *AND* "the following", *INSERT THE WORDS* "the definitions given in the Conditions of Contract and".

(a) General

ADD THE FOLLOWING DEFINITIONS:
" 'General Conditions' and 'Conditions of Contract': The General Conditions of Contract specified for use with this Contract, together with the Contract Data.

'Specified': As specified in the Standardized Specifications, the Drawings or the Project Specifications. 'Specifications' shall have the corresponding meaning."

(c) Measurement and payment

REPLACE THE DEFINITIONS FOR "Fixed charge", "Time-related charge" *AND* "Value-related charge" *WITH THE FOLLOWING:*

" 'Fixed charge': A charge that is not subject to adjustment on account of variations in the value of the Contract Price or the time allowed in the Contract for the completion of the work.

'Time-related charge': A charge, the amount of which varies in accordance with the Time for Completion of the Works, adjusted in accordance with the provisions of the Contract.

'Value-related charge': A charge, the amount of which varies pro rata with the final value of the measured work executed and valued in accordance with the provisions of the Contract.' "

PSA 2.4 ABBREVIATIONS

(a) Abbreviations relating to standard documents

ADD THE FOLLOWING ABBREVIATION:
"CKS: SABS Co-ordinating Specification."

PSA 3 MATERIALS

PSA 3.1 QUALITY

ADD THE FOLLOWING AT THE END OF SUBCLAUSE 3.1:
"All manufactured materials supplied shall be new materials unless the contrary is specified. All materials specified to be in accordance with SABS Specifications shall bear the SABS mark, where such a mark is available for the type of product."

PSA 4 PLANT

PSA 4.1 SILENCING OF PLANT

REPLACE THE CONTENTS OF SUBCLAUSE 4.1 WITH THE FOLLOWING:
"The Contractor's attention is drawn to the applicable regulations pertaining to noise and hearing conservation, framed under the Occupational Health and Safety Act, 1993 (Act No 85 of 1993) as amended.

The Contractor shall at all times and at his own cost, be responsible for implementing all necessary steps to ensure full compliance with such regulations, including but not restricted to the provision and use of suitable and effective silencing devices for pneumatic tools and other plant which would otherwise cause a noise level in excess of that specified in the said regulations.

Where appropriate, the Contractor shall further, by means of temporary barriers, effectively isolate the source of such noise in order to comply with the said regulations."

PSA 4.2 CONTRACTOR'S OFFICES, STORES AND SERVICES

ADD THE FOLLOWING PARAGRAPH BEFORE THE EXISTING FIRST PARAGRAPH IN SUBCLAUSE 4.2:

"The Contractor's buildings, sheds and other facilities erected or utilised on the Site for the purposes of the Contract shall be fenced off and shall contain all offices, stores, workshops, testing laboratories, toilet facilities, etc. as may be required by the Contractor. The facilities shall always be kept in a neat and orderly condition.

No personnel may reside on the Site. Only night-watchmen may be on the Site after hours."

DELETE "and first-aid services" *IN THE SECOND PARAGRAPH OF SUBCLAUSE 4.2 AND ADD THE FOLLOWING:*

"The Contractor shall provide on the Site and in close proximity to the actual locations where the work is being executed, one toilet per 10 workers, which toilets shall be effectively screened from public view and their use enforced. Such toilets shall be relocated from time to time as the location of the work being executed changes, so as to ensure that easy access to the toilets is maintained.

The Contractor shall, where applicable, make all necessary arrangements and pay for the removal of night soil."

PSA 5 CONSTRUCTION

PSA 5.1 SURVEY

PSA 5.1.2 Preservation and replacement of survey beacons and pegs subject to the Land Survey Act

DELETE THE WORDS "in the vicinity of boundaries" *IN THE SECOND SENTENCE OF SUBCLAUSE 5.1.2 AND REPLACE THE WORDS* "under the direction of" *IN THE SAME SENTENCE WITH* "in consultation and liaison with".

ADD THE FOLLOWING AFTER THE SECOND SENTENCE OF SUBCLAUSE 5.1.2:
"The Contractor and the Engineer shall record on the said list, their concurrence or disagreement (as the case may be) regarding the completeness and accuracy of the details recorded therein."

REPLACE THE THIRD SENTENCE OF SUBCLAUSE 5.1.2 WITH THE FOLLOWING:

"At the completion of the Contract, the Contractor shall expose all pegs that were listed at the commencement of the construction as being in order and the Contractor shall arrange with a registered Land Surveyor for the checking of the positions of all such pegs and the replacement of those that the Land Surveyor's check reveals have become disturbed or damaged. The Contractor shall, as a precedent to the issue of the Certificate of Completion, provide to the Engineer, a certificate from the registered land surveyor, certifying that all the pegs listed at the commencement of construction in accordance with the provisions of this clause, have been checked and that those found to have been disturbed, damaged or destroyed have been replaced in their correct positions, all in accordance with the provisions of the said Act.

The costs of all checking, replacement and certification as aforesaid shall be entirely for the Contractor's account. This, with the provision always that the Contractor shall not be held liable for the cost of replacement of pegs which:

(a) cannot reasonably be re-established in their original positions by reason of the finished dimensions of the permanent works, and

(b) the Contractor can prove beyond reasonable doubt to the satisfaction of the Engineer, were disturbed, damaged or destroyed by others beyond his control."

PSA 5.3 PROTECTION OF EXISTING STRUCTURES

REPLACE" Machinery and Occupational Safety Act, 1983 (Act No 6 of 1983)" *WITH* "Occupational Health and Safety Act, 1993 (Act No 85 of 1993), as amended," *AND INSERT THE FOLLOWING AFTER* "(Act No. 27 of 1956)": "as amended".

PSA 5.4 PROTECTION OF OVERHEAD AND UNDERGROUND SERVICES

REPLACE THE HEADING AND THE CONTENTS OF SUBCLAUSE 5.4 WITH THE FOLLOWING:

"PSA 5.4 LOCATION AND PROTECTION OF EXISTING SERVICES

PSA 5.4.1 Location of existing services

Before commencing with any work in an area, the Contractor shall ascertain the presence and actual position of all services which can reasonably be expected by an experienced and competent contractor to be present on, under, over or within the Site. Without in any way limiting his liability in terms of the Conditions of Contract in relation to damage to property and interference with services, the Contractor shall, in collaboration with the Engineer, obtain the most up-to-date plans as are available, showing the positions of services existing in the area where he intends to work. Neither the Employer nor the Engineer offers any warranty as to the accuracy or completeness of such plans and because services can often not be reliably located from plans, the Contractor shall ascertain the actual location of services depicted on such plans by means of careful inspection of the Site.

Thereafter, the Contractor shall, by the use of appropriate methodologies, carefully expose the services at such positions as are agreed to by the Engineer, for the purposes of verifying the exact location and position of the services. Where the exposure of existing services involves excavation to expose underground services, the further requirements of subclauses 4.4 and 5.1.2.2 of SABS 1200 D shall apply. The aforesaid procedure shall also be followed in respect of services not shown on the plans, but which may reasonably be anticipated by an experienced Contractor to be present or potentially present on the site.

All services, the positions of which have been determined as aforesaid at the critical points, shall henceforth be designated as 'known services' and their positions shall be indicated by the Contractor on a separate set of drawings, a copy of which shall be furnished to the Engineer without delay. As soon as any service which has not been identified and located as described above is encountered on, under, over or within the site, it shall henceforth be deemed to be a known service and the aforesaid provisions pertaining to locating, verifying and recording its position on the balance of the site shall apply. The Contractor shall notify the Engineer immediately when any such service is encountered or discovered on the Site. Whilst he is in possession of the Site, the Contractor shall be liable for all loss of or damage as may occur to

(a) known services, anywhere along the entire lengths of their routes, as may reasonably be deduced from the actual locations at which their positions were verified as aforesaid, due cognizance being taken of such deviations in line and level which may reasonably be anticipated, and
(b) any other service which ought reasonably to have been a known service in accordance with the provisions of this clause.

The Contractor shall also be liable for consequential damage in regard to (a) and (b), whether caused directly by the Contractor's operations or by the lack of proper protection.

No separate payment will be made to the Contractor in respect of his costs of providing, holding available on the Site and utilising the said detecting and testing equipment, nor for any costs incurred in preparing and submitting to the Engineer the Drawings as aforesaid. These costs shall be deemed included in the Contractor's other tendered rates and prices included in the Contract.

Payment to the Contractor in respect of exposing services at the positions agreed by the Engineer and as described above will be made under the payment items (if any) as may be provided for in the respective sections of the specifications pertaining to the type of work involved.

PSA 5.4.2 Protection during construction

The Contractor shall take all reasonable precautions and arrange its operations in such a manner as to prevent damage occurring to all known services during the period which the Contractor has occupation and/or possession of the Site.

Services left exposed shall be suitably protected from damage and in such a manner as will eliminate any danger arising therefrom to the public and/or workmen, all in accordance with the requirements of the prevailing legislation and related regulations. Unless otherwise instructed by the Engineer, no services shall be left exposed after its exact position has been determined and all excavations carried out for the purpose of exposing underground services shall be promptly backfilled and compacted. In roadways, the requirements of subclause 5.9 of SABS 1200 DB should be observed. In other areas compaction is to be to 93% modified AASHTO density.

PSA 5.4.3 Alterations and repairs to existing services

Unless the contrary is clearly specified in the Contract or ordered by the Engineer, the Contractor shall not carry out alterations to existing services. When any such alterations become necessary, the Contractor shall promptly inform the Engineer, who will either make arrangements for such work to be executed by the owner of the service or instruct the Contractor to make such arrangements himself.

Should damage occur to any existing services, the Contractor shall immediately inform the Engineer, or when this is not possible, the relevant authority, and obtain instructions as to who should carry out repairs. In urgent cases, the Contractor shall take appropriate steps to minimise damage to and interruption of the service. No repairs of telecommunication cables or electric power lines and cables shall be attempted by the Contractor.

PSA 5.5 DEALING WITH WATER ON WORKS

The contractor shall in particular keep free from water the entire working area. The temporary works should divert the bulk of the water. The contractor shall supply, operate and maintain such pumping plant as may be necessary to remove, control and dispose any water, including seepage, that may enter the Works. The Engineer may take or order the Contractor to take additional precautions where he is not satisfied with the Contractor's arrangements. The contractor shall not be relieved of his responsibility by reason of the Engineer taking or ordering additional precautions, or by reason of the engineer failing to do so. All expenditure incurred by JRA in taking any additional precautions or otherwise in remedying the default of the Contractor and making good of the Works shall be recovered from the moneys due to the Contractor. The Contractor shall be responsible to effect all dewatering to enable the Contractor to access and execute the Works.

The Contractor shall be responsible for the full adequate protection of the works against damage due to storms, rain, floods, stormwater, subsoil water and seepage from whatever source. The Contractor shall take over the site where the works has to be executed at the beginning of the Contract Period and the full risk and cost of dealing with all water shall be borne by the Contractor. The Contractor shall also provide all necessary pipe work, pumps and other appliances necessary for adequate dewatering of all excavations and shall maintain these in good condition and provide adequate standby equipment to ensure that no disruption of work will ensue as a result of possible breakdown of equipment.

A lump sum amount shall be provided in the Bill of Quantities to allow for the complete protection against water of any nature whatsoever, and for all dewatering where necessary.

SCHEDULED ITEM
Protection against water and storms Unit: Sum

PSA 5.7 SAFETY

REPLACE THE CONTENTS OF SUBCLAUSE 5.7 WITH THE FOLLOWING:

"Pursuant to the provisions of the Conditions of Contract, and without in any way limiting the Contractor's obligations thereunder, the Contractor shall at his own expense (except only where specific provision (if any) is made in the Contract for the reimbursement to the Contractor in respect of particular items), provide the following:

(a) Provide to its Employees on the site of the works, all safety materials, clothing and equipment necessary to ensure full compliance with the provisions of the Occupational Health and Safety Act, 1993 (Act No 85 of 1993) as amended (hereinafter referred to as the Act) at all times, and shall institute appropriate and effective measures to ensure the proper usage of such safety materials, clothing and equipment at all times;
(b) Provide, install and maintain all barricades, safety signage and other measures to ensure the safety of workmen and all persons in, on and around the site, as well as the general public;
(c) Implement on the site of the works, such procedures and systems and keep all records as may be required to ensure compliance with the requirements of the Act at all times;
(d) Implement all necessary measures so as to ensure compliance with the Act by all subcontractors engaged by the Contractor and their employees engaged on the works;
(e) Full compliance with all other requirements pertaining to safety as may be specified in the Contract.

The Employer and the Engineer shall be entitled, although not obliged, to make such inspections on the site as they shall deem appropriate, for the purpose of verifying the Contractor's compliance with the requirements of the Act. For this purpose, the Contractor shall grant full access to the site of all parts of the site and shall co-operate fully in such inspections and shall make available for inspection all such documents and records as the Employer's and/or Engineer's representative may reasonably require. Where any such investigations reveal, or where it comes to the Engineer's attention that the Contractor is in any way in breach of the requirements of the Act or is failing to comply with the provisions of this clause, the Engineer shall, in accordance with the provisions of Clause 39 of the Conditions of Contract, be entitled to suspend progress on the works or any part thereof until such time as the Contractor has demonstrated to the satisfaction of the Engineer, that such breach has been rectified.

The Contractor shall have no grounds for a claim against the Employer for extension of time and/or additional costs if the progress on the works or any part thereof is suspended by the Engineer in terms of this clause, and the Contractor shall remain fully liable in respect of the payment of penalties for late completion in accordance with the provisions of Clause 43.1 should the Contractor fail to complete the Works on or before the specified due completion date in consequence of the suspension. Persistent and repeated breach by the Contractor of the requirements of the Act and/or this clause shall constitute grounds for the Engineer to act in terms of Clause 55.1.5 of the Conditions of Contract and for the Employer to cancel the Contract in accordance with the further provisions of the said Clause 55.

ADD THE FOLLOWING SUBCLAUSES TO CLAUSE 5:

"PSA 5.9 SITE MEETINGS

The Contractor or his authorised agent will be required to attend regular site meetings, which shall normally be held once a month on dates and at times determined by the Engineer, but in any case whenever reasonably required by the Engineer. Unless otherwise indicated in the Contract or instructed by the Engineer, such meetings shall be held at the Contractor's offices on the site. At such monthly meetings, matters such as general progress on the works, quality of work, problems, claims, payments, and safety shall be discussed, but not matters concerning the day-to-day running of the Contract.

PSA 6 TOLERANCES

ADD THE FOLLOWING SUBCLAUSE TO CLAUSE 6:

"PSA 6.4 USE OF TOLERANCES

No guarantee is given that the full specified tolerances will be available independently of each other, and the Contractor is cautioned that the liberal or full use of any one or more of the tolerances may deprive him of the full or any use of tolerances relating to other aspects of the work. Except where the contrary is specified, or when clearly not applicable, all quantities for measurement and payment shall be determined from the 'authorised' dimensions. These are specified dimensions or those shown on the Drawings or, if changed, as finally prescribed by the Engineer, without any allowance for the specified tolerances. Except if otherwise specified, all measurements for determining quantities for payment will be based on the 'authorised' dimensions. If the work is constructed in accordance with the 'authorised' dimensions plus or minus the tolerances allowed, the calculation of quantities will be based on the 'authorised' dimensions, regardless of the actual dimensions to which the work has been constructed.

When the work is not constructed in accordance with the 'authorised' dimensions plus or minus the tolerances allowed, the Engineer may nevertheless, at his sole discretion, accept the work for payment. In such cases no payment shall be

made for quantities of work or material in excess of those calculated for the 'authorised' dimensions, and where the actual dimensions are less than the 'authorised' dimensions minus the tolerance allowed, quantities for payment shall be calculated based on the actual dimensions as constructed."

PSA 7 TESTING

PSA 7.1 PRINCIPLES

PSA 7.2 APPROVED LABORATORIES

REPLACE THE CONTENTS OF SUBCLAUSE 7.2 WITH THE FOLLOWING:
"Unless otherwise specified in the relevant specification or elsewhere in the Project Specification, the following shall be deemed to be approved laboratories in which design work, or testing required in terms of a specification for the purposes of acceptance by the Engineer of the quality of materials used and/or workmanship achieved, may be carried out:

(a) Any testing laboratory certified by the South African National Accreditation Systems (SANAS) in respect of the nature and type of testing to be undertaken for the purposes of the Contract;
(b) Any testing laboratory owned, managed or operated by the Employer or the Engineer;
(c) Any testing laboratory established and operated on the Site by or on behalf of the Employer or the Engineer.
(d) Any other laboratory that the Engineer approves in his absolute discretion."

PSA 8 MEASUREMENT AND PAYMENT

PSA 8.1 MEASUREMENT

PSA 8.1.1 Method of measurement, all sections of the Schedule

DELETE THE WORDS "and South West Africa".

PSA 8.1.2 Preliminary and General item or section

PSA 8.1.2.1 Contents

REPLACE THE LAST SENTENCE OF SUBCLAUSE 8.1.2.1(b) WITH THE FOLLOWING:
"Separate items will be scheduled to cover the fixed, value-related and time-related components of the Contractor's preliminary and general costs."

PSA 8.1.2.2 Tendered sums

REPLACE THE CONTENTS OF THIS SUBCLAUSE WITH THE FOLLOWING:
"Except only where specific provision is made in the Specifications and/or the Bill of Quantities for separate compensation for any of these items, the Contractor's tendered sums under items PSA 8.3 and PSA 8.4 shall collectively cover all charges for:

- risks, costs and obligations in terms of the Conditions of Contract and of this standardized specification;
- head-office and site overheads and supervision;
- profit and financing costs;
- expenses of a general nature not specifically related to any item or items of the permanent or temporary work;
- providing such facilities on site as may be required by the Contractor for the proper performance of the Contract and for its personnel, including, but without limitation, providing offices, storage facilities, workshops, ablutions, services such as water, electricity, sewage and rubbish disposal, access roads and all other facilities required, as well as for the maintenance and removal on completion of the works of these facilities and cleaning-up of the site of the Contractor's establishment and reinstatement to not less than its original condition, and
- providing the facilities for the Engineer and his staff as specified in the Contract and their removal from the site on completion of the Contract."

PSA 8.2 PAYMENT

PSA 8.2.1 Fixed-charge and value-related items

REPLACE THE CONTENTS OF SUBCLAUSE 8.2.1 WITH THE FOLLOWING:

PSA 8.2.1.1 Fixed-charge items

"Payment of fixed charges in respect of item 8.3.1 will be made as follows:
(a) EIGHTY PER CENT (80%) of the sum tendered will be paid when the facilities have been provided and approved;
(b) The remaining TWENTY PER CENT (20%) will be paid when the works have been completed, the facilities have been removed and the site of the Contractor's establishment has been cleared and cleaned to the satisfaction of the Engineer.

No adjustment will be made to the sum tendered in respect of item 8.3.1 should the value of the works finally executed or the time for completion vary in any way from that specified in the tender.

PSA 8.2.1.2 Value-related items

Payment for the sum tendered under item 8.3.2 will be made in three separate instalments as follows:
(a) The first instalment, which is 40% of the sum, will be paid when the Contractor has fulfilled all his obligations to date under this specification, the General Conditions of Contract and the Special Conditions of Contract, and when the value of work certified for payment, excluding materials on site and payments for preliminary and general items, is equal to not less than 5% of the total value of the work listed in the Bill of Quantities.
(b) The second instalment, which is 40% of the sum, will be made when the amount certified for payment, including retention moneys but excluding this second instalment, exceeds 50% of the tender sum.
(c) The final payment, which is 20% of the sum, will be made when the works have been certified as completed and the Contractor has fulfilled all his obligations to date under this Specification, the General Conditions of Contract and the Contract Data.

Should the value of the measured work finally completed be more or less than the tender sum, the sum tendered under item 8.3.2 will be adjusted up or down in accordance with the provisions of Clause 50 of the Conditions of Contract, and this adjustment will be applied to the third instalment."

PSA 8.2.2 Time-related items

REPLACE THE CONTENTS OF SUBCLAUSE 8.2.2 WITH THE FOLLOWING:

"Subject to the provisions of subclauses 8.2.3 and 8.2.4, payment under item 8.4.1 (time-related item) will be made monthly in equal amounts, calculated by dividing the sum tendered for the item by the tendered Contract period in months, provided always that the total of the monthly amounts so paid for the item is not out of proportion to the value of the progress of the Works as a whole."

PSA 8.3 SCHEDULED FIXED-CHARGE AND VALUE-RELATED ITEMS

REPLACE THE CONTENTS OF SUBCLAUSE 8.3.1 WITH THE FOLLOWING:

"PSA 8.3.1 Fixed preliminary and general charges ..... Unit: sum

The sums tendered shall include full compensation for all fixed-charge preliminary and general charges as described in subclause PSA 8.1.2.2. Payment will be made as described in subclause PSA 8.2.1.1.

PSA 8.4 SCHEDULED TIME-RELATED ITEMS

REPLACE THE CONTENTS OF SUBCLAUSE 8.4 WITH THE FOLLOWING:

"PSA 8.4.1 Time-related preliminary and general charges ..... Unit: month

The sum tendered shall include full compensation for all time-related preliminary and general charges as described in subclause PSA 8.1.2.2. Payment will be made as described in subclause PSA 8.2.2."

PSA 8.5 SUMS STATED PROVISIONALLY BY THE ENGINEER

REPLACE THE CONTENTS OF SUBCLAUSE 8.5 WITH THE FOLLOWING:

"PSA 8.5.1 Works executed by the Contractor ..... Unit: Prov Sum

The Contractor will be reimbursed in substitution of the Provisional Sums (if any) allowed in the Bill of Quantities for work to be executed by the Contractor, in the amounts determined in accordance with the provisions of Clause 6.6 of the Conditions of Contract.

PSA 8.6 PRIME COST ITEMS

REPLACE SUBCLAUSE 8.6 WITH THE FOLLOWING:

"PSA 8.6 PRIME COST SUMS

(a) Description of item to which Prime Cost Sum applies ..... Unit: PC Sum

(b) Charge required by Contractor on subitem (a) above ..... Unit: %

Subitems (a) and (b) will be provided in the Bill of Quantities for each different item to which a Prime Cost Sum applies. The Contractor shall be reimbursed under subitem(s) (a) in substitution of the respective Prime Cost Sums included in the Contract, the actual price(s) paid or payable by him in respect of the goods, materials or services supplied, but excluding any charges for the Contractor's labour, profit, carriage, establishment or other charges related to such goods, services or materials.

The Contractor shall be paid under subitem (b), the respective percentage, as stated by the Contractor in his tender, of the amount certified by the Engineer for payment under the related subitem (a). The percentages tendered by the Contractor for each respective subitem (b) included in the Bill of Quantities shall be deemed to be in full and final compensation to the Contractor in respect of any charge by the Contractor for labour, carriage profit, establishment and for any other charges related to the goods, services or materials supplied under the related subitem (a).

If the Contractor shall have omitted within his tender to insert a tendered percentage under subitem (b), or tendered a zero percentage, the Contractor's tendered rate for subitem (b) shall be deemed to be zero and the Contractor shall not be entitled to any payment under subitem (b).

Note in connection with additional tests required by the Engineer:

When a PC sum is included in the Bill of Quantities for additional tests required by the Engineer, the Contractor shall be responsible for both the cost of normal testing as described in C3.4.2.5(b) of the Project Specifications and for the cost of any additional test that indicates that the specifications have not been complied with."

PSA 8.7 DAYWORK

REPLACE THE CONTENTS OF SUBCLAUSE 8.7 WITH THE FOLLOWING:

"Measurement and payment shall be in accordance with the provisions of Clause 37.2 of the Conditions of Contract.*"

ADD THE FOLLOWING ITEMS:

"PSA 8.9 COMPLIANCE WITH OHS ACT AND CONSTRUCTION REGULATIONS (INCLUDING THE CONSTRUCTION REGULATIONS 2003) .....Unit: sum

The tendered sum shall include full compensation to the Contractor for compliance with all the requirements of the OHS Act and Regulations (including the Construction Regulations 2003) at all times for the full duration of the Contract, as described in C3.6.1. The successful tenderer shall provide the Engineer with a complete breakdown of this tendered sum.
This sum will be paid to the Contractor in equal monthly amounts subject to proper/substantial compliance.

PSA 8.10 QUALITY ASSURANCE AND MANAGEMENT PLAN .....Unit: sum

The tendered sum shall include full compensation for compiling and submitting an ISO9000 quality assurance and management plan to the Engineer and for maintaining, implementing, monitoring, recording and complying to the approved plan for the full duration of the Contract. The sum shall include for all specialists required to fulfil the above functions.

Payment will be made on a successful and approved progress basis.

PSA 8.11 COMPLIANCE WITH RECORD OF DECISION ISSUED BY GDARD AND THE ENVIRONMENTAL MANAGEMENT PLAN .....Unit: sum

The tendered sum shall include full compensation for implementing, monitoring and complying with the environmental management plan for the full duration of the Contract. The sum shall also include for all specialists required to fulfil the above functions.
Payment will be made on a successful and approved progress basis.

PSC **SITE CLEARANCE**

PSC 3 **MATERIALS**

PSC 3.1 **DISPOSAL OF MATERIAL**
ADD THE FOLLOWING:
"The Contractor shall obtain his own dumping sites for the disposal of material and all transport costs shall be included in the rates tendered for site clearance."

PSC 5 **CONSTRUCTION**

PSC 5.1 **AREAS TO BE CLEARED AND GRUBBED**
ADD THE FOLLOWING:
"Pipeline routes shall be cleared to a distance of 1,5 m on both sides of the pipeline centre line. Route pegs or markers shall not be destroyed or damaged during clearing operations."

PSC 5.2 **CUTTING OF TREES**

PSC 5.2.3 **Preservation of trees**

PSC 5.2.3.2 **Individual trees**
REPLACE THE LAST SENTENCE WITH THE FOLLOWING:
"An amount of R1000,00 will be deducted from moneys due to the Contractor as a penalty for every tree that is damaged or removed unnecessarily."

PSC 5.5 **RECLEARING OF VEGETATION**
ADD THE FOLLOWING:
"When areas have to be recleared on the written instructions of the Engineer, such reclearing shall be carried out at the Contractor's own cost and the Contractor is therefore advised not to clear the areas too soon."

PSD EARTHWORKS

PSD 2 INTERPRETATIONS

PSD 2.1 SUPPORTING SPECIFICATIONS

REPLACE SUBCLAUSE 2.1.2 *WITH THE FOLLOWING:*

"PSD 2.1.2 Any of the other SABS 1200 specifications may form part of the Contract documents."

PSD 2.3 DEFINITIONS

REPLACE THE WORD AND THE DEFINITION FOR "Borrow" *WITH THE FOLLOWING:*

"**Borrow material**: Material, other than material obtained from excavations required for the works, obtained from sources such as borrow pits or the authorised widening of excavations. 'Borrow' shall have a corresponding meaning."

REPLACE THE DEFINITION FOR "Specified density" *WITH THE FOLLOWING:*

"**Specified density**: The specified dry density expressed as a percentage of modified AASHTO dry density."

REPLACE THE DEFINITION FOR "Stockpile" *WITH THE FOLLOWING:*

"**Stockpile** (verb): The process of selecting and, when necessary, loading, transporting and off-loading material in a designated area for later use for a specific purpose"

ADD THE FOLLOWING DEFINITIONS:

"**Commercial source**: A source of material provided by the Contractor, not the Employer, and including any borrow pit, provided by the Contractor

Fill: An embankment or terrace constructed of material obtained from excavations or borrow pits. In roads it includes the earthworks up to the underside of the selected subgrade level.

Fill (material): Material used for the construction of an embankment or terrace

Roadbed: The natural in situ material on which the fill or, in the absence of fill, the pavement layers are constructed"

PSD 3 MATERIALS

PSD 3.1 CLASSIFICATION FOR EXCAVATION PURPOSES

PSD 3.1.1 Method of classifying

ADD THE FOLLOWING:

"The classification of material other than 'soft excavation' shall be agreed upon before excavation may commence.

The Contractor shall immediately inform the Engineer if and when the nature of the material being excavated changes to such an extent that a new classification is warranted for further excavation. Failure on the part of the Contractor to advise the Engineer in good time shall entitle the Engineer to reclassify, at his discretion, such excavated material."

PSD 3.2.3 Material suitable for backfill or fill against structures

REPLACE THE CONTENTS OF THIS SUBCLAUSE WITH THE FOLLOWING:

"Material used for backfill behind structures shall generally be the material excavated, subject to the following conditions:

(a) The material shall not contain an excessive number of stones retained on a 50 mm sieve;
(b) The material shall not contain large clay lumps that do not break up under the action of the compaction equipment; and
(c) The liquid limit of the material shall not exceed 40, neither shall the PI exceed 18."

PSD 5 CONSTRUCTION

PSD 5.1 PRECAUTIONS

PSD 5.1.1 Safety

PSD 5.1.1.1 Barricading and lighting

REPLACE "Machinery and Occupational Safety Act, 1983 (Act 6 of 1983)" *WITH* "Occupational Health and Safety Act, 1993 (Act 85 of 1993)".

PSD 5.1.1.2 **Safeguarding of excavations**
REPLACE "Machinery and Occupational Safety Act" *WITH* "Occupational Health and Safety Act, 1993 (Act 85 of 1993)".

PSD 5.1.1.3 **Explosives**
REPLACE THE CONTENTS OF THIS SUBCLAUSE WITH THE FOLLOWING:
"The use of explosives is prohibited on this project."

PSD 5.1.2 **Existing services**
PSD 5.1.2.2 **Detection, location and exposure**
REPLACE THE CONTENTS OF SUBCLAUSE 5.1.2.2 WITH THE FOLLOWING:
"The exposure by the Contractor of underground services, as required in terms of subclause 5.4 of SABS 1200 A (as amended) shall be carried out by careful hand excavation at such positions and to such dimensions as are agreed to by the Engineer.

Unless otherwise instructed or agreed by the Engineer, no service shall be left exposed after its exact position has been determined and all excavations carried out for the purposes of exposing underground services shall be promptly backfilled and compacted to the following densities:
(a) In roadways: 93% Mod AASHTO density; and
(b) In all other areas: 93 % Mod AASHTO density.

Where hand excavations to expose underground services have to be carried out in roadways, the Contractor shall reinstate the road layerworks in accordance with the provisions of subclause 5.9 of SABS 1200 DB.

Payment in respect of exposing the services by means of hand excavation as described above, will be made in accordance with subclause PSD 8.3.8.1."

PSD 5.1.2.3 **Protection of cables**
REPLACE SUBCLAUSE 5.1.2.3 WITH THE FOLLOWING:
"5.1.2.3 **Protection during construction**

Further to the requirements of subclause 5.4.2 of SABS 1200 A (as amended), major excavating equipment and other plant shall not be operated dangerously close to known services. Where necessary, excavation in close proximity to known services shall be carefully carried out with suitable hand tools, excluding picks wherever their use could damage the services. No additional payment will apply to such more difficult work.

Should any service not being a known service be discovered or encountered during the course of the Contract, the Contractor shall, in addition to complying with the requirements of subclause 5.4.2 of SABS 1200 A (as amended), immediately notify the Engineer thereof and implement such measures as will prevent damage of such service or, if it was damaged in the course of discovery, will prevent and minimise the occurrence of any further damage occurring."

PSD 5.1.2.4 **Negligence**
DELETE SUBCLAUSE 5.1.2.4.

PSD 5.1.6 **Road traffic control**
DELETE THE SECOND SENTENCE OF SUBCLAUSE 5.1.6.

PSD 5.2 **METHODS AND PROCEDURES**

PSD 5.2.2 **Excavation**
PSD 5.2.2.1 **Excavation for general earthworks and for structures**
ADD THE FOLLOWING TO PARAGRAPH (b):
"When the nature of the material precludes the above procedure, additional excavations shall be carried out to provide working space for the erection of formwork. The tendered rate for item 8.3.5 will be deemed to include the cost of a working width of 600 mm, but the Contractor may excavate a greater working width at no additional cost to the Employer."

REPLACE THE FIRST SENTENCE OF PARAGRAPH (e) WITH THE FOLLOWING:
"Where excavations have been carried below the authorised levels, the Contractor shall backfill such excavations to the correct level with approved gravel compacted to 93 % of modified AASHTO density or to the density of the surrounding material, whichever is the higher density. Where excavations for structures have been carried out in hard material, the Engineer may direct that over-excavation be backfilled with weak concrete if there is a danger of settlement or differential settlement of the foundations.

Where the sides of excavations against which concrete is to be cast have been over-excavated or have collapsed partially, the Contractor shall retrim the excavations if necessary and, unless other remedial measures are agreed to by the Engineer, shall cast the concrete for the structure, including the additional concrete that may be required as a result of the over-excavation or partial collapse. The cost of the additional concrete or remedial measures shall be for the Contractor's account."

PSD 5.2.2.3 **Disposal**
REPLACE THE SECOND SENTENCE WITH THE FOLLOWING:
"The Contractor shall provide all necessary spoil sites for the spoiling of all surplus and unsuitable materials and shall make the necessary arrangements with the owner of the site where the material is disposed of, and pay all charges and levies as may be applicable for the use of such spoil sites.

Every spoil site provided by the Contractor shall be approved by the local authority in whose area it is located, and the spoiling shall comply with the applicable statutory and municipal regulations as well as the requirements of the owner of the spoil site.

Payment to the Contractor in respect of locating and making arrangements for suitable spoil sites and spoiling material at the such sites will be made separately in the applicable items as scheduled."
ADD THE FOLLOWING SUBCLAUSE IN SUBCLAUSE 5.2.2:

"PSD 5.2.2.4 **Selection and stockpiling**

Approval or designation of the material in a particular borrow pit or excavation for a particular purpose does not imply that all the material in the borrow pit or excavation is suitable for the particular purpose to which the said approval or designation relates, nor that all material in the borrow pit or source should be used for the particular purpose. The Contractor shall select suitable material from that borrow pit or source, discard unsuitable material and reserve material for other purposes as necessary.

The Contractor shall organise and carry out his operations in such a manner as will prevent the contamination of suitable embankment and backfill material with unsuitable materials. Any excavated material which becomes, in the Engineer's opinion, unsuitable for use in embankments or backfill as a result of contamination, shall be disposed of in a manner acceptable to the Engineer and shall be replaced by the Contractor with materials acceptable to the Engineer, all at the Contractor's cost.

When required, or when ordered by the Engineer, material shall be stockpiled for later use. The additional costs for stockpiling material shall be separately paid to the Contractor in the applicable items as scheduled."

PSD 5.2.5 **Transport for earthworks**

REPLACE THE CONTENTS OF SUBCLAUSE 5.2.5 WITH THE FOLLOWING:
"The transport of all excavated materials, irrespective of the distance and source, shall be deemed to be free-haul, the cost of which is included in the Contractor's tendered rates and prices for the excavation of the materials. No separate compensation shall apply for the transportation of excavated materials."

PSD 7 TESTING

PSD 7.2 TAKING AND TESTING OF SAMPLES
REPLACE THE CONTENTS OF THIS SUBCLAUSE WITH THE FOLLOWING:
"The Contractor shall arrange with the approved independent laboratory engaged by the Contractor in terms of C3.4.2.5(b) of the Project Specifications to carry out sufficient tests on a regular basis as agreed between him and the Engineer to determine whether the degree of compaction, and, where applicable, the quality of materials used, comply with the Specifications and shall submit the results of these tests to the Engineer in a form approved by him.

The compaction requirements for fills shall be deemed complied with when at least 75% of the dry-density tests on any lot show values equal to or above the specified density and when no single value is more than five percentage points below the specified value."

PSD 8 MEASUREMENT AND PAYMENT

PSD 8.3 SCHEDULED ITEMS

PSD 8.3.1 Site preparation
REPLACE SUBCLAUSES 8.3.1.1 AND 8.3.1.2 WITH THE FOLLOWING:
"Where site preparation such as clearing, grubbing, the removal of large trees or the removal and stockpiling of topsoil is required, the provisions and scheduled items of SABS 1200 C shall apply."

PSD 8.3.2 Bulk excavation
REPLACE THE CONTENTS OF ITEM WITH THE FOLLOWING:
"(a) Excavate in all materials and use for embankment or backfill as ordered, from:
(a) Tower Foundation ..... Unit: m³
(b) Valve Chamber ..... Unit: m³

The unit of measurement shall be the cubic metre measured in place in accordance with subclause 8.2 of SABS 1200 D. Separate items will be scheduled for embankments and backfills for different parts of the works. The tendered rates shall cover the cost of complying with all the precautions required in terms of subclause 5.1 of SABS 1200 D (as amended), in addition to the cost of excavating in all materials, basic selecting, loading, transporting, off-loading, spreading or backfilling, watering, compacting, final grading, complying with the requirements for tolerances, providing for testing, finishing and tidying, all in accordance with the specifications.

In addition to the aforegoing, the tendered rate for subitem (b) shall further include for the costs of royalties (if applicable), whilst the tendered rate for subitem (c) shall also include for the costs of finding a source of suitable material, for making arrangements with the owner of the source, for procuring the material, for the payment of all requisite royalties, charges or damages, and for transporting the material to the site regardless of the distance involved. No payment will be made for the removal of overburden or stockpiling at the commercial source and no extra over payment shall apply for excavating in intermediate, hard or boulder material."

(b) Excavate in all materials to spoil ..... Unit: m³
The unit of measurement shall be the cubic metre of material excavated, measured in place in accordance with subclause 8.2 of SABS 1200 D.

The tendered rates shall cover the cost of complying with all the precautions required in terms of subclause 5.1 of SABS 1200 D (as amended), in addition to the cost of excavating, basic selecting, loading, transporting, off-loading at the spoil site, maintaining and finishing the spoil site, all in accordance with the specifications.

(c) Extra over subitems PSD 8.3.2(a)(1), PSD 8.3.2(a)(2) and PSD 8.3.2(b) for:
(a) Intermediate excavation ..... Unit: m³
(b) Hard rock excavation ..... Unit: m³

The rate shall cover the additional cost of the operations enumerated in subclauses 8.3.2.(a) and 8.3.2.(b) above for any portion of the excavation that is classified as intermediate, hard rock, boulder excavation class A or boulder excavation class B as applicable. (See Drawing D-2.)

(d) Extra over item PSD 8.3.2(c)(2) for hand excavation or other method (excluding blasting) to remove rock outcrops or rock underbreak after bulk excavation to form level site (alternative for soilcrete backfilling in rock overbreak) Unit: m³

The unit shall be the cubic metre (including bulking of volume) of rock outcrops removed by hand or other labour intensive method.

The rate shall cover all additional costs of the operations including labour, plant, equipment, transport etc to break, excavate, load and removal off site of small rock outcrops not successfully removed during the bulk excavation operations.

PSD 8.3.3 Restricted excavation

REPLACE THE WORDS "in 1 m increments" *AT THE END OF THE FIRST SENTENCE OF SUBITEM (a) WITH* "in the increments indicated in the Bill of Quantities".

REPLACE "in 5.2.2.1 – 5.2.2.3 (inclusive)" *AT THE END OF SUBCLAUSE (a) WITH* "in subclauses 5.2.2.1 to 5.2.2.5 (inclusive)".

ADD THE FOLLOWING SUB-SUBITEM:

"(c) Extra over subitem 8.3.3 (a) for hand excavation .....Unit: m³

This item shall apply to hand excavation ordered by the Engineer or when the Engineer considers that, owing to circumstances, excavation by mechanical excavators is not practicable. It shall not apply to hand excavation for trimming or finishing an excavation made by mechanical means.

The tendered rate shall include full compensation for the additional cost of excavating by means of hand tools."

PSD 8.3.4 Importing of materials

DELETE SUBITEM (a) OF 8.3.4.

PSD 8.3.6 Overhaul

DELETE SUBCLAUSE 8.3.6.

PSD 8.3.8 Existing services

PSD 8.3.8.1 Location

REPLACE ITEM 8.3.8.1 WITH THE FOLLOWING:

"8.3.8.1 Hand excavation for locating and exposing existing services:

(a) In roadways ..... Unit: m³
(b) In all other areas ..... Unit: m³

The unit of measurement shall be the cubic metre of material excavated, measured in place according to the authorised or actual dimensions of the excavation, whichever is the lesser. The tendered rates shall cover the cost of excavating in all materials by means of hand tools within authorised dimensions and at locations approved by the Engineer in accordance with the requirements of subclause PSA 5.4.1 for all precautionary measures necessary to protect the services from damage during excavation and backfilling, and for subsequent backfilling and compacting. Compaction of material in all areas except in roadways shall be to 93 % of the modified AASHTO density.

The tendered rate for hand excavation in roadways shall include compensation for compacting excavated or selected backfill material to 93% of modified AASHTO density. Reinstating layerworks and surfacing shall be measured and paid for in terms of SABS 1200 DB.

The tendered rates shall also include for keeping excavations safe, for dealing with surface and subsurface water, for removing surplus excavated material from the site, for transporting all material and for supplying adequate supervision during both excavation and backfilling operations."

PSD 8.3.10 **Topsoiling**

CHANGE THE UNIT TO "m³" *AND REPLACE THE CONTENTS OF THIS ITEM WITH THE FOLLOWING:*

"The unit of measurement shall be the cubic metre and the quantity shall be calculated from the authorised dimensions.

The tendered rate shall include loading of the topsoil from stockpiles, transporting, off-loading, spreading, shaping and lightly compacting the topsoil."

ADD THE FOLLOWING ITEMS IN SUBCLAUSE 8.3:

"**PSD 8.3.14** **Extra over items PSD 8.3.2.(a)(1) and PSD 8.3.3 for temporary stockpiling** ..... Unit: m³

The unit of measurement shall be the cubic metre of material from necessary excavations, temporarily stockpiled by the Contractor on the instructions of the Engineer, before being used in embankments or backfill. Measurements shall be taken in place in compacted embankment or backfill as the case may be. The tendered rate shall include for the costs, additional to those provided for in PSD 8.3.2(a)(1) and PSD 8.3.3, of off-loading, forming and maintaining the stockpile for as long as is required, reloading and transporting. Payments to the Contractor under this item will only be made in respect of that material stockpiled on the instructions of the Engineer (which instruction shall state specifically that payments for such stockpiling will be paid for under this item) and no payments will be made to the Contractor under this item in respect of materials stockpiled by the Contractor on his own volition, nor for materials necessarily stockpiled by the Contractor in consequence of the sequence of operations adopted by him in the course of executing the works, whether such stockpiling was avoidable or otherwise.

PSD 8.3.15 **Extra over items PSD 8.3.2(b) and PSD 8.3.3 for disposing of spoil material on a site provided by the Contractor** ..... Unit: m³

The unit of measurement shall be the cubic metre measured in accordance with subclause 8.2 of SABS 1200 D of surplus and/or unsuitable material disposed of, on the instruction of the Engineer, at a spoil site or spoil sites provided by the Contractor.

The tendered rate shall include full compensation for the additional cost of providing a spoil site or other means of disposing of surplus spoil material, for transporting the material regardless of the distance involved, for acceptance charges for such material and for all other incidental costs to dispose of the spoil material."

PSDB EARTHWORKS (PIPE TRENCHES)

PSDB 3 MATERIALS

PSDB 3.5 BACKFILL MATERIALS

ADD THE FOLLOWING PARAGRAPHS TO SUBCLAUSE 3.5:

"(c) Cement-stabilized backfilling

Backfilling shall, where directed by the Engineer, be stabilized with 5% cement. The aggregate shall consist of approved soil or gravel containing stones not bigger than 38 mm and with a plasticity index not exceeding 10. The soil or gravel shall be mixed with 5% cement and shall be compacted in layers of 100 mm thick to 93 % of modified AASHTO density.

(d) Soilcrete backfilling

The aggregate for soilcrete shall be mixed with 5% cement and shall consist of approved soil or gravel containing stones not bigger than 38 mm and with a plasticity index not exceeding 10. The soil or gravel shall be mixed in a concrete mixer with the cement and enough water to acquire a consistency that allows the mixture to be placed with vibrators to fill all voids between the pipe and the sides of the trench. Shuttering shall be used where necessary."

PSDB 3.7 SELECTION

REPLACE THE WORDS "if he so wishes" *IN THE FIRST LINE OF THE SECOND PARAGRAPH WITH THE WORDS* "at his own cost".

PSDB 5 CONSTRUCTION

Except only where the Engineer has included in the Bill of Quantities, particular payment items specifically therefor, the Contractor will not be paid directly for the construction and maintenance of temporary access roads and/or the provision and maintenance of bridges as aforementioned, and the costs thereof shall be deemed included in the Contractor's tendered rates for excavation."

PSDB 5.6 BACKFILL

PSDB 5.6.3 Disposal of soft excavation material

REPLACE THE WORDS "unless otherwise required in the project specification." *AT THE END OF SUBCLAUSE 5.6.3 WITH:*

"… or to spoil in accordance with the requirements of subclause PSD 5.2.2.3, as instructed by the Engineer."

PSDB 8 MEASUREMENT AND PAYMENT

PSDB 8.3 SCHEDULED ITEMS

PSDB 8.3.2 Excavation

(a) Excavate in all materials, for trenches, backfill compact and dispose of surplus material

*REPLACE "*of 1,0 m" *IN THE FIRST SENTENCE OF 8.3.2(a) WITH:*

"as specified in the Bill of Quantities."

(b) Extra over item (a) above for:

ADD THE FOLLOWING AT THE END OF THE EXISTING SUBITEM 2:

"No payments will be made under subitems (1) and (2) in respect of any materials measured and paid for under subitem 3 below."

AND ADD THE FOLLOWING NEW SUBITEMS IN 8.3.2(b):

"(3) Hand excavation where ordered by the Engineer in:

(a) Intermediate material ..... Unit: m³

(b) Hard material ..... Unit: m³

The unit of measurement shall be the cubic metre of material, measured in place according to the authorised dimensions, which was excavated by hand on the specific prior written instructions of the Engineer; provided always that the Engineer's said instruction shall have stated that measurement and payment for such hand excavation will be in accordance with this item. The tendered rate shall include full

compensation for the additional cost, effort and time resulting from excavating in the respective materials using hand methods only. The Engineer shall not be obliged to authorise payment under this item in respect of any hand excavation carried out (whether ordered in writing or otherwise), which hand excavation was in any case necessary to achieve compliance by the Contractor with his obligations under the Contract to

(i) utilise construction appropriate to the nature of the specific parts of the works; and/or
(ii) protect existing structures and/or services; and/or
(iii) comply with all prevailing legislation and regulations.

(4) Backfill stabilized with 5% cement where directed by the Engineer ..... Unit: m³

The unit of measurement shall be the cubic metre of backfill material, measured in place after compaction according to the authorised dimensions, which was stabilized on the Engineer's instructions in accordance with subclause PSDB 3.5(c). The tendered rate shall include full compensation for supplying the cement and for selecting, mixing, backfilling and compacting the stabilized material to 93 % of modified AASHTO density.

(5) Soilcrete backfill where directed by the Engineer ..... Unit: m³

The unit of measurement shall be the cubic metre of soilcrete placed on the Engineer's instructions in accordance with subclause PSDB 3.5(d), measured in place according to the authorised dimensions. The tendered rate shall include full compensation for supplying the cement and for selecting, mixing and placing the soilcrete as well as for the cost of shuttering if required."

PSDB 8.3.3 Excavation ancillaries

PSDB 8.3.3.3 Compaction in road reserves
REPLACE THE HEADING OF THIS SUBITEM WITH THE FOLLOWING:
"PSDB 8.3.3.3 Compaction in road crossings"

REPLACE THE SENTENCE, "The volume will be measured as specified in 8.2.2, 8.2.3 and 8.3.3.1", *WITH THE FOLLOWING:*
"To determine the volume in the case of gravel roads, the depth will be measured from the underside of the gravel wearing course to the top of the fill blanket, and in the case of bitumen roads, from the underside of the subbase to the top of the fill blanket. The rest of the trench shall be backfilled as specified in clauses 5.9.3, 5.9.4 and 5.9.5, as applicable, and payment will be made under item 8.3.6.1."

PSDB 8.3.3.4 Overhaul
REPLACE THE CONTENTS OF THIS ITEM WITH THE FOLLOWING:
"Measurement and payment shall be in accordance with subclause PSD 5.2.5."

PSDB 8.3.7 Accommodation of traffic
DELETE ITEM 8.3.7.

PSG **CONCRETE (STRUCTURAL)**

PSG 3 **MATERIALS**

PSG 3.2 **CEMENT**

PSG 3.2.2 **Alternative types of cement**
REPLACE THE CONTENTS OF THIS SUBCLAUSE WITH THE FOLLOWING:
Refer to Specification No LE1 for type of cement to be used on this project.

ADD THE FOLLOWING SUBCLAUSES:

"PSG 3.9 **WATERSTOPS**

PVC waterstops shall comply with the requirements of CKS 389.

PSG 3.10 **ROOFING FELT**
Three-ply roofing felt shall comply with the requirements of SABS 92 for type 40 felt.

PSG 3.11 **BUTYL RUBBER OR POLYMER SEALING STRIPS**
The dimensions of the sealing strip for use in the structures are shown on the drawings. The strips shall be permanently bonded to the prepared concrete surface in accordance with the manufacturer's specifications. The strip shall have a breaking elongation of not less than 300% and a tensile strength of not less than 4 MPa as per manufacturer's specification. The completed joint shall be guaranteed 100% watertight and resistant to the long-term effects of the retained aqueous liquid.

PSG 3.12 **LAMINATED BUTYL RUBBER OR POLYMER WATERPROOFING STRIPS**
3 mm thick laminated butyl rubber OR 2 mm thick polymer strips shall be permanently fixed to the concrete where shown on the drawings. The preparation of the concrete surface, the installation of bond breakers and aluminium backing strips, the fixing of the laminated butyl rubber or polymer waterproofing strip with an approved epoxy adhesive as specified by the particular manufacturer and the forming of lapped joints shall all be done according to the manufacturer's specifications to provide a watertight joint."

PSG 4 **PLANT**

PSG 4.5 **FORMWORK**

PSG 4.5.1 **Design**
ADD THE FOLLOWING:

"All formwork or scaffolding required for any part of the works shall be designed by the Contractor, and before commencing with the erection of any formwork or scaffolding, the Contractor shall submit the methods he proposes to use to the Engineer for approval. The Engineer has the authority to order alterations to the design or the sizes of any part of the formwork or scaffolding. The Contractor shall check the safety and suitability of all such alterations. The fact that the Engineer has approved or altered any part of the formwork of scaffolding shall not be construed as relieving the Contractor of his responsibility with regard to the strength and stability of the formwork or scaffolding."

PSG 4.5.3 Ties
ADD THE FOLLOWING:

"No plugs, bolts, ties or clamps of any description used to hold the formwork will be allowed to project into or through the concrete unless expressly approved by the Engineer. Only approved ferrules consisting of solid rods (that remain embedded in the concrete) and with removable ends shall be used to hold the formwork of the walls. The removable tie-rod ends shall facilitate removal without damage to the concrete, and no permanently embedded parts of such tie-rods shall have less than 50 mm of cover to the finished concrete surface.

The cavities left in the concrete when the tie-rod end cones are removed shall be soundly caulked with a cement mortar to which an approved shrinkage-reducing agent has been added and shall be neatly finished to a smooth surface uniform with that of the surrounding concrete. The cost of supplying special tie-rods as well as the filling of cavities left by the tie-

rod cones shall be included in the rates tendered for formwork under the appropriate payment items. On no account shall formwork be secured to reinforcing bars.

The Contractor may submit an alternative method statement for plugging of ferrule system for approval prior to commencement of construction."

PSG 5 CONSTRUCTION

PSG 5.1 REINFORCEMENT

PSG 5.1.2 Fixing

ADD THE FOLLOWING:

"The Engineer will inspect the reinforcing after it has been fixed in place, the formwork has been cleaned, cover blocks have been positioned, and before concreting commences. Should the reinforcement be supported by the joint filler, the filler shall be covered with a hard surface on the side to be concreted. The hard surface shall be sufficiently resilient to ensure that the joint and surfaces will be without defects.

Welding of reinforcing steel will not be permitted."

PSG 5.1.3 Cover

ADD THE FOLLOWING:

"The distance between pipes in the concrete and the reinforcing steel shall nowhere be less than 40 mm or 5 mm plus the maximum size of the coarse aggregate, whichever is the largest, unless otherwise specified on the drawings."

PSG 5.2 FORMWORK

PSG 5.2.2 Preparation for formwork

ADD THE FOLLOWING:

"Construction joints shall be positioned as shown on the drawings."

PSG 5.2.5 Removal of formwork

ADD THE FOLLOWING SUBCLAUSE:

"PSG 5.2.5.7 The Contractor shall make provision for the continued support of beams and slabs while the formwork is being removed and/or for back propping of beams and slabs."

PSG 5.3 HOLES, CHASES AND FIXING BLOCKS

ADD THE FOLLOWING:

"Cover blocks for reinforcing and fixtures may be placed into the concrete provided that neither the strength nor any other desirable characteristic (such as the appearance) of the concrete section is affected or impaired in the opinion of the Engineer.

The holes or cavities left by ferrule heads in the concrete of water-retaining structures shall be filled with an approved non-shrink grout applied strictly in accordance with the manufacturer's specifications."

PSG 5.4 PIPES AND CONDUITS

ADD THE FOLLOWING:

"All pipes passing through concrete floors, walls or slabs shall be cast into a concrete member simultaneously with the casting of the member. Openings for pipes shall only be left in concrete members when so directed by the Engineer or when shown on the drawings. Pipes shall be installed in such openings according to the details shown on the drawings.If watertightness is a requirement where pipes are cast into walls, floors and slabs, the Contractor shall ensure watertightness where smooth-surfaced pipes are used by using an approved method such as tape wrapping the pipes prior to casting in. The cost of such method will be deemed to be included in the rates tendered for item PSG 8.10."

PSG 5.5 CONCRETE

PSG 5.5.1 Quality

PSG 5.5.1.5 **Durability**
The exposure conditions of the concrete are classified as "severe".

PSG 5.5.1.7 **Strength concrete**

ADD THE FOLLOWING:
"The concrete mixes shall be designed by the Portland Cement Institute or a similar approved laboratory.

The minimum cement content shall be 325 kg/m³. The maximum water/cement ratio shall be 0,55 for ordinary Portland cement (OPC), CEM I 42,5 according to SANS 50197-1, or 0,50 for ordinary Portland cement blended with pulverized fuel ash (PFA).

The cement content shall not exceed 400 kg/m³ OPC in reinforced concrete or 450 kg/m³ OPC blended with PFA in reinforced concrete."

PSG 5.5.3 **Mixing**

PSG 5.5.3.2 **Ready-mixed concrete**
ADD THE FOLLOWING:
"Ready-mixed concrete may be used on the Site. The Contractor shall take samples for testing from every load delivered to the Site."

PSG 5.5.5 **Placing**
ADD THE FOLLOWING:
"Concreting of walls between horizontal construction joints shall be carried out in both directions from a point on the wall in order to close the gap with fresh concrete."

PSG 5.5.7 **Construction joints**
ADD THE FOLLOWING:
"Horizontal construction joints are permitted in structure walls in positions indicated on the drawings or approved by the Engineer. Vertical construction joints in the walls are subject to the written approval of the Engineer and the cost of all such vertical or horizontal construction joints will be deemed to be included in the rates for cast-in-situ concrete.

The construction joints in water-retaining structures shall be made strictly in accordance with the details shown on the drawings. The joints between screeds and concrete floors shall be regarded as construction joints and the surface of the floor shall be prepared as described for construction joints. Should the Contractor's method of construction necessitate the placing of a construction or other joint in a position not shown on the drawings, such method of construction and position of the joint shall be approved by the Engineer in writing. The cost of such joint shall be included in the tendered rates and shall include scabbling of the concrete where steel reinforcement is continuous. The walls shall be cast in lifts of a height that permits each lift to be poured without interruption in one continuous operation during normal working hours.

It is the Contractor's responsibility to ensure that construction joints are watertight. The Contractor's proposed method for ensuring the watertightness of such joints shall be submitted to the Engineer for his approval. For construction joints at kickers all additional costs for concrete, preparation, etc will be deemed to be included in the rates tendered for concrete in walls or sides and kicker joints or construction joints will not be measured separately."

PSG 5.5.8 **Curing and protection**
ADD THE FOLLOWING:
"The curing methods of retaining the formwork in place or covering with a waterproof membrane are strongly recommended. Concrete will not be paid for unless properly cured and proof of curing is continuously visible on site."

PSG 5.5.10 **Concrete surfaces**
ADD THE FOLLOWING SUBCLAUSE:
"**5.5.10.4** Where the surfaces of the concrete are to be additionally hardened or protected, the positions of such surfaces and the method to be used will be shown on the drawings and will be scheduled. Materials or products with a ferrous content will not be allowed."

PSG 5.5.11 **Watertight concrete**

ADD THE FOLLOWING:

"The minimum cement content shall be 325 kg/m³. The maximum water:cement ration shall be 0,55 for ordinary Portland cement (OPC), CEM I 42,5 according to SANS 50197-1, or 0,50 for ordinary Portland cement blended with pulverized fuel ash (PFA).

The cement content shall not exceed 400 kg/m³ OPC in reinforced concrete or 450 kg/m³ OPC blended with PFA in reinforced concrete."

ADD THE FOLLOWING SUBCLAUSES:

PSG 5.5.16 **Soilcrete**

Where soilcrete is specified for filling under floor slabs, the soilcrete shall comply with the requirements of subclause PSDB 3.5(d) of section 1200 DB as amended and shall be placed as specified in the subclause."

PSG 5.5.18 **Pipes and conduits**

All pipes passing through concrete floors, walls or slabs shall be cast into the concrete member simultaneously with the casting of the member. Openings for pipes shall only be left in the concrete members when so directed by the Engineer or when shown on the drawings. Pipes shall be installed in such openings according to the details shown on the drawings. If watertightness is a requirement where pipes are cast into walls, floors and slabs, the Contractor shall ensure watertightness where smooth-surfaced pipes are used by using an approved method such as tape wrapping the pipes prior to casting in. The cost of such method will be deemed to be included in the rates tendered for in item PSG 8.10."

PSG 6 **TOLERANCES**

PSG 6.2 **PERMISSIBLE DEVIATIONS**

PSG 6.2.3 **Specified permissible deviations**

ADD THE FOLLOWING:

"Degree-of-accuracy I is applicable.

Every specified permissible deviation is binding in itself. The cumulative effect of permissible deviations will not be considered. The maximum permissible vertical deviation is subject to the other permissible deviations."

REPLACE SUBCLAUSE 6.2.3(d)(5) *WITH THE FOLLOWING:*

"Vertically, per metre of height ..... subject to a maximum of .....

Permissible deviation		
Degree of accuracy		
III	II	I
mm	mm	mm
5 50	3 30	2 10

PSG 7 **TESTS**

PSG 7.1 **FACILITIES AND FREQUENCY OF SAMPLING**

PSG 7.1.1 **Facilities**

ADD THE FOLLOWING:

"The Contractor shall provide sufficient storage capacity for the concrete cubes and shall arrange to have them tested by an approved laboratory.

The cost of all testing, including the cost of sampling, storage and transport of samples shall be included in the rates tendered for concrete work."

PSG 7.3 **ACCEPTANCE CRITERIA FOR STRENGTH CONCRETE**

ADD THE FOLLOWING:
"Test results obtained from the supplier of ready-mixed concrete will not be accepted for evaluation in terms of subclause 7.3, but samples for testing shall be taken of such concrete at the point of placing."

PSG 8 MEASUREMENT AND PAYMENT

PSG 8.1 MEASUREMENT AND RATES

PSG 8.1.1 Formwork
DELETE "or splays over 20 mm x 20 mm" *FROM THE FIRST LINE OF PARAGRAPH 8.1.1.2.*

ADD THE FOLLOWING TO PARAGRAPH 8.1.1.2:
"Splays up to and including 25 mm x 25 mm will not be measured separately and will be deemed to be included in the formwork costs."

ADD THE FOLLOWING PARAGRAPHS:
"8.1.1.7 For construction joints at kickers, all additional costs for formwork to edges up to 300 mm high will be deemed to be included in the rates tendered for vertical formwork to sides of walls and will not be measured separately in narrow widths.
8.1.1.8 No formwork will be measured to edges of blinding layers under structures, and the cost thereof (if needed) will be deemed to be included in the rates tendered for concrete in blinding layers.
8.1.1.9 Back-shuttering or formwork to top revealed surfaces of sloping or conical formwork will only be measured to surfaces of over 40° and up to 85° to the horizontal.
8.1.1.10 Formwork to horizontal surfaces in pump stations, valve chambers, manholes or sumps can either be removed through the manhole cover opening or the Contractor may use permanent formwork at his own cost as no claims in this regard will be considered."

PSG 8.1.2 Reinforcement
REPLACE THE CONTENTS OF THIS SUBCLAUSE WITH THE FOLLOWING:
"The unit of measurement for steel bars shall be the ton of reinforcement in place, in accordance with the drawings or as authorised by the Engineer.

The unit of measurement for welded steel fabric shall be the kilogram of fabric reinforcement in place, and the quantity shall be calculated from the net area covered by the mesh, excluding overlaps.

Clips, ties, separators, stools and other steel used for positioning reinforcement will not be measured, unless these are shown on the bending schedules.

The tendered rate shall include full compensation for the supply, delivery, cutting, bending, welding, placing and fixing of the steel reinforcement, including all tying wire, stools, supports and waste."

PSG 8.1.3 Concrete

Delete ", or the plan size of the excavation where additional excavation is provided to facilitate erection of forms" from the second line of paragraph 8.1.3.1(c).

PSG 8.5 JOINTS

REPLACE "Unit: m" *WITH* "Unit: m or m²".
ADD THE FOLLOWING ITEMS:

"PSG 8.9 MISCELLANEOUS WORK OTHER THAN METALWORK

(a) Testing of concrete cubes..... Unit: No
(b) Supply cube-testing machine on site with recent calibration certificate and water trough Unit: Sum

The tendered rates shall include full compensation for providing all labour, materials and equipment required to carry out the work, for all preparatory work, for constructing the work scheduled in a workmanlike manner and for finishing off and cleaning up when the work has been completed.

PSG 8.10 CAST IN OF PIPES WITH OR WITHOUT PUDDLE FLANGES

All pipes cast into concrete will be with a puddle flange, or as indicated on the drawing. The rate to supply and install all special pipe fittings are as per Section L: Water Mains of the Bill of Quantities which will include all costs associated with the installation of the pipe into the concrete wall as a cast in item, including labour, formwork, grout, bentonite strips etc.

The tendered rates shall include full compensation for installing the pipe where new pipes are used (with or without a puddle flange) in the exact position as shown on the drawings, for splitting or cutting the formwork where required, for ensuring water tightness where required and for all additional costs required to install the pipes specified or shown on the drawings.

New pipes shall be measured under the items of the relevant section of the specifications.

PSL MEDIUM-PRESSURE PIPELINES

PSL 3 MATERIAL

PSL 3.1 GENERAL

ADD THE FOLLOWING PARAGRAPHS:
"Materials for this Contract must be obtained from manufacturers who operate an effective quality management system such as that described in SANS 0157 or ISO 9000

Each type of pipe delivered to the Site shall be of a standard length corresponding to the standard lengths offered by the pipe manufacturer in his catalogue, with a maximum permissible variation in length of ± 2%.

A pipe that is shorter or longer than the defined standard will be rejected by the Engineer, except when such non-standard lengths are required in terms of the Contract and have been specifically manufactured or cut as such by the pipe manufacturer or supplier."

PSL 3.8 JOINTING MATERIALS

PSL 3.8.3 Flanges and Accessories

REPLACE "…, appropriate to the class of pipe specified," *WITH* "…, and shall unless scheduled otherwise be class 16 (SANS 1123 table 1600) drilling,":

PSL 3.9 CORROSION PROTECTION

PSL 3.9.6 Corrosive soil

ADD THE FOLLOWING:
"Where shown on the Drawings, steel pipes in contact with corrosive soil shall be wrapped with Densopol 80 HT or an equivalent approved product, strictly in accordance with the manufacturer's instructions."

PSL 3.10 VALVES

REPLACE THE CONTENTS OF THIS SUBCLAUSE WITH THE FOLLOWING:
"Valves shall comply with the following requirements:
(a) They shall close clockwise and shall have a non-rising spindle and handwheel.
(b) They shall be class 16 valves complying with SABS 664.
(c) They shall comply with the requirements of SABS 1123 table 1600."

PSL 5 CONSTRUCTION

PSL 5.2 JOINTING METHODS

PSL 5.2.2 Flanges (steel pipelines)

ADD THE FOLLOWING:
"Insertion pieces (flange packing) and sets of bolts for connection of valves to pipes or specials shall be included in the scope of work for this Contract. All insertion pieces and sets of bolts as specified in Subclause 3.8.3 of SANS 1200 L Specification, shall be supplied and installed by the Contractor."

PSL 5.2.3 Welding (steel pipelines of diameter 450 mm or greater)

ADD THE FOLLOWING:
"The Contractor shall note the addition of the following specific requirements:
(i) 100% of all welded joints shall be radiographically examined and tested. All site welding shall also include for repairing corrosion protection coatings and linings as specified in the Specification.

(ii) The Contractor will be responsible for radiographic testing and adjudication of test records in accordance with and to maintain his quality control system and ensure a high standard of installation and welding. The Contractor shall be responsible to furnish all equipment and consumables required for his own testing.
(iii) The Employer will undertake radiographic tests and adjudication of test records by an Independent Third Party Inspectorate to be appointed by the Employer to act on his behalf."

PSL 5.6 VALVE AND HYDRANT CHAMBERS

PSL 5.6.1 General

REPLACE THE WORDS "drawing L-1" *IN THE SECOND LINE WITH* "the Drawings".

PSL 5.6.2 Construction of chambers

REPLACE THE WORDS "drawing L-1, L-2 and L-3" *IN THE FOURTH LINE WITH* "the Drawings".

ADD THE FOLLOWING SUBCLAUSES:

PSL 5.12 PIPELINE ROUTE MARKERS

Route markers for the various water pipelines shall be erected in the positions and shall be manufactured according to the details shown on the Drawings."

PSL 7 TESTING

PSL 7.3 STANDARD HYDRAULIC PIPE TEST

PSL 7.3.1 Test pressure and time of test

PSL 7.3.1.2 The maximum working pressure for the different pipes is indicated by the class of the pipe.

PSL 8 MEASUREMENT AND PAYMENT

PSL 8.2 SCHEDULED ITEMS

PSL 8.2.11 Anchor blocks/Thrust blocks and pedestals

INSERT "concrete" *BEFORE* "and" *IN THE LAST LINE OF THE LAST PARAGRAPH.*

ADD THE FOLLOWING:
"The tendered rates shall also include the wrapping of uPVC pipes and fittings with Densopol 80 or a similar approved material where the pipes and fittings come into contact with concrete."

ADD THE FOLLOWING ITEMS:

"PSL 8.2.16 Valve support assembly (give short description and drawing number):

(a) Specify material:
(g) Description ..... Unit: number

The rate shall cover the cost and include full compensation for all labour, plant, equipment, material, corrosion protection, transport, etc, manufacturing or providing and installing each item complete as scheduled and shown on the drawings.

PSL 8.2.18 **Pipeline route markers:**

(a) (Give description with reference to drawing) ..... Unit: number

(b) Etc for other descriptions

The tendered rate shall include full compensation for all excavation and backfill, labour, equipment and materials to manufacture and install the markers as shown on the Drawings.

PSLB BEDDING (PIPES)

PSLB 3 MATERIALS

PSLB 3.1 SELECTED GRANULAR MATERIAL

REPLACE THE CONTENTS OF THIS SUBCLAUSE WITH THE FOLLOWING:
"Selected granular material shall have a PI not exceeding 6 and shall be free from sharp-edged particles exceeding 19 mm."

PSLB 3.2 SELECTED FILL MATERIAL

ADD THE FOLLOWING:
"Selected fill material used for bedding shall, where indicated on the Drawings be stabilized with 5% cement as specified under subclause PSDB 3.5(c)."

PSLB 3.4 SELECTION

PSLB 3.4.1 Suitable material available from trench excavation

REPLACE THE WORDS "(but is not required)" *IN THE FIFTH LINE WITH THE WORDS* "(at his own cost)".

PSLB 8 MEASUREMENT AND PAYMENT

PSLB 8.1 PRINCIPLES

PSLB 8.1.5 Disposal of displaced material

REPLACE THE CONTENTS OF THIS SUBCLAUSE WITH THE FOLLOWING:
"Material displaced by the pipeline and by imported material from sources other than trench excavation, shall be disposed of at an approved site furnished by the Contractor. No haulage is payable for such material."

PSLB 8.1.6 Free-haul

DELETE THE WORDS "of 0,5 km" *IN THE FIRST LINE OF THIS SUBCLAUSE.*

PSLB 8.2 SCHEDULED ITEMS

ADD THE FOLLOWING ITEM:

"PSLB 8.2.6 Extra over items 8.2.1 and 8.2.2 for bedding stabilized with 5% cement ..... Unit: m³

The tendered rate shall include full compensation for selecting, providing stabilization agent, mixing, backfilling and compacting the stabilized material to 93 % of modified AASHTO density."

PSLD SEWER

PSLD 3 MATERIALS

PSLD 3.1 PIPES, FITTINGS AND PIPE JOINTS

PSLD 3.1.1.1 Vitrified clay pipes (rubber rings)

Add the following to this sub-clause:
All rubber rings must comply with the requirements of SABS 974.

PSLD 3.1.1.2 Vitrified clay pipes (crushing strength)

Delete this sub-clause and replace with the following:
Notwithstanding the requirements for crushing strength given in SABS 559 all vitrified clay pipes shall have a crushing strength of at least 45 kN per meter of bearing surface.

PSLD 3.1.8 Upvc Pipes

Add the following new sub-clause:
uPVC pipes shall comply with the relevant requirements of SABS 967 and shall have suitable approved joints.

PSLD 3.5 MANHOLES, CHAMBERS, ETC.

PSLD 3.5.4 CONCRETE

Add the following to this sub-clause:
Only dolomitic aggregate shall be used for the manufacturing of concrete.

PSLD 3.5.8 Manhole covers and frames

Delete this sub-clause and replace with the following:
Only precast concrete manhole covers and frames will be allowable for use in this Contract. All covers must be provided with a 5 mm thick steel lip ring. The dimensions of the covers must comply with the details given on the drawings. Where manholes are subject to traffic loads "heavy duty" covers capable of withstanding a test load of 135 kN must be used. Where traffic loads will not be experienced covers capable of withstanding a test load of 40 kN are required.

The concrete shall comply with SABS 1200 GA.

PSLD 3.6 MARKER POSTS

Add the following to this sub-clause:
Marker posts must be provided at each house connection. It must consist of a 450 mm long iron peg bent into a 16 mm ø loop at the base and cast into a rectangular concrete block 225 * 225 * 150 mm. Use class 15MPa/19mm concrete. The peg must protrude 20 mm above the concrete surface which must be level with the surrounding ground.

PSLD 5 CONSTRUCTION

PSLD 5.2 LAYING AND BEDDING

Add the following sub-clauses:

PSLD 5.2.6 Clay pipes

(Up to and including 300 mm diameter): When clay pipes of these diameters are laid between manholes, boxes or structures, laying shall commence at the lower end of the line with a stub end (500 mm long cut from a standard full length pipe) for subsequent building into the manhole, box or structure, followed by a 500 mm long standard short length (obtainable from the Suppliers or cut on Site) and thereafter by full length pipes with the last pipe cut at 1 000 mm from the inner face of the wall of the upper manhole, box or structure. The remaining gap shall then be filled in with a 500 mm long standard short length and a 500 mm long stub end, the latter for building into the manhole, box or structure.

PSLD 5.2.8 **Reinforced concrete pipes:**
Where concrete pipes are laid between structures, manholes or junction boxes, laying of pipes shall commence at the manho9le or junction box at the lower end of the pipeline with full length pipes with the last pipe cut to form a closure piece for building into the structure, manhole or junction box at the upper end of the pipeline. Only the last pipe at the upper end of the pipeline shall be cut to avoid problems with jointing.

PSLD5.2.10 **Cut pipes:**
In the case of concrete pipes, after the cut end has been finished off it shall be painted with two coats of bituminous paint to provide protection to the exposed ends of the reinforcing steel in the pipe.

PSLD 5.6 **MANHOLES, INSPECTION CHAMBERS, ETC.**

PSLD 5.6.2 **Benching**

Replace the first sentence with the following:
All concrete for benching shall be class 20MPa/19mm and only dolomitic aggregate may be used.

PSLD 5.9 **CONNECTING SEWERS**

PSLD 5.9.1 **Location and details**

Add the following to this sub-clause:
House connections must be 500 mm from boundary pegs or as shown on the drawings and must be clearly marked with marker posts.

OR

Where the main outfall sewer runs adjacent to stands, provision for future 100 mm erf connections shall be made in the form of a Y-junction according to Drawing LD-8 of SABS 1200 LD. The 100 mm leg to be plugged off with an end cap. The position of each future erf connection to be marked with a marker according to PSLD 3.6.

PSLD 5.9.2 **Marker posts**

A marker post must be placed at the end of each house connection vertically above the pipe. The marker peg must be attached to the end cap of the pipe with a 4 mm thick galvanised steel wire. The depth of the invert below the ground level must be shown clearly on the concrete block for example D = 1,50 m.

PSLD 7 **TESTING**

PSLD 7.1 **GENERAL**

PSLD 7.1.6 *Delete this sub-clause and replace with the following:*
Only air tests will be performed on pipes of all diameters.

PSLD 7.2 **TESTS AND ACCEPTANCE/REJECTION CRITERIA**

PSLD 7.2.2 **Water Test**
Delete this sub-clause and replace with the following:

Where required or where directed by the Engineer, the water test must be carried out as follows:

(a) Block the low end of the pipe line with suitably braced plugs.

(b) Check that all connections and bends are tight and stable.

(c) Fill the pipe line until a head of 1,2 m of water is achieved at the head of the line. The pressure at the low end should not exceed 6 m head.

(d) Allow the pipe line to settle, i.e. to allow water absorption and the escape of air at the joints.

(e) Measure the loss over a 30 minutes period by adding water from a measuring vessel every 10 minutes in order to maintain the head at 1,2 metres.

(f) The leakage rate should not exceed the following values given in the Table below:

Allowable loss per 100 metres of line per hour	
Diameter	***Litres***
100	6,0
150	9,0
200	12,0
225	13,5
250	15,0
300	18,0
375	22,5
450	27,0

PSLD 7.2.3 Rejection

Delete this sub-clause and replace with the following:
Failure under the air test will be deemed to be cause for rejection. After such rejection, the Contractor may, where pipelines are above the water table, apply a water test to locate the source of failure, rectify these problems at his own cost and re-apply the air test.

PSLD 7.2.6 Water tightness of manholes

Add the following to this sub-clause:
All manholes must comply with the following test requirements:

The manhole may be tested for water tightness, by filling it with water after sealing all connecting pipes with rubber plugs. The manhole must be left full for 48 hours to ensure that complete water absorption has taken place. After this period the manhole must be topped up to just below the cover and left for 24 hours. The lowering of the water level may not exceed 5 mm and no moist patches or visible leaks may occur in either the shaft or the chamber. If the manhole does not comply with these requirements the faulty parts must be removed and the caulking of the whole leaking ring must be removed and resealed. This must be done until the manhole passes the test to the satisfaction of the Engineer.

PSLD 8 MEASURMENT AND PAYMENT

PSLD 8.2 SCHEDULED ITEMS

PSLD 8.2.3 Manholes

Add the following to the sub-clause:
The rate shall cover the cost of removing the existing cover, frame and base, providing the new precast base, rebuilding the manhole to the original level and, setting and grouting the cover and frame to the correct level.

PSLD 8.2.6 Erf Connections

Replace the second sentence with the following:
The rate shall cover the cost of excavation to expose the existing connection at the junction with the sewer main (including excavation for working space), materials and labour for tying the connection into the new pipeline, backfilling, bedding and disposal of surplus material.

OR

The rate shall cover the cost of supplying and installing a Y-junction, an end cap and the marker post.

OR

Delete this sub-clause and replace with the following:
(g) Double toilet unit ..... Unit: No

(h) Single toilet unit ..... Unit: No

The rate shall cover the cost of additional excavation in all materials, backfilling, bedding, disposal of surplus material, the supply and laying of the Y-junction and the connection pipeline between the sewer line and the toilet structure and, supplying all the materials required and erecting the toilet structure as detailed on the drawings.

PSLD 8.2.13 **Rodding Eye**
(New sub-clause)Add the following payment item:
Construct rodding eye ..... Unit: No

The rate shall cover the cost of removing and disposing of the exiting rodding eye and, material and labour for constructing a new rodding to details given on the drawings.

PSME SUBBASE

PSME 3 MATERIALS

PSME 3.2 PHYSICAL PROPERTIES

PSME 3.2.1 Subbase material

REPLACE THE CONTENTS OF PARAGRAPH (a) WITH THE FOLLOWING:
"(a) The maximum particle dimension of the gravel shall not exceed 63 mm."

REPLACE THE CONTENTS OF PARAGRAPH (d) WITH THE FOLLOWING:
"(d) The CBR at specified density shall be 45 for unstabilized material as well as for stabilized material prior to stabilization."

DELETE PARAGRAPH (e).

PSME 8 MEASUREMENT AND PAYMENT

PSME 8.1 BASIC PRINCIPLES

INSERT A SEMICOLON IN THE FIRST LINE OF PARAGRAPH (b) AFTER THE WORDS "will be paid for once only" *AND DELETE THE REST OF THE PARAGRAPH.*

AMEND PARAGRAPH (d) AS FOLLOWS:

"(d) that, in the case of material from a commercial source or from borrow pits selected by the Contractor, no additional payment will be made for the class of excavation, method of processing (except stabilizing), or overhaul."

PSME 8.3 SCHEDULED ITEMS

PSME 8.3.3 Construct the subbase course/shoulders/gravel wearing course with material from commercial sources or designated borrow areas

REPLACE THE HEADING OF THIS ITEM WITH THE FOLLOWING:

"PSME 8.3.3 Construct the subbase course/shoulders/gravel wearing course with material from commercial sources"

ADD THE FOLLOWING PARAGRAPH:

"This item shall also apply to the construction of subbase course/shoulders/gravel wearing course with material from borrow pits selected by the Contractor."

PSMJ SEGMENTED PAVING

PSMJ 8 MEASUREMENT AND PAYMENT

PSMJ 8.2 SCHEDULED ITEMS

PSMJ 8.2.2 Construction of paving complete

ADD THE FOLLOWING:

"The tendered rate shall also include full compensation for straight or curved cutting units to fit edge restraints or kerbing and for the removal of waste material from the Site."

PSMK KERBING AND CHANNELLING

PSMK 3 MATERIALS

PSMK 3.1 CONCRETE

ADD THE FOLLOWING:
"The Contractor shall timeously submit the concrete mix design for cast-in-situ kerbing to the Engineer for approval and no kerbing shall be placed before the mix design has been approved."

PSMK 5 CONSTRUCTION

PSMK 5.11 TRANSITION SECTIONS AND INLET AND OUTLET STRUCTURES

DELETE THE WORDS "and with the requirements of the Project Specification" *IN THE SECOND PARAGRAPH.*

PSMK 7 TESTING

PSMK 7.2 CAST-IN-SITU AND EXTRUDED KERBING AND CHANNELLING

PSMK 7.2.1 General tests

DELETE THIS SUBCLAUSE.

PSMK 7.2.2 Alternative tests

REPLACE THE HEADING AND CONTENTS OF THIS SUBCLAUSE WITH THE FOLLOWING:

"PSMK 7.2.2 Tests

The Contractor shall carry out a minimum of three cube crushing tests per 1 000 m of kerbing placed. The cost of such tests shall be deemed included in the rates tendered for kerbing.

One cube crushing test shall consist of a set of six cubes made with concrete taken from the mixer, the kerbing machine or from any part of the work as ordered.

If, after 28 days in an approved laboratory, after three cubes of any set of six cubes have been tested, the average crushing strength is found to be more than 3 MPa below the specified strength, the kerbing represented by the cubes will be rejected.

The Contractor may apply for resubmission of the rejected section on the basis of cores drilled from this section and tested for the estimated actual crushing strength in accordance with SABS method 865 (excluding Appendix A). The cost of drilling and testing the cores is for the Contractor's account, regardless of the outcome of the tests on the cores. The number of cores required will be determined by the Engineer and the criterion for rejection or acceptance of the section represented by the cores shall be as specified above for cubes."

PSMK 7.3 RESPONSIBILITY FOR THE COST OF TESTING

DELETE THIS SUBCLAUSE.

PARTICULAR SPECIFICATION

PG G SPECIFICATION FOR ALTERNATIVE DESIGNS OF STRUCTURES OR STRUCTURAL ELEMENTS

CONTENTS

PG G1 INTRODUCTION
PG G2 CONTRACTOR'S DUTIES
PG G3 ENGINEER'S DUTIES
PG G4 DESIGN CRITERIA
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PG G7 CONSTRUCTION OF THE WORKS

PG G1 INTRODUCTION

This specification covers the procedures to the adopted and the duties to be performed by the tenderer or the contractor, hereinafter called the contractor, who wishes to submit alternative designs.

Only alternatives that will result in substantial cost savings to the client will be considered.

If the contractor wishes to submit an alternative design, he shall discuss the principle of the alternative with CivEc, hereinafter called the engineer, and obtain their provisional approval before submitting the alternative price.

It is a precondition that no alternative tender will be considered if the original bill was not priced and tendered for.

PG G2 CONTRACTOR'S DUTIES

Alternative designs shall be executed by suitably qualified personnel under the leadership of a professional engineer.

The professional engineer in 2.1 shall provide the engineer with a letter, stating clearly that he takes full professional responsibility and liability for the alternative design.

Approval of alternative designs by the engineer does not relieve the professional engineer in 2.1 of his responsibilities.

The professional engineer in 2.1 shall submit written proof to the engineer of his professional indemnity insurance together with the tender. This insurance shall be maintained.

The contractor shall obtain from the engineer all the relevant information needed for a proper design. This must include the following: design background, fire resistance, design loads, architect's drawings and special recquirements. Preliminary calculations and details shall be submitted with the alternative price, and acceptance of the above will be provisional until the complete design is received and formally accepted.

The contractor shall provide all additional information on the alternative requested by the engineer. This may include the following: further designs, further details, performance certificates from an approved testing authority and proof of successful use.

After provisional acceptance of the alternative, the contractor shall submit to the engineer full and detailed working drawings, design calculations and schedules, adequate for successful execution of the works. A full set of working drawings shall be submitted after completion of the "autoCAD".
After approval of the documentation in 2.6, no deviation from the documentation will be permitted without written approval by the engineer.

No work shall commence before the necessary documentation has been formally approved in writing by the engineer.

The contractor shall comply with all the requirements set by other members of the professional team, e.g the provision of a bill of quantities for the alternative. It is the contractor's duty to ensure that he complies with the requirements of other parties.

The contractor shall provide the engineer with sepia copies of the as-built drawings.

PG G3 ENGINEER'S DUTIES

The engineer will spot-check the documentation provided on request, comment in writing and if acceptable, formally approve the documentation.

Approval and acceptance of the documentation in no way relieve the contractor's professional engineer of his responsibilities as stated in 2.2.

The engineer will make copies, of the original structural drawings available for use by the contractor.

PG G4 DESIGN CRITERIA

All designs, drawings and detailing shall be executed in strict adherence to the latest SABS standards. When no SABS standard exists, the contractor shall obtain instructions from the engineer about the criteria to be used.

If the engineer provides specific design criteria, these take precedence over SABS standards.

The engineer has sole discretion about the design criteria to be conformed to.

Design loadings shall be obtained from the engineer.

The above requirements necessitate a detail discussion with the engineer before the preliminary design is executed.

PG G5 COSTS

the entire cost of providing an alternative design is for the account of the contractor and he must make provision for this in his alternative price.

The contractor shall reimburse the engineer on a time and cost basis and at SAACE rates for additional work necessitated by the alternative. The work starts with the first negotiations, includes meetings, spot-checks, disbursable costs, and may also include additional duties during the construction period.

The contractor must note that other members of the professional team may also have claims in terms of the alternatives, and that it is the contractor's responsibility to reimburse them individually.

Provision shall be made for the professional team's fees and expenses by adding a provision amount equal to at least 6% of the alternative price to the alternative price. The contractor shall be liable for all professional fees and expenses incurred for the alternative.

No price shall be submitted for an alternative design before 1.3 has been fully complied with, to ensure that the price relates to a provisionally acceptable design.

PG G6 DOCUMENTATION AND CONSTRUCTION PROGRAMME

Acceptance and approval of an alternative do not automatically constitute the granting of an extension of the construction period specified in the contract documents.

The engineer and other members of the professional team shall be afforded adequate and reasonable time to perform their duties.

PG G7 **CONSTRUCTION OF THE WORKS**

Construction of the alternative design shall in all respects comply with the engineer's specifications in the contract documents, or with the written specifications specifically provided for the alternative design

The contractor is reminded of the fact that he is entirely responsible for the detail inspections of the works, and that the engineer inspects the works on behalf of the client.

If a quality assurance system is prescribed in the contract documents, execution of the alternative design shall be subject to the quality assurance system

Should it become apparent during the construction period or afterwards that the design and/or construction does not conform to the specified requirements, the contractor shall be liable for the subsequent damage or loss, and he shall at his own expense execute the necessary work to ensure that the structure complies with the design requirements.

PARTICULAR SPECIFICATION

PGENR B1 GENERAL FENCING

CONTENTS

PGENRB1 01 SCOPE
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PGENR B1 01 SCOPE

This is a Particular Specification and covers the erection of new fences.

PGENR B1 02 TYPE OF FENCE

The fence shall be a security fence and shall be erected in accordance with the dimensions shown on the Drawings.

PGENR B1 03 MATERIALS

PGENR B1 03.1 POSTS, STAYS AND STANDARDS

Posts, stays and standards shall be of the type and size indicated on the Drawings. Posts shall include gate posts, straining posts and corner posts.

Metal posts, stays and standards shall comply with the requirements of CKS 82 and SABS 280. "Acceptable" in CKS 82 means "acceptable to the Engineer".

Tubular posts, standards and stays shall be galvanized in accordance with SABS ISO 1461:1999 Table 1 for type B articles. All rail and Y-sections shall be provided with a protective coating of tar or other approved material.

Corner, gate and straining posts shall be suitably drilled for stay bolts or gate fittings as indicated on the Drawings.

PGENR B1 03.2 BOLTS FOR STAYS

Bolts shall be of mild steel and galvanized in accordance with SABS ISO 1461:1999 Table 1 for type C articles. The length and diameter of the bolts shall be as shown on the Drawings. All the necessary bolts, together with nuts and washers, shall be supplied with each post.

PGENR B1 03.3 WIRE

All wire shall conform to the requirements of SABS 675 and shall be class B galvanized, except where otherwise specified below.

(a) Barbed wire

Barbed wire shall be one or both of the following types:

(i) High-tensile grade, oval shaped, single-strand wire, 2,60 mm x 2,00 mm

(ii) Mild-steel grade, double-strand, uni-directional twist wire, each strand 2,50 mm in diameter

Barbs shall be spaced at not more than 150 mm intervals.

(b) Smooth wire

Smooth wire shall be of the types specified below:

(i) Straining wire shall be mild-steel wire, 4,00 mm in diameter.

(ii) Fencing wire shall be high-tensile grade 2,24 mm diameter wire.

(iii) Tying wire or binding wire shall be 2,50 mm diameter, mild-steel, class C galvanized wire for tying fencing wire to standards and 1,60 mm diameter, mild-steel, class C galvanized wire for tying wire mesh to fencing wire.

(c) Barbed-tape concertinas

Barbed-tape concertinas shall comply with the requirements for type A in CKS Specification 592 and shall consist of close-coiled high-tensile wire with a continuous strip of flat steel barbs (barbed tape) crimped to the wire along the entire length of the wire. The coils shall further be attached to each other by clips to give a concertina configuration when pulled apart. The coils shall be of the diameter as shown on the Drawings. Each concertina shall have a minimum of 55 coils, and the maximum effective length of open concertina, when pulled apart, shall depend on the diameter of the roll, but shall be at least 12 m.

The high-tensile wire shall be class B galvanized and the barbed tape shall be made of cold-rolled carbon steel galvanized to class Z450. The concertina clips shall be manufactured from steel strip galvanized to class Z450.

PGENR B1 03.4 DIAMOND MESH

Diamond mesh (chain-link fencing) shall comply with the requirements of SABS 1373. The width shall be as shown on the Drawings, and both edges shall be clinched.

The diameter of the wire shall be 2,5 mm and the mesh size shall be as shown on the Drawings and the wire shall be class B galvanized.

PGENR B1 03.5 GATES

Gates shall comply with the requirements of CKS 146 and shall be manufactured to the dimensions shown on the Drawings.

Gates shall be complete in every respect, and shall include hinges, washers, bolts and the locking mechanism shown on the Drawings.

PGENR B1 03.6 CONCRETE

Concrete used for fencing shall comply with the requirements of SABS 1200 G.

PGENR B1 04 CLEARING FENCE LINE

Strip clearing for the fence shall be carried out in accordance with SABS 1200 C and will be measured and paid for under Section 1200 C of the Schedule of Quantities.

PGENR B1 05 INSTALLING POSTS AND STANDARDS

Straining posts shall be erected at all ends, corners and bends in the line of fencing and at all junctions with other fences. Straining posts shall not be spaced further apart than shown on the Drawings. The height of the posts above the ground shall be such that the correct clearance between the lowest wire and the ground can be obtained.

Posts shall be accurately set in holes and, where indicated, shall be provided with concrete bases to the dimensions shown on the Drawings.

Holes shall be dug to the full specified depth. Where, due to the presence of rock, the holes cannot be excavated by hand or by pneumatic tools and the Contractor has to resort to the use of explosives, he will be paid separately for the drilling and blasting operations required.

Corner, gate, end and straining posts shall be braced by means of stays or anchors, as shown on the Drawings. Pipe stays shall be bolted to the posts. Gate posts shall not be used as straining posts, but at each gate post a straining post shall be placed as shown on the Drawings and stayed by means of an anchor consisting of six strands of wire.

Standards shall be firmly planted in the ground at the spacing shown on the Drawings or as directed by the Engineer. The spacing of standards between any two straining posts shall be uniform. In rock or hard material standards shall either be driven or set in holes drilled into the rock. The size of drilled holes shall be such that a tight fit is obtained. Care shall be taken not to buckle or damage the standards when driven. Where indicated, standards shall be provided with concrete bases to the dimensions shown on the Drawings.

All posts and standards shall be accurately aligned and set plumb and shall be planted with the overhang as shown on the Drawings and at right angles to the direction of the fence. After posts and standards have been firmly set in accordance with the a foregoing requirements, the fencing wire shall be attached thereto as described below.

PGENR B1 06 INSTALLING WIRE

All fencing wire shall be carefully stretched and hung without sag and with true alignment, and care shall be taken not to stretch the wire so tightly as to cause breaking, pulling up straining posts, or being easily damaged during veld fires.

Each strand of fencing wire shall be securely fastened in the correct position to each standard with galvanized binding wire. The binding wire for each horizontal fence wire shall pass through a hole or notch in the standard, and the ends of the wire shall be wound at least four times around the fencing wire.
At the end, corner, straining and gate posts the fencing wire shall be securely wrapped twice around the post and secured against slipping by tying the end tightly around the wire by means of at least six snug, tight twists. In the case of high-tensile wire, two long windings must first be made before the six tight twists to prevent the wire from breaking at the first twist. Where smooth wire is used, the loose end shall be bent back and hooked into the opening between the fencing wire and the first winding.

Splices in the fencing wire will be permitted if made in the following manner with the use of a splice tool: The end of each wire at the splice shall be carried at least 75 mm past the splice tool and wrapped snugly around the other wire for not less than six complete turns, after which the two separate wire ends shall be wound in opposite directions. After the splice tool has been removed, the space left by it in the splice wire shall be closed by pulling together the wire ends. The unused ends of wire shall be cut close to leave a neat splice.

The gaps between gate posts and the adjacent straining posts shall be fenced off with short fencing wires.

PGENR B1 07 INSTALLING DIAMOND MESH

Where indicated on the Drawings, diamond mesh shall be stretched against the fence and properly tied to the fencing wire. The diamond mesh shall be secured by means of binding wire at 1,2 m centres along the top and bottom wires and at 3 m centres along each of the other fencing wires, unless shown otherwise on the Drawings.

PGENR B1 08 INSTALLING BARBED-TAPE CONCERTINAS

Barbed-tape concertinas shall be positioned on the fence as shown on the Drawings. The concertinas shall be fastened to the appropriate fencing wires at each standard as well as at 1,0 m maximum intervals between standards.

Rolls of barbed-tape concertinas shall be joined with binding wire at four points, spaced at equidistant intervals around the circumference of the loop. Joints shall be made to coincide with the positions of standards.

PGENR B1 09 CLOSING OPENINGS UNDER FENCES

At ditches, streams, drainage channels or other hollows where the fence cannot follow the general ground contour, the Contractor shall close the opening under the fence by means of horizontal barbed wires 150 mm apart and stretched between additional straining posts as shown on the Drawings. The opening shall be covered with strips of diamond mesh, 1 000 mm wide, fixed to the barbed wires.

In the case of larger streams, the opening below the lower fencing wire shall be closed by means of loose-hanging wire nets as shown on the Drawings. These nets shall be erected at streams only on the instructions of the Engineer.

PGENR B1 10 INSTALLING GATES

Gates shall be installed at the positions indicated on the Drawings or pointed out on Site. The gates shall be hung on gate fittings in accordance with the details shown on the Drawings. Gates shall be so erected that they swing in a horizontal plane at right angles to the gate posts and clear of the ground in all positions. Double swing gates shall close to have a gap of not more than 25 mm between them, and other gates shall close to be not further than 25 mm from the gate post.

PGENR B1 11 GENERAL REQUIREMENTS AND TOLERANCES

The completed fences shall be plumb, taut, true to line and to the ground contour, and with all posts, standards and stays firmly set.

The height of the lower fencing wire above the ground at posts and standards shall not vary by more than 25 mm from that shown on the Drawings. Other fencing wires shall not vary by more than 10 mm from their prescribed relative vertical positions.

Anchoring of a fence to structures shall be done as shown on the Drawings.

The Contractor shall, on completion of each section of fence, remove all cut-offs and other loose wire or mesh so as to leave the fence with a neat and finished appearance.

PGENR B1 12 MEASUREMENT AND PAYMENT

PGENR B1 12.01 2.4m high parkland mesh fence (Clearview or similar approved) as per drawing 14040R/WA/DET02:

The unit of measurement shall be the metre of each type of fencing wire and barbed-tape concertinas measured between end posts. Binding wire and wire used for the bracing and anchoring of posts shall not be measured for payment.

PGENR B1 12.02 New gates:

"Supply and install double sliding gate to match security fencing as per drawing 14040R/WA/DET02"

The unit of measurement shall be the number of new gates erected. A pair of gates shall be measured as one.

The tendered rate shall include full compensation for gate posts, hinges, bolts, concrete, locking mechanism and straining wire, and for the erection of the gates complete as specified and as shown on the Drawings. It shall not include compensation for any fencing wire or mesh used on the gate.

PARTICULAR SPECIFICATION

PH A SPECIFICATION FOR STRUCTURAL STEELWORK

CONTENTS

PH A1 EQUIVALENCY OF STANDARDS
PH A2 PROJECT SPECIFICATION
PH A3 APPLICABLE SPECIFICATIONS
PH A4 THE SUBCLAUSES OF SABS 1200 H ARE AMENDED AS FOLLOWS
PH A5 ADDITIONAL CLAUSES

PH A1 EQUIVALENCY OF STANDARDS

Wherever reference is made in the Contract to SABS standards and /or code requirements to be met by the goods and materials to be furnished, work performed or tested, the provisions of the latest edition or revision of the relevant SABS standards and codes in effect shall apply, unless otherwise stated in the contract. Whenever reference is made to SABS standards and codes, other authoritative standards and codes that ensure an equal or higher quality than the relevant SABS standards and codes, will be accepted subjects to the Project Engineer's prior review and written consent. Differences between the standards specified and the proposed alternative standards shall be fully described in writing by the Tenderer/ Contractor and submitted to the Project Engineer at least twenty-eight days prior to the date when the Contractor/Tenderer desires the Project Engineer's consent. In the event that the Project Engineer determines that such deviations are not of a high enough or better standard, the Tenderer/Contractor shall comply with the specified document.

A copy of the said specification shall be furnished by the contractor and shall be kept on the site.

A list of British specifications which are deemed to be equivalent to the relevant SABS specifications are listed at the end of this specification.

PH A2 PROJECT SPECIFICATION

Should a requirement of the said standardized specification be inconsistent with a requirement of the project specification, the latter shall take precedence.

Applicable Specifications

SABS 1200H: STRUCTURAL STEELWORK
SABS 1200HC: CORROSION PROTECTION OF STRUCTURAL STEELWORK

PH A4 THE SUBCLAUSES OF SABS 1200 H ARE AMENDED AS FOLLOWS

Subclause 3: Structural Steel
The steel shall be Grade 300 W for hot rolled steel sections (I, H, C, L). All members shall carry the Grade 300W steel symbol to identify steel grade prior to manufacturing.

The thickness specified of a checker (" Vastrap") floor plate, is the under-pattern thickness.

Subclause 5.1 And Subsubclause 5.1.2: Contractor Provides Shop Details
The contractor shall furnish the engineer with shop-detail drawings within two weeks of having received the design drawings. The engineer will check the drawings for conformity with design requirements and will return the drawings with additions and corrections, if any, within one week of having received them. Detailed checking of shop details for dimensional accuracy and installation fit, will not be done by the engineer.

Subsubclause 5.2.3: Cutting
The edges of flame-cut plates shall be ground smooth.

Subsubclause 5.6.1: Grouting Responsibility
Grouting shall be done by the Main contractor.

Subsubclause 5.3.4: Welding
The applicable welding code for fabrication and erection is AWS D1.1
(a) All welders shall be coded welders.
(b) The contractor shall submit welding procedures by an approved welding authority for approval and shall produce evidence acceptable to the engineer that welding procedures and welders have been tested in accordance with the requirements of AWS D1.1. Welding certificates are only valid for a period of 12 months.
(c) Approved splicing of members will be subjected to non-destructive testing. The cost of testing shall be borne by the contractor.
(d) The engineer may at his discretion identify welds for non-destructive testing by an approved authority the cost of which will be borne by the contractor.
(e) No staggered or intermittent welding is permitted.
(f) No welding on site is permitted unless approved by the engineer. Any site welder and site welding procedure will have to be re-qualified for site welding.
(g) Welding procedures and welder's performance qualifications shall conform to the requirements of AWS D1.1. These documents must be submitted in writing to the engineer and approved prior to the start of welding.
(h) The contractor shall submit for review an outline of the Quality Control measures that will be enforced by the Contractor to ensure that specified welding procedures are employed in all welding under this contract.

Weld testing
General
Personnel performing non-destructive testing other than visual shall be qualified in accordance with the stipulations of the code.
Full penetration butt welds are to be radio graphically tested in accordance with (2.5.2.2) below). A minimum of 50 % of full penetration welds shall be tested. If more than 5% of the examined welds show unsatisfactory results, then additional examinations covering all welds shall be performed.

Non-destructive examination
Non-destructive procedures, techniques and acceptance criteria shall be as required by AWS D1.1.
All non-destructive examination shall be in accordance with written procedures. The Engineer shall have the right to examine and approve the written procedures.
Full penetration but welds shall be radio graphically tested or ultrasonically tested to the requirements of AWS D1.1
Ultrasonic and radiographic examinations shall not be made within the period of 24 hours after completion of welding.
Cost of examination listed under to be borne by the contractor.
All costs (time, travelling, tests) incurred by non-destructive examinations due to non-conformance of specifications and due to any latent defects in material and welding shall be borne by the Contractor.
Fillet welds will be inspected and tested to AWS D1.1 at the discretion of the Engineer.
Certificates of non-destructive testing shall be submitted to the Engineer.

Subsubclause 5.3.4: Welding
Surfaces preparation, priming, shop and site painting shall be measured in m^2 of surface treated.

Subclause 7.1: Test Certificates
Test certificates pertaining to the steel to be used shall be submitted to the engineer by the contractor before fabrication commences.
The engineer reserves the right to inspect all structural steel in the workshop before it is delivered to the site.

Subsubclause 6.2.2.: Other Tolerances
Degree of accuracy ll shall apply unless indicated otherwise elsewhere.

PH A5 ADDITIONAL CLAUSES

PROTECTIVE TREATMENT AND PAINTING

General

All paint shall be delivered at the workshop as well as on the site in the original containers that display the manufacturer's name and trademark as well as the SABS mark. The engineer may, at his discretion, prescribe the manufacturer and the type of paint.

The coating system shall be from one manufacturer only. The paint manufacturer's instructions shall be strictly adhered to.

Surfaces in contact with each other after assembly or erection shall receive the primer beforehand, except for faying surfaces for friction-grip fasteners.

The application of the final coats of paint before erection will be permitted by the engineer only in special circumstances or where specified elsewhere.

After erection of the steelwork, the specified paint system shall be reinstated in all areas where it has been damaged. All fasteners shall also be treated in accordance with the specified paint system.

No painting on the site shall be done in inclement weather or when humidity or frost is liable to cause wet or damp conditions on the surface to be painted.

No painting shall be done if the temperature falls below 7^0C.

Welded seams shall be thoroughly steel-brushed before painting. Permission shall be obtained from the engineer before slag residue may be neutralized with acids or alkalis.

Surface preparation in the workshop

SIS 05 59 00 or ISO 8501 shall apply and shall be referred to in respect of this clause.

Manual scraping and wire brushing.

This treatment shall normally be applied in all circumstances except if and where blast cleaning is specified.
- Prior to treatment, the steel surface shall be cleaned of dirt and grease;
- Heavier layers of rust shall be removed by chipping.
- All loose mill scale, rust and foreign matter shall be removed by very thorough scraping, wire brushing , machine-brushing, grinding, etc.;
- Finally the surface shall be cleaned by vacuum cleaner, with clean dry compressed air, or with a clean brush;
- The surface shall have a pronounced metallic sheen with an appearance equal to or better than that shown on the prints designated ST 3 in SIS 05 59 00 or ISO 8501.

Blast- cleaning
This treatment may be used but is not obligatory unless so specified hereinafter. If blast cleaning is preferred to normal scraping and wire brushing, the final surface shall be equal to or better than that specified in subsubclause 3.1.2.1

Paint system
The paint system shall be applied in accordance with the specifications given in tables 3.1 and 3.2 below. Application may be by brush, roller or sprayed, or as per suppliers specifications. Red lead may not be used.

All structural steel which is not visible, e.g. purlins, rafters and trusses, shall receive only the primer coat. All visible steel shall receive the full appropriate paint system treatment.

In all cases the manufacturer's specification for any paint product must be followed.
Table 3.1 paint system for internal exposed steel surfaces
(not suitable for temperatures above 90^0C)

Coat no.	Place of Application	Time of application	MinThickness in µm	Types	SABS - specification
1. Primer	Workshop	Within 4 hours of surface treatment	50	Zinc phosphate Plascoprime 182 QD Plascon or D193-1029(Dulux)	(none)
2. Two Final coats; colour as specified elsewhere	Site	After erection	Each coat 25 to 40	High gloss enamel or structural steel paint	630 Type 1 684 Type A

Table 3.2 Paint system for external exposed steel surfaces
(not suitable for temperatures above 90^{0}C

PROTECTION OF GENERAL EXPOSED STRUCTURAL STEEL				
Coat	Product type	DFf µm		
		Min	Max	mean
1	Carbo weld 11 (weldable inorganic Zinc primer)	20	40	30
2	Carboline 193 primer (epoxy polyamide)	50	100	75
3	Carboline 134 (aliphatic acrylic polyurethane)	40	50	45

PAINT SYSTEM FOR NEWLY GALVANIZED SURFACES

3.2.1Recommended surface preparation:
- Degrease with Plascon Aquasole Degreaser GR 1 or similar approved. Any cement or foreign material must also be removed from the metal surface.
- Rinse with clean running water while protecting the floors and walls.
- Wash with Galvanised Iron Cleaner GIC 1 by Plascon, or similar approved.
- Rinse with clean running water and allow to dry. Protect the floors and walls.

3.2.2 Apply one coat of Plascon Aquafast Etch Primer no EMS 18 or similar approved to a total dry thickness of 35 micron. Must be overcoated within 72 hours to avoid excessive hardening.

3.2.3 One final coat as specified in table 3.1

HOT DIPPED GALVANIZING (See also subclause 5.9 in SABS 1200H)
Steelwork described as "galvanised" shall be galvanised after manufacturing and before delivering to site by means of the hot dipped process complying with the minimum requirements of SABS ISO 1461, 1999 latest amendment. Structural steel members shall be given as 85 micron thick galvanised coating or such other thickness as may be specified in accordance with SABS ISO 1461 (Table1)
Damaged surfaces must be thoroughly cleaned and if welding has been carried out all slag must be removed preferably by the use of a chisel hammer.

Before galvanizing all surfaces of the metalwork shall be thoroughly cleaned of all scale and rust by shot-blasting in accordance with SABS 064 or by picking and then fluxed ready for galvanising.

The Zinc coating shall be even and continuous over all surfaces free of bare spots, dull or rough patches, blisters or other imperfections. The Zinc coating shall show no signs of peeling and shall be uniform in thickness.

All M8 and greater bolts, nuts, screws and other threaded components, shall be hot-dip galvanised to SABS ISO 1461(previously articles type C)

Repairing of damaged coatings

Plant repairs

Should any black spots or uncoated areas greater than 5 mm^2 (individual) or 25 mm^2 (collective) per m^2 or per m run be present after galvanizing, the coating shall be repaired. This is to be carried out using abrasive blasting following by zinc metal spray. The zinc metal spray shall be applied at least 25% thicker than that specified and shall overlap the damaged area by 20 -25 mm. The finished coating shall be wire brushed to remove any excess metal spray.

Hot patch soldering is an alternative at the plant but is seldomly used, as the method needs to be conducted while the product is still hot before quenching.

Site repairs

Zinc metal spray as set out above.

The recommended alternative is to use a zinc rich paint provided it has at least 90% Zinc in the dry film, by mass. The paint should be a zinc rich epoxy in conformance with SABS 926. A single pack zinc rich paint such as Plascon's Plascozinc Polygalv Primer" or equal can be applied.

PARTICULAR SPECIFICATION

PLA SPECIFICATION FOR LOW PRESSURE VALVES

CONTENT

PLA 1 SCOPE
PLA 2. INTERPRETATIONS
PLA 3. MATERIALS
PLA 4. PLANT
PLA 5. CONSTRUCTION
PLA6. TOLERANCES
PLA7. TESTING
PLA8. MEASUREMENT AND PAYMENT

PLA1. SCOPE

This specification covers valves for use on low pressure pipelines up 1 000 mm diameter for transporting and controlling cold water and sewage under working pressures as stated but not exceeding 4,0 MPa. This specification must be read in conjunction with the standards laid down Johannesburg Water and in the case of a discrepancy the Council standards will take precedence. All equipment including valves, pumps must be approved by the Engineer in writing prior to procurement.

PLA2. INTERPRETATIONS

SUPPORTING SPECIFICATIONS

Where this specification is required for a project, the following specifications shall, inter alia, form part of the Contract:
(a) Project Specification
(b) SABS 1200 A or SABS 1200 AA
(c) SABS 1200 L

and the following specifications may form part of the Contract:
(a) SABS 1200 D or SABS 1200 DA
(b) SABS 1200 DB
(c) SABS 1200 G or SABS 1200 GA
(d) SABS 1200 LB

2.2 APPLICATION
This specification contains clauses which are of general application for valve contracts. Interpretations of, or modifications, alternations or additions to this specification for the purpose of this contract are set out in Portion 2 of the project specification which precedes this specification and forms part of the Contract.

1.3 DEFINITIONS
The definitions set out in the specifications listed in 2.1 shall apply.

2.4 ABBREVIATIONS
The abbreviation set out in the specifications listed in 2.1 and the following shall apply:
MFB: Metropolitan Fire Board
BSP : British Standard Pipe Thread
nb : nominal bore
SOAV: Small orifice air valve
LOAV : Large orifice air valve
DOAV : Double orifice air valve

PLA3. MATERIALS

PLA 3.1 GENERAL REQUIREMENTS

Unless otherwise required by the project specification:
(a) valves shall be manufactured from the materials specified in the relevant sub-clause below;
(b) shall be of the type and class or suitable for the working pressure specified in the project specifications or stated in the schedule or given on the drawings;
(c) shall be capable of withstanding the applicable test pressures specified in sub-clause 7.3.1 of SABS 1200 L; and
(d) jointing of the type scheduled, shown on the drawings or specified in the project specification, shall be complete with insertions, rings, packings, bolts, nuts, etc., as relevant.

PLA 3.2 PROTECTION

3.2.1Against corrosion

The cleaning and painting of valves as specified hereunder is to be carried out at the factory prior to dispatch to site.
(a) All cast iron surfaces of every valve shall be prepared for painting to a thoroughly clean condition free of all grease and deleterious matter. Steel surfaces shall be prepared in accordance with Swedish Standard SIS 05 5900 for an Sa 2½ finish.
(b) Internal surfaces shall then be treated with two coats of Copon EP 2300 or other approved non-toxic epoxy resin paint to give a total minimum dry film thickness of 160 micrometres; both coats being applied within 48 hours of commencement of painting.
(c) External surfaces shall, immediately after cleaning, be treated with one of the following alternative paint systems:
(i) System 1: for valves situated in underground chambers or exposed conditions.
Apply three coats of an approved epoxy coal tar paint to give a minimum total dry film thickness of 240 micrometres; all three coats being applied within 72 hours of commencing the first coat.
(ii) System 2: for valves situated in pump stations etc.
Apply one coat of zinc chromate primer followed by one coat of undercoat tinted where necessary, and a final coat of best quality gloss enamel. The total dry film thickness of the system shall be not less than 200 micrometres.
(d) Non-ferrous metal or stainless steel surfaces shall not be painted.
(e) After erection on site all valves shall be cleaned and the paint work refurbished where necessary to restore the condition to that at the time of leaving the factory.

3.2.2Against damage during transit to the work site

The body ends shall be sealed and the jointing surfaces protected before dispatch to the site. Any damage to the corrosion protection shall be made good after delivery to the site and prior to installation into the pipeline as per sub-clause 5.4.

PLA 3.3 REQUIREMENTS FOR SPECIFIC TYPES OF VALVES

In addition to the requirements of 3.1 and 3.2 the relevant requirements of 3.3 shall apply.

3.3.1Gate valves

Gate valves shall comply with SABS 664 for water works pattern valves of the types, classes and sizes scheduled and shall be provided with the following:
(a) the outlet connections shall be flanged or spigot plain ended as scheduled;
(b) the spindles shall be non-rising;
(c) the spindles shall be fitted with caps unless otherwise scheduled;
(d) the direction of closing shall be clockwise;
(e) type B gunmetal trim, except where type C stainless steel is scheduled in which case the latter trim shall be provided;
(f) suitable gearing, where necessary to limit the maximum torque to be applied at the hand wheel to 95 Nm under an unbalanced pressure equal to the maximum working pressure for the classes specified or scheduled. An indicator on the gear casing to show the position of the gate is to be included with the gearing;
(g) a vent cock on valves of 200 n b and larger to permit the evacuation of air or water from the body of the installed valve;
(h) the facility to permit repacking of the gland whilst the valve is under pressure;
(i) test certificates from the manufacturer, except where an inspector is appointed by the Employer to witness the testing;

(j) a suitable cast on arrow indicating the preferred flow direction through the valve, where such preference is applicable;
(k) valves of sizes and classes not covered by SABS 664 shall be at least equal to the requirements of the Specification with regard to materials and workmanship;
(l) the seat rings shall be pinned;
(m) the gland packing shall be lubricatred and graphited cotton packing in accordance with the requirements of BS 437 Type A;
(n) the design of all valves shall be such that they may be mounted upright; and
(o) in addition to the tests specified in 7.1 gate valves shall be subjected to the test procedure specified in sub-clause 6.3.1(b), 6.3.1(c), 6.3.3.2 and 6.4 of SABS 664.

3.3.5Flanges
The dimensions and drillings of flanges for valves shall comply with SABS 1123 as follows except where otherwise scheduled:

VALVE CLASS	*APPLICABLE TABLE*
Class 10	table 1000/3 but flat faced
Class 16	table 1600/3 but flat faced
Class 25	table 2500/3 but flat faced
Class 40	table 4000/3 but flat faced

PLA 4. **PLANT**
The terms of Clause 4 of SABS 1200 L shall apply where relevant.

PLA 5. **CONSTRUCTION**

PLA 5.1 SETTING OF VALVES AND FITTINGS
5.1.1 General
(a) Unless otherwise specified or shown on the drawings, gate valves, fire hydrants and air valves shall be installed upright and butterfly valves shall be installed with the main shaft horizontal.
(a) All valves inside valve chambers shall have a removable type coupling on one side.
(b) All valves shall be located in the position shown on the drawings or as otherwise directed, and not merely to suit standards lengths of pipe in urban, factory and such like areas. Closure pieces for fitting a valve into a pipeline shall not be shorter than 500 mm.
(d) Subject to approval before pipe laying commences in open country, valves may be located to suit whole pipe lengths.

PLA 5.2 CONCRETE PEDESTALS
Where so scheduled the Contractor shall construct valve pedestals complete with reinforcing, (if any), as shown on the drawings. Unless otherwise specified, prescribed mix 20 concrete with 40 mm stone shall be used. The pedestal shall be so constructed that access to bolts, plugs, cocks, etc is maintained.

PLA 5.3 HOLDING DOWN BOLTS, STRAPS, CLAMPS ETC.
Where so scheduled the Contractor shall supply and install holding down bolts, straps, clamps, or other devices as shown on the drawings for anchoring valves to valve pedestals or other concrete structures.

5.4 DAMAGE TO CORROSION PROTECTION
All valves and fittings shall be inspected after installation for damage to the corrosion protection. Any damaged areas shall be thoroughly cleaned and retreated according to the applicable subsection of section 3.2.1.

PLA 6. **TOLERANCES**
The relevant terms of clause 6 of SABS 1200 L shall apply. The tolerance in the direction of the pipeline for locating a valve shall be plus minus 100 mm.

PLA 7. **TESTING**
PLA 7.1 VALVE BODIES

(a) Before being dispatched from the manufacturer's works, the body of the valve shall be subjected to the hydraulic test specified in sub-clause 6.3 of SABS 664 carried out in accordance with the procedure set out in sub-clause 6.3.2 (a) of SABS 664. The test pressure shall be twice the specified working pressure. The Contractor shall give one week's notice to the Engineer as to the proposed time of carrying out of tests in the manufacturer's work to enable him to be present if he so wishes.
(b) In addition, each valve tested in terms of (a) above shall be subjected to the appropriate test for the particular type of valve in terms of 7.3. Each test carried out after installation shall be carried out in the presence of the Engineer.

PLA 7.2 COMMISSIONING TESTS

After installation, each valve shall be commissioned under normal conditions of flow in the pipeline, to establish that the valve performs the functions required of it in terms of the specification. After commissioning tests have been completed the Contractor shall, from time to time, make such adjustments to mechanisms as are necessary, until the period of maintenance has expired.

PLA 8. MEASUREMENT AND PAYMENT

Measurement and payment for valves will be made in accordance with the relevant clauses of SABS 1200 L, as may be amended by the Project Specification.

PARTICULAR SPECIFICATION

PLB DISINFECTING, TESTING FOR WATER TIGHTNESS AND COMPLIANCE WITH SPECIFICATIONS

CONTENT

PLB1. SCOPE
PLB2. INTERPRETATION
PLB3. MATERIALS
PLB4. EQUIPMENT
PLB5. CONSTRUCTION
PLB6. TOLERANCES
PLB7. TESTS
PLB8. MEASUREMENT AND PAYMENT

PLB1. SCOPE

This specification covers the preparation for acceptance of the reservoirs and pipes by disinfecting and testing.

PLB2. INTERPRETATION

DEFINITIONS

The definitions and abbreviations defined in the applicable standardised SABS Specifications also apply to this specification.

PLB3. MATERIALS

Not applicable.

PLB4. EQUIPMENT

Not applicable.

PLB 5. CONSTRUCTION

PLB 5.1 CLEANING, FLUSHING, AND DISINFECTING OF RESERVOIR AND PIPES

5.1.1Pipelines

After the pipelines have been successfully tested hydrostatically, they shall be flushed with clean water. The quantity of water and duration of the flushing shall be determined by the Engineer. After the flushing, the pipeline shall be filled with water containing 10 mg residual chlorine per litre. After the chlorinated water has remained in the pipeline for at least 24 hours, it shall be drained and disposed of to the satisfaction of the Engineer.

5.1.2Reservoir

After completion of the structure, it will be cleared of all waste material. The floor shall be swept with wet sawdust, in order to prevent raising dust. The internal walls and floors shall subsequently be washed down and the reservoir flushed with clean water. All water shall be drained.

The reservoir shall then be filled to a depth of 300 mm with water containing 10 mg residual chlorine per litre of water, and all internal surfaces scrubbed down with this water. The labourers carrying out this operation shall wear gas masks. After the chlorinated water has remained inside the reservoir for at least 48 hours, it shall be drained and disposed of to the satisfaction of the Engineer.

The reservoir shall subsequently be filled with water containing 3 mg residual chlorine per litre of water. This water may be used to test the reservoir and pipes for water tightness.

If any further work inside the reservoir should be called for after the reservoir has been disinfected, it shall be re-disinfected at the expense of the Contractor.

PLB6. TOLERANCES

Not applicable.

PLB7. TESTS

PLB 7.1 WATER TIGHTNESS AND TESTING

7.1.1 General

The Works shall not be certified as completed before the reservoir, reservoir accessories and pipework have been tested and proved watertight to the satisfaction of the Engineer. The Engineer also reserves the right to test for water tightness before the maintenance term has expired, and this term shall not be considered expired before the Works has been proved to be to the satisfaction of the Engineer in this regard.

During construction, the Contractor shall take the strictest measures possible to prevent the occurrence of possible sources of leakage.

7.1.2 Testing of the Tower

The testing of the Tower for water tightness shall be carried out as described in PSG 6.5 of SABS 1200 G Part 2.

Only the water for the first filling for purposes of testing shall be supplied free of charge to the Contractor; subsequent fillings of the reservoir required before it is accepted, shall be at the Contractor's expense.

The addition of additives, powders and liquids to the concrete shall not be permitted but where it is imperative, approved surface treatment of the concrete shall be accepted.

The expenses incurred by any such treatment shall however be met by the Contractor and no claim for compensation for such work shall be considered.

If at any time any repair work should be required because of lack of water tightness, the reservoir shall be retested after completion of the repair work at the expense of the Contractor.

7.1.3Testing of pipework

After completion of the pipework, the system shall be tested for leaks, as required by the Engineer.

If any part of the work does not pass a test imposed by the Engineer, the Contractor shall repair the defect or defects at his own expense, using methods approved by the Engineer. The work shall then be retested. The cost of all these additional tests shall be met by the Contractor. No work shall be accepted before having undergone and passed the prescribed tests.

All materials, labour and apparatus required for the testing shall be supplied by the Contractor. All equipment and methods used for testing shall be approved by the Engineer and all tests shall be carried out in the presence of the Engineer or his representative.

PLB 7.2 TESTING OF UNDER FLOOR DRAINS

The under floor subsurface drain shall be tested along its full length after the no-fines concrete casing has been cast, by flooding the no-fines concrete casing with water.

The water should drain away swiftly into the no-fines concrete and pass through the outlets to the gullies.

PLB8. MEASUREMENT AND PAYMENT

	Item	**Unit**
PLB 8.1	Disinfecting of reservoir and pipes	Lump sum

The unit of measurement for the disinfecting of reservoir and pipes is a lump sum.

The tendered rate shall include full compensation for the procurement and supply of all materials, equipment, labour and apparatus required for the washing and scrubbing down of all parts of the reservoir with the disinfectant solution and the removal of the disinfectant solution.

	Item	**Unit**
PLB 8.2	Testing of reservoir and pipes for water tightness	Lump sum

The unit of measurement for the testing of the pipes and reservoir is a lump sum.

The tendered rate shall include full compensation for the procurement and supply of all materials, equipment and pumping apparatus, labour and other apparatus required for the testing of the pipes and reservoir for water tightness.

PARTICULAR SPECIFICATION

PLC LAYING AND JOINING OF MEDIUM PRESSURE STEEL PIPES AND SPECIALS

CONTENTS

PLC1. SCOPE
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PLC1. SCOPE

This Specification covers the laying and jointing of electrically welded low carbon steel pipes and specials of diameter up to 2 000 mm, for transporting water and sewage under working pressures of up to 2,5 MPa.

This Specification shall be read in conjunction with SANS 1200 L and Specifications PLF, PLE and LS.

Where conflict between this Specification and SANS 1200 L occurs, the provisions of this Specification shall apply.

This Specification contains clauses that are generally applicable to the laying and jointing of medium pressure steel pipes and specials. Interpretations and variations of this specification are set out in the Specification Data.

PLC2. NORMATIVE REFERENCES

PLC2.1 SUPPORTING SPECIFICATIONS

Where this Specification is required for a project, the following specifications shall, inter alia, form part of the Contract Document:

a) Specification Data;
b) SANS 1200 Series of Standardized Specifications;
   i) SANS 1200 G or SANS 1200 GA, as applicable;
   ii) SANS 1200 L insofar as it does not conflict with this specification;
c) Specification PLF: Manufacture of medium pressure steel pipes; (LQ)
d) Specification PLE: Corrosion protection linings and coatings for steel pipes; (LR)
e) Specification PLHA: Cement-mortar protective linings, and (LS)
f) Standards listed in Appendix A.

PLC3. DEFINITIONS AND ABBREVIATIONS

For the purposes of this Specification the definitions and abbreviations given in the specifications listed in 2.1 shall apply.

PLC4. REQUIREMENTS

PLC 4.1 MATERIALS

4.1.1General

Refer to Sub-clause 3.1 of SANS 1200 L.

4.1.2Flanges

Refer to Sub-clause 4.1.3.2 of Specification PLF.

4.1.3Gaskets

Refer to Sub-clause 4.1.3.5 of Specification PLF.

4.1.4Bolts and nuts

Refer to Sub-clause 4.1.3.6 of Specification PLF.

4.1.5Welding rods

All rods shall be in accordance with Sub-clause 4.1.3.10 of Specification PLF.

4.1.6Corrosion protection

Refer to Sub-clause 3.9 of SANS 1200 L, and Specifications PLE and PLHA.

PLC 4.2 PLANT

Refer to Clause 4 the specifications listed in (b) of 2.1 above and to Sub-clause 4.1 of the specifications listed in (c), (d) and (e) of 2.1 above.

The Contractor shall furnish all equipment, tools, and supplies, including shielded-type welding electrodes. Welding machines shall be operated within the amperage and voltage ranges recommended for each size and type of electrode. Any equipment that does not meet these requirements shall be repaired or replaced upon request of the Engineer. (Refer also API 1104 Clause 1.3.)

PLC 4.3 METHODS AND PROCEDURES

4.3.1Laying

Pipes shall be laid and bedded in accordance with Sub-clause 5.1 of SANS 1200 L.

4.3.1.1 General

The pipelines shall be laid to straight grades to the levels and to the routes indicated on the drawings.

Pipes shall be laid free from cold stresses. No deflections shall be taken in curvature of pipes, but shall be taken with approved bends with exceptions as hereinafter specified. All deflections in pipes with flexible couplings shall not exceed those recommended by the manufacturer of the couplings after making allowance for ground movements, etc.

All deflections in the axis of butt-welded steel pipelines of 10o or less shall be made by mitring equally the ends of the two pipes to be joined so that the maximum mitre in any one pipe shall be 5o. Where the total deflection is 3^{o} or less, the mitring may be made in one pipe end only. Ends to be mitred shall be carefully and accurately marked and then either machine cut or machine planed. Hand planing will not be permitted. After mitring, the pipe ends shall be re-chamfered as described in Clause 4.1.5 of SANS 719. The minimum gap between pipe end root faces before welding shall be 1,5 mm and the maximum gap shall be 3,0 mm. After mitring all pipe ends shall be thoroughly cleaned before the field weld is carried out. Where the Engineer gives written approval for cold bends, they shall be made by the cold stretch method in such a manner as to preserve the cross-sectional shape of the pipe. The minimum radius of any such bend shall be twenty five times the outside diameter of the pipe. Approved bending shoes shall be used for bending of the pipes.

Snaking into the trench of butt-welded sections of steel pipeline which has been factory lined and/or coated will not be permitted without the written approval of the Engineer.

The Contractor may butt-weld factory coated and/or lined steel pipes together alongside the edge of the trench to form continuous welded pipeline sections up to a maximum length of 45 m and to lower each section into the trench, provided the pipe, coating and/or lining are in no way damaged during these operations and provided furthermore that the deflection of the pipe barrel at any point during any stage of the operation does not exceed 2% of pipe outside diameter.

During the welding of circumferential joints, the Contractor shall ensure that either rubber mats or other suitable material is laid in the pipe invert of epoxy lined steel pipes to protect the lining against damage by traffic or fall-out from arc welding at the joint. Care shall be taken not to stroke arcs on the epoxy lined areas adjacent to the weld joint. Immediately before welding of joints, the protective tape between the ends of concrete or epoxy linings and coatings and pipe ends shall be removed.

The Contractor shall ensure that pipes are strung in accordance with the Engineer's drawings for proper placement by diameter, wall thickness and specifications. Any movement of pipes resulting from failure to comply with these requirements shall be rectified at the Contractor's expense.

4.3.1.2 Handling and transporting

Pipes and specials shall be handled as specified in Sub-clause 4.3.1.1 of Specification PLF. Wrapped pipes shall be protected from grit and other sharp objects while the pipe is in the trench prior to bedding. Walking on wrapped pipes will not be allowed. The Engineer may reject any length of wrapping on which physical damage due to any cause whatsoever is visible.

Cement mortar lined pipes shall not be moved or transported for a period of 14 days after the date of lining.

4.3.1.3 Skids

Skids of sufficient number shall be supplied to support the pipe to proper height. If pipe is supported over the trench, skids shall be of sufficient length to prevent collapsing of the trench and of sufficient strength to carry the pipe.

For coated pipe a sufficient number of skids shall be used to prevent damage to the coating.

4.3.2Jointing methods

4.3.2.1Flexible couplings

The joints of steel pipes by flexible couplings shall be made only in their final laid position. Before assembling the joint, care shall be taken to ensure that pipe ends and couplings are clean and free from burrs and ridges. Such burrs and ridges shall be removed if present. Pipe ends shall be mated carefully before joints are made. Pipe ends shall be concentric and perfectly lined up and the coupling shall not be relied upon to line up or to support the pipe.

Joints shall be made and couplings assembled to the manufacturer's instructions. Two-thirds of the number of coupling bolts, equally spaced, shall first be partially tightened up in a regular sequence, using a short spanner. The remaining bolts shall then be similarly tightened. After checking the coupling alignment, the bolts shall then be finally tightened evenly, using a torque wrench.

Where couplings without central registers are used, precautions shall be taken to ensure that the pipe ends are apart by the same distance as if a coupling with central register had been used and the coupling shall be carefully centred over the pipe ends. (See Drawing No. 2014 CT 124 and 134).

4.3.2.2 Flanged joints

Jointing shall be in accordance with Sub-clause 5.2.2 SANS 1200 L, except that no epoxy paints shall be removed from flange faces. In making the joint the Contractor shall ensure that the flanges are truly parallel with all bolts evenly firm before being finally drawn up with torque wrenches to watertightness. Taper gauges shall be used to check that there is a uniform gap before and after final tightening up of bolts. Bolts shall be tightened in an approved sequence with bolts equally spaced and tightened equally at opposite ends first. The Contractor shall ensure that the correct jointing materials, i.e. asbestos gaskets and bolts and nuts are available when required. The gaskets shall be in accordance with Sub-clause 4.1.3.5 of Specification PLF. In the case of insulated joints the insulated materials shall be arranged as set out in Code of Practice No. SAECC/1.

Flanged fittings shall be so installed that there are no stresses induced into the pipework specials or fittings by forcing ill-fitting units into position or by bolting up flanges with faces not uniformly in contact with their gaskets over their whole faces.

4.3.2.3Bolts and nuts

Bolts and nuts shall be in accordance with Sub-clause 4.1.3.6 of Specification PLF.

Only correct diameters and lengths of bolts and studs shall be used. Flat washers shall be used under all nuts. The length of bolts and studs shall be such that approximately two threads protrude from the nut when fully tightened. The threads of bolts, studs and nuts shall be thoroughly cleaned and then coated with a graphite-grease compound immediately prior to assembly.

4.3.2.4 Field welding

4.3.2.4.1 General

Field welding of pipes which have been lined will only be permitted in pipes of 450 mm ND and larger where a man is able to enter the pipe to make good the lining after welding and testing in accordance with 5.17.2 has been completed. Pipes of lesser diameter may be field welded where concrete linings will be made after the pipeline has been laid and all welds have been tested and approved.

At the option of the Engineer, roll welding will be permitted provided an alignment is maintained by use of skids or structural framework to accommodate two or more lengths of pipe with an adequate number of roller dollies to prevent sag in the pipe. The entire root bead, however, shall be made with the pipe in a stationary position.

All pipes welded in the trench shall be properly laid and aligned before welding commences. Bell holes shall be excavated at all field welds. The Contractor shall not lift the pipe to provide adequate access for the welders to enable them to stovepipe weld the joint.

Both ends of pipes which are fusion-bonded epoxy coated (or otherwise painted) shall be wrapped for a distance of at least 300 mm on either side of the weld by means of an asbestos mat or other approved material to ensure that weld spatter or other damage is not caused to the coating during the welding process. The pipe trench shall be kept free of all dirt and water in the vicinity of the weld until after all corrosion protection measures have been completed and approved.

Destructive testing as specified in 5.1.2.1 shall be carried out. The Contractor shall submit to the Engineer for approval a full procedure specification as detailed in API 1104, Cl 2.3 and exhibits A and B prior to any field welding being allowed.

4.3.2.4.2Welding procedure and qualification of welders

Welding shall only be done by qualified welders who satisfy the requirements of API Std. 1104, Cl 3.0. Before any welding of pipeline materials commences, the qualification of welders shall have been approved, all detailed welding procedure specifications with weld diagrams required for their completion shall have been submitted for approval in a neat form and the welding procedure qualification tests shall have been successfully concluded all in

accordance with the relevant standard specifications. Each welder shall mark the pipe adjacent to the weld with the figure assigned to him.

Sufficient records shall be kept by the Contractor to ensure that all field welds can be subsequently identified with the welder concerned.

As far as practicable all out of trench welding shall preferably be done by an automatic submerged process and the Contractor shall provide all necessary plant to carry out this process. MSEAP welding may be used where in trench welding is done.

Heat treatment for welding shall be in accordance with API Std. 1104 if required by same and the Contractor shall provide an approved shield to protect the pipe joint from wind and weather during heat treatment and welding.

4.3.2.4.3 Line up

Pipes shall be lined up in such a manner as to prevent damage thereto. If the pipe to be used has a longitudinal seam, these seams shall be staggered by not less than twenty degrees and welded sections, or single lengths, shall be assembled in such a manner that this seam shall remain in the top quadrant of the pipe during coating operations and after lowering into the trench. (Refer to Drawings 2014 CT 138 and 140).

4.3.2.4.4Cleaning of pipe ends

Before welding, all foreign matter shall be removed from the bevelled ends. If any of the ends of the pipe joints are damaged to the extent that satisfactory welding contact cannot be obtained, the damaged pipe ends shall be cut and bevelled with an approved bevelling machine. These field bevels of pipe ends shall be made to the satisfaction of the Engineer. Should laminations, split ends, or other defects in the pipe be discovered, the joints of pipes containing such defects shall be cropped, repaired, or removed from the line as designated by the Engineer.

4.3.2.4.5 Weather conditions

No welding shall be carried out during rain or high wind unless the welder and joint are adequately protected and sheltered, to ensure that the welding is not impaired.

4.3.2.4.6 Protection of paintwork

Before welding commences, a suitable apron at least 800 mm wide shall be wrapped around both sides of the area to be welded to ensure that weld spatter does not damage the paintwork.

4.3.2.4.7 Butt-welding

Pipes and specials to be joined by field welding shall be supplied with ends bevelled for welding. All welding of joints shall comply with API Std. 1104 and only approved type welding rods shall be used. If backing rings are used, they shall be placed in position and wedged up or adjusted so that the pipe ends are completely circular and properly mated. The space between abutting pipe ends, when aligned for welding, shall be such as to ensure complete penetration without burn-through. For pipes having the same dimensions, the spacing shall be approximately 1,5 mm. The alignment of the abutting pipe ends shall be such as to minimize the offset between pipe surfaces. For pipes of the same nominal wall thickness, the offset shall not exceed 1,5 mm. Internal line-up clamps shall be used wherever practicable and may be removed after the root bead is 50 per cent completed, provided that the completed part of the root bead is in segments of approximately equal lengths, spaced about the circumference of the pipe. If conditions make it difficult to prevent movement of the pipe, or if the weld will be unduly stressed, the root bead shall be completed before releasing clamp tension.

External line-up clamps shall be used where it is impracticable to use internal line-up clamps. Partial root beads made when using external clamps shall be uniformly spaced about the circumference of the pipe, and shall have an accumulative length of not less than 50 per cent of the pipe circumference before the clamps are removed.

Tack-welding shall be carried out to maintain the root gap and position of the pipe ends during the welding proper. The number of tack-welds shall be kept to a minimum but shall not be less than four around the circumference of the pipe.

After proper preparation and tack-welding, the root bead shall be carried out followed by successive filler passes, and capper pass in accordance with the approved welding procedure.

The filler and finish beads shall be deposited by an acceptable method and each filler bead shall be approximately 3 mm in thickness. Completed welds shall have a reinforcing of not less than 0,8 mm and not more than 1,5 mm above the pipe surface around the entire perimeter of the weld, and the width of the finish or cover shall be not more than 3 mm greater than the original groove. The number of beads required shall be governed by the wall thickness of the pipe, so that the completed weld will have the reinforcement previously specified; provided, however, that each weld shall consist of at least three beads. No two beads shall be started at the same point. No mitre welds will be permitted, and all welds are to be at ninety degrees (± 5o) to the axis of the pipe. All slag and scale shall be removed from each bead for visual inspection immediately after each bead is run.

In all field butt-welds where it is possible to work inside the pipe, the inside weld shall be done first.

The chemical composition of weld metal and parent metal shall be similar and the inner weld metal or reinforcement shall not extend more than 1 mm above the inside metal surface of a pipe or special, and any excess shall be removed by grinding.

Defects caused by stray welding arc flashes shall be removed by grinding, provided that the pipe wall thickness is not reduced to less than the specified minimum thickness, otherwise the portion shall be cut out and repaired.

4.3.2.4.8 Fillet welding

Welding shall be as for butt-welding as applicable. All pipes of 600 mm ND and over shall be welded on both the outside and the inside. (Refer Drawing 2014 CT 140).

4.3.2.5 Repair of welds

Rectification of defective welds shall be in accordance with API Std. 1104 and to the satisfaction of the Engineer. All costs related to the repair of defective welds shall be borne by the Contractor. Defective welds shall be repaired immediately they are found to be so. The Engineer has the right to stop the Contractor proceeding with further pipe laying in the event of the Contractor delaying the rectification of defective welds. Furthermore, no consideration will be given to any claims arising from delays in construction resulting from such action.

All welded joints which have been repaired shall be 100% radiographed or otherwise tested to the Engineer's satisfaction at the Contractor's own expense.

4.3.3 Installation of specials and fittings

4.3.3.1 General

Welding shall comply with API Std. 1104. All specials and other fittings shall be installed in accordance with the drawings and instructions of the Engineer. Where "slip-on" or sleeve couplings are to be fitted, all surfaces shall be thoroughly cleaned to a smooth finish, care being taken to remove as little of the protective coating as possible.

4.3.3.2 Bends

Bends shall be installed true to line, level and deflection and shall be anchored in concrete where required to counteract thrust. Bends shall normally be supplied with "centre planes" marked with two small punch marks close to both ends of the bends to facilitate correct positioning of the bends in laying.

4.3.3.3 Tees

Tees for air valves shall be installed with branch barrels pointing vertically upwards. Tees for scour valves shall be installed with branch barrels horizontal or at the gradients indicated on the drawings. Tees for offtakes shall be installed as shown on the drawings.

4.3.3.4 Flanges

All flanges shall be installed with bolt holes off-centre and symmetrically off-set from the vertical centre lines of the flange. Flanges shall be installed truly square to the axis of the pipe.

4.3.3.5 Insulated flanged joints

Insulated flange joints shall be provided and installed by the Contractor where specified or instructed by the Engineer. The Contractor shall supply all materials, labour and equipment required and shall complete and prove that each insulated joint after installation in the pipeline has a resistance well in excess of the resistance to earth of the pipeline on both sides of the insulating joint. (Refer to Drawings 2014 CT 152 and 154).

4.3.3.6 Temporary closure pipes

Temporary closure pieces shall be of the same standard, diameter and wall thickness as the pipeline, except where otherwise specified or instructed by the Engineer.

4.3.3.7 Permanent closure pipes

Permanent closure pipes shall be provided and installed as pipe laying proceeds. They shall be either butt welded to adjacent pipes, or jointed to access pipes, fittings or specials by means of slip-on couplings.

4.3.3.8 Access pipes

Access pipes 6 m long with flexible couplings shall be provided where butt-welded pipelines are to be lined in-situ with concrete. These pipes shall be spaced throughout the pipeline in accordance with requirements of lining operations, but at not more than 400 m intervals. Access pipes shall be of the same standard, diameter and wall thickness as the pipeline, but shall have machined collars welded to both ends as well as to the mating pipe ends (as shown on Drawing 2014 CT 124).

4.3.3.9 *Pumps*

All pipes and electric motors to comply with the below:

W1: DATA SHEET- PUMP

No	**Item**	**Unit**	**Specified**	**Offered**
1	PUMP DETAILS			
1.1	Manufacturer			

1.2	Type of pump (centrifugal, mixed flow, axial, etc.)		Centrifugal	
1.3	Model nr			
1.4	Impeller type (bronze, stainless steel, etc)			
1.5	Impeller diameter	mm	412-423	
1.6	Rotational speed (nominal – 1500 max.)	rpm	1500 max	
1.7	DE bearing type (sleeve, roller, ball, etc.)			
1.8	NDE bearing type (sleeve, roller, ball, etc.)			
1.9	Bearing cooling method			
1.10	Method of lubrication (oil, grease, etc.)			
1.11	Shaft			
1.12	Shaft sleeve			
1.13	Seal type (mechanical, gland, etc.)			
1.14	Type of coupling			
1.15	Type of exterior coating (2-pack epoxy, FBE, etc.)			

No	**Item**	**Unit**	**Specified**	**Offered**
	MOTOR			
2.1	Manufacturer			
2.2	Type of motor (induction, synchronous, etc.)			
2.3	Motor shaft output at site conditions	kW	250	
2.4	Number of poles	no	4	
2.5	Full load current	A	480	
2.6	Voltage	V	380	
2.7	Type of starter (dol/stardelta)			
2.8	Motor efficiency	%		
2.9	Thermal protection fitted		Yes	
2.10	Bearing cooling method			
2.11	Method of lubrication (oil, grease, etc.)			
2.12	DE bearing type (sleeve, roller, ball, etc.)			
2.13	NDE bearing type (sleeve, roller, ball, etc.)			
2.14	Bearing cooling method			
2.15	Method of lubrication (oil, grease, etc.)			
2.16	VSD driven motor	Y/N	Yes	

No	**Item**	**Unit**	**Specified**	**Offered**
3	PUMP CHARACTERISTICS			
3.1	Delivery at duty point	l/s	275	
3.2	Head at duty point	m	52	
3.3	Guaranteed min. efficiency at duty point	%	80	

3.4	Power absorbed at duty point	kW		
3.5	NPSH required	m		

Deviations from specification:

List all the deviations from the specification

(If no deviations are listed it confirms that the equipment offered complies fully with all aspects of the specification.)

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4.3.4 Temporary sealing of line

4.3.4.1 Night-caps

Metal night-caps shall be used to close off all ends of each laid section of pipework when work is stopped at the end of each day or for longer periods and shall be left on the ends of sections of completed pipework until such sections are tied-in with the remainder of the completed pipeline. The night-caps shall consist of a steel plate welded into a half slip-on coupling which shall be provided with a sufficient number of lugs to secure the ring and gasket and shall be strong enough to withstand external water and earth pressure in the event of flooding or collapse of earth and the joint shall be watertight.

4.3.4.2 Air and scour valve outlets

The Contractor shall also, at his own expense, blank-off all air valve, scour valve and off-take tees with at least 8 mm thick blank flanges which shall be bolted with at least four bolts to tee flanges or shall be fixed to plain ended tee branches by using half couplings welded to the blank flanges. These shall be watertight and shall not be removed until the valves or other fittings are about to be fitted.

4.3.5 Installation of valves and meters

All valves and fittings shall be left in working order and shall be housed in chambers as specified in Sub-clause 5.6 of SANS 1200 L.

Valves, meter bodies and fittings shall be supplied, painted externally and internally. The Contractor shall thoroughly clean damaged exterior painted surfaces of all valves, meter bodies and fittings of all dirt, rust, grease and other foreign matter by methods approved by the Engineer and shall make good all damaged surfaces in accordance with 4.3.8.1 hereof.

Valves requiring special adjustment after installation such as self-closing valves shall be commissioned by representatives of the valve manufacturers. Similarly, meters shall be commissioned by the respective suppliers after installation by the Contractor.

All valves and meters supplied under separate contracts, which are defective due to circumstances outside the Contractor's control shall be repaired, replaced or modified by the valve suppliers who will also be responsible for commissioning the valves.

The mass of valves or water meters shall at no time be carried by the pipe, the flange or the coupling. Support stools shall be constructed as soon as practicable after the installation of valves and meters, and shall generally

be constructed of concrete or masonry work. Where fabricated steel stools are approved or specified they shall comply with the requirements of SANS 10044-3 and shall be fabricated to the Engineer's approval. Supports shall be welded to the pipe only where specified and linings of pipes and specials shall be made good after welding.

Hydrostatic testing of individual sections of the pipeline shall only be carried out when all scour valves, air valves and control valves have been installed, except where otherwise instructed by the Engineer in writing.

Should line control valves or other equipment supplied under separate contract not be delivered timeously to enable the Contractor to lay continuously and to test the pipeline, the Engineer may order the Contractor to substitute specially made temporary flanged closure pieces. Such temporary closure pieces shall be supplied and installed by the Contractor to enable laying and testing to proceed. Subsequently after installation of the control valves, etc., they shall be removed and shall become the Contractor's property. These temporary closure pipes shall have the same face to face dimensions as the line control valves and shall be fitted with a suitably reinforced control diaphragm plate for sealing of the section of pipeline where it is fitted.

Wall thickness and diameter of the closure pipes shall be the same as the pipeline. A 100 mm nominal bore valve-controlled by-pass shall be fitted externally around the diaphragm plate.

4.3.6 Casings, anchor blocks and chambers

4.3.6.1Concrete casing

Where the Engineer requires pipes to be encased in concrete, the work shall be done in accordance with Sub-clause 5.4 of SANS 1200 L except as detailed as follows:

a) Concrete casing shall be discontinuous at flexible couplings in the pipeline.

b) The in situ concrete bed 150 mm thick shall be cast and the pipeline laid thereon true to line and level leaving a gap nowhere less than 50 mm between the pipe and the bed.

c) After jointing the pipes shall be secured to steel loops left in the bed. Concrete shall then be punned under and around the pipes from one side only until the bottom quarter of circumference of the pipes is in contact with the concrete bed.

4.3.6.2Anchor blocks

At tees, bends, terminal valves, end caps, or where otherwise directed by the Engineer, anchor blocks shall be constructed in accordance with Sub-clause 5.5 of SANS 1200 L.

4.3.6.3Valve chambers

Valve chamber shall be constructed in accordance with Sub-clause 5.6 of SANS 1200 L. Concrete chambers shall be constructed in accordance with the relevant clauses of SANS 1200 G or GA.

4.3.7 Disinfection of potable water pipelines

After completion of the laying and testing, each potable water pipeline shall be sterilized as specified in Sub-clause 5.10 of SANS 1200 L.

4.3.8 Corrosion protection

4.3.8.1 Final painting

After successful hydrostatic testing of the pipeline, and after completion of all construction work under this Contract, all external surfaces of uncoated steelwork and surfaces of all valves and fittings shall be prepared and painted as specified in the relevant clauses of Specification PLE. In addition, all surfaces of materials which had received first

coats of paint in the course of the Contract in accordance with the specifications shall receive final coats of paint of the same colour or such other colours as may be specified or instructed by the Engineer.

All paint used shall be out of the original containers of the manufacturer and such containers are to be brought onto the site unopened. No adulteration will be permitted and paints shall be used strictly in accordance with the manufacturer's instructions.

Painting shall not be done in wet or humid weather. Refer also to Sub-clause 4.3.5.2 of Specification PLE.

4.3.8.2 Butt-welded steel pipes

4.3.8.2.1 General

As soon as practicable, but not more than 24 h after the welding of joints in the field has been approved and accepted by the Engineer, the internal lining of pipes and specials shall be made evenly continuous over the joints.

Materials for this work shall have the same properties as those used respectively for the adjacent lining or coating and shall be so applied that the finished work over the joint shall have the same quality as specified respectively for the adjacent lining or coating and shall be capable of passing the same tests as specified for adjacent lining or coating. (Refer to Drawings 2014 CT 142, 144 and 146).

Refer also to the relevant clauses of Specifications PLE and PLHA for details.

PLC 5. COMPLIANCE WITH REQUIREMENTS

PLC 5.1 TESTING

5.1.1General

Testing shall be in accordance with SANS 1200 L and Specifications PLF, PLE and PLHA, as relevant.

5.1.2Testing of field welds

5.1.2.1Destruction tests

Tests as specified in API 1104 Cl. 2.0 shall be carried out and approved prior to any field welding being done.

Radiographic tests and adjudication of test records shall be carried out by an Independent Inspectorate, appointed by the Engineer to act on his behalf. The Inspectorate shall be afforded every facility during the course of pipeline construction and testing to enable the inspection to be carried out effectively. 10% of the total length of all manual field butt welds and 2½% of the total length of field welds done by an approved automatic process shall be examined radiographically with particular reference to weld intersections, using equipment supplied and staffed by the Inspectorate.

The Engineer reserves the right to increase the length of welds to be radiographed if results obtained are not satisfactory or to reduce the length of welds radiographed to a minimum of 4% if the standard of welding is sufficiently high to warrant such a reduction.

The Inspectorate shall process and adjudicate radiographs on site. The standard of acceptability shall be in accordance with API 1104. All welds which are found to be unsatisfactory shall be repaired and re-radiographed at the Contractor's expense. The additional radiography of repaired welds shall not be deemed to be included in the overall 10% or 2½% radiography.

Field welds may be examined by radiographic inspection as stated in API 1104 Cl 2.6 and 2.8. Should two or more welders participate in making the weld, the welding foreman and the Engineer's Representative shall decide which welder is responsible for the defective work. The Engineer shall be privileged in the judgement of his inspector to cut out welds for further tests. The test welds (except the initial free test referred to in 5.1.2.1) that meet the Engineer's requirements and specifications when properly tested shall be replaced with a satisfactory tie-in at the Employer's expense. Should any test weld cut from the line prove unsatisfactory to the Engineer when properly tested, it shall be replaced at the Contractor's expense. Test welds shall be cut from the line as soon as practicable after completion to avoid unnecessary delay and expense, and shall consist of an annular ring not less than 230 mm long with the weld in the middle.

When welding the line together at places where the test welds have been cut out, one weld will be used if it is practicable to pull the line back into position; otherwise, two welds will be made by setting in a short length of pipe with a minimum length of 750 mm.

The Contractor shall furnish approved types of machines for testing. A record of the results of each test weld shall be made by the Engineer's inspector and jointly signed by the Engineer's Representative and Contractor's Representative. The Contractor will be reimbursed for extra welds at the rates tendered if scheduled in the Contract as a separate item. Extra welds shall be construed to mean those welds cut out at the Engineer's request which, after specified tests, are found to meet the Engineer's specifications, except those free initial test welds referred to herein.

Claims arising from delays in construction caused by justifiable additional radiography which may be ordered by the Engineer or re-radiography of repairs, will not be considered.

5.1.2.2Visual testing

A 100% dye penetrant test shall be carried out by the Contractor on all field welds except where radiographic testing is ordered. (Refer SANS 1200 L Sub-clause 7.2.1.)

All field welds shall be inspected visually throughout their entire length by the Contractor for signs of possible faults. Full records of the testing of each joint shall be kept by the Contractor and his findings reported to the Engineer. The Engineer and/or the Inspectorate shall inspect up to 10% of the number of field welds visually.

5.1.3Testing of fillet welds

In addition to the dye penetrant tests, each fillet weld of 600 ND and over shall be air and bubble tested by pumping air into the annular space between the welds (Refer to Drawing 2014 CT 140) to a pressure of at least double the specified working pressure. While this pressure is maintained, all welds and connections shall be tested with soap or primer. Defects found during testing shall be repaired by the Contractor, and testing continued all at the Contractor's expense until a satisfactory result is obtained.

The test tapping point shall then be plugged in an approved manner.

5.1.4Hydraulic pipe test

.....Refer to Sub-clause 7.3 of SANS 1200 L.

PLC 5.2 TOLERANCES

Tolerances shall be in accordance with Clause 6 of SANS 1200 L.

PARTICULAR SPECIFICATION

PLE SPECIFICATION FOR THE CORROSION PROTECTION OF STEEL PIPES AND SPECIALS, CAST IRON SPECIALS AND VALVES

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PLE 1. SCOPE

This Specification covers the requirements for corrosion protection and painting of steel pipes and steel and cast iron specials for water and wastewater facilities and similar situations. This Specification shall be read in conjunction with SANS 1200 HC. Where conflict between this Specification and SANS 1200 HC occurs, the provisions of this Specification shall apply.

This Specification does not cover corrosion protection by means of cement mortar linings and coatings which is covered by Specification LH.

Interpretations and variations of this Specification are set out in the Specification Data.

PLE 2. NORMATIVE REFERENCES

PLE 2.1 SUPPORTING SPECIFICATIONS

Where this Specification is required for a project, the following specifications shall, inter alia, form part of the Contract Document:

a) Specification Data;

b) SANS 1200 Series of Standardized Specifications;
   i) SANS 1200 A or SANS 1200 AA, as appropriate;
   ii) SANS 1200 HC;
   iii) SANS 1200 LH;

c) Standards listed in Appendix A, and

d) Specification PLF: Manufacture of medium-pressure steel pipes.

PLE 3. DEFINITIONS AND ABBREVIATIONS

PLE 3.1 DEFINITIONS

For the purpose of this Specification the definitions and abbreviations given in the specifications and standards listed in 2.1 and the following shall apply.

Cathodic disbondment: Progressive breakdown of the protection coatings bond to the metal surface.
Grit blast cleaning: The process of directing small particles of abrasive steel shot or other approved grit against the surface to be coated. The grade of cleanliness (as Sa 2½) shall mean in accordance with Swedish Standard SIS 05 59 00.

Holiday: A defect in a coating where the coating has been damaged, or is so thin, or the coating material has been

so degraded or contaminated that its properties are seriously impaired.

Holiday detector: An electrical device usually consisting of a ring of multiple wires mounted on a frame and electrically charged so that as the device passes along the coated surface an electrical discharge can be observed (audible alarm) at holidays or at points where the coating has failed to cover the protected surface completely.

Organic coatings: Organic pipe coatings and linings may be divided into the following categories:
a) Coal tar and asphaltic bitumen based coatings.
b) Paint and allied coatings including those based on epoxy, polyurethane, vinyl, chlorinated rubber and alkyd resins.
c) Works applied thermoplastic and thermoset coatings such as polyethylene (extruded and sintered), nylon and fusion bonded epoxy.
d) Tape wrap coatings including cold applied petrolatum-based tapes, polymer backed tapes, hot applied bituminous types and shrink-wrap coatings.
e) Films type temporary protectives.
f) Miscellaneous organic materials such as polyurethane foam.

Significant surface: The part of the article covered or to be covered by the coating and for which the coating is essential for serviceability and/or appearance.

PLE 3.2 ABBREVIATIONS

DFT : Dry film thickness
FBE : Fusion bonded epoxy
FBLDPE : Fusion bonded low density polyethylene
MS : Mild steel
Sa : Followed by a number refers to the relevant part of Swedish Standard SIS 05 59 00
UV : Ultra-violet radiation

PLE 4. REQUIREMENTS

PLE 4.1 DESIGN, MATERIALS AND MANUFACTURE

4.1.1Degreasing agent
The degreasing agent shall be water soluble.

4.1.2Thinners
Only the paint manufacturer's recommended thinners shall be used.

4.1.3Paints

4.1.3.1 General
All paints used for a particular coating system shall be obtained from the same supplier and they shall be mutually compatible.

The paints supplied shall be in accordance with SANS specifications for their respective types or the BS or ISO where no SANS specification exists and shall be of the best quality of their respective kinds.

1.1.3.2 Basic requirements (performance specification)
i) Durability. The coating shall be chemically inert, i.e. it shall as far as practicable be free of constituents subject to further oxidation, polymerisation or saponification and maintain its properties for an indefinite period. Coatings shall be resistant to biological degradation.

ii) Moisture permeability. The coating shall act as a virtually impermeable barrier to water and aggressive ions.

iii) Resistance to mechanical damage. Impact resistance shall be at least 4 joules at 20 ^{o}C (in accordance with ASTM G14).

iv) Conformability. The coating shall conform to the metal surface profile without leaving voids, gaps, laminations or pinholes.

v) Ease of site application. Requirements of surface preparation, primer, applications, temperature limits, etc., shall be reasonable and easily understood. Furthermore, the coating shall be capable of being applied under normal site conditions as generally known or as described in the Specification Data.

vi) Ease of repair. Damage to works and site applied coatings shall be capable of effective repair, and conform to the requirements of (v) above.

vii) Stability under cathodic protection. The coating shall offer a resistance high enough to maintain the protection current demand within reasonable limits. If perforation of the coating should occur, allowing electrolyte to penetrate to the pipe surface, the coating shall resist cathodic disbondment.

viii) Adhesion to pipe surface. The coating shall have a high peel resistance. This shall be demonstrated by preparing samples 50 mm wide and stating the force required to achieve peel. Adhesion shall be at least 6 N/m^2 of steel. Where vinyl or other finish coats are specified, suitable priming and surface preparation shall be carried out to improve peel resistance.

ix) Flexibility. The coating shall be flexible (Elongation: 3 % strain at 20° C. 1 % at 18° C).

x) Solvent free. Where practicable, solvent free paints shall be applied.

xi) Internal linings. Linings for potable water shall be non-toxic, non-tasting and non-tainting.

4.1.3.3Primers

The correct primer shall be selected for the surface being coated and the paint coating being used, in accordance with the manufacturer's recommendation.

4.1.3.4Vinyl copolymer paints

Vinyl copolymer (PVC) paints shall have a solids content of 50 % by mass and 32 % by volume with a viscosity of 4,5 poise ± 0,5 poise. The paint shall be stabilised against UV radiation.

4.1.3.5Polyamide cured potable water, epoxy paints

Polyamide cured potable water, epoxy paints shall be Dulux Sigmaguard EHB, Plascoguard Copon KSIR88, Ameron Amercoat 385 or equal approved. They shall be two pack polyamide cured high build epoxy paint systems having a red oxide colour.

4.1.3.6Fusion bonded epoxies (FBE)

Only the best quality of raw materials shall be used in the FBE. The components of the FBE shall consist of:

a) Epoxy resin to determine fundamental characteristics.
b) Curing agents to determine rate of cure.
c) Fillers/pigments to improve impact resistance and toughness.
d) Flow agents/stabilisers.

Strict quality control shall be maintained throughout the manufacturing process.

The FBE shall comply with Clause 3.1(b) of SANS 1217.

4.1.3.7 Chlorinated rubber

Paints shall consist of a base containing natural rubber plus a polymer of isoprene. Plasticisers shall be inert and without deleterious effect on the coating properties. A stabiliser against UV radiation consisting of organo-tin, epoxy, a lead compound, or other approved material shall be added to the paint. The coating shall be low build, quick drying.

4.1.3.8 Coal tar enamels

The paint shall be manufactured in accordance with BS 4164 or AWWA C 203.

4.1.3.9 Asphaltic enamels

The paint shall be manufactured in accordance with BS 4147.

4.1.3.10 Bituminous paints

The paint shall be manufactured in accordance with BS 4147 or SANS 802 and shall, where applied to valves or

specials, be sufficiently hard not to flow on exposure to a temperature of 75° C.

4.1.3.11 Coal tar epoxy
The coating shall consist of an approved high build, type 2 paint conforming to SANS 801.

4.1.3.12 Inorganic zinc silicate paints
Zinc-dust paints bound with a silicate binder shall have a zinc content of not less than 93 % and not more than 95 %. The balance shall consist of the binder which shall be either alkali silicate in water or an alkyl silicate in an organic solvent.

4.1.3.13 Red iron oxide
Red oxide based on alkyd media and containing an adequate percentage of anti-corrosive pigment such as zinc chromate may be used where low cost primers are permitted.

4.1.3.14Fusion bonded, low density polyethylene (FBLDPE)
Only the best quality of raw materials shall be used for FBLDPE. (See Appendix C.)

1.1.4 Tape wraps and primer

4.1.4.1General
All tapes used shall be manufactured in accordance with SANS 1117 or an internationally approved standard.

Inner wrap tape shall consist of black polyethylene Type C tape. The polyethylene film shall be at least 375 micrometres thick and the rubberised bitumen not less than 1 mm thick.

Outer wrap tape shall consist of a white polyethylene film pressure sensitive adhesive Type D tape not less than 500 micrometres thick.

Alternatively a Type C tape as specified above may be used.

Only the primer supplied with the tape shall be used.

1.1.4.2 Petrolatum mastic and tape
Only material of an approved brand shall be used for the petrolatum mastic and tape (e.g. Denso). The Contractor must in writing obtain approval from the Engineer.

4.1.4.3Mastic blankets
The petrolatum mastic shall be at least 10 mm thick and supported by a non-biodegradable synthetic fabric.

4.1.5Storage
All storage of flammable materials shall be in accordance with the requirements of the relevant local authority.

PLE 4.2 PLANT

4.2.1Handling
The plant and equipment used by the Contractor for handling of pipes, valves, pumps and other equipment, during the painting operation shall be such that no pipe shell, valve, pump casing or other piece of equipment is overstressed during any operations covered by this Specification.

4.2.2Surface preparation
The Contractor shall provide all the equipment required for grit blast cleaning, preparing and cleaning all surfaces to be painted.

4.2.3Painting
The Contractor shall provide all the equipment required for airless spray-painting, applying epoxy "hot coats", sintered epoxy powder (FBE) paint, or any other approved method of applying the paint in the shop, or required for Site painting and repairs to shop applied coats.

4.2.4Inspection and testing

All facilities and equipment required for inspecting and testing the specified corrosion protection measures shall be provided by the Contractor.

PLE 4.3 METHODS AND PROCEDURES

4.3.1Application conditions

4.3.1.1General
All factory applied coating shall be done in a properly enclosed and ventilated workshop, where conditions are such that the work will not be exposed to wind, rain, fog or dew.

Where painting has to be done on Site it shall only be carried out under favourable weather conditions and with the knowledge that conditions will remain so during the specified drying period. Where this is not practicable approved temporary shields shall be erected over the paintwork.

All paintwork shall cease under the following conditions, unless there are any specific restrictions laid down for the particular type of coating in use. When:
a) the temperature of the surrounding atmosphere falls below 5° C; or
b) the relative humidity exceeds 80 %;
c) weather conditions indicate that work is likely to be interrupted by wind, rain, snow, fog or mist, or if there is a serious forecast of these occurring during the ensuring 24 hours;
d) condensation is occurring or is likely to occur on the steel or surface being painted. The temperature of the surface being painted shall at all times be at least 3° C above dew point;
e) the ambient or surface temperatures exceed those recommended by the manufacturer for the application of the particular coating.

4.3.1.2Fire hazard
Every reasonable precaution shall be taken to eliminate all sources of ignition from the working area. Smoking shall be prohibited. An adequate number of fire extinguishers in full working order shall be available at all times.

4.3.1.3Occupational Health and Safety Act No. 85 of 1993
(Applicable in its entirety)
Protective clothing, goggles and breathing apparatus as recommended by the manufacturers of the particular paint shall be worn at all times while painting is in progress.

The concentrations of all airborne constituents shall at all times be kept as low as practicable.

Ventilation arrangements shall be such that no worker is exposed to concentrations of solvents or other paint constituents greater than the threshold limit values recommended by the manufacturers of the paint.

4.3.1.4Materials and workmanship
a) Application of paints
All paints applied in the shop shall be applied by means of airless spray machines (with solvent or hot solventless as applicable), as FBE or as approved. Paintwork carried out on Site shall be to the Engineer's approval. Significant surfaces to be painted shall be those specified in the Specification Data or shown on the drawings.

b) Colour
Successive undercoats shall have distinctive shades to facilitate full paint coverage of each coat. Unless otherwise specified in the Specification Data or directed by the Engineer, the final paint coat shall be as given in Appendix B hereof.

c) Bi-metallic corrosion
The use of dissimilar metals in contact shall be avoided where possible but where unavoidable these materials shall be selected so that the natural potential difference between them does not exceed 250 millivolts.

Electroplating or other treatment of contacting surfaces shall be employed as necessary to reduce the potential difference to the specified limits.

All materials and material finishes shall be selected for long life under the site conditions specified.

d) Finishing and painting
On completion of erection, all pipework, control gear and indicating gear shall be thoroughly cleaned.

After erection paintwork shall be washed down, using nylon brushes and detergent to remove all adhering coating and dirt.

It shall then be washed with clean water to remove all traces of detergent and the finishing coat applied as specified.

All surfaces which cannot be painted after erection shall be painted as specified herein before erection. Where two or more coats are specified, the first shall be applied in the shop and the final coat after erection. Prior to application of subsequent coats, the surface shall be roughened and washed in accordance with the manufacturer's instructions.

4.3.2 Surface preparation

4.3.2.1Parent metal to be painted or hot metallic sprayed

4.3.2.1.1General
a) All pipes, fittings and specials shall be tested and inspected for compliance with the applicable specifications before any cleaning of the surface is commenced.
b) All surfaces to be corrosion protected shall have all sharp protrusions, weld spatter, laminations and tool marks ground smooth and all sharp edges and corners radiused to a minimum of 2 mm.
c) Degreasing shall be done in accordance with Subclause 4.3.4.3.3 of SANS 1200 HC. From this stage on, pipes shall be handled with slings or on ramps which are free from dirt, oil and grease.
d) All surfaces shall be grit blast cleaned in accordance with Swedish Standard SIS 05 59 00 as specified in 4.3.2.1.2 (see also Subclause 5.4 of SANS 1200 HC and SANS Test Method 767). Surface grit blast profiles shall be as follows:

i) In the case of all surfaces to be painted or to which hot metallic sprays not exceeding 100 micrometres in thickness are to be applied, the grit blast profile shall be Class 60 (60 micrometres ± 15 micrometres).
ii) In the case of all surfaces to which hot metallic sprays 150 micrometres and over in thickness are to be applied, the grit blast profile shall be Class 100 (100 micrometres ± 25 micrometres).
iii) The air used for grit blast cleaning shall be free of all traces of oil and water.

NOTE: Where grit blasting to 3CR12 or stainless steel is required, special care shall be taken to use only clean, unused grit consisting of silicon dioxide and/or silicon carbide, or other approved grit, completely free of any traces of metal other than that being cleaned.
e) All surfaces to be corrosion protected shall be moisture dry and shall be free of soluble salts and airborne contaminants.

4.3.2.1.2High quality protection
All steel surfaces to be painted shall be grit blast cleaned to at least grade Sa 3.

Cast iron surfaces shall be degreased, washed and grit blast cleaned to at least Sa 2½.

All surfaces in the vicinity of machined surfaces, which may be damaged by grit blast cleaning, shall be hand cleaned using appropriate tools such as files, wire brushes, emery cloth, etc. The machined surfaces shall then be protected using suitable metal masks, before proceeding with grit blast cleaning as specified above.

After cleaning, all surfaces shall be inspected and all defects shall be filled in by either using an approved epoxy filler or by welding as appropriate. The surface shall then be ground smooth where necessary. The entire surface shall be such that a pinhole-free paint surface is achieved. The surface shall be feather blasted and all traces of dirt removed before the protective coating is applied.
Hand cleaning shall be done in accordance with Subclause 5.4.3.2 of SANS 1200 HC.

4.3.2.1.3Latent material defects
After cleaning, all surfaces shall be inspected and all defects shall be properly cleaned by drilling out to at least

3 mm diameter and 3 mm deep and filled in by either using an approved epoxy filler or by welding as appropriate. The surface shall then be ground smooth where necessary. The entire surface shall be such that a pinhole-free paint surface is achieved. The surface shall be feather blasted and all traces of dirt removed before the protective coating is applied (see also Subclause 5.5 of SANS 1200 HC).

4.3.2.1.4Cleaning surfaces about to be coated
See Subclause 5.6 of SANS 1200 HC.

4.3.2.1.5Manufacturer's standard paint coat on CI
Cast iron surfaces shall be cleaned by mechanical means (scraping and wire brushing) to at least grade Sa 2 or grit blast cleaned to at least grade Sa 1.

4.3.2.2Previously painted surfaces within specified overcoating time
No specific surface preparation is required other than to ensure that the surface is clean and dry and complies with the conditions of 4.3.2.1.2.

4.3.2.3Previously painted surfaces outside specified overcoating time
Preparation shall be done in accordance with the manufacturer's specification, but where none exists the following shall apply:

The surface shall be degreased and cleaned. The paintwork shall then be abraded using emery paper and the surface washed with clean water and a bristle brush. All damaged paintwork shall be repaired in accordance with 4.3.5.4.

4.3.2.4Hot dip galvanized surfaces
Surfaces to be hot dip galvanized shall be prepared in accordance with SANS 14713 and shall be degreased and cleaned using an approved degreasing agent (Oakite 31 or equal). Where the galvanized surface is to receive an epoxy coating it shall be feather blasted.

Where insufficient cleaning is achieved to ensure an entirely satisfactory coating the procedure specified in 4.3.2.1.1(c) shall be adopted.

All materials to be metal coated shall be of the full dimensions shown on the approved drawings or specified and all punching, cutting, drilling, screw tapping and the removal of burrs shall be completed before the metal coating process begins.

Control panels and other sheet metal components to be galvanized shall be grit blast cleaned to at least Sa 2½.

4.3.3Application of corrosion protection systems

4.3.3.1General
The painting of all items supplied under the Contract shall comply with the relevant clauses of SANS 1217.

See also Subclauses 5.2, 5.6, 5.8 and 5.9 of SANS 1200 HC.

All paints applied in the shop shall be applied by means of airless spray machines (with solvent or hot solventless, as applicable), or FBE as approved. Paintwork carried out on Site shall be to the Engineer's approval. Significant surfaces to be painted shall be those specified in the Specification Data or shown on the drawings.

Successive undercoats shall have distinctive shades to facilitate full paint coverage of each coat.

All surfaces which cannot be painted after erection shall be painted as specified herein before erection. Where two or more coats are specified, the first shall be applied in the shop and the final coat after erection. Prior to application of subsequent coats, the surface shall be roughened and washed in accordance with the manufacturer's instructions.

4.3.3.2Bi-metallic corrosion
The use of dissimilar metals in contact shall be avoided where practicable, but where unavoidable these materials shall be selected so that the natural potential difference between them does not exceed 250 millivolts.

Electroplating or other treatment of contacting surfaces shall be employed as necessary to reduce the potential difference to the specified limits.

All materials and material finishes shall be selected for long life under the site conditions specified.

4.3.4Application of metallic coatings

4.3.4.1General
All surfaces to be metal sprayed, electroplated, sherardized or painted shall be prepared as specified in 4.3.2.1.

Surfaces to be hot dip galvanized shall be prepared in accordance with 4.3.2.4.

4.3.4.2Galvanizing

4.3.4.2.1Hot dip galvanizing
All galvanizing shall be done by the hot dip process in accordance with SANS 14713. No alternative process may be used without the approval of the Engineer. No component which is likely to come into subsequent contact with oil shall be galvanized.

a) For sections not less than 5 mm in thickness the minimum zinc application rate shall be 610 g/m^2 (about 85 micrometres thick).
b) Where grit blast cleaning of the surface is specified and the steel contains less than 0,3 % of silicon the application rate shall be increased to 1 000 g/m^2 (about 145 micrometres thick).
c) For steels containing more than 0,3 % silicon, the application rate shall be further increased to 1 500 g/m^2 (about 210 micrometres thick).
d) For pipes of DN 150 or less, see 4.3.6.
e) Control panels and other sheet metal components to be galvanized shall be galvanized not more than four hours after commencement of grit-blasting.
f) Design, fabrication and inspection of hot dip galvanized articles shall conform to the requirements of SANS 14713.

All galvanized parts shall be protected from damage to the zinc coating during the periods of transit, storage and erection.
Damaged areas of the coating shall be touched up with an approved zinc-dust paint, as specified in 4.1.3.12, or other approved flake metallic compound.

4.3.4.2.2Metallic zinc spray coatings
Metallic zinc spray coatings shall be a minimum of 100 micrometres thick and up to 250 micrometres thick depending on the service requirements and shall be in accordance with SANS ISO 2063. (See 4.3.2.1.1(d) for anchor profiles, and 4.3.4.4 for filler coat).

The total DFT shall be 350 micrometres (± 50 micrometres).

4.3.4.3Metallic aluminium spray coatings
Metallic aluminium spray coatings shall have a coating thickness of between 75 micrometres and 100 micrometres and shall be in accordance with SANS 2063. Filler coats shall be applied in accordance with 4.3.4.4.

4.3.4.4 Resin fillers
All metallic sprays are porous and shall therefore, as soon after application of the primary coat as practicable, be filled with an approved filler that is compatible with the finish coat to be applied. Unless otherwise specified in the Specification Data, the filler shall be as specified in 4.3.7.2.1(b). The first coat shall have about 50 % more solvent added than normally applied to facilitate penetration of the epoxy material.

4.3.4.5 Inorganic zinc-rich paint (See 4.1.3.12).
The paint shall be applied to a thickness of at least 75 micrometres per coat. One or two coats (150 micrometres min.) shall be applied depending on the degree of protection specified in the Specification Data. The surface shall then be treated as specified in 4.3.4.4.

4.3.4.6 Electroplating or sherardizing
Electroplating or sherardizing shall be used to coat small parts only. Coating thickness shall be 20 micrometres to 30 micrometres. Sherardized coatings shall be in accordance with BS 4921.

4.3.4.7 Noble metals (Nickel and chromium).
The coating thickness shall vary between 25 micrometres and 250 micrometres depending on the service requirements specified in the Specification Data. These surfaces shall be 100 % pinhole-free to prevent local corrosion acceleration of the metal to be protected. Porous surfaces may require an undercoat of copper plate or other approved surface treatment before the noble metal is applied.
Chromium plated parts. Where chromium plating is specified, or offered by the manufacturer, it shall comply with the requirements of BS EN 12540 including the following provisions:
a) No blistering of any surfaces will be tolerated.
b) The finished appearance shall be bright.
c) Where the base metal is steel, plating shall be applied in accordance with Table 2.

4.3.5 General requirements for paint coatings

4.3.5.1 Primers
Where recommended by the paint manufacturer the first paint coating shall be a primer with the type and dry film thickness as specified by the manufacturer for the paint system being used.

4.3.5.2 Time period for first paint application and overcoating time
The first coat of paint shall be applied within 4 hours of grit blast cleaning if applied further than 20 km from the sea. When the paint is applied within 20 km of the sea the first coat shall be applied within 2 hours of grit blast cleaning. The time intervals apply only at relative humidities below 80 %. Above 80 % no grit blast cleaning or painting shall be done. The time period between subsequent coats shall be in accordance with the paint manufacturer's recommendations.

Subsequent coats of paint shall not be applied until the last applied coat has dried completely.
Paint surfaces which become streaky because paint has run, will be rejected.
After application of the final coat the paint shall be allowed to harden for at least two weeks.

4.3.5.3 Surfaces which will become inaccessible
Surfaces which rest on concrete, or other floors, and areas which will be inaccessible after erection, and mating surfaces, shall receive the full paint system prior to erection.

4.3.5.4 Repairs to damaged or defective paintwork
Paintwork damaged in transit or during erection shall be repaired as follows:

Should more than 10 % of the area of paintwork of any component be damaged the component shall be grit blast cleaned in accordance with 4.3.2.1 and the full paint system re-applied.

If less than 10 % of the area of paintwork of a component is damaged the damaged areas shall be cleaned in accordance with Subclause 5.10 of SANS 1200 HC.

Touching up of damage to the final paint coat will not be permitted. After repairs to the damage as specified above, the whole component shall be treated as specified in 4.3.2.3 and then completely repainted in accordance with the specifications.

4.3.6 Treatment for pipework up to DN 150
a) Pipework shall be galvanized with a heavy duty application of 700 g zinc per square metre, in accordance with SANS 14713. In addition, pipework above ground level shall receive a decorative vinyl copolymer enamel paint coating as specified in 4.3.7.2.3. The first coat shall consist of an etching primer and the second coat may be omitted.

b) All hydraulic and oil piping and fittings shall be thoroughly degreased, descaled and cleaned internally and externally after fabrication by abrasive grit blasting or pickled, thoroughly cleaned and rinsed, dipped in a hot iron phosphate solution and coated internally with an approved corrosion inhibiting, oil soluble preservative. After treatment and drying all openings shall be sealed until the pipes are installed.

4.3.7 Treatment for items over DN 150

4.3.7.1 Linings to MS and CI items

The pipework shall be lined with one of the following coatings in accordance with the Specification Data.
a) Polyamide cured epoxy paint with a DFT of 300 micrometres ±50 micrometres as specified in 4.3.7.2.1(a).
b) Solvent free epoxy "hot coat" to a DFT of 450 micrometres ±50 micrometres as specified in 4.3.7.2.1(b).
c) Where more than one coat is applied, the first and third coats shall be of a different colour to the second coat.

4.3.7.2 Coatings to MS items

4.3.7.2.1 Items permanently under water
Items permanently under water shall be grit blast cleaned in accordance with 4.3.2.1 and shall be painted with one of the following protective coatings as specified in the Specification Data:

a) A two pack polyamide cured high build epoxy in accordance with SANS 1217, Cl 3.1(a) Type 1A shall be applied to a DFT of 300 micrometres ±50 micrometres for pipes and specials. (Valves and pumps shall be coated as specified in 4.3.7.2.1 (c)).

b) A two pack solvent free epoxy "hot coat" in accordance with SANS 1217 Cl. 3.1(a) Type 1C applied by means of a hot airless machine to the thicknesses specified in 4.3.7.2.1 (c).

c) FBE shall be used wherever practicable.
FBE as specified in 4.1.3.6 shall be applied to a DFT of 350 micrometres ±50 micrometres for pipes and specials and 300 micrometers ±50 micrometers for valves and pumps.

Where pipes are to be joined by means of field welding, the paint coat shall end 50 mm from the pipe end. The uncoated pipe end shall be wrapped with an approved self-adhesive masking tape which shall overlap the paint by at least 50 mm as soon as practicable after the coating process has been completed.

d) Two coats of two-pack zinc silicate based primer applied to a total thickness of not less than 75 micrometres. The first coat shall be of the inorganic type and applied within four hours of grit blast cleaning. The second coat shall be of the organic type. Touching up of inorganic zinc silicate shall be with a single pack zinc-rich epoxy primer.

These items shall then be painted with an approved high build, non-toxic, non-tainting, coal tar epoxy coating Type 2 conforming to SANS 801, laid on in three coats to a total DFT of not less than 250 micrometres.

Where a period longer than 48 hours has elapsed after application of the second coat, the surface shall be solvent wiped and then lightly abraded with emery cloth before the third coat is applied.

e) Rock shield
Where a cement mortar rock shield to a FBE or other approved paint system is specified, the paint coating shall be cleaned as specified in 4.3.2.2 and then double tape wrapped to a total thickness of not less than 2 mm with a cement impregnated tape as specified in 4.1.7, prior to the application of the reinforcement.

All coats shall be applied in the paint shop.

Painted surfaces shall be protected from exposure to direct sunlight at all times.

4.3.7.2.2 Items above ground - normal conditions or inside underground chambers
Items above ground under normal conditions or inside underground chambers shall be grit blast cleaned in accordance with 4.3.2.1 and two coats of zinc-rich paint as specified in 4.3.4.5 shall be applied to a DFT of at least 150 micrometres.

They shall then be painted with either:
a) an approved epoxy tar paint applied in at least two coats to a DFT of at least 200 micrometres, to give a total paint thickness of at least 350 micrometres, or

b) chlorinated rubber as specified in 4.1.3.7 applied to the thicknesses specified in (a) above.

After the installation and hydraulic testing of the pipework and after the repair to the painting, if necessary, have been completed, and the paintwork has been washed down in accordance with 4.3.3, one coat of single pack pure acrylic or other approved paint shall be applied with a minimum dry film thickness of 50 micrometres.

4.3.7.2.3 Items above ground - decorative finish
Items above ground and which are to receive a decorative finish shall be grit blast cleaned in accordance with 4.3.2.1. The first two paint coats shall be applied in the manufacturer's works as follows:

- **Alternative (a)**

First coat. Within the period specified in 4.3.5.2 of grit blast cleaning a coat of a vinyl copolymer high-build primer to a minimum DFT of 65 micrometres.

Second coat. The minimum time period between the first and second coat shall be 48 hours. The second coat shall be vinyl copolymer high-build intermediate coat to the DFT specified above.

The minimum time period between the application of the second coat and subsequent handling shall be 48 hours. Upon delivery to the Site the paintwork shall be inspected and repaired in accordance with the requirements of this specification.

Third coat. After the steelwork has been erected and other building operations which are likely to damage the paintwork have been completed, the paintwork shall be repaired in accordance with 4.3.5.4. The coat shall be vinyl copolymer enamel to a DFT of 45 micrometres ± 5 micrometres. Touching up of the final coat will not be permitted. Should damage occur, the paintwork shall be repaired as specified in 4.3.2.3 and the whole item repainted.

- **Alternative (b)**

1	coat zinc ethyl silicate primer	DFT = 75 µm
1	coat 2 pack self-etch wash primer to SANS 723 or epoxy under coat as recommended by the manufacturer	DFT = 10 µm
1	coat intermediate vinyl copolymer	DFT = 70 µm
1	coat vinyl copolymer enamel of approved colour	DFT = 30 µm
		Total DFT = 185 µm

4.3.7.2.4 Items above ground on concrete pedestals
Items above ground on concrete pedestals shall be treated as follows:

Surface preparation shall be in accordance with 4.3.2.1.

Time intervals between priming and painting shall be in accordance with 4.3.5.2.

The bevelled ends of all pipes to be butt welded on site shall be suitably masked for a width of 20 to 30 mm to prevent primer application.

The primer shall be one of the reputable brands of zinc silicate primer specified in the Specification Data and may be one-pack or two-pack.

The primer shall not be applied if the ambient temperature is below 5° C or above 30° C.

The primer shall be very thoroughly mixed before use and in accordance with the manufacturer's instructions.

Only materials specified in the Specification Data shall be used. No substitutes will be permitted without the Engineer's written approval.
The primer shall be poured into the pressure pot through a 60 mesh sieve or nylon cloth.

Unless otherwise recommended by the manufacturer in writing, the primer shall be applied by conventional spray equipment using a continuously agitated pressure pot to ensure that the pigment does not settle out.

Only persons skilled in the application of zinc silicate primers shall be used for the application of this material. The work shall be carried out so that a continuous wet edge is maintained with minimum overspray. The wet film thickness shall be frequently tested to ensure uniformity of thickness.

The DFT shall be 80 micrometres ±20 micrometres.

The primer shall be cured at a relative humidity not less than 50 %. Should the ambient humidity be less than this value, the primer shall be allowed to air cure overnight. The surface shall then be sprayed with a fine, gentle mist of water to just wet the surface but not of such force that it removes or damages the coating.

Where necessary the primed surface shall be degreased as specified in 4.3.2.1.1(c). Two coats of bitumen based aluminium paint complying with SANS 802 shall then be applied. Not less than 24 h drying time shall be allowed between coats.

See also 4.3.10.11.

4.3.7.2.5Items above ground - severe conditions
a) Items above ground, under severe conditions shall be treated as specified in 4.3.7.2.2 above and then given a double outer wrap of tape as specified in the Specification Data.

b) Alternatively the pipe shall be treated as specified in 4.3.4.1 and coated with 150 micrometres of metallic zinc spray as specified in 4.3.4.2.2 and then painted as specified in 4.3.7.2.2 (b) or (c) above. Thereafter the pipe shall be tape wrapped as specified in the Specification Data.

4.3.7.2.6Items below ground in non-aggressive soil with suitable bedding
Items below ground in non-aggressive soil with suitable bedding shall be treated as follows:

The surface shall be treated as specified in 4.3.2.1 and painted as follows:
a) 300 micrometres ±50 micrometres of polyamide as specified in 4.3.7.2.1(a)
b) 150 micrometres of zinc-rich paint as specified in 4.3.4.5 followed by at least two coats of coal tar epoxy as specified in 4.3.3.11 to a minimum DFT of 200 micrometres.
c) 100 micrometres of metallic zinc spray as specified in 4.3.4.2.2 followed by at least three coats of coal tar epoxy as specified in 4.3.7.2.1(c) to a minimum DFT of 250 micrometres.

4.3.7.2.7Items below ground in aggressive soil with suitable bedding
Items below ground in aggressive soil with suitable bedding shall be treated as follows:

a) The pipe surface shall be treated as specified in 4.3.2.1 and FBE applied as specified in 4.3.7.2.1(b) to a DFT of 350 micrometres ±50 micrometres.

b) Alternatively a metallic zinc coat as specified in 4.3.4.2.2 shall be applied to at least 150 micrometres or as specified in the Specification Data up to a maximum of 350 micrometres, depending on the degree of protection required. A coal tar epoxy or enamel (as specified in 4.1.3.8) shall thereafter be applied as in 4.3.7.2.6(c) above.

4.3.7.2.8Items below ground, all soils - suitable bedding not available
Items below ground in all soils where suitable bedding is not available shall be treated as follows:
The pipe shall be treated as in 4.3.7.2.7 above and a rock shield shall be added as specified in the Specification Data.

4.3.7.2.9Alternative: FBLDPE (see 4.1.3.14)
SINTAKOTE or equal approved coating shall be applied to a DFT of 2,5 mm 0,5 mm. The test standards shall be as per Appendix C. Quality Assurance shall be in accordance with ISO 9002.
4.3.7.3Coatings to CI items

4.3.7.3.1Items permanently under water
items permanently under water shall be treated as follows:

All inside and outside surfaces to be protected shall be cleaned in accordance with 4.3.2.1.2. Where practicable all surfaces shall then be given a coat of FBE in accordance with 4.3.7.2.1(b), except that the coating thickness shall be 250 micrometres ±50 micrometres. Where a danger of distortion to machined surfaces exists, a "hot coat" shall be applied instead of the FBE coat.

Where either of the above systems cannot for one or another reason be applied, the Contractor may with the Engineer's approval apply the system described in 4.3.7.2.1(a).

The paint thickness inside bolt holes shall be reduced to ensure that bolt clearances are not seriously impaired.

The above specified painting shall be applied only after the equipment (valve, pump, etc.) has passed its hydraulic test.

All paintwork that may have been damaged during transit shall be repaired in accordance with 4.3.5.4.

4.3.7.3.2Items above ground
Items above ground shall be cleaned as specified in 4.3.7.3.3 above and painted with a prime coat in accordance with the paint manufacturer's recommendations for a vinyl copolymer paint system as specified in 4.3.7.2.3. After delivery to site the prime coating shall be repaired and after erection the item shall be cleaned in accordance with 4.3.2.3 and painted with the second coat (vinyl copolymer high build). Upon completion of the installation the third coat shall be applied (vinyl copolymer enamel).

4.3.7.3.3Items below ground in non-aggressive soil
Items below ground in non-aggressive soil shall be treated as follows:

The surface shall be cleaned in accordance with 4.3.2.1.3 and painted in accordance with the manufacturer's standard protection system.

Alternatively, all surfaces shall be degreased and cleaned in accordance with 5.2.1.1. One coat of self-etch vinyl wash primer to SANS 723 shall be applied and then painted with a two pack polyamide cured high build epoxy to minimum and maximum dry film thicknesses of 200 micrometres and 300 micrometres respectively. (250 µm ± 50 µm).

4.3.7.3.4Items below ground in aggressive soil
Items below ground in aggressive soil shall be treated as follows:

The pipe surface shall be cleaned as specified in 4.3.2.1 and at least 85 micrometres of metallic zinc spray shall be applied as specified in 4.3.4.2.2. The overcoat shall consist of either coal tar epoxy or enamel applied as specified in 4.3.7.2.1(c) above. The pipeline shall be double wrapped in a polyethylene sheath at least 250 micrometres thick before being laid.

Alternatively, these items shall be grit blast cleaned in accordance with 4.3.2.1 and shall be painted with a two pack polyamide cured high build epoxy in accordance with SANS 1217, Clause 3.1(a) Type 1A to a minimum DFT of 250 micrometres. The maximum dry film thickness shall be 350 micrometres.

4.3.8Hot dip galvanized items
When painting of galvanized items is specified, this shall be carried out on site as follows:
a) Surface shall be degreased in accordance with 4.3.2.4.
b) The surface shall be self-etch primed with a primer which is suitable for galvanized surfaces and which is compatible with a vinyl copolymer paint or other paint system specified and/or approved.
c) The surface shall be painted with one coat of vinyl copolymer or other approved paint which shall have a dry film thickness of at least 75 micrometres.

4.3.9Bolts, nuts and washers
Carbon steel bolts and nuts shall be hot dip zinc galvanized in accordance with SANS 14713 with a minimum zinc thickness of 55 micrometres. Nuts shall be tapped oversize after galvanizing to accommodate the thickness of the galvanized coating on the bolt. Where ordered bolts and nuts shall be painted with a self-etching primer after

installation. Thereafter they shall be painted together with, and as specified for the pipework item.

Where approved, cadmium electroplated or sherardized coatings as specified in 4.3.4.6 may be used. (See Specification PLF, Subclause 4.1.3.6(b)).

4.3.10Field repairs of pipe butt welds and flexible couplings, etc.

4.3.10.1General
See Subclause 4.3.8 of Specification LT.

4.3.10.2Flexible couplings and flanges buried in aggressive soil

4.3.10.2.1 Mastic blanket
After the pipeline has been hydrostatically tested and electrically bonded, where applicable, to the satisfaction of the Engineer, the couplings shall be protected by moulding with a petrolatum jelly mastic and wrapped with a non-woven synthetic-fibre tape impregnated with petrolatum. The coating of the pipe shall project at least 100 mm into the moulded portion over which length of coating the reflective finish shall be carefully removed as specified in 4.3.2.3. The unprotected portion of the pipe and coupling components shall first be cleaned from dust and other foreign matter. "Denso" petrolatum paste or equal approved shall then be applied to the coupling, leaving a thin film on the surface of the coupling and a liberal amount on bolt heads and nuts. A "Denso Mastic Blanket" or equal approved as specified in 4.1.4.3 shall then be applied to cover bolt heads and nuts, flanges and couplings.

Type C tape as specified in 4.1.4.1 shall then be wrapped spirally, including at least 100 mm of pipe coating on both sides. Care shall be taken to exclude air pockets by moulding into all depressions. The blanket shall not be stretched and shall be applied with a minimum overlap of 100 mm at ends. A final layer of Type C white polyethylene tape as specified in 4.1.4.1 shall then be applied spirally over the mould with a minimum overlap of 50 mm and in two layers. The tape shall overlap the pipe coating by at least 100 mm. The joint shall be watertight.

The Contractor shall supply all materials, labour and tools required to complete the work and also approved bedding material free from all sharp and angular pebbles and stones, passing a 10 mm square mesh, which shall be placed around moulded couplings to a depth of at least 150 mm over the top of the mould.

4.3.10.2.2 Cement mortar filled diaper
Alternatively, with the Engineer's approval, a cement mortar filled diaper, made from a non-biodegradable woven synthetic material and secured around the pipe by means of heavy gauge plastic coated galvanized steel wires may be used.

4.3.10.3Bitumen coatings and linings
Where the factory applied prime coat at pipe ends is damaged, all weld spatter shall be removed by scraping or grinding. Damaged prime coat shall be scraped away to bare metal, extending back into the areas of sound prime coat. Unprotected steel shall be wire brushed and thoroughly cleaned to at least Sa 2½. All signs of rust, oil, grease and other foreign matter shall be removed. The cleaned steel areas, including undamaged prime coated areas, shall then be wiped with a rag dampened with white spirit to remove all dust. The cleaned areas shall then be primed with an approved bituminous primer for cold application. Linings shall be made good using the same quality and grade of bitumen as on the adjacent lining. Care shall be taken not to heat the bitumen to temperatures exceeding those specified by the supplier or to maintain the bitumen at elevated temperatures for a period of time in excess of that specified by the supplier. The repaired areas shall be finished smooth and homogeneous with the existing lining.

Coatings at joints shall overlap the existing coating by a minimum of 100 mm. All reflective finish, dirt, oil and grease shall be removed from the existing coating at these laps before bitumen and glass fibre is applied. The first layer of hot bitumen shall be applied to a minimum thickness of 2,5 mm. Thereupon a double wrap of glass fibre tissue with 50 % overlap shall be applied from side to side of the existing coating.
A second flood coat of hot bitumen 1,5 mm minimum thickness shall then be applied, followed by a double wrap of glass fibre tissue with 50 % overlap and overlapping the original coating by a minimum of 50 mm. The repair shall be completed with a further hot bitumen coat of 1 mm minimum thickness overlapping the original coating by 100 mm.

Repaired coatings and linings shall be tested as specified in 5.1.1.

4.3.10.4Shop applied epoxy linings
The complete area of the weld and the uncoated section 50 mm on either side of the weld shall be chipped, scraped and wire brushed to remove all slag, weld spatter and oxidation deposits. The adjoining edge of the lining shall be rubbed with a medium grade emery paper for a distance of at least 25 mm to remove the lining gloss. The complete surface to be lined, including the emery papered edge of the existing lining, shall be wiped with a solvent recommended by the supplier of the epoxy.

The joint area shall receive three coats of epoxy applied by soft brush, each coat to be in distinctly different colours to ensure correct inter coat coverage. Each coat shall be allowed to dry for a minimum of 24 hours and a maximum of 72 hours before the succeeding coat is applied. Each coat shall overlap the existing lining by at least 25 mm. The minimum thickness of the applied lining shall be at least 300 micrometres dry film thickness or equal to the existing lining.

On completion of repairs, the repaired lining shall be tested as specified in 5.1.1.

4.3.10.5In-situ applied epoxy lining
No repairs are needed as no welding shall be allowed on lined pipes. All "tie-ins" and welding shall be completed before linings are applied. All weld spatter shall be ground off prior to lining commencing.

4.3.10.6Chlorinated rubber
The chlorinated rubber system shall be as follows:

1	coat zinc ethyl silicate primer	DFT = 75 µm
1	coat high build chlorinated rubber intermediate coat	DFT = 75 µm
1	coat chlorinated rubber enamel to approved colour	DFT = 30 µm
		Total DFT = 180 µm

4.3.10.7Coal tar coated pipes
Coal tar coated pipes shall be made good as for bitumen coatings, except that cold applied primer shall be compatible with coal tar coatings and approved coal tar shall be used. Care shall be taken that temperatures and heating times are strictly in accordance with the manufacturer's specification.

4.3.10.8Shop applied FBE coatings
All weld spatter and roughness to the weld shall be removed, by grinding if necessary, and the exposed areas of steel (about 50 mm on either side of the weld) grit blasted to at least Sa2½ as specified in 4.3.2. The pipeline shall be fully masked for at least 500 mm on either side of the weld to prevent damage to the paintwork. The operator doing the work shall not touch the cleaned area with his bare hands and shall if necessary wear suitable gloves which are free of oil and/or grease.

Butt welded pipe joints shall then be corrosion protected as follows (in order of preference):

a) Induction coil
A field inductive coil shall heat the area to be painted and FBE applied in accordance with the manufacturer's instructions (i.e. the makers of the coil and powder paint), or

b) Tape wrap
The FBE shall be lightly abraded to a matt finish using fine grit waterpaper and then wiped clean for a width of at least 150 mm on either side of the weld, using a cleaning liquid recommended by the manufacturer of the FBE to ensure good adhesion of the tape.

The cleaned area shall then be primed and wrapped with an approved Type C tape (see 4.1.4.1) not less than 150 mm wide in such a manner that the FBE is overlapped everywhere by at least 100 mm. The wrapping shall be carefully executed in accordance with SANS 10129 to ensure that no air bubbles occur, and that the tape adheres fully to the pipe and to the coating. The overlap on the tape shall be at least 50 mm.

After the application of the inner wrap tape, a double wrap of type D pressure-sensitive polyethylene tape shall be wrapped around the inner tape to a total thickness of not less than 900 micrometres and a total width of not less than 350 mm and overlapping at least 25 mm at all places.

c) The above shall also apply for FPLDPE (see 4.1.3.1.4) as applicable.

4.3.10.9Repairs at cut-in specials and tees

4.3.10.9.1 Cement mortar
Where specials and tees are cut and welded into a pipeline after the line has been laid, the following procedure shall apply for the repair of FBE coated pipes:

i) Clean and abrade the joint for 150 mm on either side of the weld as specified in 4.3.2.3.
ii) Clean all bare steel by wire brushing as specified in Subclause 5.4.3.2 of SANS 1200 HC.
iii) Apply adhesive over the whole area to be covered with mortar.
A two-pack solvent free epoxy polysulphide (Epidermix 344 supplied by ABE or equal approved) shall be used.
iv) An approved woven fibreglass bandage shall then be dunked into a pure cement grout until it is completely impregnated by the grout. The bandage shall then be applied to the FBE surfaces to be mortar covered.
v) 50 mm x 50 mm x 2 mm thick galvanized weld mesh shall then be tack welded and or wired to the bare steel areas. This mat shall be prepared before (iii) above is done, so that a minimum amount of time is required in fixing. The mat shall overlap the fibreglass bandage and protrude to within 50 mm of its outside edge. Where the branch specials are cement mortar lined and coated the wire mat shall butt the existing mortar.
vi) A 1:1½ cement:sand mortar shall then be hand applied over the whole area, covering the bandage, the steel, and butting against existing mortar coatings on the branch.

Where practicable a diaper as specified in 4.3.10.2.2 shall be used to contain the mortar.

4.3.10.9.2 Petrolatum mastic and tape wrapping.
As an alternative to the cement mortar, the procedure specified in 4.3.10.2.1 may be used with the Engineer's approval.

4.3.10.10 Steel pipe flanges
Steel pipe flanges shall be protected as for flexible couplings. (See 4.3.10.2.1).

4.3.10.11Prevention of crevice corrosion. (Pipes on pedestal supports)
All concrete plinths shall have rubber sheeting not less than 3 mm thickness, or equal approved non-porous flexible material like polyethylene backed rubber bitumen tape, bonded to the whole of the pipe contact area to prevent water penetration into the crevice.

Similarly, the clamps for the top surface of the pipe shall have rubber, or equal approved non-porous flexible material, bonded to the inner surface.

Bonding of rubber sheeting shall be carried out by the use of contact adhesive. The use of fasteners that may project on to the pipe wall is forbidden.

The pipe shall be cleaned and degreased as specified in 4.3.2.1.1(c) or as approved and shall be given a double tape wrap as specified in 4.3.10.8(b).

4.3.10.12Bitumen based aluminium paint

4.3.10.12.1Repairs to primed steel surfaces
Repairs to the pipe body are anticipated to be minimal due to the ability of the primer to resist mechanical damage, and assuming that reasonable care has been taken in the handling of the pipes.

Where repair is necessary due to mechanical damage, the damaged area shall be abraded with 50 to 120 grade abrasive paper to a bright metal finish.
If present, oil and grease shall be removed as specified in 4.3.2.1.1(c). After drying completely, two coats of 2-pack epoxy zinc rich primer complying with SANS 926 shall be applied, with 24 hours between coats. The primer shall be adequately mixed and shall be frequently stirred to prevent sedimentation of the pigment. It shall be used within the "pot life" of the material. Unused material which has started to gel shall be discarded.

4.3.10.12.2 Repairs to site welds

The area to be painted shall be cleaned as specified in 4.3.10.8.

Not less than two coats of 2-pack epoxy zinc rich primer complying with SANS 926, shall be applied allowing 24 hours between coats. The primer shall be adequately mixed and shall be frequently stirred to prevent sedimentation of the pigment. It shall be used within the "pot life" of the material. Unused materials which have started to gel shall be discarded.

Particular care shall be taken to clean the underside of the pipe and to coat as specified above.

The total dry film thickness of the zinc rich primer shall be not less than 50 micrometres.

Over-paint as specified in the last paragraph of 4.3.7.2.4.

4.3.10.13 Repairs at junction between bitumen based aluminium paint and FBE coated pipe

All metal surfaces shall be cleaned as specified in 4.3.10.8.

Two coats of zinc rich epoxy primer shall be applied as specified in 5.10.12.1 to all bare steel surfaces up to the edge of the epoxy powder coated pipe. Zinc rich primer shall NOT be applied over epoxy powder (F.B.E.) coated surfaces.

The epoxy powder coated pipe surfaces that are above ground level shall be abraded with 60 to 120 grade abrasive paper to achieve a matt surface. All dust and debris shall be removed and a bitumen aluminium paint applied as described in the last paragraph of 4.3.7.2.4.

4.3.10.14 Electrical and other control panels inside works

Note: This subclause shall apply only if the relevant coating is not specified elsewhere in the Contract Documents.

4.3.10.14.1Painting and finishing at place of manufacture

All painting material shall be applied in accordance with the paint manufacturer's instructions.

Before any steelwork is painted, the steel shall be thoroughly grit-blasted to at least Sa 3, as specified in 4.3.2.1.2, and an approved zinc chromate epoxy priming coat applied to a dry film thickness of 35 to 50 micrometres, so that the possibility of rusting or corrosion taking place is minimised. The inside surfaces of any cubicles, cabinets, etc., where condensation is liable to occur, shall be coated with an approved anti-condensation composition. After the priming coat has completely dried (see 4.3.5.2) the item to be painted shall be given one of the following protective coatings:

a) One epoxy polyester powder coat in accordance with SANS 1274 shall be applied to a dry film thickness of 75 micrometres ± 25 micrometres.

b) Two coats of alkyd baking enamel shall be applied, each coat to a dry film thickness of at least 35 micrometres to give a total dry film thickness of 70 to 100 micrometres.

The Contractor shall ensure that all component sections of a switchboard, wherever manufactured, shall have a finish of uniform texture and an exact colour match.

4.3.10.15Pumps, motors and gearboxes

4.3.10.15.1 Minimum protection: External coat - Equipment installed under cover in the dry

The equipment shall be delivered to Site with the manufacturer's standard paint coating, provided that the coatings are compatible with a vinyl copolymer paint system which shall be applied on Site.

On Site, the paint surface shall be cleaned in accordance with 4.3.2.3 and painted as specified in 4.3.7.2.3.

4.3.10.15.2 Pumps

a) Low degree of protection. This shall be in accordance with the manufacturer's standard paint system.

b) High degree of corrosion protection. All surfaces to be protected shall be cleaned in accordance with 4.3.2.1.2.

Depending on the replacement cost of the pump, paint in accordance with either 4.3.7.2.1(a) or (b) shall be applied. FBE or "hot-coat" as specified in 4.3.7.2.1(b) shall be applied internally to all pumps with a delivery branch

of 200 mm diameter or larger. Where practicable FBE shall be used.

c) High degree of abrasive and corrosive protection. Apply Belzone Supermetal Glide to the pump volute where specified in the Specification Data.

PLE5. COMPLIANCE WITH REQUIREMENTS

PLE 5.1 TESTING

5.1.1Testing and inspection

See Clause 7 of SANS 1200 HC.

The Contractor shall carry out all inspections and tests (at his own expense). The coating shall undergo holiday detection over the full surface in accordance with SANS 1217.

Repaired bitumen coatings and linings shall be tested with an approved holiday detector equipped with copper bristle detector, operating at 15 kV and 30 Hz.

On completion of repairs to shop applied epoxy linings, the repaired lining shall be tested with a wet sponge holiday detector and the thickness of repair checked by an eddy current or magnetic instrument. These tests shall be carried out by the Inspectorate on any one or a number of repairs selected at random.

5.1.2Approval/inspection certificates

A copy of the approval/inspection certificates shall be submitted to the Engineer before payment will be certified.

5.1.3Independent Inspectorate

The Engineer, at his sole discretion, may appoint an independent inspectorate to carry out any tests to verify compliance with the specifications. The independent inspectorate shall have access to all testing facilities and records and shall have the same powers as the Engineer for this purpose.

The test shall be done by an inspector holding an appropriate qualification from either CISA, SAIW or SAQCC.

The Contractor shall arrange all inspections in such a manner that, where practicable, the inspector can spend at least one whole day at a time at the factory or on Site as applicable.

5.1.4 Records and test certificates

The Contractor shall submit to the Inspectorate, copies of all records kept in connection with testing of corrosion protection and shall also submit a paint manufacturer's test certificate as detailed in Annexure B of SANS 1200 HC.

PLE 5.2 TOLERANCES

See Clause 6 of SANS 1200 HC.

The nominal thread diameter of nuts to be hot dip galvanized shall be increased as follows:

Up to and including	:	M24	about 0,4 mm
Over	:	M24	about 0,5 mm

The maximum and minimum coatings and paint film thicknesses specified are absolute values. No deviation above or below these values will be permitted. Alternatively, the allowable tolerance has been indicated in the relevant paragraph.

APPENDIX A: APPLICABLE STANDARDS

In addition to Appendix A of SANS 1200 HC, reference is made to the latest issues of the following standards:

ASTM G 14	Test method for impact resistance of pipeline coatings
AWWA C 203	Coal tar enamel protective coatings for steel water pipe
BS 381	
CBS 4147	Bitumen based hot applied coating material for protecting iron and steel including suitable primers where required
BS 4164	Coal-tar-based hot-applied coating materials for protecting iron and steel, including a suitable primer
BS 4921	Sherardized coatings on iron and steel articles
BS EN 12540	Corrosion protection of metals. Electrodeposited coatings of nickel, nickel plus chromium, copper plus nickel and copper plus nickel plus chromium
ISO 9002	Quality systems. Model for quality assurance in production, installation and servicing
SANS 723	Wash primer (metal etch primer)
SANS 767	
SANS 801	Epoxy-tar paints
SANS 802	Bituminous aluminium paint
SANS 926	Two pack zinc-rich epoxy primer
SANS 1091	National colour standard
SANS 1117	Plastic wrapping for the protection of steel pipelines
SANS 1217	The production of painted and powder coated steel pipes
SANS 1274	Coatings applied by the powder-coating process
SANS 10129	Plastics tape wrapping of steel pipelines
SANS 14713	Protection against corrosion of iron and steel in structures - zinc and aluminium coatings - guidelines
SANS 1200 HC	Corrosion protection of structural steelwork
SANS ISO 2063	Metallic and other inorganic coatings – Thermal spraying – Zinc, aluminium and their alloys
SIS 05 59 00	Pictorial surface preparation standard for painting steel surfaces.
Specification PLF	Manufacture of medium-pressure steel pipes
Specification PLC	Laying and jointing of medium pressure steel pipes and specials
OHS Act	Occupational health and safety

APPENDIX B: RECOMMENDED COLOUR SCHEME

(Code numbers shown in brackets BS 381C and SANS 1091)

ELECTRICAL ITEMS	COLOUR
Delay and tap change panels	grey (SANS G29)
Eskom equipment	grey
Emergency stop	signal red (SANS A11)
Essential supply sections of boards	orange (BS 557)
Temperature monitoring and equipment panels	External: semi-matt light orange (SANS B26) Internal: white
Terminal boxes, conduits	light orange (SANS B26)
Fire CO_2 piping	red (BS 537)
Generator	as supplied by manufacturer
Generator board	orange (BS 557)
H.V. Switchgear and boards	grey (SANS G29)
Lift motor room	grey, as supplied
L.V. switchgear	light stone (SANS C37)
Name tags	white lettering on black
Outdoor kiosks	avocado green
Power factor capacitors	as supplied
Power factor capacitors mounting panels	dark grey (BS 632)
Transformers	dark admiralty grey (BS 632)
Transformer yard equipment	as supplied by manufacturer
HAND RAILS:	lemon yellow (or stainless steel) (SANS C54)
Stanchions	black
MECHANICAL EQUIPMENT	
Blowers, compressors and ancillary equipment	strong blue (SANS F11)
Couplings and other moving parts	international orange (SANS A15)
Grease nipples	fire orange (SANS A46)
Guards	chevron black and fire orange (SANS A46)
Pumps for potable water and motors	arctic blue (BS 112)
Other pumps	to suit liquid being pumped
Pump and motor bases	dark admiralty grey (BS 632)
OVERHEAD GANTRY CRANES	
Crane hooks	chevron black and fire orange (SANS A46)
Crawl beams	international orange (SANS A15)
Gantry cranes	international orange (SANS A15)
Rails	black
PIPEWORK	
Air mains	white
Aluminium sulphate	grass green (SANS D14)
Backwash recycle	cloud grey (SANS F48)
Backwash	wedgwood (SANS F59)
Chemical mix water	cornflower (SANS F29)
Chlorine	yellow (SANS C61)
Cooling water	green (SANS D2)
Dewatering	green (SANS D2)
Lime	light green (SANS C37)
Polyelectrolyte	pastel green (SANS D65)
Potable water	blue (BS 166) (SANS F11)
Raw water	green (SANS D2)

Raw sewage and sludge	light olive green (SANS D36)
Scour valves	deep buff (SANS B24)
Service water	dark blue (SANS F11)
Small bore tubing not listed above	lemon yellow (SANS C54)
Valves	as for the pipeline
Valve handwheels: Delivery	black
Suction	orange (BS 557)

APPENDIX C: SINTAKOTE FUSION BONDED LOW DENSITY POLYETHELENE COATING

Technical Details

	Test Standards	Typical Test Results
Coating Material	ASTM D1248-72	Type 1: Category 3
Colour		Black: To impart maximum protection against above ground weathering
Resistance to Tear		Extremely High
Resistance to Temperature Changes		-30° C to +60° C
Bond Strength	AS2518 - 1992*	4-8N/mm
Coating tensile strength at yield	AS2518 – 1992	9-10 MPa
Elongation	AS2518 – 1992	300-500 %
Indentation Hardness - Shore Hardness D		40
Thermal Conductivity (Compression moulded specimen)		3400 Wm^{-4} K^{-4}
Environmental Stress Crack Resistance	AS2518 – 1992	F_{50} > 3 hours
Water absorption	ASTM D570.24hr	< 0,01% Weight
Dielectric strength (Specimen 2,2 mm thick)	ASTM D149	15kV/mm
Impact Resistance (Limestone)	ASTM G13, 100 mm dia Coated Pipe average thickness 2,4 mm	After 10 successive drops the coating had sustained virtually no damage
Impact Resistance (Falling weight)	ASTM G13, 100 mm dia Coated Pipe average thickness 2,4 mm	Mean Impact strength 1,61 kg.m (16J) Standard deviation 0,04 kg.m (0,4J)
Bendability	ASTM G10, 25 mm dia x 2,7 m Long Coated Pipe average thickness 2 mm	No failures detected. Coating showed no visible signs of deterioration or disbonding
Cathodic Disbondment	ASTM G8	5-8 mm Disbonded length

(*This Australian Standard is currently under review for adoption by the SABS as the appropriate standard for this product range in South Africa.)

PARTICULAR SPECIFICATION

PLF **SPECIFICATION FOR THE MANUFACTURE OF MEDIUM-PRESSURE PIPES**

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APPENDIX A. APPLICABLE STANDARDS

1. SCOPE

This Specification covers the manufacture and delivery to site of electrically welded low carbon steel pipes and specials of outside diameter up to 2 280 mm, for transporting water and sewage at ambient temperatures and under working pressures of up to 2,5 MPa.

This Specification shall be read in conjunction with SANS 1200 L. Where conflict between this specification and SANS 1200 L occurs, the provisions of this specification shall apply.

2. NORMATIVE REFERENCES

2.1 SUPPORTING SPECIFICATIONS
Where this Specification is required for a project, the following specifications shall, inter alia, form part of the Contract Document:

a) Specification Data;

b) SANS 1200 Series of Standardized Specifications;
   i) SANS 1200 L: Medium-pressure pipelines (see 1. above)
b) Specification PLE: Corrosion protection of steel and cast iron specials;
c) Specification PLHA: Cement - mortar protective linings and coatings for steel pipes; and
d) Specification PLC: Laying and jointing of medium-pressure steel pipes and specials

3. DEFINITIONS AND ABBREVIATIONS

3.1 DEFINITIONS
For the purposes of this Specification the definitions and abbreviations given in the applicable clauses of the specifications listed in 2.1 and the following definitions shall apply:

Cut-and-shut bend : As detailed in BS 2633, Fig 25

Fitting : a) A special or valve.
b) Any process of jointing (except welding) straight pipes to one another and to specials and valves.

Flexible pipe : A pipe of which the diameter is reduced by more than 1% under an external radial force before the appearance of cracks.

"H" : The cross-sectional shape of a weld at a skelp.

Manual shielded electric arc process welding : Electric arc welding done by hand using a filler electrode coated with a material that gasifies at the point of arc and excludes oxygen from the weld, thus improving the metallurgical quality of the completed weld.

Mitre welds : Welds which join two lengths of pipe at an angle point in such a manner that the

axis of both lengths of pipe proceed in a straight line to the point of intersection.

Nominal diameter (size) : A numerical designation of diameter which is common to all components in the piping system other than components designated by OD or by thread size. It is a convenient round number for reference purposes and is only loosely related to manufacturing dimensions.

Nominal pressure : A numerical designation which is a convenient round number for reference purposes.

All equipment of the same DN designated by the same PN number shall have compatible mating dimensions.

Pinhole : A very small hole indicating a flaw in the weld.

Pipe end bevel : A bevel cut made on the end of a pipe to afford a groove between abutting joints in order to receive weld metal.

Pipework : Includes all pipes, joints, specials, fittings and valves.

Skelp : The jointing edges of steel coils used in the manufacture of spiral welded pipe.

Special : Any pipe other than a straight pipe.

Note : Under this definition shall be included all sizes of specials of shapes such as bends, tees, crosses, angle branches, reducers, tapers and flexible couplings with or without centre registers.

Straight pipe : A straight pipe of uniform bore and of standard or non-standard length.

Welding icicles : Congested droplets of metal which extend through the weld to the interior of the pipe, caused by excessive heat or improper welding technique.

3.2 ABBREVIATIONS

The following abbreviations (additional to those referred to in 3.1) shall have the meanings given:

AISI	:	American Iron and Steel Institute
DN	:	Nominal diameter (e.g. DN 200 = 200 mm nominal diameter)
DS-AW	:	Double submerged-arc welded
E-RW	:	Electric-resistance welded
FBE	:	Fusion bonded epoxy
IRHD	:	International rubber hardness degrees
MSEAP	:	Manual Submerged Electric Arc Process
MS	:	Mild Steel
OD	:	Outside diameter, which shall mean DN + 2 (lining thickness + pipe wall thickness) or as specified in 3.2.3 and in the Specification Data
p.e.	:	Plain ended.
PN	:	Nominal working pressure (eg. PN 10 = 1 000 kPa)
SD	:	Specification Data
SA-AW	:	Semi-automatic arc welded
Scab	:	Unbonded piece of plate in tight contact with the plate
SW	:	Site weld
TP	:	Test pressure

4. REQUIREMENTS

4.1 MATERIALS

4.1.1 General

Pipes and fittings shall be of the types shown on drawings or billed and, unless otherwise required in terms of the Specification Data, they and their couplings shall be capable of withstanding the applicable test pressure specified in 5.1.2. All pipes and fittings shall be supplied complete with couplings and jointing material.

Unless otherwise specified in the Specification Data, all pipes shall be manufactured in one fixed standard length between 9 and 20 m.

4.1.2 Steel pipes, fittings and specials

4.1.2.1 Types of steel

The Contractor shall submit to the Engineer the steel maker's certificates covering all steel used in the manufacture of the pipes, etc., as required in Clause 3.4 of SANS 719.

4.1.2.1.1 Mild steel

Unless otherwise billed or shown on the drawings, pipes and specials shall be manufactured from Grade B steel plate complying with SANS 719. Flanges shall be manufactured from steel plate conforming to BS 4360 or SANS 1431 Grade 300W.

4.1.2.1.2 3CR12 Corrosion resistant steel

3CR12 corrosion resistant steel plate shall have a No. 1 finish and shall be supplied ex-factory ready pickled and passivated.

4.1.2.1.3 Stainless steel

Stainless steel shall be either 304L or 316L (as billed) in accordance with AISI Grade 304L or 316L respectively.

4.1.2.2 Pipes of nominal size up to DN 150

Unless otherwise billed or shown on the drawings, steel pipes and fittings of up to DN 150 shall be of medium class and screwed, and shall comply with the applicable requirements of SANS 62 or BS 1387.

4.1.2.3 Pipes of over DN 150

Pipes shall be made by an approved welding process.

Unless otherwise specified, straight piping and specials shall be manufactured to the following dimensions:-

Table 1: Dimensions of pipes and specials

Nominal diameter (DN)	Minimum Plate thickness* (PN 10)		Minimum outside diameter of steel pipes and specials	
	Pipes	Specials	Epoxy paint lined	Cement mortar lined

mm	mm	mm	mm	mm
200	3,0	5,0	219,1	219,1
250	3,0	5,0	273,0	273,0
300	3,0	5,0	323,9	323,9
350	3,0	5,0	355,6	375,0
400	3,0	5,0	406,4	430,0
450	4,0	5,0	457,2	480,0
500	4,0	6,0	508,0	530,0
600	4,0	6,0	609,6	640,0
700	4,5	8,0	711,2	740,0
800	5,0	8,0	812,8	845,0
900	6,0	10,0	914,4	945,0
1000	6,0	10,0	1016,0	1050,0
1200	8,0	10,0	1220,0	1255,0
1400	10,0	12,0	1422,0	1460,0
1600	10,0	12,0	1630,0	1665,0
1800	12,0	14,0	1830,0	1865,0
2000	12,0	14,0	2032,0	2070,0
2200	14,0	16,0	2235,0	2280,0

*Note: No cognizance has been taken of external forces or surge pressures on pipe wall.

Each hand welded circumferential weld made in the Contractor's works to join sections of pipe, shall be marked with the welder's identifying stamp (see 4.1.2.1).

The pipe OD and length and type of joint shall be as specified in the Specification Data and/or as shown on the drawings.

4.1.2.4 Specials

Specials of DN 150 and smaller shall comply with SANS 62: Part 1 and Part 2, or BS 1640: Part 3. Where applicable, BS 1640 may also be used for specials up to DN 600.

Specials larger than DN 150 shall be manufactured from pipes complying with 4.1.2.3 above except that helically welded pipes shall not be used. Specials shall be fabricated in accordance with BS 534 and SANS 1476, from the same grade of steel plate as used for adjoining pipes.

Unless otherwise specified in the Specification Data, all specials (except flanges) shall be suitable for a working pressure of not less than 1,6 MPa.

Typical details for weld joints and tees are shown on the drawings.

4.1.2.5 Pipe ends for pipes and specials joined by means of flexible couplings

The ends of pipes where machined spigots are omitted shall be round to within the tolerances specified in Clause 15 of BS 534 and the relevant clauses of API 5L and suitable for use with slip-on, or other special couplings. (See also 4.3.6.1 and the relevant drawings).

Unless otherwise billed or specified in the Specification Data the ends of plain ended specials to be jointed by means of flexible couplings shall be fitted with mild steel spigots machined to the OD specified and allowance made for the application of the specified protective coating, as shown on the drawings.

4.1.2.6 Design and manufacture of specials

Where specified in the Specification Data the Contractor shall be responsible for the design of all specials. He shall submit his design calculations and shop drawings to the Engineer for approval before manufacture commences. The design shall be in accordance with AWWA M11.

Bends shall either be smooth formed (hot bent) or mitred to a radius of three times the pipe OD where practicable. The

maximum angle between oblique butt-ends of segments for mitred bends shall not exceed 22½º. Details of bends are shown on the drawings. Cut-and-shut bends are not permitted.

Mitres for bends (kinks) of 10º and less shall be made in the field as part of the pipelaying operation. See Subclause 5.1.1 of Specification LT.

For all branch connections (tees) the plate thickness of the barrel and branch shall be such that the maximum stress shall not be greater than that for an uncut pipe of the theoretical required minimum thickness. Where it is more economical to provide external reinforcement in the form of collar type rings or crotch plates, as shown on the drawings, these forms of reinforcement shall be used to achieve the same results. The attachment of reinforcement to the pipe branches shall be by full penetration welding. Branch connections shall be as remote as possible from the seam weld on the barrel and shall generally be placed as follows, except where specifically indicated to the contrary on the drawings:

a) For air valve tees the centre lines of the air valve branch and the barrel shall intersect at right angles or vertically, as shown on the drawings, depending on the type of tee specified. The branch shall be flanged and have a nominal diameter greater than 50% of the main pipe diameter;

b) For scour valve tees the branch, consisting of a 90o bend, shall be located centrally on the pipe invert and point vertically downwards with the horizontal section at right angles to the barrel of the pipeline. The branch flange shall be set so that the scour valve spindle points vertically upwards, as shown on the drawings.

Taper pieces shall not have more than two longitudinal weld seams and shall have a maximum angle of divergence of 10º, as shown on the drawings.

Lifting eyes (lugs) shall be welded to all unwieldy specials and to all specials of DN 600 and larger to facilitate handling and minimise damage to the protective coating.

All specials and fittings shall be manufactured exclusively at the works of an approved manufacturer, and at one works only. See also 4.3.8. No site fabrication of specials, other than kinks of 10º or less, will be permitted.

4.1.2.7 Provision of cadwelding pads

Where pipes and specials are to be jointed by means of flexible couplings the manufacturer shall weld steel plates not less than 50 x 75 x 6 mm thick 250 mm from each end of all pipes during the pipe manufacturing process (i.e. before lining and coating) to provide adequate area for cadwelding bonding cables to the piping to make it electrically continuous and enable a cathodic protection system to be applied without damage to the coating.

4.1.2.8 Marking of pipes, specials and flanges

All pipes and specials shall be clearly hand stamped alongside a longitudinal or helical weld on one end of the pipe with the following:

a) Nominal diameter (or size) in mm (eg. DN 600);
b) Working pressure (eg. PN 6, PN 10, PN 16);
c) Grade of steel;
d) Plate thickness in mm;
e) Mass of uncoated and unlined pipe in kg/m;
f) Serial number of the pipe i.e. consecutive numbers or Item no. in the Bill of Quantities of all specials;
g) Applicable drilling table shall be stamped on the periphery of all flanges;
h) Bends shall have their "centre plane" marked with two punch marks close to both ends to facilitate correct positioning in laying.

4.1.3 Jointing

4.1.3.1 Flexible couplings

Flexible couplings for plain-ended steel pipe and adaptor couplings shall be either of the slip-on type complying with Clause 15 of BS 534 or of the slip-on type without centre register conforming to the drawings, as scheduled. Slip-on flange adaptors for steel and FC pipes shall conform to the relevant drawings.

A coupling shall be able to withstand without failure a hydrostatic test pressure of twice the working pressure specified for the pipe for which the coupling is required, and coupling flanges shall be capable of withstanding without damage all stresses caused by proper tightening of the bolts. Rubber rings shall comply with the relevant requirements of SANS 974: Part I and shall have a hardness of 66 to 75 IRHD.

All grinding off of welds shall conform accurately with the profile of the rolled section and so that no flats occur on surfaces that are supposed to be curved. The centre register (where present) shall be ground off on either side of the weld in such a manner that all sharp edges which would result in weakening of the protective coating are removed. Flexible couplings shall be supplied complete with all necessary bolts, nuts and rubber jointing rings.

4.1.3.2 Flanges

Unless otherwise specified in the Specification Data, flanges rated PN 16 or less shall be made of mild steel as specified in 3.2.1.1. Flanges rated more than PN 16 and up to PN 60 shall be made from steel manufactured in accordance with BS EN 10222 Grade 460 or as approved. For pressures exceeding PN 60 and up to PN 250 use special flanges and gaskets manufactured by HPE. (Hydro Power Engineering (Pty) Ltd, 19 Precision Street, Kya Sand, PO. Box 1148, Honeydew, 2040, -Tel. 011 462 1903, Fax. 011 704 2120) or equal approved. (Available up to DN 300 only.)

All flanges shall be suitable for Site welding (SW) to pipes and specials and shall conform to BS 2633, Section 7 with preparation of plate flanges as shown in Fig 41 ("slip-on") for pipes and specials up to DN 100 and Fig 39 or 40 ("bore and fillet") for pipes and specials DN 125 and larger.

The drilling of steel and CI flanges shall be off-centre and shall conform to the requirements of SANS 1123, BS EN 1092: Section 3.1, or ISO 7005: Part 1 as applicable, appropriate to the class of pipe specified, except that:

a) in the case of flanges for hydrant and air valve matching tees, the drilling shall conform to the drilling of the valve supplied, and

1.

b) in the case of flanges, where M27 and M33 bolts are specified in BS EN 1092: Section 3.1, M24 and M30 bolts respectively shall be used as specified in SANS 1123.

Any item of pipework, special or valve that has flanges which are incorrectly drilled will be rejected. Reaming of bolt holes to oversize dimension in order to make a particular piece fit will not be permitted.

All flanges shall be machined overall with gramophone finish in accordance with SANS 1123, or as specified below:

i) Flanges for nominal pipe diameters greater than DN 250 shall have Type B raised faces in accordance with Fig 4 and Table 7 of BS EN 1092, unless otherwise approved.
ii) Where the working pressure exceeds PN 16, and for all nominal diameters of DN 400 and over, flange faces shall be machined in accordance with matching flanges Type G (O-ring recess) and Type H (O-ring groove) as detailed in Fig 4 of BS EN 1092. (See also 4.1.3.5).
iii) Alternative to (ii) above, flanges may be machined flat face as shown in BS EN 1092, Figure 4, Type A. The flange face shall have a gramophone record finish. These flanges will only be permitted where gaskets are of the type specified in 4.1.3.5, Gasketing, paragraph 5.

For flanges not covered by BS EN 1092, and for domes and conical ends, thicknesses shall be calculated and where applicable the flanges manufactured in accordance with Section 3 of PD 5500.

4.1.3.3 Insulated flanges

The insulated materials shall be arranged as set out in Code of Practice No. SAECC/1 or SANS 10121. Flanges shall be manufactured as shown on the drawings, or as per approved alternative offered.

4.1.3.4 Loose flanges

Loose flanges for welding onto steel pipes on Site shall be manufactured from at least the same steel as specified for the pipes and shall be in accordance with SANS 1123 where applicable (see also 4.1.3.2), or alternatively in accordance with BS E N 1092.

Loose flanges shall be suitable for field welding to pipes and specials and shall conform to 4.1.3.2 in respect of attachment.

4.1.3.5 Gasketing

Each flanged pipe and fitting of less than DN 400 and rated for PN 16 or less shall be supplied complete with one insertion piece (gasket) of the appropriate diameter and made of a material that is suitable for the maximum test pressure, and one set of bolts, nuts and washers.

Unless otherwise specified in the Specification Data, asbestos gaskets in accordance with BS 1832 Grade B, and having a minimum thickness of 1,5 mm, shall be supplied for working pressures not exceeding PN 16.

Where working pressures exceed PN 16, and for DN 400 and over, rubber "O" rings dimensioned in accordance with BS EN 1092 Section 3.1, Fig. 4 for Types G and H flanges, shall be supplied to suit appropriately machined flanges.

Where flanges have not been machined in accordance with the above, spiral wound gaskets, style CG to BS 3381 shall be used. The external ring shall be made of carbon steel and electro plated. The metal windings shall consist of Grade 316 L stainless steel with asbestos filler.

Where flanges with flat faces as specified in 4.1.3.2, paragraph 1, are jointed, the gaskets shall be of the type manufactured by HPE and as specified below:

The gasket shall consist of a seal ring made from ultra high molecular weight polyethylene (UHMWPE) (section 10 mm x 5 mm minimum) which fits snugly inside a 3 mm thick x 30 mm wide (minimum) flat steel outer ring. The reuse of UHMWPE seal rings is inadmissible.

The outer ring shall consist either of:

i) A mild steel ring, hot-dip galvanized in accordance with SANS 121 to a minimum mean coating thickness of 65 µm. The finish shall be of even thickness to ensure that the ring bears evenly throughout between the two flanges.

or

ii) A 3CR12 steel ring where specified in the Specification Data.

4.1.3.6 Bolts, nuts and washers

Bolts and nuts shall comply with the relevant requirements of SANS 1700 or, where high strength friction grip bolts are specified in the Specification Data or considered necessary by the Contractor, the bolts shall comply with the requirements of BS 3139, and their use and design shall be as specified in BS 3294: Part 1 and BS 4604.

Locking devices for nuts shall be provided wherever there is a possibility of the nuts becoming loose during service. Bolts shall be of sufficient length for at least two screw-threads to protrude from the nut when assemblies are fully tightened. Two washers complying with SANS 1700 shall be supplied with each bolt.

All bolts, nuts and washers shall be hot-dip galvanised in accordance with Subclause 4.3.9 of Specification PLE.

4.1.3.7 Screwed joints

The threads for screwed joints shall comply with the relevant requirements of SANS 1109. Male ends shall have taper threads and female ends shall have parallel threads.

4.1.3.8 Plain ended specials

Each plain ended or spigot ended special, as shown on the drawings, shall be supplied with one sleeve coupling (or such other type of coupling as is shown on the drawings) to suit the particular pipe with which the special mates. The coupling shall fit the larger end of the barrel in the case of a reducer.

4.1.3.9 Spigot and socket pipes

Spigot and socket pipes shall be provided with rubber or neoprene sealing rings for forming flexible couplings or, where

so billed or shown on the drawings, caulking materials shall be provided.

4.1.3.10 Welding electrodes

The Contractor shall supply all the necessary welding electrodes, which shall be of the shielded type. The chemical composition of weld metal and parent metal shall be similar. Electrodes that show signs of deterioration or damage shall be removed from Site and replaced at the Contractor's expense. Electrodes shall comply with the requirements of BS 639.

4.1.4 Corrosion protection

Corrosion protection shall be in accordance with the relevant clauses of Specification PLE, Specification LS and as detailed in the Specification Data.

4.2 PLANT

4.2.1 The Works

Pipes and specials shall be manufactured in an approved works which has the necessary facilities to manufacture pipes consistently in accordance with the specifications.

4.2.2 Facilities for testing

The Contractor shall provide at his own cost, all facilities and equipment required for testing and shall carry out all tests at his own expense. Complete records of test results shall be kept.

The testing machines shall be of a design which will allow a steady application of the test pressure and shall be equipped with an accurate pressure gauge. Provision shall be made for expelling all air from any pipe, fitting or special under test during filling and before application of the pressure.

Test calibration certificates from an independent laboratory, verifying the accuracy of all measuring and testing instruments requiring calibration, shall be provided by the Contractor. Recalibration shall be carried out as necessitated by circumstances but at intervals not exceeding 3 months.

4.3 METHODS AND PROCEDURES

4.3.1 Storage, handling and transport

4.3.1.1 General

The pipes shall be manufactured in accordance with API Specification 5L, as applicable and where not in conflict with SANS 719.

Welding shall be in accordance with API Standard 1104 and Specification 5L. (See 4.3.3) or SANS 10044: Part V, as applicable.

Pipes and specials shall be protected against damage at all stages from manufacture to delivery. Particular care shall be taken to protect the ends of all pipes and specials against denting. Pipes shall be transported and stacked in a manner such as to prevent deformation of the pipe body in excess of 2 per cent of diameter. Dents causing a protrusion in excess of 3 mm into the interior of a pipe may result in the pipe being rejected.

Satisfactory temporary end covers shall be provided for the protection of flanges, prepared ends of plain-ended pipes and fittings, and threads, and to prevent damage to the internal lining during transportation and during handling on Site.

Pipeline materials shall be so transported, stored and handled that pipes are not overstressed at any time and fittings are not damaged in any way. All thin-walled, flexible, and soft-coated pipes shall be handled with particular care and shall be so stored that they are not subjected to concentrated pressure from stones or other objects. Pipes damaged or cracked in any way shall be removed from the Site at no cost to the Employer.

The pipes shall at all times be handled with approved equipment, employing stout, wide canvas or rubber-covered slings and wide padded skids designed to prevent damage to the exterior coating. The slings for paint coated sleek pipes

shall be at least 300 mm wide for pipes up to DN 600, 500 mm wide for pipes of DN 700 and up to DN 1200 and 800 mm wide for pipes of DN 1400 and larger, or as approved. Bare cables, chains, hooks, metal bars, or narrow skids shall not be allowed to come in contact with either the exterior coating or the interior lining of the pipes, and shall be used only with caution in the case of cement-mortar coated pipes.

All pipes in excess of 6 m, but not exceeding 20 m, in length shall be slung from two points (at about 25% of the pipe length from each end).

The Contractor shall be responsible for the transport of pipes to Site, off-loading and storage on Site, all in accordance with the Specifications.

4.3.1.2 Loading and off-loading

When transporting in railway trucks, the pipes shall be made up into a unit load, or floating load, in accordance with the current loading rules of Transnet. When transported by rail, all pipes shall be carefully handled in loading, and pipes separated so that they do not bear against each other. Separators may be approved pads, or padded wooden strips. Pads shall consist of either plastic or fibreglass bags containing sawdust or other approved material, e.g. rubber belting. The filled bags shall have a minimum width of 500 mm and a minimum length of 1,5 times the diameter of the pipe to be supported or 500 mm, whichever is the greater.

Rubber belts shall have a minimum width of 300 mm and be of sufficient length to ensure that the pipes cannot come into contact with each other while being transported. When making deliveries by road transportation, all chains, cables or other equipment used for fastening down the load shall be carefully padded.

When the deformation of pipes coated or lined with FBE or other approved painted systems exceeds 2 per cent of the diameter (1 per cent for cement-mortar lined and coated pipes), the ends of each pipe shall be properly braced with approved interior supports or spiders. The pipe sections shall be separated so that load-bearing areas rest in padded cradles.

Pipes shall never be allowed to fall from trucks.

Care shall be taken during off-loading to ensure the corrosion protection system is in no way damaged.

The Contractor will be held responsible for off-loading the pipes at the delivery site and for stacking to a height not exceeding five pipes high with pads between individual pipes, or for stringing the pipes along the trench with pipes supported by padded cradles or saw-dust filled bags to prevent contact of the pipes or specials with the ground or other hard or sharp objects.

The number of layers of bare steel pipes in a stockpile shall not exceed:

$$N = \frac{1730.f.t}{(D - t)^2}$$

where N is the permissible number of layers and D, f and t are as defined in 5.1.2.

Any material which is not delivered and off-loaded on Site in the same condition as it left the factory may be rejected by the Engineer.

Each class and diameter of pipe shall be stored separately in its own stockpile.

4.3.2 Qualified welders

Only qualified welders, certified as having passed the qualification tests as specified in Clauses 3.0 to 3.7 inclusive of API Standard 1104 or alternatively, SANS 10044: Part IV, shall be used to do all welding required. Copies of the certificates shall be made available to the Engineer.

4.3.3 Welding and inspection

Welding and inspection of welds shall be in accordance with Clauses 4.0 to 7.4 inclusive of API Standard 1104 or alternatively, SANS 10044: Part III. Where radiographic inspection is specified in the Specification Data, the procedure followed shall be in accordance with Clause 8.0 of API Standard 1104. Only qualified radiographers as specified in Clause 8.2.2 of API Standard 1104 shall be employed to do the radiography.

All butt welds and branch fillet welds on pipes and specials shall where practicable have an internal weld. The weld bead of this internal weld shall not protrude above the prolongation of the original inside surface of the pipe or special by more than 1 mm.

Internal reinforcement in the form of backing rings at weld seams shall not be permitted.

Where automatic submerged-arc welding is employed, at least one pass shall be made on the inside and at least one pass on the outside of all pipes.

The number of longitudinal weld seams on pipes and specials shall not exceed:

a) 1 for pipes up to and including DN 1000;
2.
b) 2 for pipes larger than DN 1000 and up to DN 2200.

4.3.4 Seams

Longitudinal seams, spiral seams and shop girth seams shall all be butt welded.

4.3.5 Rounding of pipe and sizing of ends

If it is necessary to reshape pipes after they have been welded, reshaping shall be performed by rerolling or by pressure. Reshaping of pipes by dropping or hammering is not permitted. Sizing of pipe ends to come within specified end tolerances is permitted. This may include expanding pipe ends either mechanically or hydraulically up to a maximum of 1,5% of its original diameter.

4.3.6 Preparation of pipe and special ends for:

4.3.6.1 Mechanical couplings

Ends for use with mechanical couplings shall be square cut or bevelled plain ends, cut square to the pipe axis, with all edge burrs, weld splatter and scratches removed. The outside of the pipe shall be free of indentations, projections or roll marks for a distance of 250 mm from each end to permit proper make up of the coupling. Longitudinal or spiral welds on the outside of the plain end shall be ground to plate or sheet surface for a minimum distance of 250 mm or 2S whichever is the greater, as shown on the drawings (see 4.1.2.5 and 4.1.2.7).

4.3.6.2 Fillet welds

Ends for use with fillet welded sleeve joints shall be prepared as specified in 4.1.6.1.

4.3.6.3 Butt welds

Pipes and specials which require joints to be butt welded on site shall be supplied with ends bevelled. Square cut ends will require approval.

For pipes and specials to be jointed by butt welding, the internal weld bead shall be ground flush with the internal surface of the pipe or special for a length of 200 mm from the ends to be jointed.

4.3.6.4 Spigot and socket

Spigot and socket ends shall be rolled or fabricated from plate, sheet or special sections to the required shape without hammering. Longitudinal or spiral welds on the inside of the socket and the outside of the spigot shall be ground to plate or sheet surface for a distance not less than the depth of insertion of the spigot into the socket, as shown on the drawings.

4.3.6.5 Bevelling
All bevelling, where required, shall be delayed until after all non-destructive testing has been completed.

4.3.6.6 Flanges
Ends to be fitted with flanges shall have the longitudinal or spiral welds ground to plate or sheet surface for a distance from the ends sufficient to accommodate the flange.

4.3.7 Repair of defects
If a pipe fails to pass any of the tests specified in 5.1, it will be rejected but the Engineer may permit repairs or alterations to be made to enable the pipe to pass the test.

Repairs of welded joints will be permitted during the process of manufacture. Where repairs are required the defective weld metal shall be cut out, and the parent metal prepared by grinding and rewelded to the satisfaction of the Engineer.

The repair procedure and performance on repairs shall be in accordance with Section 10 of API Specification 5L. Only qualified welders shall be employed (see 5.2). Each repair weld shall be marked with the welder's identifying stamp.

When the repair has been made, it shall be tested in accordance with 5.1.3(f).
On discovery of defective welds the Engineer may, at his discretion, call for additional radiographic examination until it is shown that the necessary standard is being maintained.

Should a weld repair be required on a pipe subsequent to hydraulic testing the pipe shall be retested in accordance with 5.1.2.

Dents shall, where practicable, be jacked out. (See 4.3.1.1, paragraph 3)

4.3.8 Quality assurance
Quality assurance and control during the manufacturing process shall be in accordance with ISO 9000. All specials and fittings with a pressure rating of PN 25 and over shall be manufactured at a works which has a valid listing certificate from SANS, stating that quality assurance is in accordance with ISO 9002.

5. COMPLIANCE WITH REQUIREMENTS

5.1 TESTING

5.1.1 Workmanship
Workmanship, visual inspection and repair of defects shall be in accordance with Section 10 of API Specification 5L and the standards of acceptability where shown on the drawings.

5.1.2 Hydrostatic testing
When all aspects of fabrication have been completed, but before being cleaned, lined or coated all straight pipes and specials shall be subjected to an approved hydrostatic test in accordance with SANS 719, Subclause 7.3 to a test pressure determined by the formula:-

$$P = \frac{1500.f.t}{D}$$

where P is the test pressure in kPa, D is the outside diameter of the pipe in mm, f is the guaranteed minimum yield strength in MPa for the steel plate and t is nominal wall thickness in mm.

The minimum factory test pressure for pipes shall be twice the working pressure specified in the Specification Data or P as calculated above, whichever is the greater.

The pressure shall be applied gradually by approved means and maintained without variation sufficiently long for proof and inspection. While under test pressure the pipe shall be struck smartly and repeatedly along its length with a hammer of a mass of not less than 1 kg.

Should water sweat or ooze from any part or any defects of any nature be discovered the pipe shall be emptied and the defects repaired in accordance with 5.7. The pipe shall then be retested. Should a pipe, after repair, fail to pass the second hydraulic test the Engineer may order its rejection.

The fact that any pipe may have passed the hydraulic test at the manufacturer's works shall not exempt the Contractor from his liability in terms of the General Conditions of Contract to provide materials and workmanship of an acceptable quality.

5.1.3 Non-destructive testing

Non-destructive testing shall be in accordance with Section 9 of API Specification 5L.

On completion of the hydrostatic testing (see 5.1.2) and before the ends of the pipes and specials are bevelled, non-destructive tests shall be carried out on all E-RW and SA-AW welds, as follows:

a) Longitudinal welds shall be radiographically tested (X-rayed) over 300 mm at each end of each pipe and special.

b) Longitudinal welds on straight pipes shall also be ultrasonically tested over their full length on the inside and outside of the pipe. Only approved equipment capable of continuous and uninterrupted inspection of the weld seam shall be used. The test equipment shall be checked with an applicable reference standard at least twice every working day.

c) Spiral welds shall be radiographically tested (X-rayed) over 100 mm at each end of each length of pipe and the complete "H" at all skelp welds, including 150 mm of the spiral weld in both directions away from the intersection points of the skelp and welds.

d) Spiral welds on straight pipes shall also be tested as in (b) above.

e) Circumferential butt welds shall initially be radiographically tested (X-rayed) over 100% of the weld length. When consistently acceptable results are obtained, the number of welds to be so tested may be reduced on a sound statistically controlled basis by mutual agreement between the Engineer, Inspectorate and Contractor.

f) Repairs to welds (see 5.7), shall be radiographically tested (X-rayed) over the full length of the repair.

The remainder of all welds shall be subjected to either ultrasonic or fluoroscopic tests as appropriate.

Each radiograph, the test-pieces and results and interpretations of examinations and tests shall be submitted to the Engineer within 24 hours of the particular examination or test.

5.1.4 Testing of specials

Where hydrostatic testing of specials is not practicable, the welds shall be subjected to 100% dye penetrant tests to determine surface cracks, and/or where ordered by the Engineer, to one of the tests specified in 5.1.3 to determine internal defects. Dye penetrant testing shall be done as specified in Subclause 7.2.1 of SANS 1200 L. At least 10% of all welds shall be radiographically tested.

5.1.5 Magnetic particle testing

Where requested by the Inspectorate, magnetic particle testing shall be done in accordance with ASME Boiler and Pressure Vessel Code, Section V, Article 7.

5.1.6 Destructive testing

The Engineer may require the first and thereafter every 500th subsequent pipe of each diameter to be tested to destruction in accordance with SANS 719. If practicable the Engineer may require the Contractor to repair and retest such a pipe.

5.1.7 Sampling and compliance with the specification

Sampling and compliance with the specification shall be performed in accordance with Clause 6 of SANS 719.

5.1.8 Roundness

Upon completion of the hydrostatic test, the ends of pipes and specials shall be tested by means of Go, No-go gauges to check whether flaring or cupping has occurred. If necessary the ends shall be expanded or ground until they comply with the specification. (See also 4.1.2.5)

5.1.9 Inspectorate

The Engineer, at his sole discretion, may appoint any Independent Inspectorate to carry out any tests, to verify compliance with the specifications or he may appoint the SABS as an Independent Inspectorate to act on his behalf in the carrying out of or witnessing of any of the testing requirements which follow. Any such Inspectorate shall have access to all testing facilities and records and shall be accorded the same facilities as the Engineer.

5.1.10 Marking procedure

All weld lengths to be radiographed shall be clearly marked by the Inspector using his identification symbol. This symbol shall appear on the respective radiograph. The radiographed weld and symbol shall not be obliterated by finishing processes until the respective weld has been accepted by the Inspector.

5.2. TOLERANCES

5.2.1 Dimensions, weights, lengths and roundness

The dimensions, weights, lengths and roundness shall be in accordance with Section 6 of API Specification 5L or Clause 15.3 of BS 534 as applicable. (See 4.1.2.3 for minimum diameters and plate thicknesses.)

a) End roundness for machined spigot ends: (Types A and B as shown on the drawings).

i) For working pressures smaller or equal to PN 16.

+ 0,6 mm	for			DN	<	300
+ 0,8 mm	for	350	<	DN	<	500
+ 1,0 mm	for	600	<	DN	<	700
+ 1,2 mm	for	800	<	DN	<	1 000
+ 1,2 mm	for	1 100	<	DN	<	1 400
+ 1,5 mm	for	1 500	<	DN	<	1 800

ii) For working pressures exceeding PN 16 the above tolerances shall be halved.

b) End roundness for rolled plain end: (Type D)

+ 1,6 mm over length 2S

c) Body roundness:

+ (0,01 x DN) mm	for			DN	<	250
+ (0,005 x DN + 1) mm	for	300	<	DN	<	800
+ 5 mm	for	800	<	DN	<	1250
+ 6 mm	for	1250	<	DN	<	2280

d) Length and centre to face:

+ 10 mm for all DN

APPENDIX A: APPLICABLE STANDARDS

Reference is made to the latest issues of the following standards:

API Specification 5L	American Iron and Steel Institute - Specification for LINEPIPE.
API Standard 1104	American Iron and Steel Institute - Standard for welding pipelines and related facilities.
ASME	Boiler and Pressure vessels Code, Section V, Article 7.
AWWA M 11	Steel pipe - A guide for design and installation (3rd edition).
BS 534	Steel pipes and specials for water and sewage.
BS 639	Covered electrodes for the manual metal-arc welding of carbon and carbon-manganese steels.
BS 1387	Steel tubes and tubulars suitable for screwing to BS 21 pipe threads.
BS 1640	Steel butt-welding pipe fittings for the petroleum industry: Part 1: Wrought carbon and ferritic alloy steel fittings.
BS 1832	Compressed asbestos fibre jointing.
BS 2633	Class 1 arc welding of ferritic steel pipe work for carrying fluids.
BS 3139	High strength friction grip bolts for structural engineering.
BS 3294	The use of high strength friction grip bolts in structural steelwork: Part 1: General grade bolts.
BS 3381	Metallic spiral wound gaskets for use with flanges to BS 1560: Part 1 and 2.
BS 4360	Weldable structural steels.
BS 4604	The use of high strength friction grip bolts in structural steelwork (metric series).
BS EN 1092	Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories. Steel flanges.
BS EN 10222	Steel forgings for pressure purposes.
PD 5500	Unfired fusion welded pressure vessels.
ISO 7005	Metallic Flanges: Part 1: Steel flanges.
ISO 9000	Quality management.
ISO 9002	Quality systems. Model for quality assurance in production, installation and servicing.
SANS 62	Steel pipes Part 1 Pipes suitable for threading and of nominal size not exceeding 150 mm Part 2 Screwed pieces and pipe fittings of nominal size not exceeding 150 mm.
SANS 121	Hot dip galvanized coatings on fabricated iron and steel articles - Specification and test methods.
SANS 719	Electric welded low carbon steel pipes for aqueous fluids (ordinary duties).
SANS 974	Rubber joint rings (non-cellular) Part I: Joint rings for use in gas, water, sewer, and drainage systems.
SANS 1109	Pipe threads where pressure-tight joints are made on the threads Part 1 Dimensions, tolerances and designation Part 2 Verification by means of limit gauges.
SANS 1123	Pipe flanges.
SANS 1431	Weldable structural steels.
SANS 1476	Fabricated flanged steel pipework.
SANS 1700	Fasteners.
SANS 10044	Welding.
SANS 10121	Cathodic protection of buried and submersed structures.
SANS 1200 L	Medium-pressure steel pipelines.
SAECC/1	Code of Practice.
Specification PLE	Corrosion protection of steel pipes and specials, cast iron specials and valves.
Specification PLHA	Cement-mortar protective linings and coatings for steel pipes.
Specification LLC	Laying and jointing of medium pressure steel pipes and specials.

PARTICULAR SPECIFICATION

PL G ELECTRICAL SPECIFICATION

1. SCOPE OF WORK

This electrical specification covers the electrical works required for the new high lift pumping station, pumping potable water at a flow rate of 550 l/s from the existing Robertville Reservoir into the new Robertville Tower.

The scope of work for the electrical equipment is the design, supply, delivery, installation, testing, commissioning and upholding during the trial operation period and the defects notification period of the following equipment and materials:

- Low voltage (LV) squirrel cage, induction motors.
- Low voltage (LV) motor control center with electronic VSD starters.
- Field control stations.
- MV and LV power cables.
- Cable supports.
- LV distribution boards.
- Earthing and lightning protection.
- Interior and exterior lighting.
- Power outlets.
- Connections to mechanical equipment.
- A Standby diesel generator and associated fuel tank.
- MCC
- All electrical equipment must be approved in writing by the Engineer prior to procurement.

2. GENERAL INFORMATION

a) This Section, Project Specification, shall be read in conjunction with the Standard Electrical Specifications. The Project Specification shall take preference over the Standard Specifications.
b) Only equipment based on proven technology and of high reliability shall be considered for use.
c) All schedules included in the Tender Document shall be completed in full and submitted with the Tender.
d) All relevant technical information regarding each component or item offered shall be included either in the forms to be completed by the Tenderer or as an Appendix to the Tender, in order that the Engineer can make a proper evaluation of the offer.
e) Preference shall be given to locally manufactured equipment and components. Should items not be locally manufactured, Tenderers shall clearly identify these in their Tender. Where Tenderers choose to offer imports in lieu of locally manufactured items, these shall be offered as an alternative offer, with the local items included in the main offer.
f) Where products of a particular supplier are specified, the supply of equal products from other suppliers may also be supplied if approval for such products is obtained from the Engineer.

3. STANDARDS AND REGULATIONS

All materials and equipment shall be new and of the standard and quality specified.
Tenderers shall ensure that they are fully acquainted with the contents of the applicable standard electrical Specifications.

The wiring installation shall comply fully with SANS 10142 as amended.

The design and manufacture of equipment and the complete installation shall be carried out and tested in accordance with the latest issue or amendments of the following regulations, as applicable.
a) SANS 10142 – The Code of Practice for wiring of premises as amended.
b) The Occupational, Health and Safety Act, (Act 85 of 1993).
c) The local Municipal by-laws and regulations and regulations of the local supply authority.
d) The Fire Brigade Services Act, 2000 (Act 14 of 2000).

e) The regulations of Telkom (S.A) Ltd.
f) The National Building Regulations and Building Standards Act, (Act 29 of 1996).
g) The Electricity Act, (Act 88 of 1996).

4. ELECTRICITY SUPPLY

The Existing pump station has 400 V 500 kVA electricity supply from the local supply authority (Eskom).

The Contractor shall supply and install the 400 V supply cables from the Eskom supply point to the LV Main distribution panel at the pump station as specified and shown on the drawings

The relevant electrical parameters at the points of supply to the pumpstation are as follows:

PARAMETER	PUMPSTATION
Supply voltage	415 V
Frequency	50 Hz
Fault level (3 phase)	TBA by Eskom
Voltage regulation	± 5%
Voltage dip limit (maximum allowed)	3%

5. DRAWINGS, MANUALS, TRAINING, SPARES AND TOOLS

The requirements of Standard Specification E200.7 shall be complied with, as varied or added to by this Project Specification.

5.1 Drawings

Equipment Drawings shall be submitted in hard copy and electronically in .pdf format as specified in the Standard Specifications.

The approval of Drawings shall not relieve the Contractor of this responsibility to supply the equipment according to the requirements of this Specification.

The following Drawings shall be submitted by the Contractor prior to installation work:

- Motor control schematic diagrams and workshop drawings;
- MCC termination diagrams;
- Field station workshop drawings;
- Mini-substation workshop drawings;
- Standby generator workshop drawings;

The following procedure for the approval of Drawings shall be strictly followed:

- Contractor prepares Drawings for approval;
- Contractor checks Drawings for compliance with all requirements of the Specification and submits 3 copies, signed off as checked, to the Engineer for approval (including one electronic copy);
- Engineer returns 2 copies, stamped as approved or returned for resubmission, to the Contractor;
- Manufacture of equipment commences after approval of Drawings by the Engineer;

A complete set of "As Built" Drawings, certified as accurate, shall be submitted to the Engineer immediately after completion of the Installation (including one set of electronic copies).

Layout Drawings, issued during Tender stage, shall be marked up by the Contractor showing all dimensions to buildings, including the positions of underground cables.

5.2 Operation and Maintenance Manual

Two copies of the O & M manual shall be issued to the Engineer prior to commissioning of the Works, and the Operational Acceptance Period shall not be deemed to have commenced until the manual has been issued. Before the Certificate of Completion is issued (after the successful completion of the Operational Acceptance Period) seven copies of the final approved version of the O & M manual shall be issued to the Engineer.

The manual shall be of a standard acceptable to the Engineer and shall be subject to his approval. At least one set shall contain original copies.

Binders with hard plastic covers and ring spring clip holders shall be used. To prevent damage to the content binders shall not be over-filled. A spare binder shall be provided for every three used, marked with the contract information.

Title labels which include Contract number, title, location, Contractor's name as well as the plant or process description together with volume number and contents shall be fixed on the front cover as well as on the spine of the binders.

Manuals shall be in English only, with sections of equipment arranged by labeled dividing separator sheets. Where standard literature is obtained from suppliers or manufactures, this shall be neatly photocopied in A4 size, with the applicable sections clearly marked, omitting duplicate sections in languages other than English.

Comprehensive indexes shall be included, with separate sections (with their own index) where required, as follows:

- Contact details of: consulting engineer, main contractor; all relevant sub-contractors.
- Details of the electrical equipment supplied including the name and address of the supplier, as well as descriptive and technical literature, giving performance and service information.
- Full details of control and protection systems including logic sequence charts, logic controller programs, trip settings, etc.
- Circuit diagrams.
- Dimensioned panel layout drawings.
- Cable schedules for power, control and instrumentation cables. This shall include the cable type, start and finish points, route length, duty load, size, voltage drop, number of cores, number of cores used and gland size. For cable voltages above 400 Volts, the schedule shall also include the purchase details, specification and date of manufacture.
- Record (as-built) drawings referenced to the above.
- Spares list.
- A comprehensive schedule of routine maintenance actions by time period for the system as installed.
- Test certificates for individual items of equipment and for complete sections of the Works as appropriate.
- This includes Certificates of compliance for the electrical installations, Certificate of compliance and test results of earthing installations, etc.
- Comprehensive hazard identification and risk assessment for all equipment and/or substances provided under this contract toward assisting the employer fulfill its responsibilities in terms of the Occupational health and Safety Act (Act No 85 of 1993) and in particular Section 8(2)(d).

5.3 Training

The Contractor shall arrange for three nominated technical staff members of the Employer to be trained in the operation and routine maintenance of all the electrical equipment provided under this Contract. The training shall be provided by way of on-site formal training sessions by the equipment suppliers, who shall certify that the training has been completed satisfactorily.

5.4 Spares and Tools

Spares and tools shall be provided as specified in and as called for in the Project equipment specifications in this Specification.

In addition to any spares specifically called for in this Specification, the Tenderer shall recommend any additional spares which he considers the Employer should hold. The prices of these spares must not be included in the tender price, but should be separately listed and priced in the returnable schedules. Prices for these spares shall include delivery to and off loading at the site. Items may be ordered in full or in part before the end of the maintenance period.

6. INSPECTIONS, TESTS AND COMMISSIONING

In addition to the requirements of Standard Specification E200.8, the following requirements shall be complied with:

6.1 Inspections

(a) Inspections of all switchboards and panels may be carried out by the Engineer at his discretion at the following holding points prior to release:
- after sheet metal fabrication, before painting
- after painting, before installation of equipment
- after assembly, before factory testing.

(b) All cable trenches in ground shall be inspected by the Engineer prior to cables being laid and trenches being backfilled.

(c) For equipment being manufactured in the RSA, the Engineer and a representative of the Employer will carry out factory inspections and the Contractor shall bear all travel and accommodation costs associated with the inspections

(d) During construction the onus will be on the contractor to comply with the following:
- Contractor checks and inspects equipment during all stages;
- Contractor presents Engineer with written confirmation that all equipment is in full compliance with the Specification and has been checked, inspected and fully tested. This confirmation, signed and dated by the Contractor, shall accompany a written request for the Engineer to witness final inspection and testing of the equipment (e.g. distribution board);
- During the Engineer's inspections a fault list will be drawn up, if necessary, and handed to the Contractor;
- Only after satisfactory rectification of the fault list and subsequent re-inspection or testing, may the equipment be dispatched to site;
- The Contractor shall ensure that a full copy of the Specification, as well as an approved, signed copy of the Drawings, are at hand during all inspections and testing.

6.2 Tests

The tests listed below shall be carried out on Site by the Contractor and witnessed by the Engineer and a representative of the Employer. Pricing items have been included in the Bill of Quantities for site tests. Factory tests shall be carried out in accordance with the Project equipment and material specifications in this Specification, and routine test certificates shall be provided. **Type test certificates, issued by internationally accredited test authorities, shall be provided for all MV equipment.** The cost of all factory routine and type tests (where existing certification is not available) shall be included in the supply prices for the equipment.

Switchgear:
- visual checks (including paintwork)
- impedance measurements
- insulation resistance measurement
- current and voltage transformer tests
- proving of protection scheme
- high voltage tests
- circuit breaker operation tests

- control scheme test
- load testing.

LV Cables:

- insulation resistance test (after jointing and termination)
- phase rotation test (after jointing and termination).

Earthing:

- earth electrode resistance measurements
- bonding conductor continuity tests
- soil resistivity tests.

Variable frequency converters (VFCs):

- All inspection and testing procedures shall be developed and controlled under the guidelines of the Supplier's quality system and must be registered to ISO 9001 and regularly reviewed and audited by a third party registrar.
- The VSD shall be factory pre-wired, assembled and tested as a complete package.

7. MATERIALS, FINISHING AND PAINTING OF MATERIALS AND EQUIPMENT

7.1 Materials

Materials shall be provided in accordance with Standard Specification E201 and shall be suitable for the site conditions set out in Volume 2.1 Section 1.
All mild steel shall be hot-dip galvanized after fabrication, and no cutting or drilling shall be done on site.

7.2 Finishing and Painting

Finishing and painting shall be in accordance with Standard Specification E202. All 3CR12 material shall be degreased, with any sheared edges, welds or surfaces subjected to any form of heat treatment pickled and passivated. If there is any mill scale on the material, the 3CR12 shall be non-metallic blast cleaned to SA2½, prior to degreasing.

A primer coat of strontium chromate epoxy primer or approved alternative shall be applied to a minimum dry film thickness (DFT) of 30 µm. A final coat of epoxy / polyester powder coating shall be applied by electrostatic spray and baked in accordance with the manufacturer's specification.
This final coat shall be in the colour as specified, with a minimum DFT of 50 µm, but not more than 100 µm.
The suppliers or manufacturers shall furnish paint thickness test certificates for all materials that are epoxy powder coated.
All galvanizing shall be hot-dip zinc galvanized coating done in accordance with SANS 121.
The hot-dip galvanizers shall be permit holders in terms of the SABS Mark Scheme or equivalent.

7.3 FIXING OF MATERIALS

Materials shall be fixed in accordance with Standard Specification E203. All fasteners shall be hot-dip galvanized or stainless steel. No electro-plated or zinc plated fasteners will be allowed.
Fixing to structures and concrete shall be effected by stainless steel bolts and nuts, or stainless steel threaded rod used in conjunction with an approved chemical anchor.
Where there is a possibility of electro-galvanic reaction (e.g. between stainless steel and galvanizing) the Contractor shall make use of suitable insulating washers of rubber, teflon or similar material.

8. LV MOTOR CONTROL CENTRES

8.1 General

A free-standing LV motor control centre (MCC) shall be provided inside the pump station to serve as both an MCC and the main LV distribution board for the pump station. A single-line diagram and a proposed general arrangement are shown on Drawing No. WF1.715-2-06-003

8.2 Standard Specifications

The MCC shall comply with SANS 60439-1, SANS 1973-1 and the following Standard Specifications as varied by this Particular Specification:

E204 Enclosure for MCCs
E205 : LV switchgear and controlgear
E206 : Busbars
E207 : Current transformers
E208 : LV motor protection
E209 : Wiring in MCCs
E210 : Wiring and cable terminations
E211 : Glands and gland plates
E213 : Switchboard accessories
E214 : Nameplate and labels
E215 : Metering and indication equipment

Enclosure for MCC

The MCC enclosure shall be fabricated fully from 3CR12 sheet metal, with either 3CR12 or cast aluminium frames.
Compartments in the MCC shall be sized in accordance with the proposed general arrangement drawing.
The pump station MCC shall be constructed to From Type 3b or 4a as per SANS IEC 60439-1.
Doors shall be provided on the front and back of the pump station MCC.

An interlocking device shall be provided so that the front door of a compartment cannot be opened unless the circuit breaker / isolator is in the off position, and so that the circuit breaker / isolator cannot be switched on unless the door or cover is locked.
The top of the enclosure for the pump station MCC shall be divided into a busbar chamber and a wiring channel in accordance with Clause 2.4(d) of Standard Specification E204.

The pump station shall be constructed for cable entry from below, and shall have front and back access.

The ingress protection shall be as follows:

- IP44 with doors closed
- IP2X with doors open
- IP2X between compartments.

Switchgear and Control gear

The motor ratings given on the single line diagram are the Engineer's estimates, which have been used for systems design purposes. Should the ratings of motors offered in the Tender differ from the Engineer's estimates, then the switchgear and control gear shall be sized to suit the motors offered in the tender and priced accordingly.

All MCCBs shall be lockable in the "off" position, but only with the use of an integral locking device.

Selector switches shall be provided on the front door of each drive's compartment: Switchboard Accessories for selecting manual / off / automatic and local / remote (where required) operation modes. In the manual mode the control pushbuttons on the MCC (local) and at field control stations (remote) shall be operational. In the automatic mode, the control pushbuttons shall not be operational, and control of the drives shall be transferred to the remote terminal unit (telemetry), controlling the drives.

Where standby motor-driven equipment is provided, selection shall be done by the remote terminal unit input for duty / standby selection of the drive compartments as required to implement the specified control philosophy.

Busbars

The busbars in the MCC shall be rated in accordance with the single-line diagram.
The specified covering of the busbars with heat-shrinkable material shall only apply to distribution busbars (i.e. droppers to functional units).

Motor Protection

All motor starters shall be equipped with the motor protection required in terms of Standard Specification E208, except as varied below.
Earth leakage protection (rated at 250mA) shall be provided on all motor starters for immersible / submersible equipment to operate the shunt trip of the drive's circuit breaker.
Where the thermal overload relays are mounted inside MCC compartments, an electrical reset facility shall be provided with a pushbutton on the front door of the compartment.
Separate thermistor relays and/or RTD controllers need not be provided if the motor protection relays can accept these inputs.
Each motor starter shall provide a supply to the anti-condensation heater of its associated motor (where fitted). The supply shall be taken from a dedicated earth leakage circuit breaker and shall be turned on automatically when the motor is not running.

Wiring in MCCs

The colour of the MCC wiring shall be as follows for circuits other than power circuits:

220 V ac control live	Brown
220 V ac control neutral	Black
+24 V dc control	Orange
-24 V dc control	Violet / Purple
Wiring to lamps	Red
CT circuits	Blue
PLC digital inputs	Grey
PLC digital outputs	Pink
PLC analogue inputs	Red / black (twisted pair)
PLC analogue outputs	White / black (twisted pair)

Wiring- and Cable Terminations

Power cables shall be terminated directly onto circuit breakers or contactors (as applicable) and shall not be connected up via separate terminal strips (i.e. Clause 3 of Standard Specification E210 shall not be applicable).
Power cables shall be labeled externally to the MCC to indicate the equipment being fed. Incoming supply cables shall also be labeled to indicate the source of supply.

Glands and Gland Plates

All cable glands shall be of the nickel-plated brass type and fitted with waterproof neoprene shrouds.

Gland plates in the pump station MCC shall be provided for cable entry from below. Gland plates shall be mounted at 400mm above finished floor level and shall be bolted to robust brackets welded to the framework of the MCC. Gland plates shall be manufactured with a minimum thickness of 2mm. Where single core cables are terminated, the gland plates shall be manufactured from non-ferrous material of adequate thickness.

Switchboard Accessories

Control Push Buttons

Motor control compartments shall be equipped with control push buttons as needed.
Control push buttons shall be of the round, flush, spring-loaded type of 22,5mm diameter.
Push buttons shall be colour-coded as follows:

Emergency stop	Red
Lamp test	Black
Reset	Blue
Start	Green
Stop	Red
Open / close	Black on White
Up / down / left / right	Black on White
Forward / reverse	Black on White

Indicator Lights

Motor control compartments shall be equipped with indicator lights as needed:
Indicator lights shall have lamps comprising a cluster of four light-emitted diodes in a common housing. A light's lens shall be of the specified colour and shall be least 20mm in diameter. The lights shall be clearly visible through an angle of 180° in a brightly lit room (500 – 600 lux) and the contrast between an energized condition and a de-energized condition shall be clearly visible from all sides as well as from the front.
Indicator lights shall be colour-coded as follows:

Indication	Colour	Example / Comment
Local / Auto / SCADA Mode	White	
Busbar Alive	White	
Closed	Red	Valves, penstocks
Differential Pressure – HIGH	Amber	
Differential Pressure – NORMAL	Green	
Earth Fault	Amber	
Emergency stop	Amber	
Mechanical Seal Failure Warning	Amber	Sub- / Immersible Pumps
Moisture in Coolant	Amber	Sub- / Immersible Pumps
Moisture / Water Ingress	Amber	
Motor Winding Over Temperature	Amber	May be flashing AMBER

Indication	Colour	Example / Comment
Open	Green	Valves
Overload	Amber	
Running	Green	
Starter Alive (Circuit Healthy)	Green	
Stopped & Power Available	Red	
Tripped	Amber	

Name Plates and Labels
The requirements of the applicable SANS specification relating to name plates and labels shall take precedence over the Standard Specification.

Metering and Indication Instruments
Metering and indication instruments shall be provided in accordance with the single-line diagram for the MCCs.
The size of ammeters and voltmeters shall be 96mm x 96mm on compartment doors that are 600mm x 600mm or larger in size, and 72mm x 72mm on all smaller compartment doors.

Runhour meters shall be provided for all motor starter compartments to match the ammeters and voltmeters in size. The runhour meter shall count to 99 999.9 before returning to zero, and it shall not be possible to reset the meter.

8.3 Test Reports

The switchboard manufacturer shall be in possession of a Permit to Apply Certification Mark, issued by the South African Bureau of Standards (or approved equivalent), in terms of the Specific Permit Conditions of SANS 1973-1 and have evidence of all the seven type tests as required in IEC 60439-1 and SANS 1973-1.

Only authorized holders of these test reports may design and construct the switchboards.

Copies of relevant test reports shall be made available to the Engineer upon request.

The Contractor shall re-torque the pump station MCC busbars on site once fully populated and connected up, prior to switch-on, and shall issue a certificate to the Engineer confirming that the busbar arrangement is still to the same standards as at the time of the initial construction and is safe for operation.

Suppliers/Manufacturers of switchboards equal to or below 10 kA shall be in possession of a Permit to Apply Certification Mark, issued by the South African Bureau of Standards (or approved equivalent), in terms of the Specific Permit conditions of SANS 1973-3.

8.4 Installation
The pump station MCC shall be installed over a cable trench on the elevated platform provided with front and back access as shown on the layout drawing.
Cable trench bridging supports shall be provided to support the pump station MCC in accordance with Clause 4 of Standard Specification E204.

8.5 Measurement and Payment
The single-line diagrams, typical motor starter schematic and MCC accessories schedule have been provided to guide the Contractor in his design of the MCCs. However, the prices for the supply of MCCs shall include for all equipment / components / materials required to comply with this Particular Specification and referenced standard specifications. The price for the installation of the MCC shall include the provision of cable trench bridging supports

9. LV MOTOR STARTERS:

9.1 General

Three 400 V low voltage Variable frequency converters (VFCs) shall be provided for the booster pump motors at Protea Glen pumpstation The VFCs shall enable smooth starting of motors up to rated speed which shall be controlled by the PLC via Modbus TCP. The design of the starters shall allow for the supply authority's voltage dip limit to be met, whilst allowing the motor to develop adequate starting and accelerating torque.

The VFCs shall be fed from dedicated motor feeder circuit breakers in the LV switchboard. These VFCs shall be connected as shown on the LV single-line diagrams.

9.2 Equipment Specification

The scope of works shall include the design, manufacture, factory tests, delivery, installation, on-site tests, commissioning and maintenance for 12-months of three (3) 400V 150 kW variable frequency converter (VFCs) for the new pump motors at the new Protea Glen Pump station

The VFCs shall be provided in accordance with Standard Specification E234 as varied by this Detailed Electrical Specification. Reference in the Standard Specification to a "variable speed drive" shall be taken as a reference to "variable frequency converter".

The power rating stated above is the Engineer's estimate, and the Contractor shall ensure that the size of the VFC supplied matches the actual size of motor supplied, taking all losses and the motor efficiency into consideration.

The pump sets shall be considered as an S1 (Continuous) type load as defined in SANS 600034.
The Scope of Works shall include, but is not limited to:

- Design, supply and installation of three (3) variable frequency converter;
- Supply and install LV cables;
- Earthing, bonding and EMC mitigation;
- Manufacture drawings;
- Quality assurance;
- Undertake and submission of line supply and shaft line design data to demonstrate compliance with quality of supply criteria set by Eskom as well as the mitigation of torsion forces on the motor;
- Operating and Maintenance manuals;
- Testing and Commissioning;
- Training of identified number of Employer's operating, technical and technical staff on the operation and maintenance of the VFC drives;
- Issuing test report / certificate of compliance;
- 12-months defects liability period;
- 5-year post installation maintenance contract (if approved by the Employer), and
- Off-site diagnostic monitoring of the VFC installation.

9.3 Acceptable Manufacturers

The variable frequency convertors shall either be Emerson, Zest, Mitsubishi, Schneider, Danfoss or equally approved.

9.4 Construction and performance

The VFCs will be rated for use with standard squirrel cage induction motors driving centrifugal water pumps. The Contractor shall be responsible for the system (VFC / motor combination) performance, including overload capability, motor and load starting torque and speed holding accuracy. The minimum acceptable overload capacity shall be at least 110% of the nominal torque continuously. Common mode filters and/or dv/dt filters shall be supplied to minimize shaft bearing currents and ensure that impulse voltages at the motor terminals are slower than the acceptable rise times.

The VFC shall be internally protected so that no damage occurs to it during normal operational faults such as:

- Short circuit or open circuit on the output cables;
- Power supply "dips" or loss of ac supply (including re-application of ac supply);
- Over- and under voltage of the ac supply;
- Motor over load and under load;
- Motor stall;
- Over speed;
- Earth fault; and
- Switching the drive output onto a stationary motor.

The VFC shall employ fully digital, space vector control to ensure optimum response to supply and load transients, maximum motor performance (thermal as well as dynamic) and the most comprehensive fault diagnostics. All drive settings shall be in software and the drive shall not require any pots to be changed on site during commissioning or when any replacement boards are installed.

Incomer sections shall be fitted with disconnectors. Rectifiers shall be fitted with suitable protection, supplier shall state the method of protection. The VFC shall be supplied as cabinet units equipped with an active supply unit and low harmonic line filter.

9.5 Harmonics control

The Contractor shall ensure that the harmonic limits in NRS 048-2 are not exceeded.
In order to achieve the required harmonic limits, either VFCs with active front ends or a combination of VFCs with high-pulse diode front ends and associated harmonic filters shall be provided.
Should DFE VFCs be provided, tuned harmonic filters shall be provided for each VFC individually.

9.6 Motor protection

The VFC shall provide protection for the motor against the following:

- Thermal overload;
- Locked rotor;
- Under-voltage;
- Short circuit; and
- Earth Fault.

9.7 Cooling

Tenderers shall state the maximum heat losses and the cooling air requirements for each drive when operating at the duty point. The VFC panels shall be equipped with fans for drawing air in through filtered louvres and discharging the air out the top of the panel.

9.8 Dip Ride-Through

The VFCs shall be capable of riding through the following voltage dips below nominal supply voltage:
dips of up to 30% and lasting up to 3s; and

a) dips of up to 100% and lasting up to 100 ms.

It is accepted that the motor speed and VFC output power may be reduced during the ride-through period. However, the motor shall not be allowed to reach a pullout condition.

Tenderers shall submit with their tender a curve that shows the dip ride-through capability of the offered VFCs.

The VFCs shall also be capable of riding through a loss of auxiliary power for up to 1s.

9.9 Automatic restart

Should the VFC be subjected to a voltage dip or power interruption of a magnitude and / or duration that causes the VFC to shut down, the VFC shall not automatically restart itself. However, the VFC shall be available to be restarted by the pump station's control system.

9.10 Motor compatibility

The VFCs shall be compatible with standard squirrel cage induction motors without derating of the motors being necessary as a result of output harmonics.
Compatibility with standard motors also implies that it should not be necessary to use motors with upgraded insulation. The VFCs shall therefore be designed to limit voltage stressing of the motor winding insulation due to high dV/dt, excessive peak voltage of the output waveform and high common mode voltages to within the voltage stress withstand capability of the motors.
The VFC supplier shall ensure that the maximum allowable increase in the floating neutral voltage does not exceed the following conditions:

- Peak Voltage = 1.9 x Vn (rms); and

- dv/dt = 7-15 kV/µs.

Where Vn is the rated RMS voltage of the motor.

These values must not be exceeded at any condition of VFC operation. Sine filters are mandatory if there is doubt that these limits are not achievable.

Though the motors should have insulated bearings the contractor shall confirm the bearing insulation.

Where the insulation is determined not sufficient the contractor shall supply clamping devices to limit the potential shaft currents through the bearing.

9.11 Control and monitoring

VFCs shall provide feedback, to and be controlled by the pumpstation's PLC in the automatic mode. Selected signals shall be made available for connecting to the PLC system as specified in the Detailed Electronic Specification.

In addition, local control at the VFC shall be possible via a panel mounted keypad, conforming to the following requirements.

The keypad shall be detachable with at least a back lit 4-line, 20 character alphanumeric operating display for programming and control. The displayed messages shall be in user-friendly, descriptive text. Coded messages are not acceptable.

Parameter setting shall be possible using the keypad with user-friendly text messages. Password protection shall be provided to prevent unauthorized tampering with the set parameters.

It shall be possible to set the keypad to display (simultaneously or by continuous scrolling) any three of the following parameters or actual values, as selected by an engineer on site:

- Input Voltage;
- Input Frequency;
- Output Voltage;
- Output Frequency;
- DC Bus Voltage;
- Output power;
- Output Torque;
- Output Current;

- Motor Speed;
- Speed reference;
- Run / Stop / Fault; and
- Remote / Local Control.

At least the following drive functions shall be available from the keypad:

- Run;
- Stop;
- Accelerate;
- Decelerate;
- Set Parameters;
- Scroll through and view actual values; and
- Fault Analysis.

E-stops at the pumps shall be hard-wired to the VFC to isolate power to the pump motors in case of emergency.

10.6 Installation

The low voltage VFD-starters shall form part of the MCC which shall be installed inside the pumpstation, in the positions indicated on the electrical equipment layout, Drawing.

10.7 Measurement and Payment

The price for the supply and installation of the low voltage VFD-starters shall include for all of the following which have not been separately measured in the Bills of Quantities:

- Programming software for the motor protection relays, and a data cable for connecting a relay to a laptop PC.
- Factory tests.

10. FIELD CONTROL STATIONS

Field control stations which are equipped as specified below shall be provided for the following equipment at the pumpstation:

LV pump motors :emergency stop pushbuttons

The field control stations shall be constructed in accordance with the typical general arrangement, Drawing and shall be installed in an easily-accessible position alongside the associated equipment.

11. LOW VOLTAGE POWER CABLES

11.1 General

LV cables shall be provided in accordance with single line diagram for LV MCCs and distribution boards.

The cables shall be supplied and installed in accordance with Standard Specification E231 as varied by this Project Specification.

Should the ratings of LV motors differ from the Engineer's estimates (on which the single-line diagrams are based), then the motor supply cables shall be sized to suit the actual motor ratings. The voltage drop from the MCC to the motor terminals shall not exceed 2% of the motor rated voltage at motor rated current.

11.2 LV Cables

LV cables shall be provided as follows:

- From the Mini-substation to the LV MCC at the pump station
- From the LV distribution boards to LV loads as indicated on the single-line diagrams.

- The lighting and s power installations in the Pump Station pump hall shall be watertight industrial type surface mounted installations. All fittings and appliances shall be surface mounted, and shall be fed with cables installed on galvanised cable ladders, or in galvanised conduits, fixed on the surface of structures, complete with brass bushes on the ends.

All multicore LV power cables shall be 600 / 1000V PVCPVCSWAPVC cables with stranded copper conductors.

All ECC cable connections shall be water tight to IP66.

11.3 Installation

LV power cables shall be installed on wall mounted cable ladder in cable trenches inside buildings and on vertical / horizontal structure-mounted cable ladder to equipment.

Excavations and the laying of cables, either directly in the ground or in ducts, shall be in accordance with Clause 3 of Standard Specification E231.

All cable routes indicated on the Engineer's drawings are provisional and the final routes shall be confirmed with the Engineer on site before cables are installed.

11.4 Measurement and Payment

- Prices for cable trench excavations and the laying of cables shall be determined in accordance with Clause 3 of Standard Specification E231.
- Prices for the installation of cables in the ground shall include for cable marking tape.
- Prices for the installation of cables on cable ladder / tray shall include for fixing clamps or cable ties.
- Prices for the termination of cables shall include for all material required for the termination.
- Cable lengths given in the Bill of Quantities are provisional and subject to re-measurement on site. Unit prices shall allow for wastage, as only the nett length will be measured for payment purposes.

11.5 CABLE SUPPORTS

Cable supports (ladder / tray) shall be provided in accordance with Standard Specification E220 and the cable routes and supports layout drawings.
Pricing shall include for the supply and installation of all materials and accessories to provide the complete support installation.

12. LOW VOLTAGE DISTRIBUTION BOARDS

12.1 General

Low voltage (LV) distribution boards shall be installed in the location shown on the drawings in the Pumpstation and in the Guard house.

The LV distribution board in the pumpstation is part of the free-standing LV motor control centre (MCC) which shall be provided inside the pump station to serve as both an MCC and the main LV distribution board for the pump station and although it is described in item 9 above it must also complies with this section.

12.2 Equipment

All DBs shall be manufactured from 2mm 3CR12 steel and powder coated to National colour standard SANS 1091:2004, equipped with doors and shall be watertight with a rating of IP65.
'Normal' sections shall be Electric orange
'Standby' sections shall be Signal red

All LV switchgear and control gear shall be suitable for the system fault level indicated on the drawings.

The busbars shall be positioned in such a way to allow for easy extension to the sides by adding additional panels, and to allow for cable entry from the bottom. Their spacing shall be such that the cables can be connected to them in a neat and safe configuration. The busbars shall be rated for the full load capacity of the main switch and shall be capable of withstanding the fault level as indicated on the drawings for 3 seconds.

The ammeters shall be of the maximum demand indicating type.

It shall be possible to lock any motor feeder MCCB in the open position.

The motor feeder circuit breakers shall be of the 'slow curve' type for motor applications with ratings as specified on the drawings.

Surge arrestors shall be complete with failure indication facility. These units shall be installed on all phases plus neutral and shall be as accessible as circuit breakers. Surge arrestors shall be solidly earthed by means of 16 mm² insulated earth wire.

Detachable gland plates suitable for receiving the cable shall be provided at the bottom side of Distribution board with glands.

12.3 Type tests:

The Contractor shall obtain the Engineer's approval of type test reports for MCCBs and other components used in all distribution boards before commencement of supply.

12.4 Drawings:

The Contractor shall supply all materials and components to provide complete DBs. The Contractor shall submit the detailed drawings along with component details/makes etc. for necessary approval.

12.5 Inspection;

All tests and inspection shall be made at the place of manufacturer. The manufacturer shall provide reasonable testing and inspection facilities and co-operation without any charge to satisfy him that the material is being supplied is in accordance with this specification. The proto of distribution boards shall be inspected by employer or his representative for approval before commencement of supply.

12.6 Installation

Wall mounted distribution boards shall be mounted with the top of the board not higher than 2100 from finished floor level and with the bottom of the board not lower than 900 from finished floor level.

All boards shall be positioned at a distance no less than the depth of the board from any opening or doorway

All wall mounted distribution boards shall be mounted on P1000 unistrut against the walls.

All cable entries into distribution boards shall be from the bottom.

13. EARTHING AND LIGHTNING PROTECTION

13.1. General

The earthing system which shall be provided at the Pumpstation shall comprise the following:

- An earth electrode and associated main earth bar.
- Earthing conductors
- Earth continuity conductors
- Bonding

13.2. Earth Electrode and Main Earth Bar

At the pumpstation a foundation earth electrode and its associated main earth bar shall be provided in accordance with Standard Specification E216 as qualified in this Project Specification.

The earth electrode shall be a foundation earth comprising copper earth conductor and earth rods buried under the perimeter concrete foundation of the pump station as shown on the earthing layout Drawing No. WF1.715-2-06-006.

A 95 mm² bare copper conductor shall be installed as one continuous length with the two ends of the loop brought to the main earth bar.

The indicated number of 16 mm diameter 2 m long "Copperweld" earthing rods shall be driven vertically into the ground through the blinding layer at the bottom of the foundation trenches, in the positions indicated on the earthing layout drawing. Once all the rods have been fully driven, the copper conductor shall be exothermically welded to the exposed head of each rod.

The tails of the copper conductor shall be run in PVC conduit between the point where the conductor tails rise from the foundation and the main earth bar. The conduit shall be built into the building structure.

At each corner of the building near the "Copperweld" rod, a 2 m long bare copper conductor tail shall be exothermically welded to the foundation earth conductor. The free end of each tail shall be run to a position at the outer edge of the concrete skirt around the building and arranged for easy retrieval. These positions shall be clearly marked on the record drawings.

At the indicated main earthing bar position, a tinned copper bar, as per the illustration on Drawing No. WF1.715-2-06-006, shall be installed horizontally against the cable trench wall. The copper bar shall be mounted on moulded epoxy insulators to space the bar 30 mm from the wall. Each insulator shall be provided with two, moulded-in 12 mm brass studs. The stud at the base of each insulator shall be screwed into an internally threaded wall anchor (at least 50 mm long) and the copper bar shall be secured to the remaining stud on each insulator with a brass nut, brass washer and cadmium plated spring washer. The copper bar shall be provided with at least fourteen 13 mm diameter holes at 35 mm centres. The two outer holes shall be employed for mounting the bar whilst the remaining holes shall each be fitted with 12 mm diameter bolts, nuts, washers and spring washers.

The two ends of the foundation earth conductor shall be fitted with lugs and bolted to the tinned earthing bar as indicated on the earthing layout, Drawing No. WF1.715-2-06-006.

All earthing conductors shall be continuous lengths without joints between terminations. Any damage to earthing conductors shall be reported in writing to the Engineer and, subject to his approval, shall be repaired by means of exothermic welding. Once the earth electrode has been installed, its resistance shall be measured and the results shall be submitted in a report to the Engineer. The Engineer will instruct the Contractor if further electrode enhancement is required.

13.3. Earthing Conductors

Earthing conductors shall be installed from the main earth bar to equipment earth bars / terminals in accordance with the illustration of the main earth bar arrangement on Drawing No. WF1.715-2-06-006.

Earthing conductors shall be PVC-insulated copper conductors or bare copper earth conductor as indicated and sized in accordance with the earthing diagram, Drawing No. WF1.715-2-06-006.

13.4. Earth Continuity Conductors

Earth continuity conductors shall be installed with all LV power cables in accordance with Standard Specifications E216 and as shown on the single line diagrams.

13.5. Bonding

All accessible extraneous part of electrical equipment / electrically-driven equipment shall be bonded in accordance with SANS 10142-1. The roof of the pump station and its steel support trusses shall be bonded to the steel support columns, and the columns shall be bonded to the foundation earth electrode all around the perimeter of the building.

14. INTERIOR AND EXTERIOR LIGHTING

14.1 General

The lighting installation in the pumpstation's pump hall shall be a watertight industrial type surface mounted installation. All fittings and appliances shall be surface mounted, and fed with cables installed as follows:
All cabling for the lighting installation shall be installed in galvanised conduits, fixed to the surface of structures, complete with suitable bushes on the ends.
All cables exposed by the removal of the protective sheath, which connect into light fittings, plugs, switches etc shall be strictly in accordance with the SANS 10142 colour coding:

- All neutral cables shall be black. Where blue cables have been supplied, these shall be covered by a black shrink wrap sheath, etc.
- All live cables shall be red.
- All earth cables shall either have a green and yellow sleeve, or the sleeve shall be stripped off to leave bare copper.

Except for the control room and ablution block, the lighting installation in the rest of the pumpstation shall be an industrial type surface mounted installation. All light switches shall be installed in surface mounted extension boxes. The control room and ablution block installations will be recessed in the walls, with flush wall switches built into conduit boxes.

Aviation Warning Beacons lights shall be mounted on top of the new water tower as shown on the drawings.

All lamps and control gear shall be rated for the supply voltage of 230 V as specified.

14.2 Equipment

The lighting installation shall be as indicated on the drawings. Fittings offered by the Contractor shall be as indicated on the drawings or approved equivalent.

Light fittings shall be supplied and installed complete with lamps, electronic control gear, diffusers, mounting facilities, etc., as applicable. All fittings shall be new and unused and shall be delivered to site as packed by the supplier. Fixing of luminaires shall not compromise the protection rating of the luminaire. All bulkhead fittings shall be provided complete with special mounting brackets.

14.3 Installation

All light fittings in the pump station shall be connected to a dedicated Pratley type junction box. Disconnection of a light fitting shall not affect the operation of other light fittings on the same circuit. The cable between the junction boxes shall be heat resistant silicon insulated cabtyre.

The permanent luminaires intended for installation shall not be used for temporary lighting during construction. The Taking-Over Certificate for the installation will not be issued unless all light fittings and lamps are in working order.

The operating circuits of discharge type fittings shall be provided with suitable power factor compensation, ensuring a power factor better than 0.9.

The installation shall be reticulated along the cable ladders in positions indicated on the drawings.

The Contractor shall ensure that the integrity of the luminaires, switches and draw boxes shall remain as required (IPX6 etc.) at all times. All bulkhead type fittings shall be equipped with special mounting brackets.
All access holes shall be sealed off with compression glands and other suitable covers to ensure a weather proof installation, as required.

All lighting switches in the watertight industrial installation area shall be weather proof, IPX6 rated, ultra violet (U.V.) protected, non-corrosive types mounted on the surface, suitable for 16 Amp 230 Volt 50 Hz and shall be rotary-cam operated.

14.4 Measurement and Payment

- Prices for the supply of light fittings shall be complete with lamps
- Prices for the supply of class1 division1 light fittings shall be complete with appropriate compression gland.

15. POWER OUTLETS

15.1 General

The small power installation in the pump station's pump area shall be a watertight industrial surface mounted installation. All fittings and appliances shall be surface mounted. All cabling for power outlet installation shall be installed on galvanised cable ladders, or in galvanised conduits, fixed on the surface of structures, complete with brass bushes on the ends.
All power outlets shall be installed in surface mounted extension boxes.

15.2 Equipment

The small power installation shall be as indicated on the drawings. Appliances offered by the Contractor shall be as indicated on the drawings or approved equivalent.
In the watertight industrial installation:

- The Contractor shall allow for Industrial type weather proof 3 Pin switched socket outlets, as shown on the drawings. The switched socket outlets shall be non-corrosive, IPX6, rated at 15 Amp 230 Volt 50 Hz, shall have rotary-cam operated switching mechanism and shall be installed on the surface. The switched socket outlet shall be complete with male plug. The configuration shall be the same as the normal 3 pin domestic plugs used South Africa and the unit shall accommodate the watertight as well as the normal sockets.
- The Contractor shall allow for Industrial type weather proof 3 phase 32 Amp 400 Volt 50. Hz, 4 – pole, 5-pin switched socket outlets, rated IPX6. The switched socket outlet shall be complete with male plug. The circuit wiring shall be as indicated on the single line diagrams.

Samples shall be submitted to the engineer for approval.

15.3 Measurement and Payment

Prices for the supply of industrial 3-pin and 5-pin socket outlets shall be for units complete with male plugs.

16. LOW VOLTAGE MOTORS

Low voltage motors for the mechanical equipment shall form part of the mechanical equipment and shall comply with Standard Specification E241:
LV motors shall be priced as part of the associated mechanical equipment.

17. CONNECTIONS TO MECHANICAL EQUIPMENT

Where the single-line diagrams indicate a local disconnector at the load-end of feeders to mechanical equipment such as a crane and ventilation fans, the feeder cable shall be terminated at a wall-mounted disconnector alongside the

mechanical equipment, and the final connection from the disconnector to the equipment shall be made by the installer of the mechanical equipment.

18. ENGINE DRIVEN ELECTRICITY GENERATING SET

18.1 Technical Standards

The following technical standards shall apply to this scope of work and all work and materials/equipment/services shall comply with every aspect of each of these standards where applicable:

LOCAL AND INTERNATIONAL STANDARDS		
NO	**SPEC NO.**	**TITLE**
	BS EN 55014-1:1997	Electromagnetic compatibility. Requirements for household appliances, electric tools and similar apparatus. Emission. Product family standard
	SANS 10142	The wiring of premises
	SANS 342	Automotive diesel fuel
	SANS 60947	Low-voltage switchgear and control gear
	SANS 60439-1	Low-voltage switchgear and control gear ASSEMBLIES Part 1: Type-tested and partially type-tested ASSEMBLIES
	SANS 60186	Voltage transformers
	SANS 60044-1	Instrument Transformers Part 1 : Current transformers
	SANS 10292	Earthing of low-voltage (LV) distribution systems
	SANS 156	Moulded-case breakers
	SANS 1574	Electric cables - Flexible cords and flexible cables
	SANS 8528	Reciprocating internal combustion engine driven alternating current generating sets: Parts 1-7, 9,10,12
	SANS 1632	Batteries
	SANS 1652	Battery chargers - Industrial type
	SANS 60529	Degrees of protection provided by enclosures (IP Code)
	SANS 1091	National colour standard

18.2 Referenced Documentation

Should any ambiguity arise between drawings and specification, tenderers are obliged to bring such ambiguities to the attention of the Engineer.

18.3 General

This specification specifies the standby power requirements for the pump station.
The standby power system comprises a stationary diesel alternator set to provide standby power for the purpose of running:

- 2 x 132 kW electric motor driven pump sets – Method of starting: VFD Starter
- 6 kW Lighting and General load.

Should the ratings of LV motors differ from the Engineer's estimates (on which the size of the diesel alternator set is based), then the diesel alternator set shall be sized to suit the actual motor ratings.

No redundancy is required on the standby supply and hence a single diesel alternator set shall be provided.

The standby power generator shall be located inside a containerized sound attenuated canopy adjacent to the pump station buildings. The exact position to be determined on site and to be agreed with the Engineer.

Site conditions:

Ambient temperature: 0-50^{0}C. Relative humidity: 95% non-condensive

Altitude: 1753 m above sea level

Environment: Regular

18.4 Scope of Work

This section defines the equipment, work and material forming part of the standby power generating plant.

The standby power supply shall consist of a diesel engine driven LV alternating current generating, sound attenuated canopy set as well as all the necessary control and power systems and fuel storage.

For the detail specification of the diesel alternator set refers to the returnable schedules. Tenderers shall provide all the information requested in Volume 1 Section T2.2 Schedule E Part 5. Failure to do so may render a tender invalid. All tenderers shall state in writing in their tenders that they comply with every aspect of the specification except for the non-compliances which they should list. Failure to do so may render the tender invalid. The onus rests on the Tenderer to submit a request for clarification if uncertainty regarding the scope or specification exists.

18.5 Included in the scope of supply

Contractors are to note that any omission from the scope as defined below shall not relieve them from the legal obligation to provide a fully functional system, complete in all respects, ready to operate and with the standard guarantees and warranties as contractually agreed in order to fulfill the requirements of this specification as well as good engineering practice and workmanship. The responsibility lies with the contractor to allow for all work, equipment and materials in order to comply and to clarify any uncertainties with the Engineer in writing.

This specification calls for the supply, manufacturing, testing, delivery, installation and commissioning of the following as set out in Volume 1 Section T2.2 Schedule E Part 5.

A1 Diesel engine complete with all systems, accessories, protection, metering, monitoring, control, labeling etc. as described in detail under Item 2.

A2 Alternator complete with all systems, accessories, protection, metering, monitoring, control, labeling etc. as specified under Item 3.

A3 Mechanical structure and canopy complete including base frame, coupling, vibration dampening, sound attenuation, etc. as specified under Item 4

A4 Fuel system complete including day tank, fuel supply lines, top-up supply line with pump and connector, valves, filters, protection, metering, monitoring, control, labeling, accessories, etc. as specified under Item 5

A5 Exhaust system complete including, pipes/ducting, silencer, expansion bellows, lagging, accessories, metering, monitoring, control, labeling etc. as specified under Item 6.

A6 Switchgear and electrical complete with all systems, accessories, protection, metering, monitoring, control, labeling etc. as under Item 7.

A7 Control complete with all systems, accessories, protection, metering, monitoring, control, labeling etc. as specified under Item 8.

A8 Batteries and battery charger complete with all systems, accessories, protection, metering, monitoring, control, labeling etc. as specified under Item 9.

A9 Earthing system including cables, pre-drilled tinned copper earth bar, earth bar mountings, accessories, labeling etc. as specified under Item 10.

A10 Terminals, wiring and cabling as specified under Item 11 which includes all low voltage power and control cables from the field to the diesel alternator's control panel/s.

A11 Corrosion protection as specified under Item 12.

A13 Spares and special tools as specified under Item 14.

A14 All type tests certificates, factory acceptance tests, cold and hot commissioning, operational tests, site test, etc. as specified under Item 15.

A15 All marking, labeling and documentation etc. as specified under Item 16.

A16 All setting up and adjustment of protection, control and operational parameters including software programming of equipment. Protection and other relevant settings shall be in conjunction with the Protection Specialist appointed for the main distribution network.

A17 All relevant signals for monitoring and control required by the plant main process control system shall be commissioned right through from the field equipment to the plant process control system.

A18 All relevant signals for control and interlocking required by the main electrical distribution protection scheme shall be commissioned right through from the field equipment to the relevant switchgear panel terminals.

18.6 Excluded from the scope of supply

The following items shall be excluded from the scope of supply of this part of the contract and are included elsewhere:

B1 Any civil works including buildings, foundations, plinths, structures, concrete trenches, earthworks, etc. The contractor shall provide all the necessary drawings and information to enable the civil contractor to provide for all the civil and building related requirements of the emergency power supply system.

B2 All external network cabling/fibre from the communications network interface of the standby generator control system to the main plant control system. The interface shall be the cable/fibre connection point on the communications card inside the diesel alternator PLC or control panel.

B3 Grading of the network protection settings.

B4 Developing and coding of any plant control and SCADA software. The software interface shall be the communications network protocol which will be developed in conjunction with the plant control specialist.

B7 Any control and protection equipment required for the standby alternator LV circuit breaker on the pump station Main LV and generator control panel. Any programming or setting of any equipment on the pump station Main LV and generator control panel will be performed by the plant protection specialist and support shall be provided to him by the contractor's specialist/s.

B8 Lightning protection system for diesel alternator plant shall be excluded from the scope of supply.

18.7 Equipment

A. Diesel Engine/Alternator Set

The standby generator will only be required during mains power failure conditions. The Contractor shall perform all the necessary calculations/modeling in order to size the generator set for the application. The onus rest on the Contractor to ensure that the standby generator unit selected shall be adequate to ensure that it would be able to start the individual motor loads as specified. Should the unit chosen by the Contractor fail in any aspect it shall be replaced by an adequate unit at the Contractor's own cost. A single generator set shall be offered, as multiple sets operating in parallel will not be considered.

The standby generator set shall be provided with dummy loads and with the associated control gear. The dummy loads must switch in automatically when the generator is tested in the test mode, or either run in the automatic mode when the load on the generator is less than 35% of the standby generator set's rated capacity. The dummy load must not be less than 35% of the engine total output power.

The proposed size of the alternator specified in the detail data schedules is indicative only of the order of magnitude of the unit expected. The Contractor shall under no circumstances be relieved from his responsibility to provide an adequately sized unit due to this specification.

Regarding the alternator protection, the Contractor shall specify in detail all the components required for the complete installation even if they are not included in the scope of supply. This information shall be made available to the designers/manufacturers of the pump station Main LV and generator control panel. The Contractor shall ensure that proper coordination takes place between the generator supplier and the switchboard manufacturer to ensure that the integrated system will function correctly as specified.

18.8 Mechanical Build

A duplex frame has been specified for the diesel engine/alternator unit. The Contractor shall clearly state with motivation if he wishes to propose a different arrangement. However, the diesel engine/alternator unit shall be mounted in such a way that the complete unit can be lifted by crane. It shall also be possible to lift either the alternator or diesel engine separately for replacement purposes e.g. by loosening a joint/s connecting the two units together. Whatever the mechanical design of the frame and engine/alternator coupling, it shall be aimed at minimizing the risk of misalignment between the engine and alternator without requiring extremely sophisticated alignment equipment

All components of the diesel engine/alternator set system shall be mounted on the base frame except for the day fuel tank. The connections to this system shall be designed in such a way that they can easily be disconnected without risk of damage when the complete diesel engine/alternator unit or the individual diesel engine or alternator units need to be removed.

Vibration dampening mountings shall be adequate to comply with the maximum allowed vibration levels specified in the applicable standards.

Sound attenuation of the engine/alternator unit shall comply with the levels specified in Volume 1 Section T2.2 Schedule E Part 5 item 6.1d Maximum outlet noise level. The maximum sound levels specified under this section shall apply anywhere directly outside the generator room. This implies that all components included in the scope of the diesel/alternator supplier shall comply with this requirement. This shall include for any material required for soundproofing of the generator room walls, floor and roof.

18.9 Fuel System

The day tank shall be part of the base frame. The size of the tank as specified in the schedules is the preferred size pending any legal restrictions in volume of flammable substances allowed. Tenderers shall provide a general layout drawing of the tank installation, routing of fuel lines, breather pipe and refueling line. Any building work or concrete foundation work shall be excluded from the scope.

The material for fuel tanks has been specified as hot dipped galvanised mild steel. The tanks shall be provided with a protective inner lining as specified. Tenderers shall tender according to the specification but may offer alternatives separately priced.

18.10 Exhaust system

Tenderers are to include for any ducting required to ensure adequate cooling of the engine. Where ducting is required this shall be indicated on the general layout drawing provided by tenderers.

18.11 Control System

This section relates to signals and SCADA requirements with respect to control, monitoring, alarm and trip annunciation. All signals from the standby power plant shall be provided to the communications network. Where a proprietary protocol is provided other than the plant standard protocol selected, a suitable, field tested interface shall be provided for conversion of the protocol.

The interface between the plant control system and the diesel alternator system shall be the diesel alternator set control panel terminal strip, where signals for external control purposes shall be provided in the format dictated by the control systems interface (to be provided after order placement). All external hardware and software shall be excluded from the scope of supply. However, the tenderer shall allow for specialist resource to develop the system in conjunction with the main distribution network specialist and the main plant control system specialist

18.12 Interlocking Requirements with Distribution Network

The diesel alternator control and protection system shall make available all the signals and parameters to be measured as specified in this document and in Volume 1 Section T2.2 Schedule E Part 5. The Contractor shall ensure that all the necessary interface equipment shall be provided for this purpose, and the individual components shall be specified to fulfill the requirements of the external control and protection systems. The type, rating and number of contacts required will be specified at a later stage after the main plant protection and control systems interfaces have been specified. All metering, monitoring and alarm input signals shall be provided via the plant communications network interface; however some signals may have to be duplicated in hardwired format where applicable. The same applies to control output signals.

All potential-free auxiliary contacts required for remote tripping/interlocking/indication of the Alternator 400 V circuit breaker inside the pump station Main LV and generator control panel shall be provided. Potential-free auxiliary contacts required for any other remote hardwired tripping, alarm or indication purposes shall be specified and provided. The number of contacts shall be finalized during detail design.

Auto transfer upon mains restoration will be controlled by the pump station PLC which will be provided and programmed under the control and instrumentation portion of the contract.

18.13 Proposed Regular Testing of Emergency Supply

Regular testing of the emergency supply as prescribed by the manufacturer will be performed at rated load by using the essential equipment as main load. The test sequencing and control shall be provided for in the main plant control system and falls outside the scope of this section. Each tenderer shall specify both the no-load and full-load recommended testing intervals and duration for the diesel alternator set.

18.14 Logistic Support

In terms of logistic support the Tenderer shall provide typical lead times for replacement of the complete unit or alternator or engine or other components; typical lead times to repair the engine, alternator and other components, as well as lead times for spare parts for the engine, alternator and other components. The Tenderer shall indicate for what period of time spare parts will be available for the engine, alternator and other components. The Tenderer shall indicate which repairs can be performed on site and which will require repair at the supplier's workshops; and also provide lead times for collection and delivery of the engine, alternator and other components. The Tenderer shall indicate what the guarantees and warranties are on all repairs. The Tenderer shall indicate what the lead time is for technical support on any aspect of the system, and shall also indicate the availability of qualified personnel to assist with problems either remotely or physically on site.

18.15 Manufacture and Installation

Detail layout and general arrangement drawings shall be provided by the Contractor prior to commencement of manufacture of any component and within one month after contract award. All special civil requirements for installation purposes shall be specified in the tender.

No equipment shall be shipped prior to final factory acceptance testing and issue of factory test certificates. As witnessing of these tests by the client's quality control representative/s is compulsory, the contractor shall only commence with shipping after obtaining the proper signed off acceptance certificate. The contractor shall provide a documented quality control trail throughout the manufacturing process all the way through installation, commissioning and operational testing.

Cold commissioning shall be performed prior to energizing of any part mechanically or electrically. Upon completion of hot commissioning, a commissioning test report shall be provided together with a complete set of marked-up as built drawings and documentation.

18.16 Payment and Measurement

Due to the packaged nature of this part of the plant the Contractor shall provide for all materials, components, parts, labour, etc. to completely fulfill the requirements of this specification, the applicable standards and the data schedules. Allowance shall be made for specialist labour to fully integrate the plant into the system. The Tenderer is reminded of the remoteness of the installation site, in order to properly cost for site establishment.

PARTICULAR SPECIFICATION

PLGA **TELEMETRY**

1. Enclosures - Power coated Cabinet (e.g. P 204 for inside or P 101 to P 104 for outside)
   a.Outstation
   b.Termination Box With Voltage (LED) indication
   c.Battery Box.
   d.Field Junction Box (Level instrumentation)
   e.Earth from RTU Box
2. SSE Outstation ribbon type , standard (SSE RTU-12 – CPU Module 14 Way), I/O Modules , galvanic isolators , LPU's , ¼ Wave LPU, Internal wiring , Wiring to J/Box , Installation and commissioning
3. MDS Data Radio SD4 SS; MDS Data Radio SD4 ES
4. PSU – SSE 230Volt 7 amp (including load shedding unit)
5. 12 -24 Converter 5 A
6. SSE Tag Reader access control and Programming
7. Load shed 24V
8. Battery 12 V – 18AHr; 48AHr and 100AHr SLA type
9. Galvanized Pipe 50mm x 2mm x 6m (For antenna)
10. Omni directional antenna (if possible) with LM 400 Coax cable plus earthing (Type of antenna will depend on the site installation)
11. All Analog except battery voltage must be galvanic isolated at the RTU side and must have lightning protection at the instrument side if outside the building
    a.All pump stations must have the following Analog (Minimum requirement)
        i.Battery Voltage
        ii.Suction Pressure (Type = 4-20mA With Display see attached specs)
        iii.Delivery Pressure (Type = 4-20mA With Display see attached specs)
        iv.Inflow / Outflow (If required from metering department) * optional requirement
        v.Motor Amps (If required Electrical Department)* optional requirement
        vi.Ultrasonic level transducer (Type= Pulsar) and Submersible level transducer (ITS) if there is a tower / reservoir
        vii.All flow meters instantaneous flow and accumulated flow and forward and reverse flow
        viii.20 % spare Analog and termination capacity
12. On the incomer a power meter must be installed (Make Schneider PM5310) with a modem and a 24 month data contract that will connect (via GPRS) to the existing database Schneider software (Energy on Line – EON)
13. All digitals except door switches, must have lightning at the signal side if outside the building
    a. All available signals from VSD
    b. All pump stations must have the following Digitals (Minimum requirement) or list of available signals from VSD:
        i.Main Door Alarm
        ii.Telemetry Door Alarm
        iii.Mains Fail
        iv.Pump Run
        v.Pump Auto
        vi.Pump trip
        vii.Pump Phase Fail
        viii.Pump set Out of service
        ix.Pump Interlocks
        x.Reservoir Bypass
        xi.Tower Bypass
        xii.Station Phase Fail
        xiii.Bearing Temperatures Warnings (motor and pump DE and NDE)
        xiv.Vibration Warnings (motor and pump DE and NDE)
        xv.Motor winding temperatures warnings
        xvi.Flood Alarm

xvii.Flow Counters * optional requirement
xviii.Passive Infra Red Detector
xix.Sump Overflow Alarm (If existing)* optional requirement
xx.Reservoir Overflow (conductivity Probe)
xxi.Hi Level / hi-hi Alarm (Level probes) * optional requirement
xxii.Generator Signals (If existing) * optional requirement
xxiii.20 % spare Digital and termination capacity

14. All available generator signals to interface via MODBUS to the telemetry system
15. All instrumentation cable must be 12 Core multi strain 0.5 mm oval screened with extra neutral wire.
16. Trenching
    a. All trenches must be at least 400mm deep, with a minimum of 50mm sleeve (not more than 3 cables per sleeve) .
    b. Instrumentation cable and power higher than 24 V not allowed in the same sleeve.
    c. At least one draw wire per sleeve
    d. Every 20m there must be a cable inspection box
    e. Only soft sand on cable, no rocks in trenches
    f. Cable indicators on cable and above ground
17. Lugs / Ferrules on all cables and all cables must be clearly marked as per drawing
18. All conduit must be at least 20mm galvanized
19. Telemetry Hut (where applicable)
    a.DB Board with earth leakage, isolators for the Telemetry, Lights, plugs
    b. 15 Amp plug socket to accommodate drill machines, laptops etc.
    c.Work surface / table top
    d.Brick Building
    e.Concrete Roof
    f.Heavy duty steel door compatible with JHB Water high security lock with security gate
    g.Fluorescent light
    h.Sleeve openings for power cable, signal cables, earthing, and metering cables
20. Block Diagram, line diagram and I/O list and a site diagram with cable routes
21. SCADA /OPC
    a. Define Tags (I/O)
    b. Create I/O in OPC and SCADA
    c. Create Programs in OPC
    d. Logging
    e.Trending
    f. Alarming
    g. OPUS- reports
    h. Data Warehousing\
    i. ASI – Reporting
    j. Detail Mimics
    k. Region Mimic
    l. Update Script programs
    m. Detail Maps
    n. Overview Mimics

PARTICULAR SPECIFICATION

PLGB PUMPS

PLGB 1 TESTING AND COMMISSIONING
PLGB 2 DRY WELL PUMPING
PLGB 3 ELECTRIC MOTORS

PLGB 1 TESTING AND COMMISSIONING

SCOPE

This section covers the factory and on site testing and commissioning requirements for all equipment supplied and installed under this contract. The procedures described are the minimum required and additional tests/requirements are specified in the relevant standard and detail specifications.

Testing Sequence

The testing to be performed includes:

a) Factory acceptance testing at the manufacturers premises prior to packaging and transportation.

b) Before official commissioning commences the Contractor shall test his equipment as described below to ensure that the plant has been installed correctly.

c) After the Contractor has been satisfied that his equipment is in running order, the commissioning of the plant will commence as described below.

Factory Testing

a) The Engineer reserves the right to visit and enter the manufacturer's works during the design and manufacturing stages for the purposes of interim and final inspections and for progress information acquisition. Where the Contractor makes use of third parties for the manufacturing and/or procurement of equipment, the Contractor shall ensure that this requirement is agreed with the third party.

b) The Engineer reserves the right to be present at all or any tests (or, at the Engineer's discretion repeats of such tests) conducted on the equipment.

c) One calendar week's notice of pending tests shall be given to the Engineer in writing.

d) Three copies of all test records are to be submitted to the Engineer for approval.

Inspections

a) The Engineer will require seven (7) days notification to avail himself for any tests or inspection. The Contractor shall arrange for the maximum number of tests and inspections to be done on the same day.

b) In the event of the Contractor requesting the Engineer to inspect, measure, test or commission any sections of the works where the Contractor has not completed such sections of the works and is not ready for the Engineer to inspect, measure, test or commission the sections of the works or where the testing of the works fails due to the neglect of the Contractor to test such sections of the works prior to notifying the Engineer to witness the tests, the Contractor shall pay the Engineer per hour for his travelling time and time spent on site or in the factory re-imburse the Engineer for all other costs incurred in travelling to and from site in accordance with the Association of Consulting Engineer's recommended time and cost tariffs.

c) The Contractor shall furthermore be liable for the Engineer's costs as specified above for all inspections, measurements, tests and commissioning that the Engineer has to undertake after the expiry of the completion period allowed for in this contract and where no extension of time has been granted.

SITE TESTING OF EQUIPMENT PRIOR TO COMMISSIONING

a) The Contractor shall timeously inform the Engineer when he intends to perform his first tests and start-up of equipment in order to allow a representative of the Engineer to witness the tests.

b) Before starting up any section of the mechanical plant or filling tanks and sumps with liquid, the Contractor shall clean out the tanks, pipes, fittings, equipment or structures, and, if necessary, make arrangements with other Contractors to remove their building rubble from the structures, check that all safety devices and alarms have been set and activated, all nuts have been tightened correctly, that all the equipment is complete and ready for start-up, that the plant has been installed correctly, and that three copies of the operating manuals have been handed over to the Engineer.

c) Each section of the equipment shall be started up by the Contractor, who shall ensure that all oil fillings, lubrication, vibration monitoring, etc, have been correctly completed. In addition, he shall be responsible for the first re-filling of all the lubricating oils as well as for adjusting the plant to operate according to specification. Before any equipment is started or energised, the Contractor shall ensure that it is safe for personnel and equipment on site to do so. Allowance for these costs shall be made in his tendered rates and sums.

d) The Contractor shall conduct his own tests on the equipment and, only when he is satisfied that these tests meet the requirements of the specifications, shall he notify the Engineer that he is ready to conduct the official tests on completion. The Contractor shall not conduct an official test without the Engineer being present or his approval to do so. All equipment tested shall conform to the requirements specified.

COMMISSIONING

a) The Contractor shall be responsible for commissioning all sections of the works and shall perform all of the tasks set out below and as detailed in the relevant standard and detail specifications:

i) Prior notice of and proper arrangements for the commissioning shall be made with the Employer, Engineer, supply authority, and all electrical Contractors and suppliers of equipment, which will be affected by the commissioning operation.

ii) If plant and equipment, which has been supplied by others has to be commissioned, the supplier's specific permission thereto, together with any specific requirements relating to commissioning shall be obtained prior to commissioning.

iii) All sections of the works shall be carefully inspected by a responsible representative of the Contractor to ensure that all construction and installation work has been properly completed.

b) Commissioning and testing on site shall be carried out by experienced personnel under the Contractor's supervision.

c) All equipment necessary for the purpose of the tests shall be provided by the Contractor and remains the property of the Contractor.

d) All pre-commissioning tests and checks shall be agreed with the Engineer prior to the commencement therewith.

e) When all the tests required before commissioning, or tests before tests on completion, have been completed and accepted by the Engineer, the commissioning may proceed. The commissioning period shall be undertaken over a trouble-free period of at least thirty consecutive calendar days. During this period the Contractor shall instruct the operating staff in the correct procedures of operating the plant under all circumstances of operation, including emergency conditions, the correct servicing of every part, the type of oil or grease to be used, and similar instructions. This shall be done by demonstration and confirmation, in writing, and operating manuals shall be referred to for this purpose.

f) At least four weeks before commissioning commences the Engineer will be requested to provide the Contractor with commissioning sheets for all the equipment installed by the Contractor. These forms shall be completed by the Contractor during the commissioning period and all items listed shall be entered. Final hand-over certificates will not be issued for equipment with incomplete commissioning reports. Information that is not available or applicable, or reasons for not performing certain tests shall be agreed with the Engineer.

g) The thirty day commissioning period will commence with a day-one test and terminate with a day-thirty test in compliance with the commissioning report. Commissioning of the plant (which includes the thirty

days between the day-one and day-thirty tests) shall include operating under conditions which shall adequately prove that all the specifications are met. All safety devices, stand-by plant, automatic controls and protection devices shall be adequately tested for reliability and correct functioning. The Contractor may be called upon to repeat testing during the maintenance period if the performance of any equipment supplied under this contract is suspected to be substandard by the Engineer. Such tests shall be for the Contractor's account and shall comply with the requirements specified. Copies of updated commissioning reports shall be provided to the Engineer within two days after a test has been performed.

h) After the Contractor has provided training to the Employer and provided all other contractual requirements have been met, the latter will sign the commissioning report.

i) Once a commissioning report is complete, the Engineer and the Contractor will sign and date the report, whereupon the Engineer will notify the Employer that maintenance for that particular piece of equipment from then on is the Employers responsibility in compliance with the general conditions of contract.

j) Programs for the day-one tests, day-thirty tests and instruction/training sessions with the client shall be prepared by the Contractor and provided to the Engineer no less than two weeks before the commissioning period commences. Weekly updates to these schedules shall be provided by the Contractor for the duration of the commissioning period.

k) Note that if any equipment should fail during the 30 day commissioning period, the equipment shall be repaired or replaced by the Contractor, and testing and commissioning will commence from scratch.

l) During the thirty-day commissioning period, the Contractor shall be responsible for providing all labour and materials (including testing equipment) and shall carry out all the servicing and any adjustment of the plant required for ensuring that it operates as specified.

m) Valid calibration certificates shall be available for all testing equipment on site during the commissioning period.

n) The Contractor shall conduct all the tests required to satisfy the Engineer that the plant is capable of performing in accordance with the specification, and shall make allowance therefor in his tendered rates and prices. Any defects detected during the commissioning period shall be made good by and at the expense of the Contractor, including all additional costs incurred by the Employer and his representatives and the Engineer. These tests shall be conducted to certify that the plant, as installed, is operating in accordance with the specified requirements. Note that all equipment will be tested as part of a system, where appropriate, and will not be passed if all protection devices, interlocking with other equipment, etc, is not fully functional.

MEASUREMENT AND PAYMENT

All costs for equipment, labour and other expenses for the on-site testing and commissioning of equipment shall be included in the tendered rates for testing and commissioning as set out in the measurement and payment clauses of each piece of equipment and in the schedule of quantities. Any additional tests specified in the standard and detail specifications shall also be included in the tendered rates.

PLGB 2 DRY WELL PUMPING

SCOPE

This specification covers the supply, delivery, installation, testing, commissioning and payment item descriptions for dry-well pumping equipment. Dry-well pumping equipment shall mean pumping equipment of which the motors may or may not be submersible, but which operate in a non-submersible mode.

STANDARDS

1.1.1 **National and international standards**

The latest edition, including all amendments up to date of tender of the following particular national and international specification, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof:

BS 5316, Part 1	:	Acceptance tests for centrifugal, mixed flow and axial pumps

ISO 281/1 : Rolling bearings – Dynamic load ratings and rating life

1.1.2 **Standard specifications included in this contract document**

The following standard specifications bound in this document shall be read in conjunction with this specification:
STD SPEC :ELECTRIC MOTORS
STD SPEC :POWER TRANSMISSION COUPLINGS
STD SPEC :EQUIPMENT FOR THE MEASUREMENT OF FLUID/FLOW PROPERTIES
STD SPEC :GENERAL CORROSION PROTECTION
STD SPEC :TESTING AND COMMISSIONING

TECHNICAL REQUIREMENTS APPLICABLE TO ALL PUMP TYPES

1.1.3 **Pump layout**

Together with their tenders, tenderers shall provide full details and drawings of the proposed pump layout, including all pipework to facilitate coupling with existing pipes which shall be subject to the approval of the engineer before acceptance of the tender. The design of all pipework, if required by the detail specification, and layout shall be included in the tendered rates. The tenderer shall submit details with regard to the required plinth sizes and civil requirements in order to install the equipment.

1.1.4 **Material**

The contractor shall take cognisance of the operating environment and the properties of the pumped liquid when selecting the materials of manufacture for the pump components. Full specifications in this respect shall accompany the tender and the tenderer's advice will be considered.

1.1.5 **Condition monitoring**

Pumps fitted with motors rated in excess of 110 kW shall be designed to accept transducers for the monitoring of:
-the vibration levels in three mutually perpendicular directions, and
-the lubricant temperature of the bearings.
Adequate access around the bearing housing shall be available for the positioning of transducers.
The system analyser to be used to interface with the transducers will be detailed in the detail specifications and the contractor shall ensure that his fittings on the pumps are compatible with suitable transducers. Accelerometer type transducers are preferred for vibration monitoring.

1.1.6 **Pump casings**

Pump casings shall be manufactured from high-grade cast steel or grey iron No 30, rigidly secured to a bed plate or base, and shall be finished off smoothly before a high-quality corrosion protection system is applied. The casing shall be selected for a minimum of 1 000 kPa or 1,5 times the actual discharge pressure, whichever is the greater. The removing of parts may in no way interfere with the pipework.

1.1.7 **Pump shaft**

The shaft shall be manufactured of high-tensile steel. Where the shaft passes through stuffing boxes it shall be fitted with renewable sleeves of high-quality, wear-resistant alloy.
The shaft shall be so designed that the running speed is well below the first critical speed, and the complete rotor shall be accurately balanced after assembly.

1.1.8 **Pump impeller**

The impeller shall be bored and keyed. All parts inaccessible to machining shall have a smooth finish. The impeller shall be hydraulically, statically and dynamically balanced.

1.1.9 **Bearings**

Only ball or roller bearings shall be installed and bearings shall have a minimum L_{10h} basic life rating of 25 000 hours at the rated load and speed for the application unless specified to the contrary in the detail specification.

Special bearings shall be provided to absorb any axial thrust that may be caused by the characteristic of the impeller or by the type of coupling selected between the pump and the motor.
Pump shaft bearings shall be carried outside of the main casing and glands on extensions to the main casing.
Bearings shall be positively sealed against water penetration.
Bearing numbers shall be given for all bearings in the pumps to facilitate replacement.

1.1.10 **Wearing rings**

Wearing rings shall be easily replaceable.

1.1.11 **Shaft seals**

a. **Clean-water pumps**

Pumps shall be fitted with stuffing boxes and shall have packings of adequate depths unless otherwise specified in the detail specification. A lantern or water seal shall be housed between the inner and outer packing rings and shall be connected by copper tubing to the discharge volute.
The packing shall be designed to permit high speed rotation without the possibility of seizing and charring the packing material or shaft. An automatic water seal shall be provided to prevent the entry of air into the pump.
Drains from the pump seals shall be provided. These shall discharge visibly into funnel-shaped receivers before discharging to a suitable drainage point. Drainage pipework shall be included in the tendered rates for the pump.

b. **Sewage pumps**

The pumps shall be fitted with stuffing boxes as above but a separate clean water supply shall be provided to the glands. This will either be done by means of pumps supplied by the contractor or as specified in the detail specification.
A mechanical seal arrangement as described below for sludge pumps may also be offered as an alternative to glands.

c. **Sludge pumps**

All pumps utilized for the pumping of biological sludges shall be fitted with double, flushed mechanical seals, which shall be included in the cost of the pumps.
Pump shafts shall be hardened and accurately ground where the seal bears on the shaft.
The mechanical seals shall be supplied by a reputable supplier and shall be of the axial direction, face-type shaft seals. The rotating seal face shall be mounted on a flexible member, the latter also sealing on the shaft.
The flexible member shall be manufactured from rubber, PTFE or equivalent material suitable for the operating environment.

1.1.12 **Coupling between pump and motor**

The pump and motor shall either be separately mounted on a common base frame or the motor shall be flange mounted to the pump. The former method is preferred for centrifugal pumps and the latter for positive displacement pumps.
No V-belt couplings will be accepted, unless required in the detail specifications or approved by the engineer. In this case, the bearings shall be suitable for such operation.
The pumps and motors shall be directly coupled with a suitable type of coupling which will satisfactorily take up minor misalignment or off-setting of the motor and pump shaft.
Refer to the standard specification on power transmission couplings for additional specifications.

1.1.13 **Pump motor**

Unless otherwise specified, each pump shall be supplied complete with an electrical motor which shall comply with the requirements as specified in the standard specification on electric motors.

1.1.14 **Base plate/frame**

The pump and electric motor shall be mounted and levelled on a common base plate of fabricated steel construction or cast iron. Machined facings shall be provided to receive the pump and motor.
The base plate shall be bolted down onto a concrete base. The concrete base will be constructed by others.
Before fabrication is commenced with, detailed drawings of the base including its exact position in the building shall be submitted to the engineer for approval.

The contractor shall supply the required holding down or mounting bolts manufactured from galvanized or plated high tensile steel to be grouted into the plinth pockets by others. The contractor shall be responsible for the grouting of the base plates/frames.
The pump shall be accurately aligned with the motor and at least two dowel pins shall be installed in the base plate.

1.1.15 **Accessories**

The pump shall be fitted with air cocks, drain cocks, lifting eyes if the mass of the pump is more than 25 kg and all guards required in terms of the Occupational Health & Safety Act, (Act 85 of 1993).
All pumps supplied shall be fitted with glycerine filled pressure gauges on the suction and delivery sides. The pressure gauges supplied shall have a face diameter of at least 100 mm. The pressure gauge scale shall be sized such that the normal operating pressure shall be at approximately 60% of full scale, but not higher than 80% of full scale. The gauge shall be protected against the deleterious effects of surge over pressures up to the pressure rating of the pipe system. Chemical seal gauge protectors shall be installed on all gauge installations with the exception of gauge installations for potable water. Each gauge installation shall be fitted with a 3-way gauge cock to isolate the pressure gauge when not required.
The pressure gauge installation shall be such as to minimize vibration on the pressure gauge. Pressure gauges installed on separate pedestals are preferred above gauges installed on the pump or pipework.
The location of the pressure gauge fitting shall be as per BS 5315 and shall also be such that the pressure gauge is easily accessible and can be clearly seen from the emergency stop station for the pump.

1.1.16 **Priming of pumps**

Where the pump is connected to a flooded suction manifold, a master gate valve shall be fitted in the manifold as close as practicable to the water retaining wall as a safety precaution against flooding.
Where the pump is so installed that it is dependent on a foot valve or reflux valve to maintain priming at start-up it shall be provided with additional priming arrangements such as piping and valves not less than 50 mm in diameter supplied from a head tank well above the pump. An electrically operated priming pump or a hand-operated diaphragm pump will also be considered. Where an adequate volume of water is available in the discharge line at a low head, priming may be carried out by means of a bypass around the discharge reflux valve.

1.1.17 **Lubrication details**

The pump housing shall be fitted with a sight glass or a dipstick facility to monitor oil levels where applicable.
Suitable lubrication arrangements such as accessible grease nipples shall be provided.
Full details on lubrication intervals, oil and/or grease specifications and acceptable substitutes shall be specified in the operations and maintenance manuals.

1.1.18 **Pump technical details and installation**

The pump shall be a currently catalogued product. Documentation shall include performance curves or selection tables, indicating flow, head, NPSH required, power absorbed, speed and efficiency for the expected range of operational conditions.
Performance curves and selection tables shall be based on a reproducible and certified test carried out in an approved laboratory. Certified detail selection shown on these performance curves or tables shall be submitted.
The flow rate at break-off point of the curve for the impeller selected shall be at least 1,5 times that of the maximum flow rate specified.
The head at zero delivery of the curve for the impeller selected shall be at least 1,2 times the maximum head in the pump's operational range.
The possible percentage variation of data measured on site by the supplied and/or installed instrumentation when compared with the catalogued performance data must be submitted.
All calculations for static and dynamic heads are to be based on an atmospheric pressure above sea level as specified in the detail specifications.

The engineer or his representative reserves the right to call for -

a. test certificates and reports from the manufacturer's quality control laboratory or an independent test laboratory such as SABS, and/or
b. site inspection, customer reports/references and user's interviews, and/or

c. Full engineering, design and component selection details -
in order to check the correctness of the service life claimed.
The pump shall be installed in accordance with the manufacturer's instructions and shall be maintained in an "as new" condition until taken over by the Employer.
The required unobstructed space left around the installation for maintenance and servicing of the equipment shall be in accordance with the manufacturer's instructions, local authority by-laws and with the Occupational Health & Safety Act, Act 85 of 1993.
Pumps shall be statically, dynamically and hydraulically balanced, at the manufacturer's works, to within the design operating range.
If the contractor is required to be responsible for the pipework by the detail specification, he shall ensure that overhauling and removal of the pumps is possible without extensive dismantling or any cutting of pipework.
A metal lubrication instruction plate shall be attached to the pump where it is clearly visible. The plate shall indicate the recommended lubricant, points of lubrication and the recommended frequency of lubrication.
Detailed pressure drop and net positive suction head calculations for the system shall be included in the operations and maintenance manuals.

CENTRIFUGAL PUMPS

Centrifugal pumps shall comply with relevant and applicable items under the clause on technical requirements regarding all pump types, as well as the following:
Preference will be given to pumps of the self-regulating type and where the power consumption characteristic is such that with an increase in delivery to beyond a certain limit, the power consumption decreases, thereby ensuring that the motor is not overloaded in the event of a large reduction in pumping head.
The casing for centrifugal pumps shall be horizontally or vertically split to allow removal of parts.
The efficiency of the pump shall not be less than 90 % of its maximum efficiency at the selected operating point, where the latter shall not be less than 80 %.

PROGRESSING CAVITY PUMPS

Progressing cavity pumps shall comply with relevant and applicable items under the clause on technical requirements regarding all pump types, as well as the following requirements:
The pump shall be of the progressing cavity type with a stator and a rotor, similar to Mono, Orbit or approved equivalent pumps.
The stators of the pumps shall be manufactured from a suitable wear-resistant rubber and shall be formed by moulded-to-metal construction. The rubber shall be resistant to wear and heat caused by the occasional dry running of the pumps and the maximum permissible time span during which the pumps can run dry without any damage caused to the pumps, shall be indicated in the covering letter at tender stage.
The rotors shall be manufactured from stainless steel 316.
Shaft sealing shall be by packed glands with a flush-fitting lantern ring. The gland surface areas shall be hard chrome plated.
The efficiency of the pumps shall not be less than 75%. The normal operational efficiency of the pumps shall not be less than 3% below the peak efficiency of the pumps.
Each pump shall have a suitably calibrated pressure relief valve fitted in the delivery pipework immediately downstream of the outlet flange. This valve shall be included in the tendered rates.

DIAPHRAGM PUMPS

Diaphragm pumps shall comply with the relevant and applicable items under the clause on technical requirements regarding all pump types, as well as the following:
The contractor shall take special care to ensure that the materials of construction, in particular the diaphragm material, are resistant to the corrosive actions of the liquid being pumped. The relevant liquids are frequently highly corrosive chemicals such as ferric chloride.
The pump mechanism for diaphragm pumps shall incorporate a positive return of the plunger. Pumps with spring-returns on the plungers are not acceptable. The pumps shall be single units and shall be of a modular, standard design.
Flow dampers shall be installed if required to protect the reflux valve seats incorporated in the pump head.
Each pump shall have a suitably calibrated pressure relief valve fitted in the delivery pipework immediately downstream of the outlet flange. This valve shall be included in the tendered rates.

PERISTALTIC PUMPS

Peristaltic pumps shall only be supplied if specified in the detail specification.
The pump shall consist of a pump casing with rotor and pumping tube, the rotor being driven through a gearbox by a flange mounted electric motor. The motor and gearbox shall comply with the standard specification on electric motors and the standards specification on gearboxes.
The pumping tube or hose shall be manufactured from a compliant, tough material resistant to cracking and special care shall be taken to ensure that it is resistant to chemical attack from the pumped liquid. The tenderer shall indicate at tender stage which material he intends to use for the specified application.
The pumping hose shall have an outer diameter to inner diameter ratio of not less than 1,75.
The pumping hose shall be easy to replace and each pump shall be supplied with a spare replacement hose.
The rotor shall have at least two rollers mounted on roller bearings, and the rotor shaft shall also be supported in roller bearings. All bearings shall be permanently sealed.
It shall be possible to rotate the pump in the reverse direction for cleaning/maintenance purposes.

SPECIAL REQUIREMENTS IN RESPECT OF CHEMICAL DOSING PUMPS

The contractor shall refer to the standard specification on chemical dosing plant with regard to special requirements for chemical dosing plant and chemical dosing pumps shall also conform to the following:
-Chemical dosing pumps shall either be progressing cavity, diaphragm or peristaltic type pumps unless otherwise specified in the detail specification.
-The contractor shall select suitable materials of manufacture for all components in order to render the pump resistant to chemical attack from the pumped liquid whilst retaining effective performance from the pump.
-The flow rate of diaphragm pumps shall be variable between certain values given in the detail specifications. A fine-adjustment facility shall be incorporated with positively distinguishable increments as given in the detail specifications. The stroke length shall be manually adjustable and shall be calibrated as a percentage of the full stroke.
-Variable speed drives may be required on all types of pump as specified in the detail specification. The contractor shall ensure that the electric motor has sufficient cooling facilities while the motor runs for extended periods at the minimum speed setting, as prescribed by the contractor. The minimum speed setting shall never be less than 40% of the maximum running speed.
-The contractor shall include in the maintenance manuals of the pump, graphs which show the flow of the liquid chemical (in /h) vs the stroking speed (in strokes per minute) for various stroke lengths, varying from 10% to 100% of the full stroke, in steps of 10% of the full stroke.
-Gearboxes may be fitted to dosing pumps in accordance with the standard specification on gearboxes, and the AGMA service factor, based on installed power, shall not be less than 1,75. Details on the service factor calculations are supplied in the standard specification on gearboxes.

TESTING AND COMMISSIONING

1.1.19 Test to be performed

a. All pumping equipment shall be subject to the commissioning tests as described in the standard specification on testing and commissioning.

b. At least one of each type or size of pump supplied shall be subject to a delivery flow rate test. Flow rate or volumetric flow testing facilities will be supplied by others unless otherwise specified in the detail specification.

c. The operating point of each pump shall be determined.

d. Efficiency tests will only be performed when specified in the detail specification.

e. NPSH tests will only be performed when specified in the detail specification.

1.1.20 Pump operating point

During the day-01 commissioning tests the pump operating point shall be determined by observing the following:
-pump delivery and suction pressures, and
-electric motor power consumption.
If no efficiency tests are required in the detail specification then the motor power consumption shall be calculated from the voltage and current measurements obtained during the commissioning test.
The contractor shall supply the necessary adaptors, fittings and pressure gauges to measure the suction and delivery pressures. If no gauge fittings exist on the suction side, then the suction pressure conditions will be calculated from the system properties.

1.1.21 Flow rate (delivery), efficiency and NPSH tests

a. Testing will be done in accordance with BS EN ISO 9906.

b. Power consumption of electric motors shall be as determined by the three Wattmeter method where efficiency tests are required in the detail specification.

1.1.22 Test conditions

a. All tests will be performed in situ.

b. The pumped medium or liquid specified as the process liquid in the detail specifications shall be utilized during the tests. The contractor shall obtain from the pump manufacturer, the test point for clean water corresponding to the specified duty point for the pumped liquid, in order to relate the measured performance to the pump suppliers' curves which are based on water.

1.1.23 Additional tests

Additional tests may be specified in the detail specification.

CORROSION PROTECTION

All corrosion protection shall be in accordance with the standard specification on corrosion protection.

MEASUREMENT AND PAYMENT

ItemUnit

The payment item shall include all costs related to the full supply chain on the pump incl, but not limited to supply, transport, install, test, and commission the pump.

PLGB 3 ELECTRIC MOTORS

SCOPE

This specification covers all electric motors that may be incorporated in any of the items of equipment to be supplied under the contract.

STANDARDS

1.1.24 **National and International Standards**

The latest edition, including all amendments up to date of tender of the following particular national and international specifications, publications and codes of practice shall be read in conjunction with this specification and shall be deemed to form part thereof :

	SANS 60034		-		Three-Phase Induction Motors (all parts)
	SANS 60529		-		Enclosures for electrical equipment (classified according to the degree of protection that the enclosure provides)
	SANS 60034				Rotating Electrical Machines
1.1.1.	DIN 3404	1.1.2.	-	1.1.3.	Lubricating nipples; button head
	SANS 1701-2-8		-		Rolling bearings Section 8: dynamic load ratings and rating life

1.1.25 **Standard specifications included in this contract document**

The following Standard Specifications bound in this document shall be read in conjunction with this specification:

Standard Specification: Testing and Commissioning

Standard Specification: General Corrosion Protection

GENERAL REQUIREMENTS

Electric motors shall comply with the requirements of SANS IEC 60034 and shall at minimum be of efficiency rating IE3.

All motors shall be standard catalogue models and shall be readily available.

All motors shall, where possible, be from the same manufacturer and shall have the same interchangeable frames. Variations in type and size shall, where possible, be limited to prevent stocking a variety of special spares.

WORKING VOLTAGE AND SUPPLY SYSTEMS

The motors shall be capable of operating within ± 10% of the nominal supply voltage without risk of damage. All motors shall be suitable for operating continuously at the specified 3-phase voltage system under actual

service conditions, including the ± 10% voltage tolerance, without exceeding the specified temperature rise determined by the resistance on a basic full load heat run.
At +10% voltage, the magnetic circuit shall be over fluxed and continuous operation at +10% V shall not result in deleterious heating.
All motors shall be capable of operating continuously under actual service conditions at any supply frequency between 48 and 51 Hz together with any voltage between plus and minus 5 percent of the nominal supply voltage.
The slip-in speed of any motor at 80 percent of the nominal voltage at 50 Hz shall not exceed a percentage agreed on by the engineer, and the motors shall be capable of operating at this voltage for a period of five minutes without deleterious heating.

TEMPERATURE RISE
The temperature rise, as determined by resistance, of all motors, shall not exceed the following derated values :

Insulation class	E	B	F	H
Temperature rise (K)	50	60	80	100

EFFICIENCY AND POWER FACTOR
The efficiency of all motors shall be guaranteed by the contractor and shall comply with the requirements of 60034 part 30 and shall comply with efficiency class IE3. Deviations from the guaranteed efficiency shall be within the limits specified in SANS 60034-30.
The guaranteed efficiency of each size and rating of motor shall be as determined in accordance with SANS 60034-2-1 and shall be of the high confidence class. A basic test certificate of efficiency will be accepted for a motor of identical size and rating or a basic test of efficiency shall be conducted if no certificate is available.
The power factor of motors with a capacity of 20 kW or more shall not be less than 0,85 under all operating conditions.

VIBRATION
Motors shall be statically and dynamically balanced.
All motors shall be checked for vibration without load, and at full rated voltage at the manufacturer's works, and the vibration amplitude as measured shall be in accordance with SANS 60034: Part 14, quality grade 'Special'.
The ratio of axial to radial vibration shall not exceed 0,5.

NOISE LEVEL
Unless otherwise specified motors shall be of 'normal sound power', in compliance with SANS 60034-9 Rotating electrical machines part 9: Noise limits.

ENCLOSURE AND FRAME
Each motor shall be protected to the degree required by its application, and its enclosure shall be designed for the system of cooling associated therewith.
Notwithstanding the requirements above, the minimum degree of protection shall be IP55 to SANS 60529 and, unless otherwise required, motors shall preferably be of the totally enclosed fan-cooled (TEFC) type.
All motors of the vertical-spindle type and exposed to the weather, shall be provided with a robust canopy of approved design.
Medium-length motors are preferred but short-length motors may be accepted where space is limited and written permission has been granted by the engineer. Motor frame sizes shall be in accordance with SANS 60072-1 and 60072-2

MOTOR TYPE
Motors shall be of the squirrel-cage induction motor type. Slip-ring induction motors or other approved types will be considered if the contractor is of the opinion that better results could be obtained by using such motors. Full electrical and mechanical details of each alternative shall be submitted with the tender documents.

RATING AND STARTING REQUIREMENTS

Motors shall be adequately rated for the service for which they are intended, and due allowance shall be made for the temperature, altitude, climatic conditions and variations in the supply voltage. Motors shall, however, not exceed 120% of the required capacity without prior approval having been obtained from the engineer.

Not only shall motors be based on the full load requirements, but the motor capacity and starting characteristics shall be compatible with the requirements of the driven equipment.

Where motors are required to drive high inertia loads, the starting torque of the motor and the torque curve of the driven load shall be submitted to the engineer for approval prior to manufacture. Such motors shall be capable of three starts per hour, with two consecutive starts from normal operating temperature, or more frequently if required by the engineer.

Motors shall be of the continuously running duty class S1 unless otherwise specified in the detailed specification or if a more onerous duty is dictated by the drive requirement.

All squirrel-cage induction motors shall be suitable for direct-on-line starting at full voltage. Single-speed motors shall conform to SANS 60034-12, characteristics unless otherwise approved by or dictated by the drive requirements.

All motors shall be capable of starting its associated load with a minimum accelerating torque of not less than 5 percent of full-load torque when the voltage at the motor terminals during starting is reduced to 80 percent of the nominal value.

Unless otherwise approved, the -15 percent tolerance on locked-rotor torque permitted by SANS 60034-1 will not be accepted and shall be limited to -10 percent.

Documentation shall include performance curves to suit the expected working conditions.

BEARINGS

All motors shall, wherever possible, be provided with pre-lubricated sealed bearings.

Regreasable bearings shall require only one lubrication per year. Grease lubrication of ball or roller bearings, where approved, shall be by means of hexagonal button-type grease nipples to DIN 3404.

Grease-lubricated bearings shall have relief holes to ensure that the bearings have been correctly packed, which holes shall be positioned so that the excess grease can be easily removed. Cups shall be fitted to contain excess grease.

Bearings shall be protected against eddy currents and shall be capable of withstanding vibrations caused by unbalanced loads.

All bearings shall be designed for a minimum L_{10h}, basic life rating of 50 000 hours at the rated load and speed for the application in accordance with SANS 1701-2-8.

EARTHING

All motors shall be provided with a machined or spot-faced boss tapped to receive a bolt of not less than 10 mm in diameter for earthing purposes, which is located on one side between the mounting feet.

TERMINAL ARRANGEMENTS

The line connections of each motor shall be brought out to a terminal box located in an approved position. In the case of two-speed motors, separate terminal boxes shall be provided for each speed.

Terminal boxes shall be of the totally enclosed type designed to exclude the ingress of dust and moisture and sealed from the internal circuit of the motor, and shall be manufactured from sand-cast metal. The terminal boxes be as specified in SANS 1804-2. The terminal box shall be so designed that the cable entry may be made in any one of four positions placed at right angles to one another.

Terminal boxes shall be of ample size to allow the cable to be terminated in the box. Under no circumstances will the cable be allowed to be in contact with the inside of the box or lid.

Terminals shall be of a substantial design and shall be suited to receive cable lugs. Pinch-screw connections will not be accepted.

The terminal arrangement shall permit the motor to be disconnected from its supply cable without damaging the cable tails and shall allow the supply cable and motor windings to be tested separately.

The electrical clearance and creepage distances, with the correct cable terminations in position, shall comply with the requirements of SANS 60034.

Terminal markings shall be clear and permanent and shall comply with SANS 60034. Irrespective of the direction of rotation required on the site, the connections shall be such that, when the supply leads L1-L2-L3 are connected to the motor terminals U-V-W respectively, the motor shall rotate in a clockwise direction when viewed from the driving end.

Motors suited for only one-directional rotation, shall be clearly marked as such by an arrow fixed to the motor frame at the driving end.
Before the contractor orders terminal boxes for electrical equipment he shall supply details of the proposed boxes to the engineer for approval. These precautions are necessary to ensure that the size of the connecting blocks installed is sufficient to accommodate the cables supplied and connected by another contractor, and that sufficient space exists within the box to route cables conveniently.

MOTOR/LOAD COUPLING

Motors shall be coupled direct to the equipment to be driven by means of approved couplings and/or gearboxes. Refer to the relevant sections for general specifications on transmission couplings and gearboxes. Vee-belt and chain drives will be considered only if direct coupling of the motor to the equipment is impossible or impractical. Motors driving vee-belt or chain drives shall be fitted with heavy-duty bearings suited to the full side thrust at 120% of full load torque and short-term overloads of up to 250% of the full load torques during starting. The stiffness of the rotor shaft shall be checked to ensure that resonance and fatigue do not occur.
Where applicable, the flanges of the motors and equipment shall be identical.
The precision tolerance class shall apply to all flange-mounted motors with regard to concentricity, perpendicularity and shaft run-out.

ADDITIONAL SPECIFICATIONS FOR TWO-SPEED MOTORS

The following additional specifications apply to all two-speed motors :

a. **Terminal markings shall be as per SANS 60034-7.**
b. **The starting current shall not exceed six times the full load current of the high-speed rating.**

ADDITIONAL REQUIREMENTS

The rotation speed of motors shall not exceed 1 500 r/m unless approved otherwise by the engineer.
Thermistor protection shall be provided for each winding of each motor.
The preferred class of insulation is Class F, derated in accordance with the relevant clause above.

TESTING

Tests on completion (commissioning tests) shall be performed as described in the specifications covering testing and commissioning.

MEASUREMENT AND PAYMENT

No separate payment will be made for electric motors for equipment.

PARTICULAR SPECIFICATION

PL GC VARIABLE SPEED DRIVES

CONTENTS

PL GC1 GENERAL
PL GC2 PERFORMANCE
PL GC3 CONTROL AND MONITORING
PL GC4 PROTECTION AND MONITORING

PL GC 1 GENERAL

The controller shall be of the type suitable for controlling the speed of 3 phase, 380V-525V, 525-600V, and 525-690V induction motors.

The controller shall be capable of operating continuously at nominated full load rating with expected variations of +/- 10% in the supply voltage and +/- 2% in the supply frequency.

The controller shall be capable of operating continuous operation at full load in an maximum ambient temperature of 50ºC, with a 24hour average maximum of 45 ºC. Care shall be taken during installation to ensure that the controller is protected from direct sunlight and weather.

The controller be shall have a ventilation solution that provides total separation of the cooling air from the electronics section of the controller, in order to reduce risk of contaminants entering the drive, using principles such as cold plate technology, or an externally mounted heat sink, or preferably back channel cooling

Where the controllers are separately wall mounted the enclosure protection rating shall comply to the following guidelines:

- In clean areas where no dust and moisture are present the rating shall be minimum IP20.
- In areas where moisture or harsh environmental conditions are present the controller shall be protected to IP54 and/or IP66 rating. There shall be no de-rating of the maximum ambient temperature for an IP54 and/or IP66 enclosure.

Controllers shall have metal enclosures to prevent the radiated radio frequency interference noise (RFI) from affecting the operation of other equipment. The metal enclosures must be earthed with a low impedance connection to the main earthing system.

The controller shall be manufactured to quality assurance and manufacturing standards according to ISO 9001.

PL GC2 PERFORMANCE

The controllers shall be specifically designed for constant torque operation; but shall also incorporate a choice of output waveforms designed to control quadratic loads to give the controller flexibility over a wide application area. The tenderer shall state the kVA output power of the controller in both constant and quadratic torque loads.

In constant torque mode the controller shall be capable of supplying starting torques of up to 150%-160% of the motors rated torque.

In quadratic torque mode the output voltage from the controller shall be formed in accordance with the quadratic load torque output of the centrifugal fan or pump. A choice of programmable starting torques up to 110% shall be provided to accelerate the motor to its pre-set speed.

The controller shall be of the type utilising advanced digital PWM technology. Preference shall be given to systems where the output waveform is sinusoidal at all frequencies, such that the motor power is fully utilised at the motors rated speed, and no motor de-rating is necessary.

Suppliers that can show a test of the motors temperature rise on controller operation, where the motor is operated at full load and speed, shall be seen to be suitable proof. The test shall be based on a class B temperature rise on class F winding insulation.

If de-rating is applicable the tenderer shall supply curves showing the necessary de-rating of the motor, using class B temperature rise, should be given at rated speed and load to ensure that no overheating occurs.

The controller shall automatically correct the output voltage during main's variations of +/- 10% to prevent loss of torque and speed variations occurring during motor operation.

To prevent over-magnetisation of the motor at low speeds and light loads the controller shall incorporate automatic flux control of the motor. A single fixed voltage boost that cuts out a predetermined frequency will not be considered as automatic control of the flux.

The controller shall automatically adjust the output frequency and voltage to maintain a stable motor speed of +/- 0.5% of the motor's rated speed. The accuracy shall be maintained over a speed and loading range of 10% to 100% without the use of a closed feedback loop.

Where the controller is specified to control overhauling loads it shall be fitted with a dynamic brake option. A separate external braking resistor shall be supplied according to the duty cycle required.

For hoisting loads where there is danger that load can fall under dynamic braking control due to failure of the controller, whatever the reason, the controller shall incorporate the necessary inbuilt safety functions and relay output to ensure an overriding holding mechanical brake is released. On starting the holding brake must only be released by the relay in the controller when the motor is fully magnetised.

The controller shall incorporate automatic tuning and setting of the main motor parameters. The tuning shall be based on measurements of the motors inductance and resistance. The tuning must be done at standstill in order not to affect the application before the controller is tuned.

The automatic tuning shall stop and register an alarm condition if the automatic tuning detects an out of balance in the motor windings, or cannot set the correct parameters for the motor.

Radio Frequency Interference

Tenderers are reminded that the plant contains equipment sensitive to RFI interference (such as PLCs or Computers). Full compliance to the standards is requested. The controller should be well protected and immune to electrical disturbance in order to ensure high reliability

The controllers shall comply with the EMC immunity standards:

- **EN 61000-4-2 (IEC 1000-4-2): Electrostatic discharges (ESD)**
  Simulation of electrostatic discharge from human beings.

- **EN 61000-4-3 (IEC 1000-4-3): Incoming electromagnetic field radiation, amplitude modulation.**
  Simulation of the effects of radar and radio communication equipment as well as mobile communications equipment.

- **EN 61000-4-4 (IEC 1000-4-4) Burst transients.**
  Simulation of transients brought about by switching with a contactor, relays or similar devices.

- **EN 61000-4-5 (IEC 1000-4-5) Surge transients.**

Simulation of transients brought about e.g. by lightning that strikes near installations.

- **ENV 50140: Incoming electromagnetic field, pulse modulated.**
  Simulation of the impact from GSM telephones.

- **ENV 50141: Cable-borne HF.**
  Simulation of the effect of radio transmission equipment connected to supply cables.

- **VDE 0160 class W2 test pulse: Mains transients.**
  Simulation of high-energy transients brought about by main fuse breakage, switching of power factor correction capacitors, etc.

The controllers shall comply with the EMC emission standards:

- **EN 55011 Class A1: Cable born from (150Khz-30Mhz). Radiated (30Mhz-1Ghz.)**
  The controller must comply to EN 55011 Class A with 150 m of screened/armoured cable.

The controllers shall be fitted with metal enclosures (to form a Faraday Cage) to limit the radiated RFI noise from the controller. The enclosures shall be earthed to the main earth grid with a low impedance connection.

Separate RFI Filters

Where RFI filters are supplied from a separate supply source, documentation showing the test results of the RFI and controller combination and its compliance to EN55011 shall be supplied as evidence of conformity including the maximum length of cable.

The separate RFI filters shall be mounted in metal enclosures to the same protection rating as the controller, and located as close to the mains connection terminals of the controller as possible.

Ferrite cores mounted on the input cables will not be considered as RFI compliance.

Harmonics and Power Factor

Tenderers are reminded that the plant contains a high portion of harmonic producing loads. The information requested in this section of the specification is important for the evaluation of the total plants harmonic distortion limits.

Mains Harmonic currents generated by the controller must be limited by external mains reactors OR reactors in the d.c. bus of the controller. Preference shall be given to controllers that include reactors in the d.c. bus circuit.

Controllers that do not include a reactor mounted in the d.c. bus shall be supplied with external three phase reactors connected on the mains side of the controller. The reactors shall be fitted to each phase and shall have a minimum impedance of 5%. The reactors shall be mounted in steel enclosures to a rating equivalent to the controller.

When external three phase reactors are supplied Tenderers shall include the amount of voltage drop that will occur over the reactors at full load, and advise how the controller will respond to the lower voltage.

When both external input reactors for harmonic reduction and output reactors are fitted the tenderer shall sate the amount of expected derating which will occur on the motor when running at rated speed and load.

Tenderers shall include a spectrum of harmonic generating currents in the 1^{st}-25^{th} harmonic range, and shall state both the cos ϕ_1 and the power factor of the controller at 100% load.

Calculation of the power factor must be based on the ratio of the fundamental current, and its displacement from the voltage, to the total RMS current which includes all harmonic currents up to and including the 25^{th}.

Cos ϕ_1 will not be accepted as power factor as it only applies to power factor in loads which draw a sinusoidal current.

In order to eliminate any system resonance occurring within the motor's operating frequency range, the controller shall be provided with several bypass frequency adjustments. The bandwidth shall be adjusted as a percentage of the recorded by-pass frequencies. If high effiency motors is used the controller must have a built in anti resonance algorithm in order not to cause resonance in the system.

The controller shall be suitable for control of high inertia loads and be able to catch a rotating motor under any operating condition without tripping. Whether through large supply interruptions, or by the action of switching on and off the motor isolating switch when the motor is running.

The function shall also ensure that a motor on a high inertia load already prerotating, even in the reverse direction, can be switched onto, braked to zero speed by d.c. injection braking incorporated in the controller, and then accelerated to the preset speed in the correct direction.

The controller shall incorporate a PID regulator to enable closed loop control of the process. The regulator shall operate in conjunction with the ramp adjustments to allow smooth acceleration into regulation. Remote monitoring of the feed back signal via a 0/4 - 20mA signal from the controller is required.

To prevent condensation build up in the stator the controller shall incorporate a pre-heat function. When the motor is stopped it shall receive a low d.c. voltage from the controller.

Controllers shall be capable of allowing motor cable runs of up to 300 metres with an un-screened / unshielded cable and 150m with a screened / shielded cable. If the controller cannot allow this cable length, the tenderer shall state the maximum cable length allowed, and the motor coil reactance value intended to be used to increase the cable length. The tenderer shall state clearly the voltage drop and additional motor derating that will occur when motor reactors are fitted.

The controller shall be suitably protected to allow for switching to take place on the output via, a contactor or isolating switch without damage to the inverter transistors.

PLGC3 CONTROL AND MONITORING

All analogue and digital control inputs and outputs shall be galvanically isolated from each other and from the mains supply and shall be capable of withstanding a test voltage of 2.5 kV dc for 1 sec. For safety reasons, only controllers that have galvanic isolation as an integral part of the controller will be accepted.

The controller shall respond to speed commands from 0-10 V dc, 2-10 V dc 1-5 V dc and 0/4-20 mA control signals, and their respective inverted signals.

For maximum noise immunity on the digital inputs the sink current shall be minimum 10 mA and 24 V for each input. The internal power supply for the supply to the digital inputs shall have a minimum capacity of 200mA at 24V.

The controller shall have an alpha-numeric display and shall provide comprehensive information on the controller and the motor's condition. The following is considered as minimum requirements:

- Reference % of control signal
- Frequency Hz
- Display of feedback signal
- Current A
- Torque %
- Power kW
- Energy kWh
- Output voltage V
- d.c. voltage V
- Motor thermal reserve %
- Inverter thermal reserve %

The tenderer shall state clearly which displays are available, in particular whether the controller can display energy kWh and torque, and what alternative methods can be used if the controller cannot display these parameters.

one programmable analogue outputs shall be provided for monitoring. A choice of 0-20 mA and 4-20 mA shall be provided. The programmable options shall include as a minimum Hz, Amps, and Torque.

Two programmable relays shall be provided for remote monitoring of the controller. The programmable options shall include as a minimum ready, run, and alarm. The contacts shall have a minimum rating of 250 V, 2A ac
The run relay function shall initiate a run signal only when the frequency output from the controller is greater than 0.5 Hz.

The controller shall incorporate the following totalisers.

- Hour run meter
- Kilowatt Hours

The controller shall display all faults in clear English text. The following is considered as minimum requirements.

- Inverter fault
- Over voltage/Under voltage
- Over current
- Ground Fault
- Over Temperature
- Overload
- Motor Trip

The tenderer shall state whether the controller can provide clear English text or if the faults are distinguishable only through a code system.

The controller shall preferably be fitted with a USB serial port, and be supplied with suitable software utilising a windows environment to display all monitoring, fault, alarm and status signals. The software shall allow parameter changes to be made to the controllers settings by uploading the data from the controller, changing the parameters, and then downloading the data to the controller again. Storage of each controllers operating and set-up parameters shall be able to be stored on diskette.

The controller shall have provision to accept an option card for high speed serial communication. PROFIBUS, PROFINET, Ethernet, Modbus Plus or DeviceNet are accepted fieldbus standards.

The controller design should be such that an external 24 Volt supply can be connected to maintain operation of the microprocessor and serial communication bus during the loss of AC power.

The controller shall preferably be supplied with safe stop functionality suitable for category 3 installations as defined by **EN 954-1** and **SIL 2/IEC 61508** this feature will prevent a drive from starting accidently.

PLGC4 PROTECTION AND MONITORING

The controller shall shut down safely under the following conditions and operate the alarm relay. The controller display shall indicate the nature of the fault in clear English text.

-Over voltage-Over Temperature
-Under voltage-Overload
-Over current-Motor trip
-Earth fault-Inverter fault

The controller must not be destroyed by a short or an earth fault on the outputneither by switching on the output.

The controller shall provide for both automatic and manual reset operation. Automatic reset shall only operate on over current and over and under voltage. In automatic mode there shall be a programmable choice of up to 10 reset attempts per fault before the controller shuts down making manual reset necessary to restart the system. The restart time after a trip in automatic mode shall be adjustable.

For safety reasons the controller must have a trip lock function preventing an operator resetting the controller under extreme condition.

In manual reset mode the reset shall be accomplished from both the keypad on the controller and by remote signal.

The controller shall be equipped with a data log menu that will allow storage of the type of faults that have occurred. Last fault memory shall be required in the event of power failures.

The controller shall include electronic motor thermal overload protection where the trip time is based on the motors running frequency, actual motor current, operating time and the motors rated current. The device shall automatically modify the trip time to take into account operation at low speed. On trip the controller shall indicate that the fault is a motor thermal trip.

The controller shall include a motor PTC thermistor input for use when motors are fitted with thermistors and shut down the motor when the PTC resistance value increases above its safe operating value. On trip the controller shall indicate that the fault is a motor thermal trip. The controller should also provide for an Atex approved solution for the protection of certified Ex proof motors, regardless of supplier, in Zone 1 and 2 (Gas) and Zone 21 and 22 (Dust), in accordance to the dedicated additional measures of the motor´s Ex protection system.

The tenderer shall state whether full repair facilities are available, and in which local provinces and bordering countries they are located.

PROJECT SPECIFICATION

PLGD **STANDBY DIESEL GENERATOR**

1. General

The specification covers the supply, delivery, complete installation and commissioning on site in full working order of an emergency diesel generator to provide emergency electrical power for UPS systems, computer hardware.

Full particulars, performance curves and illustrations of the equipment offered must be submitted with the tender. Tenderers may quote for their standard equipment complying with the specification and any deviation from the specification must be fully detailed.

The set shall be fully automatic i.e., shall start when any one phase of the mains supply fails and shall shut down when normal supply is re-established. The set shall be capable of delivering the specified output continuously under the site conditions, without overheating.

The client will provide a plant room as shown on the drawings included in the detailed specification.

Tenderers must confirm that the space is sufficient for the installation of the generator set, fuel tank and the control board and shall indicate the proposed layout of their equipment on the drawing in red ink.

The tenderer must furnish detailed description and illustration of the equipment offered and must complete the questionnaire following this specification.

Failure to submit any of the information asked for may disqualify the tenderer.

2. Installation

Except for those items specifically excluded, tenderers must include for the complete installation and wiring of the plant in running order.

3. Warning notices

Tenderers must include in their tender for all notices that are required under the safety acts applicable to the area in which the installation is carried out.

4. Drawings

The successful tenderer must, within two weeks after receipt of an order, submit detailed drawings and wiring diagrams of the plant and switchgear.

5. Guarantee

The successful tenderer will be required to guarantee the complete plant for a period of 12 months from the date it has been taken over by the client in running order.

If during this period the plant is not in working order, or not working satisfactorily owing to faulty material, design or workmanship, the contractor will be notified and immediate steps shall be taken by him to rectify the defects and/ or replace the affected parts on site, at his own expense.

6. Operational instruction

After completion of the installation, and when the plant is in running order, the successful tenderer will be required to instruct an attendant in the operation of the plant, until he is fully conversant with the equipment and handling thereof.

Three copies of maintenance, fault–localizing and operating manuals are to be handed over to a representative of the client.

7. Tests

Tests are to be carried out at the supplier's premises, before the generating set is delivered to site, at which time a representative of the client will be present to ensure that the generating set complies with the specification and delivers the specified output.

8. Engine

The engine must comply with the requirements laid down in SANS ISO 8528 and must be of a solid injection, compression ignition type, running at a speed not exceeding 1500 rpm. The engine must be amply rated for the required electrical output of the set, when running under the site conditions. The starting period for either manual or automatic switching on until taking over the specified load by the generating set in two steps shall not exceed 20 seconds. The tenderer shall specify the initial one-step load capability of the generating set.

The engine shall be capable of delivering an output of 110% of specified output for one hour in any period of 12 hours consecutive running, in accordance with SANS ISO 8528.

Curves furnished by the engine maker, showing the output of the engine offered against the speed, for both intermittent and continuous operation, as well as fuel consumption figures, must be submitted with the tender.

8.1 Lubrication

Lubrication of the main bearings and other important moving parts shall be a force-feed system. An automatic low oil pressure cut out must be fitted, operating the stop solenoid on the engine, and giving a visible and audible indication on the switchboard.

8.2 Fuel pump

The fuel injection equipment must be suitable for operation with commercial brands of diesel fuel normally available in South Africa.

8.3 Cooling

The engine must be a water-cooled type, with a built-on heavy duty, tropical type radiator.

All air ducts for the cooling of the engine are to be allowed for. The air shall not be allowed to re-circulate in the plant room and an air duct shall be supplied from the radiator face to discharge louvres in the plant room wall.

8.4 Governor

The speed of the engine shall be controlled by a governor in accordance with SANS ISO 8528 if not otherwise specified in the detail specification. When the initial one step load is suddenly switched on or full load off the temporary speed variation shall not exceed 10%. The permanent speed variation shall not exceed 1% of nominal engine speed. The governor shall be electronic.

8.5 Derating

The engine must be derated for the site conditions as set out in the detail specification.

The derating of the engine shall be in accordance with the engine manufacturers derating curves. Copies of these derating curves or tables must be included with the tender response.

8.6 Starting and Stopping

The engine shall be easily started from cold, without the use of any special ignition devices, under summer as well as winter conditions.

Tenderers must state what arrangements are provided to ensure easy starting in cold weather.

The electrical circuits for heaters shall be taken from the control panel and must be protected by a suitable circuit breaker.

Besides the automatic starting and stopping, provision must be made on the control board for manual starting and stopping of the set.
The automatic control shall make provision for three consecutive starting attempts of 10 seconds with 10 second intervals. Thereafter the set must be switched off and the starter failure relay on the switchboard must give a visible and audible indication of the fault.

8.7 Starter battery

The set must be supplied with a new fully charged maintenance free lead-calcium type battery. The battery must have sufficient capacity to provide the starting torque stipulated by the engine maker, and for at least six consecutive starting attempts. The battery must be housed on a suitable tray or stand.

8.8 Exhaust silencer

It is essential to keep the noise level as low as possible. An effective exhaust silencing system of the residential type is to be provided to limit the noise level to approximately 75 dBA @ 7 metres from the exhaust outlet or as specified in the detailed specification.

The exhaust pipe must be flexibly connected to the engine to take up vibrations transmitted from the engine, which may cause breakage. The exhaust pipe and silencer inside the plant room must be lagged to reduce heat and noise transmission.

9. Alternator

The alternator shall be of the self excited brushless type, with enclosed drip - proof housing, and must be capable of supplying the specified output continuously with a temperature rise not exceeding class H as laid down in BS 5000 for rotor and stator windings. The alternator shall be capable of delivering an output of 110% of the specified output, for one hour in any period of 12 hours consecutive running. Windings shall be fully impregnated for tropical climate and must have an oil resistant finishing varnish.

9.1 Alternator Protection

On the switchboard a multi-pole circuit breaker with instantaneous short circuit trips and thermal overload trips must be installed for protection of the alternator against short circuit and overload.

9.2 Regulation

The steady state voltage regulation must not exceed ± 1% of nominal voltage specified between no load and full load with the power factor between unity and 0.8 lagging and within the driving speed variation of 4.5%.

9.3 Performance

Following the application of 70% of full load, or the initial one step load capability of the engine, the transient voltage shall not exceed 15% and will recover to the nominal voltage within 500 mS.

9.4 Output voltage

The set shall have a site output as set out in the detail specification.

10.Operation Selector

A four-position selector must be provided on the control panel marked “AUTO”, “MANUAL”. “TEST” and “OFF”.

With the selector on “AUTO” the set shall automatically start and stop according to mains supply being available or not.

With the selector on “TEST” it shall be possible to start and stop the set with the push buttons but the running set shall not be switched to the load, UNLESS the mains supply fails during this test, in which case the set will be switched to the load.

With the selector on “MANUAL” the set must take load when started with the push button but it must not be possible to switch the set onto the mains or the mains onto the running set.

With the selector on ”OFF” the set shall be completely disconnected from automatic controls for cleaning and maintenance of the engine.

11.By pass switch and combined mains isolator (see detailed specification for requirement)

The switchboard must be equipped with a manually operated on-load by-pass switch, which shall either connect the incoming mains to the automatic control gear or directly to the outgoing feeder. In the latter position the automatic control gear, including the Change-over gear shall be isolated for maintenance purposes.

It is required that the bypass switch isolator be mechanically isolated from the automatic control gear preferably in the lower portion of the switchboard cubicle.

12.Battery Charging

Equipment must be provided on the switchboard for charging the battery from the Mains. The charger shall be constant voltage, current limiting, operate automatically in accordance with the state of the battery and be capable of a continuous RMS current of at least 6 amps with an AC ripple content of less than 1% in order to prolong the life of the battery.

A flush mounted ammeter, suitably scaled, reading the charging current and a flush mounted voltmeter indicating the battery voltage must be provided on the switchboard. An engine driven alternator must be provided for charging the battery during operation of the set.

13.Starting and stopping delay

When the main supply is interrupted on one or all phases, the voltage sensors shall initiate the starting cycle. A 0-15 seconds adjustable start delay timer shall be provided to prevent start up on short power interruptions.

A stop delay timer is required to keep the set running for a period of 0-5 minutes, adjustable, after the main supply returns. After changing back to the main supply a 0-5 minutes timer shall be provided to keep the set running for a cooling period at no load before stopping.

14.Mains fail simulation key switch

A main supply failure simulation key switch with TEST and NORMAL positions must be installed in the switchboard. In the TEST position, set must be operated as if mains had failed, start and take load.

15.Coupling

The engine and alternator must be directly coupled by means of a high quality flexible coupling for double bearing alternators, or a flexible plate supplied by the alternator manufacturer in the case of a single bearing alternator.

16.Fuel Tank

The tank shall have sufficient capacity to run the engine on full load for a period of 8 hours, providing the following capacities are not exceeded: 200 litres for freestanding day tanks, or 900 litres for set-mounted tanks. A 110% catch tank shall be installed under the fuel tank if floor standing or as required by local authorities.

The tank shall be fitted with a suitable filter, a full height protected and sight glass calibrated in percentage, shut off valve and low level alarm at 30%, giving an audible and visible signal on the switchboard.

For sets rated at more than 100 kVA an electrically operated pump with a suitable length of oil resistant hose must be supplied, for filling the fuel tank from 200 litre drums or as required by the detailed specification. For smaller sets a manually operated wing pump is to be supplied.

The inter-connecting fuel piping shall consist of black steel and connection to vibrating components shall be flexible tubing. A water trap shall be provided in the fuel pipeline between the tank and engine. A drain valve must be fitted to the underside of the fuel tank.

17.Base frame

The engine and the alternator of the set shall be built together on a common base frame, of simplex/duplex type. For set mounted panels a Duplex frame will be preferred, consisting of a heavy duty inner frame on which the alternator and engine are secured with an outer floor standing frame between which purpose made anti-vibration mountings in "V" formation are mounted. The Panel will be mounted on the floor standing frame. The Simplex type base frame will consist of a heavy-duty steel frame on which the alternator and engine are secured fitted with floor standing spring type anti-vibration mountings. The set must be placed direct on the concrete floor. A drip tray must be fitted under the engine. The tray must be large enough to catch a drip from any part of the engine.

18.Switchboard

A switchboard must be supplied for the set, and is to incorporate all equipment necessary for control and protection of the generating set, the automatic change over and battery charging equipment.

The switchboard shall be a totally enclosed unit and shall consist of steel panels.

The steelwork of the boards must be thoroughly de-rusted, primed with zinc chromate and finished with two coats of signal red enamel, or baked epoxy powder coating.

Suitable rated terminals must be provided for all circuits. Where cable lugs are used, these shall be crimped. Screwed terminals shall prevent spreading of the strands.

All wiring shall have each wire fitted with a cable or wire marker of approved type and the numbering of these markers must be shown on a wiring diagram of the switchboard.

The automatic control and protection control equipment shall be mounted on a separate easily replaceable small panel and shall preferably be designed and manufactured in the RSA. The automatic control shall be microprocessor based and shall be programmable, unless otherwise specified. The manufacturer shall guarantee the availability of compatible exchange control units for at least 10 years.

All equipment on the switchboard, such as contactors, isolators, busbars, etc. shall have ample current carrying capacity to continuously handle at least 110% of full load alternator current without overheating.
Wiring between stationary and hinged panels or doors shall be made between terminal blocks or clamped in such a manner as to afford flexibility without damage to the wires. The wires shall be neatly bundled and tie wrapped.

18.1 Earthing

An earthing bar must be fitted in the switchboard to which all non-current carrying metal parts shall be bonded.

The neutral point of the system must be solidly connected to this bar. Suitable terminals must be provided on the earth bar for connection of the main earth conductors, which will be supplied and installed by others or as specified in the detailed specification.

18.2 The following equipment is required in the board

(a) One flush 96 mm square dial voltmeter, scaled, reading the alternator voltage.
(b) One flush voltmeter selector switch with 6 metering and one off position, connecting the voltmeter to phase and neutral.
(c) One flush 96 mm square dial indicating type frequency meter, indicating the alternator frequency.
(d) An hour meter with cyclometer counter, reading the number of hours the plant has been operating. The smallest figure on this meter is to read 1/10th hour.
(e) One set of fuses or cb's for potential circuits of the meters.
(f) Flush 96 mm square dial maximum demand ammeters for measuring the alternator current, scaled to suit complete with necessary current transformer with resettable pointer.
(g) One isolator for the mains isolation (check detailed specification for requirement).
(h) Automatic – change over control equipment. (check detailed specification).
(i) One circuit breaker for alternator protection against overload and short circuit conditions (check detailed specification for requirement).
(j) One four-position operation selector switch.
(k) Two push buttons or one switch marked "Start" and "Stop" for manual starting and stopping the set.
(l) Battery charging equipment as specified, complete with flush ammeter and voltmeter.
(m) Relays with re-set pushes as specified, for engine protection and warning.
(n) Fault indicating lights.
(o) Mains fail simulation key switch.
(p) Switch for fuel pump.
(q) Warning hooter.
(r) By pass switch.
(s) Test pushbutton to test all indicator lamps.
(t) Suitable terminals for incoming main and alternator cables, for the outgoing feeder and for the earth connection.
(u) Any other equipment necessary for the correct and safe operation of the installation.

18.2 Protection and alarm devices

Relays with reset push buttons are required to give a visible and audible signal and stop the engine when any of the protective devices operate.

Protection must be provided for high engine temperature, low lubrication oil pressure, overspeed/underspeed, start failure, low water level, overload, low fuel, battery charger fail, faulty switch position, emergency stop and abnormal voltage.

A potential free common alarm contact for remote monitoring must be supplied, unless otherwise specified in the detailed specification.

19.MAINTENANCE

The tender is inclusive of all breakdown maintenance, 24 hour emergency callout and four preventative maintenance visits during the first 12 months calculated on standby use of the generating set, excluding consumables such as oil and filters. A fully priced pro-forma maintenance agreement must be submitted with the tender, catering for four preventative visits per annum and 24 hour emergency callout facility. The number of bona-fide service technicians employed by the tenderer and stationed in Gauteng will be stated in the tender response.

PARTICULAR SPECIFICATION

PLHA **SPECIFICATION FOR CEMENT MORTAR LINING**

CONTENT

PLHA1. MATERIAL FOR MORTAR LINING
PLHA 2. SAMPLES, TESTS AND LABORATORIES
PLHA 3. CEMENT SLURRY
PLHA 4. CEMENT MORTAR
PLHA 5. APPLICATION OF MORTAR LINING
PLHA6. THICKNESS AND SURFACE FINISH OF LINING
PLHA7. CURING
PLHA8. INSPECTION AND TESTING OF LINING
PLHA9. LINING DEFECTS

PLHA1. MATERIAL FOR MORTAR LINING

1.1CEMENT

Cement shall be Ordinary Portland Cement or Rapid Hardening Portland Cement or a combination of these cements which shall comply with the latest requirements of SABS ENV 197-1:1992 (Parts 1 & 2) This specification covers the erection of new welded razor mesh fences.

Pozzolanic material shall not be used in addition to or to replace a portion of the cement.

Cement used for trial mortar mix to be specified by the Tenderer and all cement used for this contract shall be procured from the same factory unless otherwise permitted by the Engineer in writing. The name of the factory shall be stated by the Tenderer.

Cement shall be delivered to the site in a dry condition undamaged by exposure to the weather and shall be stored on the site in approved weather and damp-proof conditions.

All cement spilled from broken pockets on working surfaces floors shall not be used on the work. It shall be swept up each day and removed from the work together with all broken pockets of cement.

SAND

Sand for cement mortar shall be river sand, natural pit sand, crusher sand or a blend of the sands provided it is clean and the grains are inert, durable and uncoated. The supplier and type of sand and its typical grading envelope shall be stated by the Tenderer.

Sand shall be well graded and a sieve analysis of a representative sample carried out in accordance with SABS Method 829 shall show that it complies with the following grading requirements:

Sieve size (mm)	Percentage passing by mass
1,180	100
0,075	1 to 10

Sand shall be free from injurious amounts of dust, clay lumps, shale, soft or flaky particles, mica, loam, oil, alkali and other deleterious substances. The maximum percentage by mass of deleterious substances shall not exceed the following limits:

Deleterious substances	Percentage by mass
Shale	1
Clay lumps	1

	Mica and other deleterious substances Sum of all deleterious substances	2 3

The water demand of the sand is defined as the quality of water in liters required to make one cubic meter of a mortar which having a sand to cement ratio by mass of 1,0 has a consistency of 8,5 mm DB penetration when tested in accordance with BS 4551: 1980. The water demand of the sand shall not exceed 340 ℓ/m^3.

The water demand of the sand shall be determined from at least three trial cement mortar mixes each of a different water content and shall be stated by the Tenderer.

Sand tested for organic impurities in accordance with SABS Method 832 shall yield a test solution not darker in colour than the reference solution.

The chloride content of the sand determined by SABS Method 830 shall not be greater than 0,01 percent.

The Contractor shall submit samples of the sand to the Engineer for his approval before use. Prior to commencing the work the Contractor shall submit a report in detail from an approved testing laboratory showing that the sand complies with the specifications.

Sand shall be stored on site on an impermeable surface, protected from the weather and washed sand shall be allowed to drain freely for at least 24 hours before use. The Engineer may require the Contractor to test the sand daily (or more frequently if necessary) for moisture content, impurities or grading before use.

WATER

Water for mortar shall be clean and free from injurious amounts of dissolved mineral salts, organic matter or other substances, which may impair the strength or durability of the mortar.

ADMIXTURES

Admixtures is other material apart from cement, sand and water, that is added to the cement mortar or painted onto the bare steel surface prior to cement mortar application.

No admixtures shall be used that has a deleterious effect on the electrochemical passivation of the steel surface by the cement mortar or on the potable water flowing in the pipe after the lining has been placed. In addition no admixtures shall be used that impairs the durability, fatigue strength or ability of the mortar to resist impact loadings.

Prior written approval of the Engineer shall be obtained for the use of any admixture and the Contractor shall submit test data to substantiate the admixture performance.

PLHA2. SAMPLES, TESTS AND LABORATORIES

The testing laboratories of the SANS, CSIR, SAIW, PCI or other laboratories subject to the prior approval in writing of the Engineer, will be accepted as approved laboratories in which tests or designs required by the specification may be carried out.

The cost of supplying samples and making any test shall be borne by the Contractor.

The Contractor shall make all required arrangements for tests and present the Engineer on a regular basis with all test results.

PLHA3. CEMENT SLURRY

Cement slurry for use with the hand application of mortar to large areas greater than two square meters in extent or with the repair of lining defects shall consist of cement water and admixture.

A suitable admixture is a styrene-butadiene copolymer latex (SBR) manufactured for use with Ordinary Portland Cement as a bonding agent. The proportions of cement, water and admixture shall be in accordance with the manufactures directions.

PLHA4. CEMENT MORTAR

COMPOSITION

Cement mortar for steel pipe lining shall be composed of cement, sand, water and, if required, admixture, that are well mixed and of proper consistency to obtain a dense, homogeneous coating of the required thickness that will adhere firmly to the pipe surface.

PROPORTIONS

The mortar mix shall be designed to produce mortar which attain the specified compressive and flexural strengths, and which will in addition have high density and in permeability

Cement mortar shall have a minimum cement to water ratio by mass of 2,8 and a minimum sand to cement ration by mass of 1,0.

The workability of the mortar shall be the consistence measured by the dropping ball penetration test carried out in accordance with BS 4551:1980.

The proportions of cement, sand and water shall be based upon laboratory tests made with the cement, sand and water to be used on the work. These proportions together with the design workability shall be stated by the Tenderer.

The exact proportions of the constituents shall be determined by the characteristics of the sand used, the condition of the cleaned pipe surface, the thickness of the lining, the size of pipe and the lining equipment used.

Two mortar mixes shall be designed: one suitable for machine application and one suitable for hand application where machine application is impracticable. Guide workability levels for designing these mixes are a nine mm penetration and a six mm penetration respectively

The Contractor shall timeously submit a report in detail of the proposed cement mortar mix designs to the Engineer for his approval before the work begins. This report, from an approved testing laboratory, shall show that the mixes comply with the Specification and shall give for each design mix for at least three different water contents, one of which corresponds to the design workability to be determined by the Engineer, the 7-day and 28-day mortar prism compressive and flexural strengths and consistence obtained when using the materials proposed for the work.

STRENGTH

The mortar compressive and flexural strength shall be determined from 160 mm by 40 mm by 40 mm prisms stored, demoulded, cured and tested in accordance with the “ISO” SABS Method 866. High frequency (200Hz) vibration shall be used to compact the mortar when moulding in order to expel all the air entrained when mixing. A minimum period of two minutes shall be used.

The minimum mortar strengths below which not more than five percent of results may fall are:

Age of Cement Mortar	Compressive Strength (Mpa)	Flexural Strength (Mpa)
7 day	45	5,5
28 day	60	6,5

At least six representative prisms shall be made by the contractor for each day of machine lining application. Three of these prisms shall be tested at seven day's age and three at 28 day's age. The six prisms shall be made from one batch of mortar sampled whenever possible from the hopper of the lining machine.

BATCHING, MIXING AND WORKABILITY

All mortar shall be batched and mixed under the supervision of a competent and experienced person.

All materials shall be batched by mass and the combined error in weighing the materials shall not exceed two percent. Equipment performance shall be checked when required by the Engineer and the Contractor shall provide the necessary apparatus for this testing.

All weighing and measuring equipment shall be checked daily and if necessary, adjusted, before cement mortar mixing commences.

The quantity of water used in each batch of mortar shall be carefully adjusted to maintain the cement to water ratio required for the approved mix.

Allowance must be made for the moisture content of the sand, which shall be determined either by weighing and drying or by the speedy moisture meter. Allowance shall also be made for moisture collecting on the interior of pipe surfaces, the method of transporting the mortar from the mixer to the lining machine and the trowelling system used.

Mixing shall be continued for not less than 90 seconds after all the materials including water are in the mixer. All mortar shall be thoroughly mixed and the whole of each batch shall be uniform, free of lumps and free from segregation. The minimum time of 1½ minutes may be increased at the discretion of the Engineer.

Adequacy of mixing shall be judged visually and if in the Engineer's opinion mixing is unsatisfactory, the mixer shall be replaced by a machine, which will produce acceptable mixing.

Any batch not complying with the Specification shall be removed from site or disposed of as directed by the Engineer or Inspector.

The workability of the freshly mixed mortar shall be determined periodically from a sample taken immediately prior to being transported to the lining machine, or where practicable from a sample taken at the lining machine itself.

Once the optimum workability for the day's run is determined the consistence shall not vary by more than one mm DB penetration.

Freshly batched mortar shall be applied to the pipe and finished before the initial set has commenced. Under no circumstances shall the addition of extra water to the unplaced mortar in order to restore workability be allowed. Fresh mortar that has lost its workability due to the onset of initial set shall be removed from site or disposed of as directed by the Engineer or Inspector.

PARTICULAR SPECIFICATION

PSTRU E BUILDING WORK

CONTENTS

PSTRU E 01 SCOPE
PSTRU E 02 BRICKWORK, PLASTER WORK AND FLOOR SCREEDS
PSTRU E 03 PAINTING
PSTRU E 04 MEASUREMENT AND PAYMENT

PSTRU E 01 SCOPE

This is a Particular Specification and covers the various construction activities associated with the erection of buildings which form part of this Contract. Building work shall be carried out in accordance with the National Building Regulations, SABS 0400, the applicable clauses of the SABS Standardized Specifications and the information contained in this Specification. Work appurtenant to the erection of buildings such as earthworks, concrete work, structural steelwork, etc shall be carried out as specified in the appropriate Standardized Specifications and will be measured and paid for under those Specifications.

PSTRU E 02 BRICKWORK AND PLASTER WORK

PSTRU E 02.1 MATERIALS

(a) Bricks
Bricks shall comply with SABS 227 and shall be of the class scheduled or shown on the Drawings. Satisfactory proof of the load-bearing capacity of the bricks offered shall be submitted before deliveries are made to the Site. Air bricks shall be well-burnt terracotta and shall be free from cracks and blemishes and lined with copper mosquito gauze. Three samples of each type of brick shall be submitted to the Engineer for approval. All subsequent deliveries shall be of a standard equal to or better than that of the approved samples.

(b) Cement
Cement shall comply with the requirements of SABS 471 and shall be stored under cover. The use of Portland blast-furnace cement (PBFC) which complies with the requirements of SABS 626 will only be allowed if approved by the Engineer.

(c) Aggregate
Fine aggregate shall consist of natural sand, or crushed rock or gravel, and shall be hard, clean and free from adherent coatings or other deleterious matter. Sand for plaster and mortar shall comply with the requirements of SABS 1090, whereas the aggregates for normal and granolithic floor screeds shall comply with the requirements of BS 1199 and BS 1201 respectively.

(d) Water
Water shall be clean and free from clay, silt, oil, acid, alkali, organic or other matter which would impair the required strength and durability of the mortar, plaster or floor screed.

(e) Wall ties
Wall ties shall be of the galvanized, crimped, single-wire type, 3,5 mm in diameter, and shall comply with the requirements of SABS 28.

(f) Damp-proof sheeting
Damp-proof sheeting shall comply with SABS 248, type FV for fibre felt, or SABS 952, type B for embossed polyethylene sheeting.

PSTRU E 02.2 CONSTRUCTION OF BRICKWORK

(a) Cement mortar

Cement mortar shall, unless otherwise specified, consist of one part Portland cement to four parts sand (1:4) by volume for normal brickwork and one part Portland cement to three parts sand (1:3) by volume for reinforced brickwork. The ingredients for cement mortar shall be measured in proper gauge boxes on a boarded platform and thoroughly mixed. Alternatively, mixing may be by means of an approved mechanical batch mixer. Only when the dry ingredients have been thoroughly mixed and a mixture of uniform colour has been obtained may the water be added in sufficient quantity to obtain mortar with the required consistency. Cement mortar shall be used within two hours of adding water to the mix and shall not be used after two hours or if it has begun to set. Mortar shall be turned over frequently to prevent it from setting until it is used.

(b) Brickwork

Dimensions of all the brickwork shall be set out and built as shown on the Drawings. Bricks shall be kept wet before laying and the top of brickwork shall be wetted before any further bricks are laid. Bricks shall be well buttered with mortar before being laid and all joints shall be thoroughly flushed up as the work proceeds. All joints to face brickwork shall be neatly made and key-drawn with a 6 mm key. Brickwork shall be carried up in a uniform manner with no portion being raised more than 1 m above an adjacent portion. All perpends, quoins, etc, shall be kept strictly true and square and the whole properly bonded together.

Brickwork shall be built in stretcher bond or english bond as shown on the Drawings, and bats shall not be used except where required for the bond. All joints shall be 10 mm wide and four courses shall measure 340 mm. Brickwork for cavity walls and solid walls built in stretcher bond shall be tied with wall ties placed not more than one metre apart in every third course, and shall be staggered vertically. At openings, the ties shall be positioned not more than 300 mm apart along the periphery of the opening and 150 mm from the opening.

Face brickwork shall be kept perfectly clean and rubbing down of the brickwork shall not be allowed. Scaffold boards shall be turned back during heavy rain to avoid splashing. Soiled brickwork shall be cleaned at the Contractor's expense, and the cleaning method shall be approved by the Engineer.

(c) Reinforced brickwork

Brickwork over door and window openings shall be reinforced with steel rods, welded or expanded mesh, etc. Reinforcement shall be placed in each course of brickwork for a minimum of four (4) courses or as shown on the Drawings. Reinforced brickwork shall continue at least 300 mm on each side of the openings. Brick lintels shall be built upon rigid temporary supports left in position for not less than seven (7) days after brick-laying. Prestressed concrete lintels may be used where approved by the Engineer.

(d) Key for plaster

Joints of all brickwork receiving plaster shall be raked out, or the brick surfaces shall otherwise be prepared with an acrylic slurry or any other approved bonding agent.

(e) Damp-proofing

A damp-proof course shall be laid over the full width of all the walls at a minimum height of 150 mm above the final ground level or wherever else it may be required, and it shall be lapped for at least 150 mm at angles and joints. A damp-proof course shall also be laid and stepped up under all external sills.

(f) General

Rough and fair cutting shall be performed as required, and the brickwork shall be fitted around any steel work. Face brickwork shall be carefully cut and fitted to suit fittings. Chases shall be left or formed for edges of concrete floors, staircases, etc. Chases shall also be provided wherever they may be required for pipes, conduits, switch boxes, distribution boards, and the like. Joints shall be raked out for flashings.

PSTRU E 02.3 PLASTER WORK

(a) Plaster coats

A plastered finish shall consist of a single coat, comprising one application of a 1:6 cement sand mixture with a wood or steel-float finish.

(b) Thickness
The total thickness of the plaster finish shall be 13 mm minimum and 20 mm maximum.

(c) Workmanship
All plaster work shall be finished smooth and ready to receive paint. Plaster shall be flush with the faces of all switch and plug boxes, the interiors of which shall be kept free from plaster. Plastered surfaces shall be plumb and jambs and reveals shall be formed square. The plasterer shall cut out and make good all cracks, blisters and other defects and leave the plaster work, on completion, in a state which is acceptable to the Engineer.

PSTRU E 03 PAINTING

PSTRU E 03.1 GENERAL

No paint shall be applied to any surface containing traces of dust, grit, grease, oil, loose rust, millscale or corrosion products of any kind or to any surface that is not free from moisture. Where necessary, surfaces shall be thoroughly washed to remove all traces of soluble salts and/or corrosive air-borne contaminants prior to painting, and the surfaces shall be dried and painted immediately thereafter. Welding shall be completed in so far as it is possible before painting commences, but in cases where welding can be done only at a later stage, no paint shall be applied to within 75 mm of the proposed weld position unless otherwise specified. Welds and adjacent parent metal shall be abrasive blasted and/or ground and all contaminants such as flux shall be removed prior to painting. Surfaces of members which are to rest on concrete or other floors or which will be otherwise inaccessible after erection shall receive the full paint system prior to erection. Damaged paint areas on metal surfaces shall be cleaned, rust spots removed where applicable and the surrounding paint which is still intact shall be feathered for a distance of 20 mm beyond the damaged area. Spot priming and repair shall consist of all the coats previously applied and shall overlap the damaged area. Damaged galvanised areas shall be cleaned and any rust spots and any flakes of the coating surrounding the damaged area removed. The coating shall then be restored by zinc spraying or soldering, or painting with a zinc-rich paint, as may be approved by the Engineer.

Where the shop coat is allowed to age for a few months before the final painting is done, light sanding or rubbing with steel wool or scrubbing with clean water using a bristle brush shall be carried out. Steel to be embedded in concrete shall not be painted below 50 mm from the final level of the concrete. Each priming coat and each undercoat of paint shall be inspected and approved by the Engineer before any subsequent undercoat or finishing coat is applied. All finishing colours shall be as shown on the Drawings, or as directed by the Engineer.

PSTRU E 03.2 MATERIALS

Paints shall comply with the requirements of the appropriate Specifications below:

(a) Primers

SABS 312	:	Red-lead based for structural steel
SABS 678	:	For wood
SABS 679	:	Zinc chromate for steel
SABS 723	:	Etch-wash primer for metals
SABS 912	:	Calcium plumbate for galvanized iron
SABS 926	:	Zinc-rich epoxy for steel

(b) Undercoats

SABS 681	:	For all undercoats

(c) Finishing coats

SABS 515	:	For interior use, flat and egg-shell finish
SABS 630	:	For interior and exterior use, high-gloss enamel
SABS 631	:	For interior and exterior use, oil gloss paint
SABS 633	:	For interior use, emulsion paint
SABS 634	:	For exterior use, emulsion paint
SABS 684	:	For exterior use on structural steel
SABS 801	:	For interior and exterior use, epoxy-tar paint

SABS 802 : For interior and exterior use, bituminous aluminium paint
SABS 887 : For interior use, glossy and egg-shell varnish

The Contractor shall furnish the Engineer with the following information and details regarding the paints and decorative materials for the painting system he proposes to use, for written approval:

(i) The name of the manufacturer and trade name
(ii) The brand, type or grade of paint and the appropriate SABS Specification
(iii) Manufacturer's data sheets, colour references, instructions for use, including surface preparation, sealers, primers, undercoats, finishing coats, coat thicknesses and curing periods, which shall all be considered as being part of these Specifications if approved by the Engineer
(iv) Safeguards to protect the applied paint from damage until the work is accepted by the Engineer
(v) The shelf or pot life of materials, if applicable
(vi) An undertaking that the proposed paint system is suitable for its intended use and that the various coats of paint are compatible with one another

Where proprietary brands are used, the manufacturer's priming and all subsequent coats of paint suitable for that particular brand shall be employed in accordance with the manufacturer's instructions. No other materials of a similar nature and quality or from another manufacturer may be used instead of those approved, unless written permission to do so has been obtained from the Engineer. All materials shall be brought onto the Site in containers sealed by the manufacturer. Paints of a different quality, type, brand or colour shall not be mixed, or thinned and shall not be adulterated in any way, but shall be used as supplied by the manufacturer. Any mixing or tinting required shall be carried out by the manufacturer. Tinting of paint on the Site by the Contractor will only be allowed with the written permission of the manufacturer and the Engineer.

PSTRU E 03.3 INSPECTION AND PRELIMINARY WORK

Before commencing paintwork, the Contractor shall carefully inspect the surfaces to be painted to satisfy himself that the surfaces are in a satisfactory or acceptable condition to receive the paint system specified. All metal fittings and fastenings shall be removed where applicable before the preparatory processes are commenced. On completion, the metal fittings and fastenings shall be cleaned and refitted in position.

PSTRU E 03.4 WORKMANSHIP AND FINISHES

Paint may be applied by spray, brush or roller depending on the materials used, the surface to be painted, and the manufacturer's instructions. Every coat of paint, irrespective of the method of application, shall be adequately and permanently keyed or bonded to the base material or previously applied coat, and shall be evenly distributed, continuous, free from sags, runs, brush marks, pin holes or other imperfections, and shall dry to a smooth finish.

An approved water trap and air-regulating valve shall be furnished and installed on all equipment used in spray painting. Before painting the interiors of buildings they shall be cleaned and the floors shall be washed and kept free from dust during the progress of the interior work. The Contractor shall protect all nearby surfaces against disfigurement by spatters, splashes and smirches of paint or paint materials. The Contractor shall be responsible for any damage by paint or dirt caused by his operations to vehicles or property or injury to persons and he will be required to provide protective measures to prevent any such damage or injury and make good, where required, at his own expense.

If passing traffic creates dust which may harm or spoil the appearance of external painted surfaces, the Contractor shall sprinkle the adjacent areas with water, at his own cost, for a sufficient distance on each side of the location where painting is being done. Undercoats shall be tinted by the manufacturer to distinguish between successive coats. The final coats or finishing coats of paint shall be applied after all the other work in the vicinity has been completed. The painter shall keep some of the final paint in reserve in the event of his having to make good any patching which may be required as a result of damage or unforeseen circumstances. Upon completion, the Contractor shall, in the case of buildings, clean all glass, remove all paint spots from walls, floors and fittings, and leave the premises clean and fit for occupation. All inflammable materials, comprising solvents, thinners, wiping cloths, etc, shall be placed in tightly closed containers and properly disposed of.

PSTRU E 03.5 **PAINTING OF PLASTER, CONCRETE OR BRICK SURFACES**

(a) Surface preparation

Surfaces for painting shall be prepared by sandpapering, scraping or wire-brushing to remove loose material, dust, laitance, scum or other deleterious materials or high spots. Defective areas shall be cut out where necessary and made good with an approved non-shrink filler. Cracks shall be cut out, suitably keyed, and given a coat of an approved bonding agent before the filler is applied. All patches shall be rubbed down to an even surface. Surfaces shall be washed and allowed to dry. Surfaces shall be treated with neutralising liquid for walls, and if the surface is coarse or textured, either one full coat of pigmented wall sealer or one full filler coat shall be applied in addition to the neutralising liquid.

(b) Paint application

Prior to the emulsion paint being applied, the surface shall be sealed with an approved clear sealer and primed with an undercoat diluted to 50%. Emulsion paint (PVA or acrylic) shall then be applied in two finishing coats. Egg-shell finish (alkyd oil-based), oil gloss paint or enamel gloss paint shall be applied as follows: one coat of universal undercoat shall be applied and it shall be followed by one coat of a mixture comprising 50% of the undercoat and 50% of the paint to be used for the finishing coat. A finishing coat of semi-gloss egg-shell, or oil gloss paint or enamel gloss paint shall then be applied.

PSTRU E 03.6 **PAINT THICKNESS**

Unless otherwise specified, all coats of paint, whether prime coat, undercoat or finishing coat, shall have a dry-film thickness of not less than 0,200 mm, irrespective of the method of application.

PSTRU E 03.07 **INSPECTION**

The Contractor shall provide the necessary equipment to establish whether the primers, undercoats and finishing coats have been applied to the correct thickness according to the correct applications. The Engineer may take samples of the paints during painting operations for testing and quality control.

PSTRU E 04 **MEASUREMENT AND PAYMENT**

PSTRU E.01 **BUILDING WORK:**

All building works shall be measured as a complete unit per building or structure. The three buildings that will be measured under these items are the:

i) Guard house
ii) Valve room
iii) Generator room

The guard house will be paid as a single line item for the complete construction of the guard house, including all labour, materials, plant, equipment etc. as per the drawings.
The valve room will be paid as two line items for the comp construction of the guard house, including all labour, materials, plant, equipment etc. as per the drawings. The overhead gantry is measured separately. The concrete works and formwork relating to this building is measured elsewhere.
The generator room will be paid as a single line item for the complete construction of the room, including all labour, materials, plant, equipment etc. as per the drawings. The Genset is measured elsewhere.

The tendered rates shall include full compensation for all labour, plant, equipment, transport, etc, manufacturing or providing and installing each item complete as scheduled and shown on the Drawings, and shall include all corrosion protection where applicable.

Johannesburg Water SOC Ltd

Johannesburg Water

VOLUME 1

PART 4: SITE INFORMATION

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C4 SITE INFORMATION

C4.1.1 GENERAL

This section describes the site at the time of tender to enable the Contractor to price his tender and to decide upon his method of working and programming and risks.

C4.1.2 Site Location

The site is situated on the corners of Anvil and Main Reed Road in Robertsville, Johannesburg.

C4.1.3 Access To Site And Restrictions

Although the works are located on sites within the Employer's property and/or reserve, the contractor may have to obtain permission from JRA to excavate road surfaces in order to execute the works required as part of this Contract. Any other permission as may become necessary shall be the responsibility of the Contractor to obtain.

Having been granted access to works areas by the Employer, other service authorities and private owners, the Contractor shall adhere to any agreed conditions of access and ensure the works area is left in a condition similar to when it was first accessed.

C4.1.4 Existing Services, Servitudes And Wayleaves

A number of existing services have been located through a subsurface detection drawings and others have been marked out on site. Existing services identified are electrical servitude, water pipes and some unidentified anomalies bordering the proposed location of the tower and pump station. For detailed specification the Contractor shall refer to clauses PS1.5 (Temporary Works), PS4.5 (Existing services), and PS4.8 (Permits and wayleaves).

C4.1.5 Security

The Contractor shall be responsible for the security of his personnel, materials, equipment and construction plant on and around the site of the Works and for the security of his camp (if applicable). The Employer in this regard will consider no claims.

Refer to clause PS6.1 (Security)

C4.1.6 Nature Of Ground And Subsoil Conditions

The Geotechnical report is available on request. It shall be the Contractor's responsibility to acquaint himself with the conditions of the site.

C4.1.7 Geotechnical Report And Borehole Cores

The Geotechnical report is available on request.

TECHNICAL SPECIFICATIONS

FOR

CATHODIC PROTECTION & AC MITIGATION

INSTALLATIONS

ON

JOHANNESBURG WATER

BULK STEEL WATER PIPELINES

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1. General Preamble

1.1 Scope

This Specification defines the minimum and mandatory requirements governing the manufacturing, supply, and installation of both Cathodic Protection (CP) and AC mitigation (ACM) systems for Johannesburg Water's bulk water supply pipelines.

The "Client" shall refer to the asset owner's, in this case Johannesburg Water SOC Ltd, Corrosion Engineer or his designated representative.

The "CP Engineer" shall refer to the CP design engineer or his designated representative.

The "Contractor" shall refer to the supply and/or installation contractor.

Unless otherwise agreed by the purchaser's CP Engineer in writing, the materials and specifications used shall strictly follow the clauses of this specification.

The requirements of this specification may not necessarily be repeated in the bill of quantities or typical drawings issued. Thus, this specification must be strictly adhered to.

In the event of any detail that is not fully addressed in this specification and that is warranted to be carried out by the Contractor, the work shall be performed in accordance with the relevant applicable codes and best recognised engineering practices in the cathodic protection (CP/Corrosion) industry.

1.2 Legal Requirements

All works shall be conducted in compliance with the relevant sections of the OHS Act. the Contractor is responsible for ensuring that all personnel are equipped with appropriate PPE.

All materials, plant and equipment shall be the best of their respective kinds and spare parts, replacements and servicing facilities shall be readily available from local sources.

All work shall be carried out by qualified personnel and correctly supervised.

The Contractor shall be required to backfill and compact all excavations and ensure that all waste products and materials are removed from site and safely disposed of. All civil works are to be accepted/rejected by an approved competent civil professional.

Should any requirement of the project specification conflict with any requirements of the standardised or particular specifications listed in the list of specifications, the requirement of the project specification shall prevail.

1.3 Alternative Materials, Equipment & Work

If alternatives pertaining to materials, equipment and work method are submitted, the Contractor shall supply with their quotation/proposal all detailed specifications, designs, calculations, drawings, and a fully priced Schedule of Quantities as per the original quotation and/or any alterations and any further information that may be required by Johannesburg Water for the proper evaluation of the offer.

The attention of the Contractor is particularly drawn to the high standard of materials, workmanship, testing and performance applicable to the Contract as a whole.

Johannesburg Water reserves the right to carry out a factory inspection at their discretion.

Should any requirement or provision of the Project Specification conflict with any requirement of any standardised (SANS) specifications or any drawings, the order of precedence, unless otherwise specified, are:

- Project Specification
- Drawings
- SANS Specifications
- Schedule of Quantities

Note: Any discrepancies will be brought to the attention of the Engineer or designated representative in writing.

When all tests have been successfully completed to the satisfaction of Johannesburg Water, an Operational Acceptance Period shall commence and shall consist of a continuous period of operation of 12 months free from trouble.

During the operational acceptance period the Contractor shall carry out all necessary servicing and any adjustments required at their expense.

1.4 Guarantee Period

The Contractor is required to supply a written guarantee on the items supplied by them for a period of 2 years from date of site acceptance testing (SAT) under continuous working conditions after the successful completion of the abovementioned Operational Acceptance Period. The only exceptions shall be for damages arising from vandalism, mechanical damage, and external fire and/or flooding which are not caused by the Contractor.

Any faults as may be certified by Johannesburg Water due to poor materials, workmanship, or the Contractor’s design (where applicable), shall be remedied and faulty goods replaced entirely at the Installation Contractor’s cost.

The Contractor is responsible for the guarantee of all items under the terms of the tender and for the safe delivery and installation of the equipment and materials, as called for in the Schedule of Rates and Quantities, unless otherwise instructed in writing by Johannesburg Water.

1.5 Safety and Work Procedures

The Contractor shall ensure that a competent person is assigned to the works at all times in terms of OHS Act. The Contractor shall ensure that he complies with all statutory regulations, municipal by-laws, etc. concerning pollution and the health and safety of his personnel and members of the public who may be affected by his work. The Contractor shall provide for all necessary safety precautions and risk assessments and the loss control or safety officer shall prepare a safety plan for the area to be worked in. The Contractor shall advise the Engineer of all hazardous materials to be brought on site.

All electrical commissioning works and tie-ins to Eskom or the relevant power supplier shall be carried out by a qualified Electrician registered with the Electrical Contracting Board of South Africa.

All excavation and construction work shall be carried out strictly in accordance with the relevant Health and Safety regulations of local authorities or relevant departments within the Relevant Metropolitan Area.

Oily or solvent rags shall be kept segregated in closed containers and in minimum quantity. Any spillage of volatile material shall be wiped up immediately. Solvents and volatile materials shall be stored in designated areas.

The Contractor shall provide and erect such scaffolds and rigging as may be required. All scaffolds and rigging shall comply with the requirements of the OHS Act. Temporary welded support elements are not permitted except where written approval has been granted by the Engineer.

The Contractor shall ensure that the relevant electrical, civil, roads, rail or other departments are timeously informed of proposed project works. The necessary wayleave approval for each aspect of the work shall be kept on file for inspection during the project. On completion of the works, the Contractor shall include the wayleave forms with the documentation to be handed over to Johannesburg Water. Furthermore, the Contractor shall ensure that the relevant departments are approached to determine:

- Specific requirements according to the SAECC
- Specific department safety regulations.
- Specific construction restrictions and timing.
- Notification of work requirements.
- Procedures for work approval.
- Location of services that may be affected during construction.
- Public notification requirements to inform residents or business owners of potential disruptions.

The Contractor shall inform Johannesburg Water of the requirements and ensure that the relevant minutes of meetings with departments are kept of record for the duration of the works. The relevant project information and minutes of meetings with third parties shall be copied to Johannesburg Water at the end of the project. the Contractor shall prepare typical Hazard Identification and Risk Assessment forms for each of the major aspects of a construction project namely:

- Excavation, backfilling, and compaction.
- Lifting and moving of heavy equipment on site.
- Operation of machinery on site.

- Road traffic management.
- Working in trenches deeper than 1.5m.
- Managing pedestrian traffic nears construction works.
- Electrical testing, connections, and commissioning.
- Locking out and securing of sensitive areas during normal work hours and after hours.
- Entry into pipes of 800mm diameter or less.

1.6 Handling and Storage

The following precautions shall be taken for the site storage and handling of supplied items:

- All coated components shall be handled using soft slings and/or acceptable methods that will not cause damage.
- All components to be transported shall be loaded with support blocks, packaging and packing between pieces and tight lashing to avoid chafing.
- Off-loading at site shall be conducted using the same care and precautions for on-loading. Components shall not be tipped off the transportation.
- Coated corrosion protection items shall be stored under cover where possible.
- Items not stored under cover shall be stored in such a manner as to avoid retention of water and allow good air circulation.
- Items shall be stored on baulks of timber to raise the lowest level above the rain splash zone.
- Items shall be stacked using timber packing or other approved means to avoid item- to-item contact. Sufficient bearing area of packing shall be used to avoid damage to items.

1.7 Cathodic Protection Design Requirements

The Cathodic Protection system requirements i.e. design life, type, materials, supply, and installation method shall be as specified by the CP Engineer. The buried / immersed steel components should be designed to be accessible for the purposes of supplying, installing, applying, inspecting, and maintaining the CP system.

The guidelines to ensure accessibility and suitability for maintenance and upkeep of the complete CP system shall be drawn from SANS 15589 “Cathodic Protection of Pipeline Transportation systems; Part 1 On-Land pipelines”.

1.8 Qualified Staff

The Contractor shall ensure that there are at all times sufficient suitably qualified, experienced, and skilled staff to carry out and supervise all activities.

1.9 Quality Assurance

1.9.1 Contractor Qualification

All material, certification and records of the Contractor will be subject to examination by the CP Engineer. This shall include the checking and testing of the equipment. If any deviation to

the approved QCP or product quality is found, the Contractor may be instructed to perform additional testing and quality surveillance, at no additional cost to the Client. The CP Engineer may, at his discretion, require a Quality Audit of the Contractor's facility to ensure that he has the management, facilities, and skilled staff to carry out the work in accordance with the specification.

The Contractor shall accept full responsibility for the quality of his work and of materials used, irrespective of any quality surveillance that may be carried out by The CP Engineer.

1.9.2 Quality Control

The Contractor shall have the necessary equipment and qualified staff to carry out the quality control required to ensure compliance with the specification.

Quality control shall be carried out by a qualified inspector who is independent of the installation or construction activities. Quality control cannot be carried out by the site supervisor, or any member of staff involved in production and programming.

The Contractor shall keep at least the following records:

- Material Batch Records
- Site Data Sheets Records
- Records of Specific Tests as required by The CP Engineer

These records shall be kept in a format that meets the approval of The CP Engineer. The cost of quality control shall be included in the Contractor's tender price.

Before the commencement of the contract, the Contractor shall prepare a Quality Plan detailing each activity to be carried out during the execution of the works. Each activity shall be supported by a detailed Works Procedure for that activity. The Quality Plan will also detail the inspection requirements of each specific activity, listing whether it be a review, witness or hold point, and define the responsibilities of the various parties at each stage of the works.

The Contractor shall provide the necessary documentation to be used during these inspections. Such documentation shall be reviewed and approved by The CP Engineer beforehand.

1.9.3 Quality Surveillance

The CP Engineer or his representative shall perform independent quality assurance inspections.

For the purpose of carrying out quality surveillance, the CP Engineer shall be granted access to any part of the Contractor's premises relevant to the work being carried out, at any reasonable time. The Contractor shall provide, at his own cost, any equipment or labour necessary to gain access to the works that are in progress.

The CP Engineer or his representative may remove any reasonable samples of materials to carry out testing. Rejection of the samples will place a hold on the use of material of the same batch number and may lead to rejection of all that batch of material and the reworking of any components that have already been worked on with rejected material.

The CP Engineer may carry out reasonable destructive tests at his sole discretion to ascertain compliance with the specification.

A report shall be compiled by the CP Engineer for each visit. A copy of the report will be given to the Contractor on completion of each surveillance visit.

In the event that the materials pass the destructive testing, the Contractor will be entitled to bill the Client for destroyed materials. In the event that the materials fail the destructive testing, the Contractor will not be compensated for the destroyed materials.

1.10 Completion and Handover Documentation

The Contractor shall, on completion of a project provide full documentation for all installed equipment and materials including as-built drawings, data sheets, operations, and maintenance manuals etc. The documentation shall be provided in the form of 1 full colour hard copy and one electronic PDF on a USB C Memory Stick (flash drive).

2. Relevant Specifications

Below is a list of typical relevant specifications that may be used in the execution of a project. Where applicable, items specified in this document shall comply with the latest revision of the stated specifications and other specifications quoted or referred to within these documents:

NOTE: Where there is a contradiction, the project specification takes preference. The exact specifications to be used will be specified by the CP Engineer at the Pre-Job Conference also known as the “kick-off” meeting.

American Society for the Testing of Materials (ASTM)

ASTM B265-20a (2020) Standard specification for titanium and titanium alloy strip, sheet, and plate

ASTM B338-17 (2021) Titanium Alloy for Heat Exchangers

ASTM A518/A518M-99 (2022) Specification for corrosion resistant high silicon iron castings

ASTM G57-20 (2020) Method for field measurement of soil resistivity using the Wenner Four Electrode method

ASTM D293/D293M-18 (2018) Standard Test Method for the Sieve Analysis of Coke

British Standards Institution (BS) Specifications

BS EN IEC 60076 Power Transformers

BS 1016 Methods for analysis and testing of coal and coke

BS 1872 Specification of electroplated coatings on tin

BS 6001 Sampling Procedures for Inspection by Attributes

International Electrotechnical Commission (IEC) Publications

IEC 60038 2009 Standard voltages

IEC 60028 International Standard of Resistance for Copper.

IEC 60051 Direct Acting Indicating Analogue Electrical Measuring Instruments and their Accessories.

IEC 60071 Insulation Co-ordination.

IEC 60076 Parts 1-5 Power Transformers.

IEC 60144 Degree of protection of enclosures for low voltage switchgear and control gear

IEC 60146 Semiconductor Converters.

IEC 60189 PVC Insulation and PVC Sheath.

IEC 60269 Low voltage fuses – Fuses mainly for Industrial applications.

IEC 60445 Identification of equipment terminals and of Terminations of certain designated Conductors, including general rules for Alphanumeric system.

IEC 60616 Terminal and tapping markings for power transformers.

National Association of Corrosion Engineers (NACE)

NACE SP0169	Control of External Corrosion on Underground or Submerged, Metallic Piping Systems
NACE SP0177	Mitigation of Alternating Current and Lightning Effects on Metallic Structures and Corrosion Control Systems
NACE SP0188	Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.
NACE SP 0207	Performing close-interval DC pipe-to-electrolyte potential surveys on buried or submerged metallic pipelines
NACE SP0286	Electrical Isolation of Cathodically Protected Pipelines NACE SP0502 Pipeline External Corrosion Direct Assessment Methodology
NACE SP0572	Design, Installation, Operation and Maintenance of Impressed Current Deep Groundbeds
NACE RP 0104	The Use of Coupons for Cathodic Protection Monitoring Applications
NACE TM 0102	Measurement of protective coating electrical conductance for underground pipeline
NACE TM 0109	Techniques for aboveground evaluation of the coating condition of underground metallic pipelines
NACE TM 0497	Measurement Techniques Related to Criteria for Cathodic Protection on Underground or Submerged Metallic Piping Systems
NACE Pub 10A190	Measurement Techniques Related to Criteria for Cathodic Protection of Underground or Submerged Steel Piping Systems

NACE Pub 10A196 Impressed Current Anodes for Underground Cathodic Protection Systems

South African National Standards (SANS)

SANS 10142-1 2021 (Ed 3.01)	The wiring of premises Part 1: Low-voltage installations
SANS 1091 2012 (Ed 2.01)	National colour standards for paint
SANS 10129 2011 (Ed 1.02)	Plastic tape wrapping of steel pipelines.
SANS 10140 - Part 1 2008 (Ed 2.01), Part 2 2008 (Ed 2.03), Part 3 2017 (Ed 3.01):	Identification - Colour Marking.
SANS 10064 2011 (Ed 3.01)	Preparation of steel surfaces for coating.
SANS 121 2011 (Ed 2.0)	Hot dip galvanised coatings on fabricated iron and steel articles.
SANS 1700-7-1 2003 (Ed 2.0)	Fasteners (Hexagonal Head Bolts)
SANS 122-2020 (Ed 1.04)	Pressure-sensitive adhesive tapes for electrical purposes (Metric Units)
SANS 10199 2016 (Ed 2.02)	The design and installation of an earth electrode specifications
SANS 10313 2018 (Ed 3.03)	Protection against lightning – Physical damage to structures and life hazard
SANS 1063 2020 (Ed 4.01)	Earth rods, couplers, and connection
SANS 1411-1 2020 (Ed 2.02)	Materials of insulated electric cables and flexible cords Part 1: Conductors
SANS 1411-2 2014 (Ed 2.04)	Materials of insulated electric cables and flexible cords Part 2: Poly-Vinyl-Chloride (PVC)
SANS 1411-3 2014 (Ed 2.03)	Materials of insulated electric cables and flexible cords Part 3: Elastomers
SANS 1411-4 2014 (Ed 2.04)	Materials of insulated electric cables and flexible cords Part 4: Cross-linked Polyethylene (XLPE)
SANS 1411-5 2017 (Ed 3.03)	Materials of insulated electric cables and flexible cords Part 5: Halogen free, flame-retardant materials
SANS 1411-6 2008 (Ed 2.01)	Materials of insulated electric cables and flexible cords Part 6: Armour
SANS 1507-1 2020 (Ed 1.02)	Electric cables with extruded solid dielectric insulation for fixed installations (300 / 500 V to 1900 / 3300 V) Part 1: General
SANS 1507-2 2018 (Ed 1.03)	Electric cables with extruded solid dielectric insulation for fixed installations (300 / 500 V to 1900 / 3300 V) Part 2: Wiring cables
SANS 1507-3 2020 (Ed 1.04)	Electric cables with extruded solid dielectric insulation for fixed installations (300 / 500 V to 1900 / 3300 V) Part 3: PVC distribution cables

SANS 1507-4	2022 (Ed 1.06)	Electric cables with extruded solid dielectric insulation for fixed installations (300 / 500 V to 1900 / 3300 V) Part 4: XLPE distribution cables
SANS 1507-6	2021 (Ed 2.01)	Electric cables with extruded solid dielectric insulation for fixed installations (300 / 500 V to 1900 / 3300 V) Part 6: Service cables
SANS 15589	2009 (Ed 1) Part 1	Petroleum and natural gas Industries – Cathodic Protection of pipeline transportation systems. Part 1: On-land pipelines.
SANS 50162	2010 (Ed 1.00)	Protection against corrosion by stray current from direct current systems.
SANS 53509	2009 (Ed 1.00)	Cathodic Protection measurement techniques
SABS 10142-1	2021 (Ed 3.1)	Wiring of Premises - LV Installations
SANS 10108	2023 (Ed 7.00)	The classification of hazardous locations and the selection of equipment for use in such locations
SANS 60529	2013 (Ed 1.2 and IEC Corr 1, 2)	Enclosures for electrical equipment classified by IP code
SANS 10086-1	2023 (Ed 4.02)	The installation, inspection and maintenance of equipment used in explosive atmospheres Part 1: Installations including surface installations on mines

The relevant SANS Standardised Specifications for Civil Construction shall apply.

It shall be the responsibility of the Contractor to obtain at his own expense, copies of the relevant editions of the documents referred to above. Subsequent amendments or revisions to these documents that have direct bearing on the project specification shall be clarified in writing with The CP Engineer before construction commences.

In addition to this, all elements of the Contract Documents shall be available for inspection on Site at all times.

3. Glossary of Terms / Definitions

AC:	Alternating Current
ACM:	Alternating Current Mitigation
Anode:	The electrode of an electrochemical cell at which oxidation occurs. Electrons flow away from the anode in the external circuit. Corrosion usually occurs and metal ions enter the solution at the anode.
Anode Groundbed:	One or more anodes installed below the Earth’s surface for the purpose of providing a long-lasting, corrosion-resistant, positive connection to earth in a cathodic protection system, that enables the required current to pass into and through the electrolyte to the steel surface to be protected. A sacrificial anode groundbed sacrifices itself in favour of the steel structure being protected.

Bill of Quantities (BOQ):	The pricing instructions that are in the tender document that contains the quantities to be supplied or installed.
Bonding:	A method of connecting metal surfaces to each other by cable using exothermic or pin brazing techniques; often used to establish electrical continuity along pipelines coupled with mechanical joints.
Cathode:	An electrode of an electrochemical cell at which reduction (gain of electrons) is the principal reaction. Electrons flow toward the cathode in the external circuit.
Cathodic Protection:	The process to reduce or prevent corrosion of metal structures in contact with an electrolyte by the flow of direct current from the electrolyte into the structure surface.
Client:	The “Client” shall refer to the asset owner’s Corrosion CP Engineer or his designated representative.
Continuity Bonding:	A suitable electrical connection, usually metal, that provides electrical continuity between structures that can conduct electricity.
Contractor:	The supply and/or installation contractor.
CP Engineer:	The individual appointed by the Client who may be internal to the organisation or an outsourced Professional Service Provider.
Current Drainage Survey:	Survey aimed at determining the amount of DC current required to render a particular structure cathodic to accepted criteria.
DC:	Direct Current
Drain Point:	The point on the pipeline where the connection of the negative terminal of the cathodic protection voltage source is made to conduct (drain) the returning current from the pipeline to the foreign voltage source.
Electrolyte:	A conductive liquid or material such as soil or water in which an electric current can flow.
Earth Spike:	16 mm diameter, threaded type, 1.5 m long electroplated SANS 1063.
Earth Cable:	70 mm^2 bare stranded copper
Exothermic Welding:	An exothermic welding process that makes use of copper oxide and aluminium powder to weld copper cables to a pipe or other steel structure.

Flange:	A mechanical joint comprising two flush steel faces, usually at pipe ends, used to join pipe lengths.
Forced Drainage Unit (FDU):	A unit comprising of a TRU and a bypass diode connected between pipe and rail.
Foreign Structures/Pipelines:	Metal structures or pipelines other than that under consideration in contact with the same electrolyte as the structure/pipeline and which are or may become under the influence of the structure/pipeline's cathodic protection system.
Impressed Current:	A DC electric current supplied by a device employing a power source that is external to the electrode system.
Insulating Flange:	An insulating flange typically comprises a gasket of phenol resin with insulating sleeves over high tensile bolts fitted with insulating washers. The purpose of the isolating flange is to stop current flow between a pipe and structural steel or earthing systems.
"IR Free" potential:	The pipe-to-soil potential measured immediately after the cathodic protection system is switched off and the applied electrical current stops flowing to the pipeline surface, but before polarisation of the pipeline has decreased.
Monitoring Enclosure:	An enclosure designed to house recording equipment for monitoring purposes.
Natural Drainage Unit (NDU):	An electrical device comprising a diode and surge protection units linked between pipe and rail to allow the flow of current back to the rail under certain conditions.
Natural Potential:	The pipe-to-soil potential measured shortly after installation of the pipe when the soil has been backfilled and compacted. No cathodic protection is applied, polarisation caused by cathodic protection is absent and no significant stray current is present.
OEM:	Original Equipment Manufacturer
"OFF" Potential:	The pipe-to-soil potential measured immediately after the cathodic protection system is switched off and the applied cathodic protection electrical current stops flowing to the pipeline surface but may still include stray current or foreign service interference in the measured value.
"ON" potential:	The pipe-to-soil potential measured while the cathodic protection system is continuously operating.
O&M:	Operations and Maintenance Manual (also OMM)

Pipe-to-Soil Potential:	The difference in electrochemical potential between a pipeline or foreign structure/pipeline and a specified reference electrode in contact with the electrolyte. Similar terms such as structure-to-soil potential, pipe to electrolyte potential are sometimes used as applicable in the particular context.
Polarisation:	The change of the pipe-to-soil potential caused by the flow of DC current between an electrolyte and a steel surface.
Reference Electrode:	An electrode with an open circuit potential that is constant under similar conditions of measurement, which is used for measuring the relative potential of other electrodes or metals under varying electrolyte environments.
Sacrificial Anode System:	Anodes manufactured from materials that are sacrificed preferentially when placed in a galvanic couple with another metal i.e. Magnesium coupled to steel in soil.
SRE:	Stationary Reference electrode
Stray Current:	Current that flows through paths other than an intended circuit i.e. current flow though the soil that originated from a DC traction railway line. The current may cause interaction with the cathodic protection system and often acts upon foreign structures and/or pipelines.
Transformer Rectifier Unit (TRU):	An electrical device designed with the purpose of stepping down either single or three phase power to a suitable voltage and then rectifying the power supply to provide a suitable DC output.
Viking-Johnson Type Coupling:	A coupling that uses a rubber seal on both sides of the coupling barrel, allowing flexibility of the joint, but also electrically insulating one length of pipe from another.

4. Cathodic Protection and AC Mitigation Materials

4.1 Impressed Current Anode Groundbed Materials

4.1.1 Mixed Metal Oxide Anodes

The anode construction shall be as follows:

Substrate	Ductile Pure Titanium
Length	1000mm
Diameter	25mm

Weight	910g
Anode Coating	Mixed Metal/Metal Oxide Plasma Sprayed or alternative ceramic.
Environment	Must be able to support oxygen and hydrogen evolution.
Tail cable	16mm^2 PVC/PVC
Output current	8 Amps
Life expectancy	20 years at 8 Amps

The ceramic mixed metal/metal oxide coating must withstand the evolution of oxygen and chlorine and be compatible to ASTM B338, CP Titanium Grade 1 or 2.

Cable connection is to be at the centre of the anode, care has to be exercised so that no copper is exposed beneath the titanium tube which could result in anode string burnout.

The ends of the tubes have to be effectively sealed against ingress of moisture.

The cable to titanium tube connection resistance should be less than 500μΩ.

Anode tail cables shall be of sufficient length to connect directly with the ring main cable or distribution cabinet without buried splices.

Anodes are to be supplied with a certificate from the supplier confirming compliance with specification.

An anode from each supply batch may be randomly selected and tested by an accredited third-party laboratory as detailed below.

Test	**Minimum requirement / test method**
Test solution	10 % by volume Sulphuric Acid (H_2SO_4)
Test temperature	Less than 50`C for duration of the test
Test current density	20 000A/m^2 minimum
Test duration	Minimum of 36 days at the specified current density
Coating adhesion test	The coating adhesion shall comply in full to ASTM B571
Metallurgical/SEM analysis	Anodes will be sectioned and the MMO/PMO coating verified

4.1.2 High silicon Iron Anodes

The silicon iron anodes shall be centrifugally cast tubular anodes and manufactured in accordance with BS 5750 or IS0 9002.

The anodes shall typically have an external diameter of 71mm and an internal diameter of 45mm and be nominally 1 065mm long.

The anode shall possess a steel terminal, which shall be located centrally within the walls in order to ensure that the anode is consumed uniformly and to ensure that a balanced spread of current is achieved throughout its length.

A PVC/PVC (double insulated), colour red, stranded copper cable 16mm² shall be brazed to the steel terminal. The connection area shall be filled with a two pack, solvent free epoxy resin. The epoxy shall be cast in two separate installations for each end.

Great care must be taken to ensure that the brazing does not damage the PVC insulation. Care must also be taken to ensure that the epoxy covers a minimum of 30mm of the PVC/PVC insulation of the cable.

The anode connection and encapsulation shall be suitable for continuous use in wet conditions for 20 years.

The anode shall be free from internal porosity, blowholes, cracks, or inclusions.

The weight of the anode, without cable and epoxy shall be a minimum of 14kg and possess a minimum density of 7,0 g/ml.

The anode life shall be 40 Amp years minimum as determined for use without coke.

4.1.3 Anode and Spacer Canisters

Anode and spacer canisters are to be made up from galvanised spiral ventilation ducting with the ends being sealed with galvanised endcaps which are to be secured to the canister wall by means of pop rivets. Dimensions of canisters are given elsewhere.

Anode canisters are to be fitted with a PVC cable gland sized to match the anode tail size. The gland is to be installed at one end of the canister through the side wall.

Anodes are to be centralised in the anode canisters both radially and longitudinally and filled with calcined pitch coke.

Spacer canisters are to be filled with coke only.

During filling of canisters, the material is to be firmly tamped to ensure no cavities or air pockets form.

The assembled canisters are to be sufficiently robust to withstand transport, handling, and installation.

4.1.4 Calcined Pitch Coke

Calcined pitch coke to meet the following specification:

Table 1: Calcined Pitch Coke Specification

Element	Limits	Test Method
Fixed Carbon	99.50% min	ASTM D 4239-94
		100% (%Ash+%VCM)
Ash and Volatiles	0.25% max	ASTM D 4422-89
		BS 1016 Part 4
Sulphur	0.25% max	ASTM D 4239-94
Moisture	0.15% max	ASTM D 3173-78
Bulk Density	1200 Kg/m3	ASTM D 527
	200 kPa	0.2180 ohm-cm
Resistivity Vs Pressure	400 kPa	0.1509 ohm-cm
	600 kPa	0.1139 ohm-cm
	800 kPa	0.0959 ohm-cm
	1000 kPa	0.0831 ohm-cm
Particle Size Distribution	95% between 0.15 and 1mm	ASTM D 293-69

4.1.5 Cable Jointing Kits

Cable jointing kits are to be of the low voltage type for 600/1000V insulated cables and are to comprise of the following:

- Two-part resin in transparent two chamber bag with integrated closed mixing and pouring (CMP) system. The resin expiry date is to be indicated on the resin packaging.
- Translucent mould body with snap fit closing system. Straight moulds are to be used for straight cable joints while branch moulds are to be used for anode tail to ring-main connections.
- Pre-cut foam sealing elements to provide reliable sealing to the mould body for all cable application diameters.
- Closure cap to prevent contamination.
- Suitably sized ferule or brass line tap for straight or branch cable connection respectively.

4.2 Transformer Rectifier Units

4.2.1 Manual Tap Change Transformer Rectifier Unit

4.2.1.1 General

The TRU is to comprise a step down, double wound Transformer requiring either a 240V or 380V supply, and a rectifier bridge to produce a DC output.

The TRU output voltage and output current are given in the bill of quantities. The Transformer shall be double wound and continuously rated in accordance with BS 171. The transformer shall have an earth screen between the primary and secondary to intercept voltage transients, and the insulation on the primary shall be able to withstand 16kV between phases and between phases and earth.

The transformer shall have suitable taps on the primary, or secondary windings, connecting to brass terminals for selection of the voltage. The latter shall have an insulating cover in order to prevent accidental contact with the live circuit.

The transformer must be capable of maintaining the output voltage constant within the designated current rating.

The Rectifier bridge shall consist of silicon diodes connected for full wave rectification and rated at twice full load current. Each diode shall be rated at 1600 PIV, and for continuous operation at 120`C. The diodes are to be mounted on aluminium heat sinks which will be cooled by convection cooling.

The diodes are to be screwed into the heat sink using a heat conducting paste which shall exclude moisture and care must be taken to apply the correct torque value when screwing in the diode.

The output voltage shall be adjusted manually by means of two rotary (tap) switches connected to taps on the primary or secondary of the Transformer. These shall be of the knife action type suitable for "on load" switching and sealed against the ingress of dust.

One tap switch shall be for coarse adjustment at 4 equal voltage intervals equal to 25% of the total voltage rating and one for fine switching at 4 equal voltage intervals equal to 25% of the coarse voltage intervals.

Protection against current surges shall be provided by means of a circuit breaker and fuses. The circuit breaker shall of the thermal or magnetic type and located in the primary circuit before the power transformer. The circuit breaker must engage/disengage all phases of the AC supply and be capable of completely isolating the TRU except the 16A 220V switched socket.

A fuse is to be located in in each of the phases between Transformer secondary and the bridge, and also on each of the positive and negative legs. The fuses must not only be capable of failing on a short circuit, but also when the output current exceeds the rated current by 40% and such that no part of the circuit is damaged.

A 0.5mH choke capable of continuously carrying the full load current is to be included in each of the positive and the negative legs immediately before the output terminals.

A shunt is to be included between the Rectifier bridge and the choke on the negative leg and connected to an ammeter for current measurement. The shunt is to be such that 1mV corresponds to 1 Amp.

The TRU is also to be fitted with surge protection devices and meters, the details of which are described below.

4.2.1.2 Meters and Monitors

The TRU shall include the following meters.

DC voltmeter for measurement of output voltage

DC voltmeter for measurement of pipe potential

DC ammeter for measurement of output current

DC hour meter

AC Voltmeter for measurement of AC supply voltage between phases.

kWhr meter

The pipe potential voltmeter is to be digital with a minimum input impedance of 10 megohms. The height of the LC display digits shall not be less than 12,5mm with an accuracy of 1,5% at maximum reading.

The pipe potential voltmeter shall be connected to the "pipe monitoring" terminal and the "reference electrode" terminal. The "pipe monitoring" terminal shall not be connected to the "pipe" terminal.

All other meters are to be analogue. The two DC voltmeters and DC ammeter are to be individually connected to a toggle switch, which must engage/disengage both leads to the meter.

The analogue meters shall be 96mm square with an accuracy of 1,5% at maximum reading.

All meters shall be discreet, sealed, and flush mounted (except for the kWhr meter).

The meters shall be labelled as follows:

Output Voltage	Reference Potential
Output Current	DC Hour Meter
kWhr Meter	AC Voltage

Two differently coloured captive terminal sockets (female banana jacks) must be located beneath each of the output voltmeter, output ammeter and reference voltmeter, to enable one to check that the meters are reading correctly. The value of the shunt must also be indicated below the ammeter e.g. 50mV 50A. The banana jack connected to the pipe must also be indicated for the output voltmeter, and the two banana jacks for the reference voltmeter must also be indicated.

The DC hour meter shall indicate the time the DC current has been flowing. Tenderers are to supply details of the DC hour meter circuit.

The DC output voltmeter shall have a "glass" type fuse in each lead.

Note: Female banana jacks must not be supplied for testing of the AC voltage.

4.2.1.3 Surge Protection

Indoor type lightning arrestors shall not be used.

Moving away from the rectifier bridge towards the output terminals, surge protection will be sequentially installed as follows:

Two off DehnGuard S 275 or equivalent, are to be connected in series between positive and negative legs. Between the two S 275 devices, a connection to the earth bar is to be made via a DehnGuard S 275. In addition to the above, a DehnGuard S 600 or equivalent, in parallel is to be connected between the positive and negative legs.

Followed by:

Between positive leg and earth, two parallel DehnGuard S 150 MOV in series with a Dehn Ex-FS (120kA) spark gap with Cu-W electrodes. Between the two DehnGuard S 150 and the spark gap described above, a Dehn Ex-FS (120kA) spark gap shall be connected to the negative leg. All spark gaps to have Copper Tungsten electrodes.

All the diodes are to have their own individual R - C snubber network.

4.2.1.4 Wiring and Busbars

Wherever possible flexible, multistrand cable is to be used.

Joints or splices in any wiring will not be permitted. Not more than two conductors shall be connected to any one terminal.

All conductors shall be numbered at both ends with reference to the Schematic Wiring Diagram supplied.

All conductors excluding busbars shall be routed in trunking or harnessed.

Busbars shall be aluminium or tinned copper. The latter shall be tinned after cutting, forming, and drilling. Tinning shall be in accordance with Grade Sn6C of BS 1872.

Busbar joints shall be bolted, and the mating surfaces coated with petroleum jelly or a similar water repellent paste prior to assembly.

Bolted joints shall be provided with spring washers. Fasteners on aluminium busbars shall be tinned or cadmium plated.

4.2.1.5 Colour Coding and Labelling

The following colour codings should be adhered to:

Positive electrical cables : Red

Negative electrical cables	:	Black		
Earth cables	:	Green/Yellow		
Electrical supply cables	:	(1st phase)	:	Red or Brown
		(2nd phase)	:	White
		(3rd phase)	:	Blue
Cable for reference electrode	:	Red		
Electrical warning signs	:	Black on yellow background		
Monitoring cable	:	Black		

Power transformer secondary cables shall be grey, and they are to have an approximately 30mm heat shrink sleeve at either end, the colour of which is to be red (brown), white or blue as appropriate to the phase.

If busbars are used on the power transformer secondary, they are to be insulated by means of a yellow heat shrink sleeve.

All components and/or components assemblies shall be labelled.

Labels shall cross reference to the circuit diagram.

Labels shall be of the engraved type (multi-layered phenolic plastic) with black letters on a white background except the positive output terminal label which shall be in white letters on a red background. Alternatively aluminium silk screen labels may be used. Labels shall be in upper case letters with a height of 6mm for component labels and 10mm for output terminal labels.

Output terminals shall be labelled as follows:

+ GROUNDBED

- PIPE

PIPE MON

REF ELECT

EARTH

Labels shall be fixed by means of screws or pop rivets such that they shall not become dislodged during the life of the unit. Screws and rivets to be brass or aluminium. Cable tags to be plastic.

Cables shall be identified by means of permanently marked ferrules with black lettering on a white background. Ferrules shall be slip-on-type and matched to the size of the cable.

Ferrules shall be situated so as to read right way up on horizontal cables and from lug to insulation on vertical cables.

4.2.1.6 Cable Ends and Terminals

Cables shall be terminated at each end by means of lugs.

Control cable lugs shall be pre-insulated or insulated by means of heat shrink sleeves.

Power cable lugs shall be insulated by means of heat shrink sleeves or slip-on rubber shrouds colour coded as follows:

AC	:	Red, White, and Blue according to phase.
DC Positive (Groundbed)	:	Red
DC Negative (Pipe)	:	Black

All terminals shall be completely accessible after completion of all wiring.

Terminals on power connections shall be provided with lock nuts and washers.

Output terminals shall be fully insulated from the metal of the housing and shall comprise brass bolts, each provided with nuts, lock nuts, washers, and tinned copper cable lugs suitable for the specified cable size.

The negative terminal shall be M10 and the positive terminal M16.

Separate terminals size M6 shall be provided for the pipe monitoring cable, and reference electrode.

A 10mm diameter hole shall be drilled in the earth bar in order to facilitate connection via a lug to the earth cable.

4.2.1.7 Earthing

The surge diversion units shall all be connected to the common earth incorporating the primary AC supply earth, transformer screen and the transformer rectifier housing.

The common earth will consist of 30 x 3mm tinned copper or 40 x 5mm aluminium busbar.

On installation, the common earth shall be connected to a local earth by means of two 35mm² copper cables. The local earth is to be constructed so as to ensure a resistance of 10 Ohms or less is achieved.

All electrical circuits shall be floating with respect to earth.

4.2.1.8 Spares

The following spares are to be supplied with the TRU:

Fuses	:	three of each type and rating used
Diodes	:	two of each type and rating used
MOV	:	five of each type and rating for R-C network; 2 for all other MOV
Spark Gaps	:	one of each type and rating

The spares are to be mounted on the inside of the cabinet door.

4.2.1.9 Auxiliary AC Supply

The TRU shall be provided with a standard 220V single phase 16A 3-point plug for providing power to auxiliary devices. The auxiliary AC supply is to be protected by an earth leakage device. The three-point plug shall be connected to the input side of the main circuit breaker such that power is still available even if the main circuit breaker has tripped.

4.2.1.10 Inspection and Testing

The following tests shall be carried out at the Manufacturer's works. All equipment shall satisfactorily pass such tests and a test certificate made available to the CP Engineer. All testing shall be carried out at the Manufacturer's expense.

In the event that any of the tests detailed below, or the complete inspection, is waived, then this shall not release the Manufacturer from his obligation to supply completely satisfactory equipment or warranted performance as specified, and to supply "type test" results from essentially similar units.

4.2.1.10.1 Insulation Tests

The apparatus shall withstand a 1KV insulation test from the AC input to frame, DC output to frame, and primary to secondary sides of the main transformer.

The insulation test described earlier shall be repeated immediately on conclusion of the heat run test.

4.2.1.10.2 Efficiency Tests

Efficiency tests shall be carried out at 25%, 60% and 100% of maximum current at full rated voltage. A minimum efficiency of 65% is to be achieved.

4.2.1.10.3 Heat Run Tests

The units shall be run for at least 6 hours continuously at maximum current and voltage output with all the doors closed. The difference in temperature between the inside of the transformer rectifier and ambient shall be plotted against the time (in hours) and the test run until there is no increase in temperature difference (the curve levels off).

The maximum temperature difference increase shall be not more than 20`C.

A similar temperature time test shall be carried out on the main power rectifier bridge heat sink. The maximum temperature difference between heat sink and TRU internal shall not be more than 50`C.

The maximum temperature that may be obtained in the cabinet under any circumstances is 65`C.

4.2.1.10.4 Current Overload Tests

Tests shall be carried out to ensure that the circuit breaker or fuse operate under conditions where the current exceeds the rating of the TRU in a slowly rising mode. For this test the current is to be increased at 10A intervals every half hour starting from the TRU rating until one of the fuses or breaker operates. The results are to be entered into the performance test certificates.

The CP Engineer may also call for other tests to prove compliance with the specifications.

The tests shall be carried out in the presence of the CP Engineer. The successful Tenderer will issue a Test Certificate on completion of Tests which shall be signed by the CP Engineer.

4.2.1.10.5 Documentation

The Transformer Rectifier shall be supplied with the following:

(1) Wiring / Circuit diagram with component list

(2) Operations and Maintenance Manual

The above are to be mounted inside of the unit.

The Wiring Diagram with Component List are to be encapsulated in polyester fibreglass, mounted on an aluminium plate which shall be fixed by means of wing nuts to four studs welded to the TRU frame, thus rendering the drawing removable.

Six copies of the Operations and Maintenance Manuals are to be supplied to the CP Engineer for forwarding to the Client. The manual is to include a detailed fault finding / troubleshooting procedure.

4.2.1.11 Guarantee

The equipment shall carry an unconditional two-year guarantee except for damages arising from vandalism, mechanical damage, external fire, flooding, or ground subsidence caused by mining or earth tremors. The unit shall operate continuously on site for a period of 2 weeks after which the 2-year guarantee will commence.

4.2.2 Automatically Controlled Transformer Rectifier Unit

4.2.2.1 General

The TRU is to comprise a step down, double wound Transformer requiring a 220V or 380V supply, and a rectifier bridge to produce a DC output.

The TRU output voltage and current is given in the bill of quantities. The transformer shall be double wound and continuously rated in accordance with BS 171. Single wound (auto) transformers are not permitted except as a means of controlling the primary current of the main double wound transformer. The transformer shall have an earth screen between the primary and secondary to intercept voltage transients, and the insulation on the primary shall be able to withstand 16kV between phases, and between phases and earth.

The Transformer shall have suitable taps on the primary or secondary windings, connecting to brass terminals for coarse selection of the voltage. These shall have an insulating cover in order to prevent accidental contact with the live circuit. The voltage taps shall be equivalent to 40, 60, 80 and 100V DC for the 100V unit, 25, 50 and 76V DC for the 76V unit and 20, 35 and 50V DC for the 50V unit.

Protection against current surges shall be provided by means of a circuit breaker and fuses. The circuit breaker shall of the thermal or magnetic type and located in the primary circuit before the power transformer. The circuit breaker must engage/disengage all phases of the AC supply and be capable of completely isolating the TRU except the 16A 220V switched socket (see latter).

A fuse is to be located in one of the legs (for single phase) and on each of the phases (for three phase) between Transformer secondary and the bridge, and also on each of the positive and negative legs. The fuses must not only be capable of failing on a short circuit, but also when the output current exceeds the rated current by 40% and such that no part of the circuit is damaged.

A 0.5mH choke capable of continuously carrying the full load current is to be included in the negative and positive legs immediately before the output terminals.

The Rectifier bridge shall consist of six silicon thyristors Semikron or equivalent, connected for full wave rectification, which shall be rated at twice full load current and 1600 PIV. The thyristors shall be rated for continuous operation of 120`C and are to be mounted on aluminium heat sinks which may be cooled by convection cooling or forced cooling. If forced cooling is employed the heat sink may be mounted anywhere in the cabinet, but the heatsinks must have a thermal switch which will stop the operation of the unit if the temperature rise is excessive, and which will automatically reset once the temperatures has dropped. The heat sinks are to be mounted on the lower half of the cabinet if the convection cooling method is employed.

Care must be taken not to exceed the manufacturer’s torque value when screwing in the thyristor. The thyristors are to be screwed into the heat sink using a heat conducting paste which shall exclude moisture.

The output voltage shall be infinitely variable by means of an electronic control circuit acting on the thyristors. This circuit shall also have current limiting facilities. Both the "constant current" and "current limit" facilities are to act on the total output current and not on the Rectifier part of the circuit or the bypass circuit.

Units which use the rails as the anode have a bypass diode; the latter is simply a power diode capable of shunting excessive currents (several hundred amps) from pipe to rail without going through the Transformer or Rectifier circuit. The bypass diode is located close to the DC output terminals.

A DC current transformer shall be included between the rectifier bridge and the choke and connected to an ammeter for measurement of Rectifier Current.

A current measuring shunt is to be located on the negative leg with the measuring cables terminating at two female banana terminals under the DC ammeter. The shunt is to be such that 1mV corresponds to 1A.

In parallel with the negative cable, a monitor cable shall be connected to the pipeline and connected to the monitor terminal. This cable shall not carry "current" and is to be used only for measurement of pipe-to-soil potential.

4.2.2.2 Control Circuit

The control circuit shall control the firing of the thyristors and perform the following functions:

(1) Maintain output current constant at any preset value

(2) Maintain pipe potential constant at any preset value

(3) Have current limit facility at any value of output current

All the above functions shall be carried out by one Control Card. All the connections to the Control Card are to be by means of a plug-in ribbon cables.

The TRU must have a ready mounted spare Control Card such that in the case of failure of the one card the ribbon cable may be disconnected and connected to the spare card.

The current limit facility shall be adjustable from 0 - 100% of current output via a suitable wire wound pot and the knob must be set (calibrated) against a graduated scale marked 0 - 10, with 10 the maximum output of the TRU.

When operating in the constant potential mode, in the event of failure of the monitoring or reference cables, or of the reference electrode itself, the TRU must operate at the preset current limit.

Selection of operation (constant current/constant potential) is to be by means of a suitably marked change over switch.

The wiring must be such that the electronic control circuit makes contact with the monitor and reference cables only when the change-over switch is in the constant potential mode.

In the constant current mode, the feed-back signal is to come from a DC CT and not from a shunt.

4.2.2.3 Meters and Monitors

The TRU shall include the following meters:

DC voltmeter for measurement of output voltage

DC voltmeter for measurement of pipe potential

DC ammeter for measurement of output current

DC ammeter for measurement of by-pass current (for FDU’s)

DC hour meter

AC Voltmeter for measurement of AC supply voltage between phases.

kWhr meter

The pipe potential voltmeter is to be digital with LCD display and with minimum input impedance of 10 megohms. The height of the LCD display digits shall not be less than 12,5mm with an accuracy of 1,5% at maximum reading.

The pipe potential voltmeter shall be connected to the "pipe monitoring" terminal and the "reference electrode" terminal. The "pipe monitoring" terminal shall not be connected to the "pipe" terminal.

All other meters are to be analogue. The two DC voltmeters and DC ammeter are to be individually connected to a toggle switch, which must engage/disengage both leads to the meter.

The analogue meters shall be 96mm square with an accuracy of 1,5% at maximum reading.

All meters shall be discreet, sealed, and flush mounted (except for the kWhr meter).

The meters shall be labelled as follows:

Output Voltage	Reference Potential
Output Current	By-Pass Current
DC Hour Meter	AC Voltage
kWhr Meter	

Two differently coloured captive terminal sockets (female banana jacks) must be located beneath each of the output voltmeter, output ammeter and reference voltmeter, to enable one to check that the meters are reading correctly. The value of the shunt must also be indicated below the ammeter e.g. 50mV 50A.

The banana jack connected to the pipe must also be indicated for the output voltmeter and the two banana jacks connected to the reference voltmeter must also be indicated.

The DC hour meter shall indicate the time the DC current has been flowing. Tenderers are to supply details of the DC hour meter circuit.

The DC output voltmeter shall have a "glass" type fuse in each lead.

Note: Female banana jacks must not be supplied for testing of the AC voltage.

4.2.2.4 Surge Protection

4.2.2.4.1 Load Surge Protection

Indoor type lightning arrestors shall not be used.

Moving away from the rectifier bridge towards the output terminals, surge protection will be sequentially installed as follows:

Two off DehnGuard S 275 or equivalent, are to be connected in series between positive and negative legs. Between the two S 275 devices, a connection to the earth bar is to be made via a DehnGuard S 275. In addition to the above, a DehnGuard S 600 or equivalent, in parallel is to be connected between the positive and negative legs.

Followed by:

A 0,5mH Choke in the positive leg

A 0,5mH Choke in the negative leg

Followed by:

Between positive leg and earth, two parallel DehnGuard S 150 MOV in series with a Dehn Ex-FS (120kA) spark gap with Cu-W electrodes. Between the two DehnGuard S 150 and the spark gap described above, a Dehn Ex-FS (120kA) spark gap shall be connected to the negative leg. All spark gaps to have Copper Tungsten electrodes.

In place of the spark gaps, and Dehn MOVs, an Electrolytic varistor may be installed.

All thyristors are to have their own individual R - C rubber network.

4.2.2.4.2 Electronic Circuit Surge Protection

The electronic circuit must be protected from both the AC and DC sides.

The DC feed into the control module shall have the following surge protection:

From the pipe monitor cable terminal a 100-ohm 100 watt 300 µH resistive choke shall be installed in line with the DVM and Control Module, followed by an MOV to earth, type Semikron SKVA20B130 or equivalent.

After the above, between the monitor and the reference circuits, a Dehn Blitzductor (92744) clamping voltage or equivalent, is to be installed.

An earth screen is to be located between the primary and secondary of the 380/18V or 220/18V transformer supplying power to the electronic circuitry.

Immediately on the output of the above transformer (18V) a Dehn surge arrestor or equivalent, Dehn Blitzductor (92744), is to be located between each phase and star point.

An earth screen is to be located between the primary and secondary of the transformer supplying power to the electronic circuitry.

4.2.2.5 Wiring and Busbars

Wherever possible flexible, multistrand cable is to be used.

Joints or splices in any wiring will not be permitted. Not more than two conductors shall be connected to any one terminal.

All conductors shall be numbered at both ends with reference to the Schematic Wiring Diagram supplied.

All conductors excluding busbars shall be routed in trunking or harnessed.

Busbars shall be aluminium or tinned copper. The latter shall be tinned after cutting, forming, and drilling. Tinning shall be in accordance with Grade Sn6C of BS 1872.

Busbar joints shall be bolted, and the mating surfaces should be coated with petroleum jelly, or a similar water repellant paste prior to assembly.

Bolted joints shall be provided with spring washers. Fasteners on aluminium busbars shall be tinned or cadmium plated.

4.2.2.6 Colour Coding and Labelling

The following colour codings should be adhered to:

Positive electrical cables	:	Red		
Negative electrical cables	:	Black		
Earth cables	:	Green/Yellow		
Electrical supply cables	:	(1st phase)	:	Red or Brown
		(2nd phase)	:	White
		(3rd phase)	:	Blue
Cable for reference electrode	:	Red		
Electrical warning signs	:	Black on yellow background		
Monitoring cable	:	Black		

Power transformer secondary cables shall be grey, and they are to have an approximately 30mm heat shrink sleeve at either end, the colour of which is to be red (brown), white or blue as appropriate to the phase.

If busbars are used on the power transformer secondary, they are to be insulated by means of a yellow heat shrink sleeve.

All components and/or components assemblies shall be labelled.

Labels shall cross reference to the circuit diagram.

Labels shall be of the engraved type (multi-layered phenolic plastic) with black letters on a white background except the positive output terminal label which shall be in white letters on a red background. Alternatively aluminium silk screen labels may be used.

Labels shall be in upper case letters with a height of 6mm for component labels and 10mm for output terminal labels.

Output terminals shall be labelled as follows:

+ GROUNDBED

- PIPE

PIPE MON

REF ELECT

EARTH

Labels shall be fixed by means of screws or pop rivets such that they shall not become dislodged during the life of the unit. Screws and rivets to be brass or aluminium. Cable tags to be plastic.

Cables shall be identified by means of permanently marked ferrules with black lettering on a white background. Ferrules shall be slip-on-type and matched to the size of the cable.

Ferrules shall be situated so as to read right way up on horizontal cables and from lug to insulation on vertical cables.

4.2.2.7 Cable Ends and Terminals

Cables shall be terminated at each end by means of lugs.

Control cable lugs shall be pre-insulated or insulated by means of heat shrink sleeves.

Power cable lugs shall be insulated by means of heat shrink sleeves or slip-on rubber shrouds colour coded as follows:

AC	:	Red, White, and Blue according to phase.
DC Positive (Groundbed/Rail)	:	Red
DC Negative (Pipe)	:	Black

All terminals shall suitably labelled and be completely accessible after completion of all wiring.

Terminals on power connections shall be provided with lock nuts and or spring washers.

Output terminals shall be fully insulated from the metal of the housing and shall comprise brass bolts, each provided with nuts, lock nuts, washers, and tinned copper cable lugs suitable for the specified cable size.

The negative terminal shall be M10 and the positive terminal M16.

Separate terminals size M6 shall be provided for the pipe monitoring cable, and reference electrode cable.

A 10mm diameter hole shall be drilled in the earth bar in order to facilitate connection via a lug to the earth cable.

4.2.2.8 Earthing

The surge diversion units shall all be connected to the common earth incorporating the primary AC supply earth, transformer screen and the transformer rectifier housing.

The common earth will consist of 30 x 3mm tinned copper or 40 x 5mm aluminium busbar.

On installation, the common earth shall be connected to a local earth by means of two 35mm² copper cables.

All electrical circuits shall be floating with respect to earth.

4.2.2.9 Spares

The following spares are to be supplied with the TRU:

Fuses	:	three of each type and rating used
Diodes	:	two of each type and rating used
MOV	:	five of each type and rating for R-C network; 2 for all other MOV
Spark Gaps	:	one of each type and rating
Control Card	:	one off

4.2.2.10 Safety Devices

The TRU must contain certain devices which will protect the unit from damage during gross overheating conditions. This may arise during particularly hot weather conditions and/or when the TRU operates at a current output exceeding the rated output but below that of an outright short. It should also be pointed out that excessive current may also cause damage to the cables external to the TRU.

The TRU shall therefore contain the following safety devices:

1) Circuit Breaker:

This shall be matched as close as possible to the rating of the TRU output current and shall not merely be used as an isolation switch.

2) Thermal Switch:

A Thermal cut out switch shall be mounted on the power thyristor heat sink assembly and shall automatically engage/disengage when the temperature reaches 85`C.

3) DC Fuses:

The DC fuses shall operate before or when the output current reaches a value of 40% greater than the TRU rated value. This value shall also be such that no damage to any of the components or wiring occurs.

4.2.2.11 Bypass Circuit

Where the TRU is to be used with the railway as the anode, it is to be supplied with a bypass circuit which shall consist of a 3000 PIV 800A diode mounted on an appropriate heat sink in series with a 200A fuse and a 200mV 200A shunt. These components are to be mounted across the positive and negative legs between the electrolytic varistor and the chokes. The need for a bypass diode will be indicated, in the Bill of Quantities.

4.2.2.12 Auxiliary AC Supply

The TRU shall be provided with a standard 220V single phase 16A 3-point plug for providing power to auxiliary devices. The auxiliary AC supply is to be protected by an earth leakage

device. The three-point plug shall be connected to the input side of the main circuit breaker such that power is still available even if the main circuit breaker has tripped.

4.2.2.13 Inspection and Testing

The following tests shall be carried out at the Manufacturer's works (unless an alternative place is specified and approved by the CP Engineer). All equipment shall satisfactorily pass such tests and a test certificate made available to the Purchaser. All testing shall be carried out at the Manufacturer's expense.

In the event that any of the tests detailed below, or the complete inspection, is waived, then this shall not release the Manufacturer from his obligation to supply completely satisfactory equipment or warranted performance as specified, and to supply "type test" results from essentially similar units.

4.2.2.13.1 Insulation Tests

The apparatus shall withstand a 16kV insulation test from the AC input to frame, DC output to frame, and primary to secondary sides of the main transformer.

The insulation test described earlier shall be repeated immediately on conclusion of the heat run test.

4.2.2.13.2 Efficiency Tests

Efficiency tests shall be carried out at 25%, 60% and 100% of maximum current at full rated voltage. A minimum efficiency of 65% is to be achieved.

4.2.2.13.3 Heat Run Tests

The units shall be run for at least 6 hours continuously at maximum current and voltage output with all the doors closed. The difference in temperature between the inside of the transformer rectifier and ambient shall be plotted against the time (in hours) and the test run until there is no increase in temperature difference (the curve levels off).

The maximum temperature difference increase shall be not more than 20`C.

A similar temperature time test shall be carried out on the main power rectifier bridge heat sink. The maximum temperature difference between heat sink and TRU internal shall not be more than 50`C.

The maximum temperature that may be obtained in the cabinet under any circumstances is 65`C.

4.2.2.13.4 Constant Current / Potential Tests

Constant current and constant potential tests shall be carried out on thyristor control units at various voltage and current levels as decided by the CP Engineer. For the constant potential test the supplier shall have available a 200-litre drum filled with appropriate solution, together with relevant anode, cathode, and reference electrode.

The control parameters are to remain within 5% of any preset value above 5% of the rectifier output voltage.

4.2.2.13.5 Current / Overload Tests

Tests shall also be carried out to ensure that the circuit breaker or fuse operate under conditions where the current exceeds the rating of the TRU in a slowly rising mode.

The rectifier shall be run at increasing steps of 10A for 30minutes, starting from the maximum current rating of the unit, until one of the fuses or breakers operates. The results of the tests are to be entered on the performance test certificate.

The CP Engineer may also call for other tests to prove compliance and the specifications.

The tests shall be carried out in the presence of the CP Engineer. The Manufacturer will issue a Test Certificate on completion of Tests which shall be signed by the CP Engineer.

4.2.2.15 Documentation

The Transformer Rectifier shall be supplied with the following:

(1) Wiring / Circuit diagram with component list

(2) Operations and Maintenance Manual

The above are to be mounted on the inside of the unit.

The Wiring Diagram with Component List are to be encapsulated in polyester fibreglass, mounted on an aluminium plate which shall be fixed by means of wing nuts to four studs welded to TRU frame, thus rendering the drawing removable.

Six copies of the Operations and Maintenance Manuals are to be supplied to the CP Engineer for forwarding to the Client.

The manual is to include a detailed fault finding and troubleshooting procedure.

4.2.2.16 Guarantee

The equipment shall carry an unconditional two-year guarantee except for damages arising from vandalism, mechanical damage, external fire, flooding, or ground subsidence caused by mining or earth tremors. The unit shall operate continuously on site for a period of 2 weeks after which the 2-year guarantee will commence.

4.2.3 Switch Mode Cathodic Protection Rectifier Unit (SMCPR)

4.2.3.1 General

The SMCPR is to comprise an input rectifier and filter, a high frequency invertor, a high frequency output transformer, output rectifier and a smoothing circuit. The smoothing circuit shall ensure ripple is less than 2% of output voltage The output of the unit is to be controlled by means of a high speed PID control circuit such that the response time of the unit is less than 100mS.

The SMCPR is to have an output capacity as given in the bill of quantities with the ratio of current to voltage to be configurable as required.

The unit shall have a power factor correction of greater than 0.99 and an energy efficiency of 70% to 95% dependent on output settings.

Protection against current surges from the AC supply shall be provided by means of a circuit breaker and fuses. The circuit breaker shall of the thermal or magnetic type and located before the input rectifier. The circuit breaker must be capable of completely isolating the power supply except the 16A 220V switched socket (see later).

The power semiconductors are to be mounted on aluminium heat sinks cooled by convection cooling. No forced cooling is permitted.

The output voltage shall be infinitely variable within the capacity limits of the unit by means of a control circuit acting on the inverter circuit. This circuit shall also have current limiting facilities.

Output DC current, output DC voltage, incoming AC voltage, reference potential, current set point and potential set point are to be displayed on the digital display.

Banana plug terminals are to be located under the digital display to allow for manual measurement of output DC current, output DC voltage and reference potential.

In parallel with the negative cable, a monitor cable shall be connected to the pipeline and connected to the monitor terminal. This cable shall not carry "current" and is to be used only for measurement of potential.

The SMCPR shall be of such a design and size that it may be installed inside a precast concrete bunker type or an underground type enclosure.

4.2.3.2 Control Circuit

The control circuit shall perform the following functions:

(1) Maintain output current constant at any preset value within the capacity limits of the unit.

(2) Maintain pipe potential constant at any preset value within the capacity limits of the unit.

When operating in the constant potential mode, in the event of failure of the monitoring or reference cables, or of the reference electrode itself, the SMCPR must operate at the preset current limit.

The control circuit shall have the following additional built-in features:

- Integrated interrupter – GPS synchronised
- Communication interface – Modbus RS232, GSM
- Data Logging – Output current, output voltage, reference potential, heat sink temperature, all recorded events must be time stamped.

- Alarm monitoring – AC and DC surge protection failure, AC circuit breaker trip, DC output breaker trip, door open switch. All alarms are to be displayed on the digital display.
- Interface with Johannesburg Water Scada system – the controller shall be capable of interfacing directly with the Scada system

4.2.3.3 Surge Protection

4.2.3.3.1 Load Surge Protection

Indoor type lightning arrestors shall not be used.

Moving away from the smoothing circuit towards the output terminals, surge protection will be sequentially installed as follows:

Two off DehnGuard S 275 or equivalent, are to be connected in series between positive and negative legs. Between the two S 275 devices, a connection to the earth bar is to be made via a DehnGuard S 275. In addition to the above, a DehnGuard S 600 or equivalent, in parallel is to be connected between the positive and negative legs.

Followed by:

A 0.5mH Choke in the positive leg

A 0.5mH Choke in the negative leg

Followed by:

Between positive leg and earth, two parallel DehnGuard S 150 MOV in series with a Dehn Ex-FS (120kA) spark gap with Cu-W electrodes. Between the two DehnGuard S 150 and the spark gap described above, a Dehn Ex-FS (120kA) spark gap shall be connected to the negative leg. All spark gaps to have Copper Tungsten electrodes.

4.2.3.3.2 Electronic Circuit Surge Protection

The electronic circuit must be protected from both the AC and DC sides.

The DC feed into the control module shall have the following surge protection:

From the pipe monitor cable terminal a 100-ohm 100 watt 300 µH resistive choke shall be installed in line with the Control Module, followed by an MOV to earth, type Semikron SKVA20B130 or equivalent.

After the above, between the monitor and the reference circuits, a Dehn Blitzductor (92744) clamping voltage or equivalent, is to be installed.

An earth screen is to be located between the primary and secondary of the step-down transformer supplying power to the electronic circuitry.

Immediately on the output of the above transformer a Dehn surge arrestor or equivalent, Dehn Blitzductor (92744), is to be located between live and neutral.

4.2.3.4 Wiring and Busbars

Wherever possible flexible, multistrand cable is to be used.

Joints or splices in any wiring will not be permitted. Not more than two conductors shall be connected to any one terminal.

All conductors shall be numbered at both ends with reference to the Schematic Wiring Diagram supplied.

All conductors excluding busbars shall be routed in trunking or harnessed.

Busbars shall be aluminium or tinned copper. The latter shall be tinned after cutting, forming, and drilling. Tinning shall be in accordance with Grade Sn6C of BS 1872.

Busbar joints shall be bolted, and the mating surfaces should be coated with petroleum jelly, or a similar water repellant paste prior to assembly.

Bolted joints shall be provided with spring washers. Fasteners on aluminium busbars shall be tinned or cadmium plated.

4.2.3.5 Colour Coding and Labelling

The following colour codings should be adhered to:

Positive electrical cables	:	Red
Negative electrical cables	:	Black
Earth cables	:	Green/Yellow
Electrical supply cables		
(1st phase)	:	Red or brown
(2nd phase)	:	White
(3rd phase)	:	Blue
Cable for reference electrode	:	Red
Electrical warning signs	:	Black on yellow background
Monitoring cable	:	Black

All components and/or components assemblies shall be labelled.

Labels shall cross reference to the circuit diagram.

Labels shall be of the engraved "sandwich" type (multi-layered phenolic plastic) with black letters on a white background except the positive output terminal label which shall be in white letters on a red background. Alternatively aluminium silk screen labels may be used.

Labels shall be in upper case letters with a height of 6mm for component labels and 10mm for output terminal labels.

Output terminals shall be labelled as follows:

+ GROUNDBED

- PIPE

PIPE MON

REF ELECT

EARTH

Labels shall be fixed by means of screws or pop rivets such that they shall not become dislodged during the life of the unit. Screws and rivets to be brass or aluminium. Cable tags to be plastic.

Cables shall be identified by means of permanently marked ferrules with black lettering on a white background. Ferrules shall be slip-on-type and matched to the size of the cable.

Ferrules shall be situated so as to read right way up on horizontal cables and from lug to insulation on vertical cables.

4.2.3.6 Cable Ends and Terminals

Cables shall be terminated at each end by means of lugs.

Control cable lugs shall be pre-insulated or insulated by means of heat shrink sleeves.

Power cable lugs shall be insulated by means of heat shrink sleeves or slip-on rubber shrouds colour coded as follows:

AC	:	Red, White, and Blue according to phase.
DC Positive	:	Red
DC Negative (Pipe)	:	Black

All terminals shall suitably labelled and be completely accessible after completion of all wiring.

Terminals on power connections shall be provided with lock nuts and or spring washers.

Output terminals shall be fully insulated from the metal of the housing and shall comprise brass bolts, each provided with nuts, lock nuts, washers, and tinned copper cable lugs suitable for the specified cable size.

The negative terminal shall be M10 and the positive terminal M16.

Separate terminals size M6 shall be provided for the pipe monitoring cable, and reference electrode cable.

A 10mm diameter hole shall be drilled in the earth bar in order to facilitate connection via a lug to the earth cable.

4.2.3.7 Earthing

The surge diversion units shall all be connected to the common earth incorporating the primary AC supply earth, transformer screens and the SMCPR housing.

The common earth will consist of 30 x 3mm tinned copper or 40 x 5mm aluminium busbar.

On installation, the common earth shall be connected to a local earth by means of two 35mm² copper cables.

All electrical circuits shall be floating with respect to earth.

4.2.3.8 Spares

The following spares are to be supplied with the SMCPR:

Fuses	:	three of each type and rating used
Power Semiconductors	:	two of each type and rating used
MOV	:	2 of each type of MOV
Spark Gaps	:	one of each type and rating

4.2.3.9 Safety Devices

The SMCPR must contain certain devices which will protect the unit from damage during gross overheating conditions. This may arise during particularly hot weather conditions and/or when the SMCPR operates at a current output exceeding the rated output but below that of an outright short. It should also be pointed out that excessive current may also cause damage to the cables external to the SMCPR.

The SMCPR shall therefore contain the following safety devices:

1) Circuit Breaker:

This shall be matched as close as possible to the rating of the SMCPR output current and shall not merely be used as an isolation switch.

2) Thermal Switch:

A Thermal cut out switch shall be mounted on the power thyristor heat sink assembly and shall automatically engage/disengage when the temperature reaches 85`C.

3) DC Fuses:

The DC fuses shall operate before or when the output current reaches a value of 40% greater than the SMCPR rated value. This value shall also be such that no damage to any of the components or wiring occurs.

4.2.3.10 Auxiliary AC Supply

The SMCPR shall be provided with a standard 220V single phase 16A 3-point plug for providing power to auxiliary devices. The auxiliary AC supply is to be protected by an earth

leakage device. The three-point plug shall be connected to the input side of the main circuit breaker such that power is still available even if the main circuit breaker has tripped.

4.2.3.11 Inspection and Testing

The following tests shall be carried out at the Manufacturer's works (unless an alternative place is specified and approved by the CP Engineer). All equipment shall satisfactorily pass such tests and a test certificate made available to the Purchaser. All testing shall be carried out at the Manufacturer's expense.

In the event that any of the tests detailed below, or the complete inspection, is waived, then this shall not release the Manufacturer from his obligation to supply completely satisfactory equipment or warranted performance as specified, and to supply "type test" results from essentially similar units.

4.2.3.11.1 Insulation Tests

The apparatus shall withstand a 16kV insulation test from the AC input to frame, DC output to frame.

The insulation test described earlier shall be repeated immediately on conclusion of the heat run test.

4.2.3.11.2 Efficiency Tests

Efficiency tests shall be carried out at 25%, 60% and 100% of maximum current at full rated voltage. A minimum efficiency of 70% is to be achieved.

4.2.3.11.3 Heat Run Tests

The unit shall be run for at least 6 hours continuously at maximum current and voltage output with the door of the enclosure closed. The difference in temperature between the inside of the enclosure and ambient shall be plotted against the time (in hours) and the test run until there is no increase in temperature difference (the curve levels off).

The maximum temperature difference increase shall be not more than 20`C.

A similar temperature time test shall be carried out on the heat sink. The maximum temperature difference between heat sink and SMCPR internal shall not be more than 50`C.

The maximum temperature that may be obtained in the cabinet under any circumstances is 55`C.

4.2.3.11.4 Constant Current / Potential Tests

Constant current and constant potential tests shall be carried out at various voltage and current levels as decided by the CP Engineer. For the constant potential test the supplier shall have available a 200-litre drum filled with appropriate solution, together with relevant anode, cathode, and reference electrode.

The control parameters are to remain within 5% of any preset value above 5% of the rectifier output voltage.

4.2.3.11.5 Current / Overload Tests

Tests shall also be carried out to ensure that the circuit breaker or fuse operate under conditions where the current exceeds the rating of the SMCPR in a slowly rising mode.

The rectifier shall be run at increasing steps of 10A for 30minutes, starting from the maximum current rating of the unit, until one of the fuses or breakers operates. The results of the tests are to be entered on the performance test certificate.

The CP Engineer may also call for other tests to prove compliance to the specifications.

The tests shall be carried out in the presence of the CP Engineer. The Manufacturer will issue a Test Certificate on completion of Tests which shall be signed by the CP Engineer.

4.2.3.12 Documentation

The Rectifier shall be supplied with the following:

(1) Wiring / Circuit diagram with component list

(2) Operations and Maintenance Manual

The above are to be mounted on the inside of the unit.

The Wiring Diagram with Component List are to be encapsulated in polyester fibreglass, mounted on an aluminium plate which shall be fixed by means of wing nuts to four studs welded to the door, thus rendering the drawing removable.

Six copies of the Operations and Maintenance Manuals are to be supplied to the CP Engineer for forwarding to the Client.

The manual is to include a detailed fault finding and troubleshooting procedure.

4.2.2.13 Guarantee

The equipment shall carry an unconditional two-year guarantee except for damages arising from vandalism, mechanical damage, external fire, flooding, or ground subsidence caused by mining or earth tremors. The unit shall operate continuously on site for a period of 2 weeks after which the 2-year guarantee will commence.

4.2.4 Natural Drainage Unit

4.2.4.1 General

Stray current corrosion is generally caused by traction DC currents, which leave the pipe to return to the rail via the ground. If the current returns via a metallic conductor, rather than through the ground, corrosion is prevented, and protection is achieved. The above situation occurs when the rail is at a negative potential and the pipe at a positive potential with respect

to the rail. The function of the NDU is to drain off the current back to the rail in a manner such as not to cause corrosion. The rail potential normally fluctuates, however, and when it goes positive the pipe will also be at a positive potential (if the two are connected via a normal bond) and hence undergo accelerated corrosion.

An NDU is essentially a unidirectional current device with associated surge protection, fuses, etc. It is critically important that the diode does not fail, but should it fail, the fuse shall operate promptly. Surge protection is therefore of the utmost importance and the fuse must be matched according to the maximum current which is likely to be drained.

4.2.4.2 Electrical Layout

The Natural Drainage Unit shall consist of a surge diode, together with fuses, chokes, ammeter, disconnecting link and surge protection devices.

From the pipe terminal, a busbar shall connect to the diode anode via a series shunt, while the diode cathode is connected to the rail busbar via a fuse. A 300uH 1000A choke is to be installed in each of the pipe and rail legs.

Pullout links are required in each of the output legs. An ammeter and shunt are to be installed on the "protected" side of the surge protection devices.

4.2.4.3 Surge Protection

Between the pipe and rail legs, before the two chokes, two Dehn S 150 or equivalent in parallel shall be connected in series to a spark gap, EX-FS (120kA) with copper tungsten electrodes, or equivalent. Between the two Dehn S150 and the spark gap, a Dehn EX-FS (120kA) with copper tungsten electrodes shall be connected to earth.

On the other side of the chokes, two off Dehn S 275 or equivalent, in series, are to be connected between the pipe and rail legs. Between the two S 275 devices a connection to the earth bar is to be made via a Dehn S 275.

Next to the above, a DehnGuard S 600 or equivalent, is to be connected between the positive and negative legs.

4.2.4.4 Component Rating and Characteristics

Component		Rating
Diode	:	1000A3000PIV
Wiring	:	1000A
Chokes	:	1000A300uH
Disconnecting Links	:	1000A Continuous, 300A Load switching
Fuse	:	1000A
Shunt	:	50mV/1000A
Ammeter	:	1000A

The temperature inside the cabinet may reach 60^0C. All components are to be rated for cooling under natural convection conditions.

The fuse must be fast acting and have a lower I^2t value than the diode.

Snubbing Network comprising a disc ceramic capacitor, resistor and MOV is to be installed directly across the diode.

The ammeter shall be analogue, 96mm square with an accuracy of 1.5% of maximum reading.

The two disconnecting links shall be of the knife action or of the "pull out" type (e.g. fuse holder), suitable for the easy and safe connection/disconnection of the circuit.

4.2.4.5 Spares

The following list of spares shall be provided (one of each) on the spares rack/panel.

Component Description	No.	Component Reference
Spark Gap	1	Dehn EX-FS Cu-W electrodes or equivalent (120kA).
MOV	1	Dehn VM130 or equivalent.
MOV	1	Dehn VM280 or equivalent.
MOV	1	Semikron SKV20 B420 or equivalent.
Fuse	1	Fast acting and 1000A.

4.2.4.6 Drawing and Component List

An electrical schematic diagram and component list must be affixed to the NDU

4.2.4.7 Guarantee

The equipment shall carry an unconditional two-year guarantee except for damages arising from vandalism, mechanical damage, external fire, flooding, or ground subsidence caused by mining or earth tremors. The unit shall operate continuously on site for a period of 30 days after which the 2-year guarantee will commence.

4.3 Transformer Rectifier Unit Enclosures

Note that all transformer rectifier enclosures are to be labelled by means of aluminium silk screen labels.

Labels shall be in upper case letters with a height of 10mm.

Labels are to be fixed to a readily visible internal surface of the enclosure by means of epoxy adhesive.

4.3.1 Buried Type

The buried type enclosure is to be manufactured from UV stabilized sheet moulding composite (SMC) with 30% glass fibre content.

The enclosure is to have the following minimum characteristics:

- Load and Impact Strength
    - SANS 558 2009 HD Roadway
    - SANS 558: EN-124 B125 (125kN)
- Opening and Depth of Enclosure
    - Daylight Opening 650mm
    - Depth 1000mm
- Metal Components and Fasteners
    - 304 Stainless Steel
- Water Ingress Protection
    - IP68
- Locking Mechanism
    - Mechanical and electronic locking system complete with alarm monitoring devices and centralised management platform
- Lid
    - Raised dual lid system for water ingress protection
- Mounting Chassis
    - The mounting chassis is to be on a worm screw mechanism to allow the installed equipment to be raised and lowered from the inside of the enclosure.

The enclosure is to be encased in 30MPa concrete such that the full circumference has minimum cover of 300mm for the full depth.

4.3.2 Mega Bunker Type

The concrete bunker is to be manufactured from concrete with a 7-day strength > 35MPa and is to be reinforced with hot dip galvanised Y12 reinforcement bars. All exposed edges are to be radiused or chamfered.

On the top of the bunker there are to be two M24 threaded sockets to accommodate lifting eye bolts which are to be supplied with the unit but are to be removable. The sockets are to be manufactured from 400 grade stainless steel and are to be welded to 50mm-by-50mm x 3mm base plate 400 grade stainless steel base plate prior to being cast into the concrete structure.

The bunker is to have a minimum height of 1430mm. There are to be two internal compartments, the upper one with an opening in the front of the unit which will accommodate a door and lower one with an opening the bottom of the unit that will accommodate incoming cable ducts. The two compartments are to be separated by means of a 304 stainless steel gland plate.

The minimum dimensions of the upper internal enclosure are to be (W) 810mm x (H) 730mm x (D) 640mm. The minimum wall thickness is to be 150mm.

The door is to be manufactured from 5mm thick hot dip galvanised mild steel. The hinges are to be internal and concealed. The door shall have three shrouded sockets to accommodate locking bolts. The locking bolts shall have a locking pattern unique to Johannesburg Water and all units shall be keyed alike.

4.3.3 Equipment Shelter Type

The enclosure is to be manufactured from reinforced concrete with a 7-day strength > 35MPa. All exposed edges are to be radiused or chamfered.

The enclosure is to have a minimum wall thickness of 90mm and to have external dimensions of (W) 2040mm x (H) 2260mm x (D) 2040mm.

The walls and roof are to be formed in a single casting whereafter the floor is to be cast in.

The enclosure is to have two lifting holes on each side to facilitate transport and placement.

The enclosure is to have a heavy duty galvanised “safe” door which is cast into the unit during manufacture.

The door lock shall have a key which is unique to Johannesburg Water. All units are to be keyed alike.

4.3.4 Transformer Rectifier Unit Enclosures Painting Requirements

Concrete structures are to be sealed and painted with an undercoat and then painted with an exterior PVA paint. The colour shall be Grey Green according to SABS 1091 H40.

4.3.5 Perimeter Security Measures for TRU Enclosures

Where required additional security measures will be installed as follows:

4.3.5.1 Outer Security Barrier

The outer security barrier is to consist of a 250mm thick 40MPa reinforced concrete slab and 700mm high bund wall topped with a 2m high Cochrane ClearVu (or equivalent) high-security barrier complete with anti-climb security spikes.

The fence uprights and gate posts are to be welded to the reinforcing cage inside the concrete. The gate is to be made of the same material as the fence with a steel square tubing frame. The gateway is to be 900mm wide and the gate is to open outwards. The hinges are to be internal and concealed. The door shall have three shrouded sockets (top middle and bottom) to accommodate locking bolts. The locking bolts shall have a locking pattern unique to Johannesburg Water and all units shall be keyed alike.

Prior to the casting of the concrete base, cable conduits and the TRU earthing system are to be installed.

110mm diameter conduits are to be installed from the pipeline and the power supply at a minimum depth of 1m. The conduit of the TRU earthing cables is to commence directly underneath the earth grid.

On completion and backfilling of the conduits and earthing installations an area of 4.5m x 4.5m is to be levelled and compacted to a density of at least 90% of the modified AASHTO maximum dry density prior to the casting of the reinforced concrete base and bund walls.

Details of this concrete structure are given elsewhere.

4.3.5.2 Remotely Monitored Electronic Intruder Detection and CCTV

4.3.5.2.1 General

This component of the work is to be carried out by a specialist sub-contractor. Tenderers are to provide full details of the subcontractor they intend using.

The system required must be able to detect, verify and deter intrusion. In addition, response services must be deployed once intrusion is verified.

The electronic security system is to consist of the following:

- Accoustic Fenceline Intruder Detection System
- Dual Passive infra-red / Ultrasonic motion detectors
- High definition CCTV cameras with motion detectors
- Remotely monitored radio
- Siren, PA System and pepper spray
- Battery back up and solar panel in vandal resistant enclosure. as supplied by Interlock systems or equivalent
- 24 hour control room monitoring
- 24 armed response.

The description of how it will operate is given below:

- The fenceline intruder detection system will detect detect sharp frequencies and vibrations associated with intrusion attempts on the outer security barrier. Intrusion attempts detected will send a signal to the control room and activate the CCTV cameras.
- Should the operator observe attempts to damage or penetrate the outer barrier he will be able to address the intruder via the PA system and warn him to vacate the area. Should the intruder not heed the warning, the siren will be activated and thereafter pepper spray may be deployed if required. The operator may then make an assessment of the situation and decide whether the armed response vehicle should be dispatched.
- The passive motion detectors will be positioned to detect an intruder within the primary security perimeter or on the Rocla enclosure roof. This will trigger an alarm in the control room and activate the siren. The control room operator may then immediately activate the pepper spray. The armed response vehicle will immediately be dispatched.

4.3.5.2.2 Fenceline Intruder Detection System

- The detection system shall make use of an acoustic sensor cable that is attached to the fence to detect any cutting, climbing, lifting or jumping off the fence.

- A single run of the cable in the middle of the fence shall detect intrusion attempts for the the whole height of the fence.
- The system shall utilize false alarm filtration as follows:
    - The equipment shall make use of algorithms to detect only sharp frequencies and vibrations associated with intrusion attempts while filtering the long frequencies from weather and other abient noise
    - The system shall have adjustable levels of sensitivity that may be configured as required.

4.3.5.2.3 Passive Motion Detectors

- Passive dual infrared / ultrasonic pet immune security grade motion detectors are to be the outdoor type.
- Two units will be required which will be installed in diagonally oposite corners of the enclosure against the concrete bund walls.

4.3.5.2.4 High Definition CCTV Cameras with Motion Detectors

- CCTV Cameras must be minimum 2 Mega Pixel IP Cameras
- To include varifocal lenses and IR (Infrared) motion detectors with range of 20m.
- A total of 4 cameras will be required with 2 being mounted on a 6m pole.
- Cameras to have at least 30 minutes of internal memory space.

4.3.5.2.5 Remotely Monitored Radio

- Radio must be GSM based with remote access from control room to arm and disarm the system.
- The radio must also be linked with the armed response control room.

4.3.5.2.6 Remotely Activated Siren, PA System and Pepper Spray

- The siren, PA system and pepper spray must be managed from the off-site control room through the CCTV system.

4.3.5.2.7 24 Hour Control Room Monitoring

- Only event driven CCTV monitoring shall be used - no continuous streaming. The system however must have the capability of sending hourly signals to the control room confirming health check. This must be be monitored in the control room and the software must raise an alarm if the heath check was not successful.
- The CCTV management software must have an audit trail and have alarm monitoring capability - no freeware software shall be used.

4.3.5.2.8 24 Hour Armed Response

- The Armed response is to be a separate entity from the control room. A local armed response service provider with an established footprint and track record in the area is to be utilised.
- The alarm system must be integrated with the CCTV system and must send individual signals to the armed response service provider.
- Signals to be monitored will be :
    - alarm (with zoneID),
    - pen and close (with user ID),
    - AC Fail,
    - battery low,
    - tamper alarm
    - Periodic test.

4.3.5.2.9 Battery Back-up and Solar Panel

The back-up battery **is** to have sufficient capacity to allow the entire electronic monitoring system to operate for 48 hours.

The solar panel is to have sufficient capacity to fully charge the back-up battery within 6 hours. The solar panel is to be housed inside a vandal resistant enclosure as supplied by Interlock Systems or equivalent. The solar panel is to be mounted on the roof of the TRU enclosure.

4.4 Monitoring Facilities

4.4.1 Stationary Reference Electrodes

The details of the reference electrode are as follows:

Housing	:	Porous ceramic of minimum dimensions 130mm diameter x 300mm high
Element	:	16mm^2 spiral copper conductor (total length of conductor inside housing shall be a minimum of 2m)
Medium	:	copper sulphate crystals in saturated copper sulphate gel (110mm diameter by 220mm high)
Seal on housing	:	Primary cement cap and secondary epoxy resin Cap.
Cable Tail	:	Single core copper 16mm^2 red PVC/PVC.
Prepackaged bag	:	Cotton bag approximately 195mm diameter x 460mm long.
Chemical backfill	:	75% hydrated gypsum, 20% Bentonite, 5%

		Sodium Sulphate.
Accuracy	:	+/- 10mV over 15A (<3 micro-amp load)
Stability	:	0ºC to 55ºC

4.4.2 Coupons

The coupon shall comprise a circular steel element that is flush mounted in a suitable acid, alkali, and chemically resistant epoxy. The coupon material shall be similar to the pipe material. The coupon shall be connected to a standard 2 core 2.5mm^2 cabtyre cable with all the connections encapsulated in epoxy. The cabtyre shall exit the coupon assembly via a suitably sized cable gland. The cabtyre cable length shall be 10m unless specified otherwise. For AC measurements the coupon shall be machined from an 11 mm diameter steel rod. For DC measurements the coupon shall be machined from a 36 mm diameter steel rod.

4.4.3 IR Free Control Card

The IR Free control card shall have termination points for the pipe negative and monitor cables, the coupon negative and monitor cables and the reference electrode cable. The control card shall serve to connect the coupon negative and pipe negative cables via a normally closed reed switch in series with a suitably rated shunt.

4.5 Monitoring and Bonding Facility Enclosures

Note that all monitoring enclosures are to be labelled by means of aluminium silk screen labels.
Labels shall be in upper case letters with a height of 10mm.
Labels are to be fixed to a readily visible internal surface of the enclosure by means of epoxy adhesive.

4.5.1 Buried Type

The enclosure is to be manufactured from UV stabilized sheet moulding composite (SMC) with 30% glass fibre content.

The enclosure is to have the following minimum characteristics:

- Load and Impact Strength
  - SANS 558 MD (4kN)
- Opening and Depth of Enclosure
  - Daylight Opening 350mm
  - Depth 600mm
- Metal Components and Fasteners
  - 304 Stainless Steel
- Water Ingress Protection
  - IP68
- Locking Mechanism

- Mechanical and electronic locking system complete with alarm monitoring devices and centralised management platform.

- Lid
  - Raised dual lid system for water ingress protection.

The enclosure is to be encased in 30MPa concrete such that the full circumference has minimum cover of 300mm for the full depth.

4.5.2 Bunker Type

The concrete bunker is to be manufactured from concrete with a 7-day strength > 35MPa and is to be reinforced with hot dip galvanised Y12 reinforcement bars. All exposed edges are to be radiused or chamfered.

On the top of the bunker there are to be two M24 threaded sockets to accommodate lifting eye bolts which are to be supplied with the unit but are to be removable. The sockets are to be manufactured from 400 grade stainless steel and are to be welded to 50mm-by-50mm x 3mm base plate 400 grade stainless steel base plate prior to being cast into the concrete structure.

The bunker is to have a minimum height of 1400mm. There are to be two internal compartments, the upper one with an opening in the front of the unit which will accommodate a door and lower one with an opening the bottom of the unit that will accommodate incoming cable ducts. The two compartments are to be separated by means of a 304 stainless steel gland plate.

The minimum dimensions of the internal enclosure are to be (W) 480mm x (H) 860mm x (D) 385mm. The minimum wall thickness is to be 150mm.

The door is to be manufactured from 5mm thick hot dip galvanised mild steel. The hinges are to be internal and concealed. The door shall have two shrouded sockets to accommodate locking bolts. The locking bolts shall have a locking pattern unique to Johannesburg Water and all units shall be keyed alike.

A white powder coated 3Cr12 chassis plate with dimensions (W) 440mm x (H) 820mm, is to be mounted on the rear wall of the bunker enclosure by means of galvanised Rawl bolts.

4.5.3 Big Head Test Post Type

The test post is to be manufactured from concrete with a 7-day strength > 35MPa and is to be reinforced with hot dip galvanised Y10 reinforcement bars. All exposed edges are to be radiused or chamfered.

The test post is to have a total height of 1400mm and is to have an enclosure at the top with internal dimensions of (W) 168mm x (H)160mm x (D)150mm. The minimum wall thickness around the enclosure is to be 65mm. The post is to have a 32mm PVC conduit installed from the base of the post to the top enclosure.

The enclosure is to have a 5mm thick HDG steel door with concealed internal hinges and a 3-lever lock. The key is to be unique to Johannesburg Water and all units are to be keyed alike.

4.5.4 Mega Big Head Test Post Type

The test post is to be manufactured from concrete with a 7-day strength > 35MPa and is to be reinforced with hot dip galvanised Y10 reinforcement bars. All exposed edges are to be radiused or chamfered.

The test post is to have a total height of 1600mm and is to have an enclosure at the top with internal dimensions of (W) 200mm x (H)240mm x (D)160mm. The minimum wall thickness around the enclosure is to be 90mm. The post is to have a 32mm PVC conduit installed from the base of the post to the top enclosure.

The enclosure is to have a 5mm thick HDG steel door with concealed internal hinges. The door shall have a shrouded socket to accommodate a locking bolt. The locking bolt shall have a locking pattern unique to Johannesburg Water and all units shall be keyed alike.

4.5.5 UPVC/Concrete Test Post

Test Posts are to be constructed from a 315mm class 16 UPVC Pipe, 1.5m in length. The internal cavity is to be filled with 50 MPa concrete up until 150mm from the top of the pipe.

Two integral flush mounted copper “banana jack” type terminals are to be cast into the concrete such that they are accessible inside the 150mm upper pipe cavity. The terminals are to be connected to pipe and reference electrode cables and are to be labelled “PIPE” and “REFERENCE” respectively. Labels shall be of the engraved type (multi-layered phenolic plastic) with black letters on a white background and are to be fixed to the concrete by means of suitable screw-in anchors.

A PVC endcap is to be fitted to the top of the UPVC pipe. The test post end cap is to be secured on opposite sides by means of two splined grub screws with a minimum diameter of 8mm. The endcap and its fastening screws shall be of such a design as to prevent ingress of rainwater.

4.5.6 Monitoring Structures Painting Requirements

Monitoring structures are to be sealed and painted with a suitable undercoat and then painted with an exterior PVA paint. The colour shall be Grey Green according to SABS 1091 H40.

4.6 Link Panels

Link panels are to be manufactured utilising 6mm thick paper based phenolic resin boards as a base. The linking system is to comprise of a 25mm by 3mm tinned copper bus bar (length determined by number of links), 80mm x 20mm x 3mm tinned copper links and 40mm x M10 brass bolts c/w nuts, washers, and spring washers.

The bus bar is to be mounted across the top of the phenolic board while terminal bolts for each of the incoming cables are to be mounted across the bottom of the board with the links in

between. The links are to be fastened to the bus bar by means of brass bolts spaced at 45mm centres.

The link panel is to be supplied with two insulated stand-off mounts comprising of 20mm diameter by 20mm thick PVC stand-off spacers and 6mm stainless steel bolts.

4.7 Insulating Flanges

An insulating flange consists of an insulating gasket, bolt sleeves and washers, approximately sized steel bolts and washers and a voltage limiting spark gap for Protection of the insulating material.

The insulating gasket between flanges to be in accordance with the following table based on pipe diameter and pressure ratings. The ID of the pipe and gasket shall in all instances be equal:

No.	Field test pressure MPa	Nominal pipe diameter mm	Insulating gasket material
1.1	Lower or equal to 2,5	All diameters	3,2mm Thick High-Density Polyethylene to PEH Hostalen GM5010 Specification, full face gasket in one piece.
1.2	Higher than 2,5	All diameters	3,2mm Thick High-Density Polyethylene to PEH Hostalen GM5010 SA Specification, full face gasket in one piece with detail “A” and “0” rings.
2.1	Lower or equal to 4,6	Smaller or equal to 1200	3,2mm Thick Fabric Reinforced Phenolic (Tested to BS5102 Appendices A-M Type III) full faced gasket in one piece with neoprene or nitrile rubber faces 0,8mm thick.
2.2	Lower or equal to 4,6	Bigger than 1200	3,2mm Thick Fabric Reinforced Phenolic (Tested to BS5102 Appendices A-M Type III) full faced gasket with not more than 2 only factory made lap joints, with neoprene or nitrile rubber faces 0,8mm thick.
No.	Field test pressure MPa	Nominal pipe diameter mm	Insulating gasket material
3.1	Lower or equal to 4,6	Smaller or equal to 1200	3,2mm Thick Fabric Reinforced Phenolic (Tested to BS5102 Appendices A-M Type III) full faced gasket in one piece with 0,8mm thick “Prolok Super” or similar Compressed

			Asbestos Fibre (to BS 1832 Grade A) full faced gaskets on each side.
3.2	Lower or equal to 4,6	Bigger than 1200	3,2mm Thick Fabric Reinforced Phenolic (Tested to BS5102 Appendices A-M Type III) full faced gasket in one piece with 0,8mm thick “Prolok Super” or similar Compressed Asbestos Fibre (to BS 1832 Grade A) full faced gaskets on each side, but with no more than two factory made lap joints.

Insulating sleeves shall be minimum of 1mm thick glass fibre reinforced polyester. Total length of sleeves is to be 2-3mm less than the length between the inside faces of steel washers. The insulating sleeves shall fit completely inside the insulating washers and extend partially inside the steel washers.

Insulating washers shall be 3,2mm thick fabric reinforced phenolic resin with OD the same as that of the machined steel washers, 2 off for each stud bolt. The ID to be sliding fit over OD of insulating sleeve.

Steel washers shall be machined with diameter and thickness to SABS 1149, Table 3.

Stud bolts and studs shall be grade 8.8 and nuts grade 8 to SABS 136. Stud bolts diameters shall be selected to the next smaller size for installation in standard drilled flanges. Stud bolts shall be machined down to the next standard smaller size and suitable smaller nut to be used. All studs, bolts and washers are to be hot dip galvanised.

Explosion-proof Spark Gap Type ExFS shall be installed across the flange faces complete with hot-dip galvanized mild steel mounting brackets to suit the flange bolt. The width of the holding bracket of the explosion-proof spark gap shall be the same as the steel insulating washers and the bottom end be rounded off to fit into the spot faced area of the valve and/or steel flange.

4.8 High Potential Magnesium Sacrificial Anodes

The anode composition shall be as follows:

Element	**Percentage**
Aluminium	5.30 – 6.70
Manganese	0.15 – 0.30
Zinc	2.50 – 3.50
Silicone	0.10 Maximum
Copper	0.02 Maximum
Iron	0.003 Maximum

Other	0.03 Maximum
Magnesium	Balance

The anode shall be free of blowholes, cold lap seams and any other imperfection which may detract from its performance.

The anode shall have cast into it a length of galvanised steel tube or rod running at least 90% of the anode length. The steel tube or rod shall also be suitable for the electrical connection of the anode cable to the anode and shall terminate in a recess at one end of the anode. In the case of a steel rod, this is achieved by drilling a suitable hole into the end of the rod.

The anode cables shall be 10mm^2 PVC/PVC (double insulated) stranded copper and of a length given in the Schedule of Rates and Quantities.

The 10mm^2 copper cable shall have the insulation removed for a length such that at least 25mm of copper is inserted in the tube/rod hole and flood soldered.

No mechanical connection of the anode cable to the anode is permitted.

The length of cable insulation removed shall be such that at least 20mm of insulation extends into the anode recess.

The anode recess shall be flooded with electrician’s bitumen (pourable grade) which shall not be heated in excess of 180`C. The bitumen shall completely fill the recess but not spill over to the external surface of the anode.

The anode cable insulation shall extend into the bitumen. No bare copper cable shall extend outside the bitumen. The maximum cable to anode resistance shall be 1mΩ.

Under no circumstances shall the anode be handled by picking it up by its cable, nor should the cable be pulled except initially as a test after making the cable to anode connection.

The anode shall have a solution potential when buried in any type of soil more negative than -1.7V with respect to a saturated copper/copper sulphate reference electrode. The anode must be able to maintain this potential at 100mA output.

The anode capacity shall be a minimum of 1200A hrs/kg.

For buried installations, anodes shall be pre-packed in cotton bags containing a mixture of 70% gypsum, 25% bentonite and 5% sodium sulphate, in a finely powdered form.

The anode shall be placed in the centre of the bag and be completely surrounded by the gypsum/bentonite/sodium sulphate backfill.

The cotton bags shall measure approximately 250mm in diameter, and be firmly tied at the top, where the cable exits, such that the backfill does not run out.

The anodes are to be installed complete with the backfill and cotton bag. Any plastic bag over the anodes must be removed and they shall be soaked in fresh clean for 30 minutes water prior to installation.

4.9 Sacrificial Anode Mounting Bracket

For valve chamber installations, anodes are to be attached to the chamber walls by means of suitable mounting brackets and Rawl bolts. Mounting brackets are to be manufactured from non-metallic material have a design life of 25 years. The design is to be such that the anode will not make mechanical contact with the Rawl bolts.

4.10 Gradient Control Mats

Gradient control mats (GCM) are to be made of 1.2m - 2.4m sheets of 100mm x 100mm x 4mm steel wire weldmesh. The mesh is to be hot dip galvanized to SANS 121-2000.

Separate sheets are to be interconnected by means of thermit welding. A purpose made mould utilising 45g weld metal is to be used.

Cable to mesh connections are to be by thermit welding. A purpose made mould utilising 45g weld metal is to be used.

Interconnection and cable to mesh connections are to be encapsulated using a viscoelastic mastic and tape wrap system.

4.11 Gradient Control Wires

Gradient control wires shall be zinc ribbon. The composition of the zinc shall be as per ASTM B418-95 – Type II.

The zinc ribbon geometry will be of the “standard” dimensions as follows:

- Cross section (D1 x D2) 12.7 mm x 14.3 mm
- Radii (R1 x R2) 2 mm x 5 mm
- Zinc weight 0.89 kg/m
- Steel core diameter 3.3 mm
- Potential -1.1 V vs CSE
- Capacity 780 Amp hrs/kg

Zinc ribbon is to be typically supplied in 400m lengths without any joints. The material shall not crack when uncoiled for installation.

Cable connections are to be made at either end of the ribbon by means of crimped and soldered tinned copper ferules. Cable is to be 25mm^2 green/yellow insulated copper. Cable to ribbon connections are to be encapsulated using a viscoelastic mastic and tape wrap system.

4.12 Solid State Decoupling Devices

The SS-DCD shall be non-electrolytic, fail safe and maintenance free. Fail safe shall imply that the failure of any SS-DCD component, shall result in an open circuit system and not a short circuit system. That is, the pipeline or structure shall never be directly connected to the earthing or grounded system.

Two types of decoupling devices are used. The first type will be used to decouple the zinc ribbon from the pipeline and the second to decouple the gradient control mats from the pipeline.

Details for decoupling zinc ribbon are as follows are as follows:

- Steady state AC current: 45A
- AC fault current rating: 3.7kA for 500ms
- 50Hz AC impedance: 0.04Ω
- Lightning current rating (10/350μs)) 100kA
- DC blocking voltage: -12/+1V
- Diode PIV 1500V
- Diode forward surge current 1200A
- DC steady state current (15 min): 60A
- DC sparkover voltage: 1.0kV
- Lightning impulse voltage: 2.2kV

The decoupling device shall comprise a suitably rated diode stack capable of blocking direct current in both directions at the specified voltages.

Once the blocking voltage is exceeded, the diode stack shall be capable of conducting the steady state DC up to 60A (15-minute rating) without overheating.

The device shall exhibit a progressive, smooth transition from blocking to conduction and vice versa without commutating.

A bypass capacitor (network) shall be connected in parallel with the diode stack to conduct 50Hz AC up to the blocking voltage of the diode stack.

The capacitor and diode network shall be protected by a suitably rated spark gap for high voltage and lightning induced transients. This will include the appropriate inductance required to decouple the spark gap from the diode stack in terms of lightning protection zone standard practice.

The decoupling device shall be of open frame construction to permit maintenance / replacement of component parts. The unit will be mounted inside an IP65 rated enclosure. Component parts shall be of reputable manufacture with proven performance record and certificated test data.
The decoupling device shall be provided with two M10 terminals at each pole for the connection of 25mm² single core cables.

Details for the decoupling of gradient control mats are as follows:

- AC fault current rating: 50kA
- DC blocking voltage: 100V
- Lightning current rating 8/20: 40kA
- Lightning impulse clamping voltage: <500V
- Response time: 25ns

Equipment is to be certified by a SANAS accredited testing laboratory. Certification is to cover the following:

- **Safety Grounding**

Providing an "effective ground-fault current path" as defined in one of the following:

- 2002 NFPA 70 (US National Electrical Code - NEC), Article 250.2, and required in 250.4(A)(5)
- Canadian Standards Association CSA C22.2 No. 0.4-M1982 (reaffirmed 1999), using Canadian Electrical Code Part I, section 10-500, 10-806 as a guide.
- Providing over-voltage protection in accordance with the applicable requirements of ANSI C62.11

- **Blocking Cathodic Protection Current**

Providing DC isolation of objectionable DC ground currents from cathodic protection systems as defined in NFPA 70, Article 250.6(E)

- **Hazardous Location Use**

The PCR shall be certified for use in Class I, Division 2, Groups A, B, C, D hazardous locations by UL and C-UL, according to one of the following:

- U.S. National Electrical Code section 500-505
- UL 1604: "Electrical Equipment for Use in Class I and Class II, Division 2, and Class III Hazardous (Classified) Locations"
- CSA C22.2 No.213-M1987: "Non-Incendive Electrical Equipment for Use in Class I, Division 2 Hazardous Locations"
- ATEX directive 94/9/EC, according to the standard EN50021:1999 "Electrical apparatus for potentially explosive atmospheres - Type of protection 'n'.
- **Environmental Rating**

  The enclosure shall be certified to environmental rating IP68 (submersible to 2m).

4.13 Cathodic Protection Cables

Cathodic Protection cables shall be insulated and rated for voltages up to 600V/1000V and shall have stranded copper conductors in accordance with SABS 1507 or ASTM Specification B-8.

All cathodic protection cables are to be double insulated PVC/PVC or XLPE/PVC. Cable to be used for AC mitigation earthing is to be single insulated.

Colour coding is to be as follows:

Positive	:	Red
Negative	:	Black
Reference Electrode	:	Blue
Earth	:	Green/Yellow

In certain instances, multi-core power cabling might be required, such as 4 Core PVCI/PVCS/SWA/PVCS.

In certain special circumstances cables will require PVDF/HMWPE insulation.

4.14 Cable to Pipe Connections

4.14.1 Stud-Weld

Stud welding is to be carried out by means of a capactive discharge stud welding tool. The procedure is to be performed as per the methodology specified by the equipment manufacturer. Studs are to be M8 and of suitable length for the application. Studs are to be copper plated, and nuts and washers are to be brass.

After installation, welds shall be tested by striking the weld with a 2kg hammer. Should any movement occur, the stud shall be re-welded and re-tested.

4.14.2 Thermit Weld

Thermit welds are to be performed as per manufacturer's specifications. Weld charges for pipe connections are to be no larger than 15g.

For 10mm^2 and 16mm^2 cables, a single 15g charge may be used to make the connection. For 35mm^2, the cable is to be split in two and welded with two 15g charges. For 70mm^2, the cable is to be split into four and welded with four 15g charges.

After installation, welds shall be tested by striking the weld with a 2kg hammer. Should any movement occur, the weld shall be repeated and re-tested.

4.15 Coating Repair

All coating material shall be sourced from Johannesburg Water approved suppliers. All coating applications shall be carried out in accordance with the procedures and data sheets provided by the coating material suppliers.

All cable to pipe connection and coating repairs shall be witnessed by the client's nominated representative.

5. Cathodic Protection and AC Mitigation Installations

5.1 Excavations

Prior to commencing with excavations. All necessary wayleaves are to be obtained. The proposed excavation area is to be scanned with ground penetrating radar (GPR) and the positions and depths of detected services are to be marked on the ground and recorded.

5.1.1 Cable and Anode Groundbed Trenches

Cable and anode groundbed trenches are to be excavated to a width of 300mm and depth of 1m for cables and 2.5m for anode groundbeds. Topsoil to a depth of 300mm is to be removed and stored separately.

Prior to the laying of cables or anodes inside the trench all loose rocks are to be removed from the trench floor. Trenches are to be backfilled with the native material and compacted by means of a mechanical rammer in 300mm layers. Care is to be taken when laying the first layer of backfill to ensure that no rocks or other sharp objects are placed on top of the cables.

Cable warning tape is to be installed 600mm below final ground level.

Topsoil is to be replaced as the final layer.

5.1.2 Excavation of Pipelines

Topsoil to a depth of 300mm is to be removed and stored separately. Excavation is to be carried out to a depth 300mm above the level of the pipe overt (as determined by the GPR survey). The remaining 300mm is to be carried out by hand until the pipe overt is exposed and the position and direction of the pipe is clear.

Should full circumferential excavation be required, excavation on either side is to proceed by mechanical means allowing 200mm beyond the expected pipe diameter. The remaining material is to be removed by hand. Excavation underneath the pipeline is also to be carried out by hand.

Excavations are to be backfilled with the native material and compacted by means of a mechanical rammer in 300mm layers. Care is to be taken when laying the first layer of backfill to ensure that no rocks or other sharp objects are placed on top of the cables. In cases where the pipe was found to have been installed with selected backfill or imported material, this is to be reinstated.

Cable warning tape is to be installed 600mm below final ground level.

Topsoil is to be replaced as the final layer.

5.1.3 Excavation for Gradient Control Wire Installations

Topsoil to a depth of 300mm is to be removed and stored separately. A 300mm wide trench is to be excavated to a depth of 0.8m. The floor of the exaction is to be level and free of loose stones and rocks prior to the installation of gradient control wire.

Excavations are to be backfilled with the native material and compacted by means of a mechanical rammer in 300mm layers. Care is to be taken when laying the first layer of backfill to ensure that no rocks or other sharp objects are placed on top of the wire.

Topsoil is to be replaced as the final layer.

5.1.4 Excavation for Gradient Control Mat Installations

Topsoil to a depth of 300mm is to be removed and stored separately. Excavation is to be carried out to a depth of 0.5m in a 1.2m wide border around the valve chamber. The floor of the excavation is to be level and free of loose stones and rocks prior to the installation of gradient control mesh. Where required, excavations for the installation of sacrificial anodes are to be made in the floor of the gradient control mat excavation. These are to be of sufficient size to accommodate the anodes below the mesh with a 300mm cover.

Excavations are to be backfilled with the native material and compacted by means of a mechanical rammer in 300mm layers. Care is to be taken when laying the first layer of backfill to ensure that no rocks or other sharp objects are placed on top of the mesh.

Topsoil is to be replaced as the final layer.

5.2 Concrete Encasement

5.2.1 Concrete Encasement of Cables

Prior to the pouring of concrete, the trench should be cleared of any loose rocks and the cables should be positioned in the centre of the trench. A 200mm thick layer of 30MPa concrete is to be poured over the cables. Concrete is to be allowed to set such that it can be stood on prior to backfilling and compaction proceeding.

5.2.2 Concrete Encasement of Gradient Control Mats

Once the gradient control mat has been installed and approved for backfilling by the CP Engineer, a 200mm thick layer of 30MPa concrete is to be poured over the mat. Concrete is to be allowed to set such that it can be stood on prior to backfilling and compaction proceeding.

5.3 Installation of Enclosures

5.3.1 Buried Type

Buried enclosures are to be installed as per the manufacturer's specifications ensuring that the IP68 rating is maintained.

The enclosure is to be encased in 30MPa concrete such that there is a minimum cover of 200mm of concrete for the entire circumference and the entire length of the enclosure.

5.3.2 Bunker and Mega Bunker Type

The bunker is to be placed on a 100mm thick concrete foundation of dimensions equal to the dimensions of the bunker base. Prior to the casting of the base, a 110mm diameter conduit with long radius bend is to be installed starting at a depth of 1m and coming above ground through the centre of the foundation. The horizontal portion of the conduit is to extend for a distance such that it will end in line with the concrete surround of the bunker.

After installation, a 30MPa concrete surround is to be cast around the bunker base. The surround is to extend 800mm from the bunker on all sides. The surround is to be 150mm thick and to be reinforced with 100 x 100 x 4mm weld mesh. The surround is to have a 20mm fall away from the bunker.

5.3.3 Equipment Shelter Type

The enclosure is to be placed on a 150mm thick concrete foundation of dimensions equal to the dimensions of the enclosure base. Prior to the casting of the base, 110mm diameter conduits with long radius bends are to be installed starting at a depth of 1m and coming above ground through the foundation. There are to be two incoming conduits, one to the centre of the foundation and one to a position in line with the centre of the inside surface of the enclosure wall on the left side of the entrance there is also to be a conduit installed between the position adjacent to the wall and the position at the centre of the slab. The horizontal portions of the incoming conduits are to extend for a distance such that they will end in line with the outer edge of the concrete surround.

After installation, a 30MPa concrete surround is to be cast around the enclosure base. The foundation beams are to be used as formwork for the surround. The surround is to be 150mm thick and is to have a 10mm fall away from the enclosure. The surround is to lie at a level 10mm below the door opening.

5.3.4 Big Head Test Post and uPVC Test Post Type

The test post is to be installed such that the bottom 500mm is below final ground level. The base of the test post is to be encased in 30MPa concrete covering the lower 400mm of the test post to a thickness of 300mm.

After installation, a 30MPa concrete surround is to be cast around the test post. The surround is to extend 800mm from the test post on all sides. The surround is to be 150mm thick and to be reinforced with 100 x 100 x 4mm weld mesh. The surround is to have a 20mm fall away from the test post.

5.4 Monitoring Facilities

5.4.1 Stationary Reference Electrodes

Stationary reference electrodes are to be installed adjacent to the pipeline at the 3 o'clock position. The reference electrode is to be 300mm away from the pipe wall. The reference electrode is to be soaked in water for 10 minutes prior to being installed.

Two 10mm^2 black double insulted cables are to be connected to the pipeline adjacent to the reference electrode installation.

The electrode is to be backfilled with the same selected backfill material that surrounds the pipeline. Cables are to be brought to the surface and terminated inside the monitoring enclosure.

5.4.2 Coupons

Coupons are to be installed immediately adjacent to pipe wall directly opposite the reference electrode.

The coupon is to be backfilled with the same selected backfill material that surrounds the pipeline.

The cable is to be brought to the surface and terminated inside the monitoring enclosure.

5.4.3 IR Free Control Cards

IR Free cards are to be installed inside the monitoring enclosure. Mountings are to be of the stand-off type to ensure that no part of the card is in contact with any part of the enclosure.

Cable terminations are to be carried out utilising the correct termination lugs as per the control card design drawing.

5.5 Continuity and Cross Bonding Facilities

5.5.1 Continuity Bonds

5.5.1.1 Flanges and Couplings

Continuity bonding of buried flanges is to be achieved by connecting a pair of black double insulated copper cables to the pipe on either side of the joint. In the case of Viking Johnson type couplings or flange adapters, a connection is also to be made to the barrel of the coupling.

For pipelines of less than 700mm diameter, the cable is to be 16mm^2 and for pipelines of 700mm diameter and greater, the cable is to be 35mm^2.

The entire pipe joint is to be coated as per the specified coating manufacturers methodologies and data sheets.

5.5.1.2 Valve Chambers

5.5.1.2.1 Internal Continuity Bond

The continuity bonding cable is to be connected to the pipe on one side of the inside of the chamber and is to be securely mounted to the wall inside galvanised conduit utilising

galvanised hospital saddles. All conduit end points are to be fitted with plastic end caps. Cable to pipe connection points are to be suitably coated.

In certain cases, continuity bonding cables may be required to terminate at a suitable link panel mounted on the chamber wall.

The length of cable and conduit, number of pipe connections and the size and configuration of link panels will be specified in the bill of quantities.

Double insulated cable is to be used. For pipelines of less than 700mm diameter, the cable is to be 16mm^2 and for pipelines of 700mm diameter and greater, the cable is to be 35mm^2.

5.5.1.2.2 External Continuity Bond

The pipe is to be excavated immediately adjacent to the chamber wall and a trench 1m deep is to be excavated around the chamber adjacent to the wall.

The continuity bonding cables are to be connected to the pipe on one side of the outside of the chamber and are to be routed around the chamber inside the trench. Cable to pipe connection points are to be suitably coated.

The length of cable and number of pipe connections will be specified in the bill of quantities.

Parallel double insulated cables are to be used. For pipelines of less than 700mm diameter, the cable is to be 16mm^2 and for pipelines of 700mm diameter and greater, the cable is to be 35mm^2.

5.6 Insulating Flange Materials

Insulating flange materials are to be installed by a qualified fitter. The torque settings prescribed for the given flange set are to be met but not exceeded.

The explosion proof spark gap is to be installed on the upper-most stud on the flange set.

5.7 Sacrificial Anodes

5.7.1 Buried Installation

Sacrificial anodes are to be installed vertically inside the excavated trench such that the top is 1m below final ground level. Prior to installation, anodes are to be removed from any plastic packaging and soaked in clean fresh water for 15 minutes prior to installation. Anodes are never to be lifted or moved by their cable tails.

5.7.2 Valve Chamber Installation

For valve chamber installations, anodes are to be attached to the chamber walls by means of suitable mounting brackets and Rawl bolts. Anodes are to be mounted horizontally and pipe invert depth or at the level of the underside of and valves or fittings, whichever is lower.

Cables are to be routed to the link panel in suitably mounted galvanised conduits.

5.8 Impressed Current Groundbeds

Anode and spacer canisters are to be carefully lowered into the trench using suitable slings. The cable is to be kept clear to prevent it being damaged in the process. The cable is not to be used to manoeuvre the anode canisters in any way.

The ring main cable is to be laid out on the edge of the trench and the anode tails are to be alternately spliced to each leg of the ring main. The cable jointing kits and cables are to be secured in position and not moved until the epoxy resin has set.

Prior to the ring main being laid into the trench, the anode and spacer canisters are to be backfilled with native material excluding any rocks larger than 30mm diameter such that they have 100mm cover. Thereafter the cables are to be laid in the trench and covered with 100mm of similarly screened material before the remaining backfilling is carried out.

5.9 Gradient Control Mats

The GCM's are to be installed around the outside of valve chambers at a depth of 0.5m in a 1.2m wide border with a 200mm thick 30MPa concrete slab over it. In addition, the same mesh is to be installed underneath the chamber floor. In the case of existing chambers, the weld mesh is to be installed on the chamber floor and then covered with a 50mm concrete screed.

GCM's are to be assembled on site to the required sizes with the constituent weld mesh sheets being joined by means of thermit welds at 400mm spacing.

Magnesium anodes are to be installed horizontally 300mm below the outer grid and connected to the grid by means of 16mm^2 PVC/PVC insulated cable.

The separate components of the GCM (the surround and sub-floor mats) are to be connected to the pipeline by via a suitable link panel installed inside the valve chamber. Pipe connection cables are to be black 16mm^2 PVC/PVC insulated copper cables. GCM connection cables are to be green/yellow 16mm^2 PVC insulated copper cables.

Connections between the weld mesh and the cables is to be by means of thermit welding.

All thermit welded GCM connections are to be completely sealed using a viscoelastic mastic and tape wrap system. The entire heat affected portion of the weld mesh and 50mm beyond the start of the cable insulation is to be encapsulated.

5.10 Gradient Control Wires

Gradient control wire (zinc ribbon) is to be carefully unrolled from the coil in such a way that no twisting or kinking of the material occurs. The material is to be laid flat and straight on the trench floor.

Cable connections are to be made at either end of the ribbon by means of crimped and soldered tinned copper ferules. Cable is to be 25mm^2 green/yellow insulated copper. Cable to ribbon connections are to be encapsulated using a viscoelastic mastic and tape wrap system.

The gradient control wires are to be backfilled with native material excluding any rocks larger than 30mm diameter such that they have 100mm cover. Thereafter the remaining backfilling is carried out. Cable warning tape is to be installed 300mm above the level of the wire installation.

5.11 Solid State Decoupling Devices

Decoupling devices will be installed inside enclosures at locations along the AC-affected portions of the pipelines, through which the gradient control wires will be connected to the pipelines.

The devices are to be securely mounted in the designated location using suitable expansion bolts.

Cables shall be terminated by means of lugs. insulated by means of heat shrink sleeves or slip-on rubber shrouds colour-coded to match the cable insulation.

All terminals shall be suitably labelled and be completely accessible after completion of all wiring.

Terminals shall be provided with lock nuts and or spring washers.

5.12 Cables

Cables are to be carefully unrolled from the coil in such a way that no twisting or kinking occurs. Cables are to be laid flat and straight on the trench floor.

Cables are to be backfilled with native material excluding any rocks larger than 30mm diameter such that they have 100mm cover. Thereafter the remaining backfilling is carried out.

Cable warning tape is to be installed 300mm above the level of the cable installation.

5.13 Installation of Cable to Pipe Connections

Cable to pipe connections are to be by means of stud welding or thermit welding.

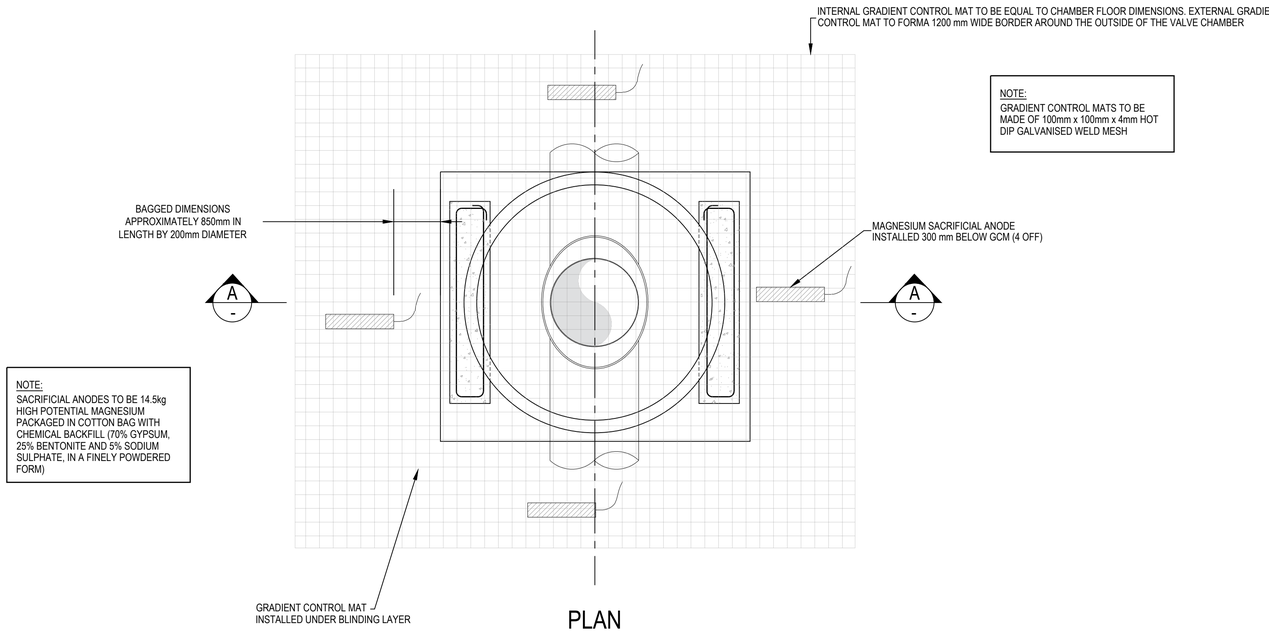
Installations are to be carried out according to the manufacturer’s specifications by a technician who has undergone training from the manufacturer and has a valid certificate to indicate this.

5.14 Installation of Coating Repair Materials

Coating repair applications are to be carried out according to the manufacturer’s specifications by a technician who has undergone training from the manufacturer and has and has a valid certificate to indicate this.

Appendix 1 : Specification Drawings

Drawing Number	Drawing Title
JW-23-01-D01 Rev 0:	Typical Air Valve Gradient Control Mat
JW-23-01-D02 Rev 0:	Typical Scour Valve Gradient Control Mat
JW-23-01-D03 Rev 0:	Typical Equipment Shelter Type TRU Enclosure
JW-23-01-D04 Rev 0:	Typical Mega Bunker Type TRU enclosure
JW-23-01-D05 Rev 0:	Typical Buried Type TRU Enclosure
JW-23-01-D06 Rev 0:	Typical Bunker Type Monitoring Enclosure
JW-23-01-D07 Rev 0:	Typical Buried Type Monitoring Enclosure
JW-23-01-D08 Rev 0:	Typical Big Head Type Monitoring Enclosure
JW-23-01-D09 Rev 0:	Typical Large Chamber Gradient Control Mat
JW-23-01-D10 Rev 0:	Typical Valve Chamber Anode Installation
JW-23-01-D11 Rev 0:	Typical Valve Chamber Continuity Bond (Internal)
JW-23-01-D12 Rev 0:	Typical Valve Chamber Continuity Bond (External)
JW-23-01-D13 Rev 0:	Typical Link Panel
JW-23-01-D14 Rev 0:	Typical PVC Type Monitoring Enclosure
JW-23-01-D15 Rev 0:	Typical Electrical Schematic for a Switch Mode Cathodic Protection Rectifier Unit
JW-23-01-D16 Rev 0:	Typical Electrical Schematic for a Single-Phase Manual Tap Change Transformer Rectifier Unit
JW-23-01-D17 Rev 0:	Typical Electrical Schematic for a Three Phase Manual Tap Change Transformer Rectifier Unit
JW-23-01-D18 Rev 0:	Typical Electrical Schematic for a Three Phase Thyristor Controlled Transformer Rectifier Unit
JW-23-01-D19 Rev 0:	Typical Electrical Schematic for a Three Phase Thyristor Controlled Forced Drainage Unit
JW-23-01-D20 Rev 0:	Typical Electrical Schematic for a Natural Drainage Unit
JW-23-01-D21 Rev 0:	Typical Anode Groundbed Installation
JW-23-01-D22 Rev 0:	Typical TRU Enclosure Perimeter Security
JW-23-01-D23 Rev 0:	Typical TRU Enclosure Perimeter Security – Concrete Foundation Detail



PLAN

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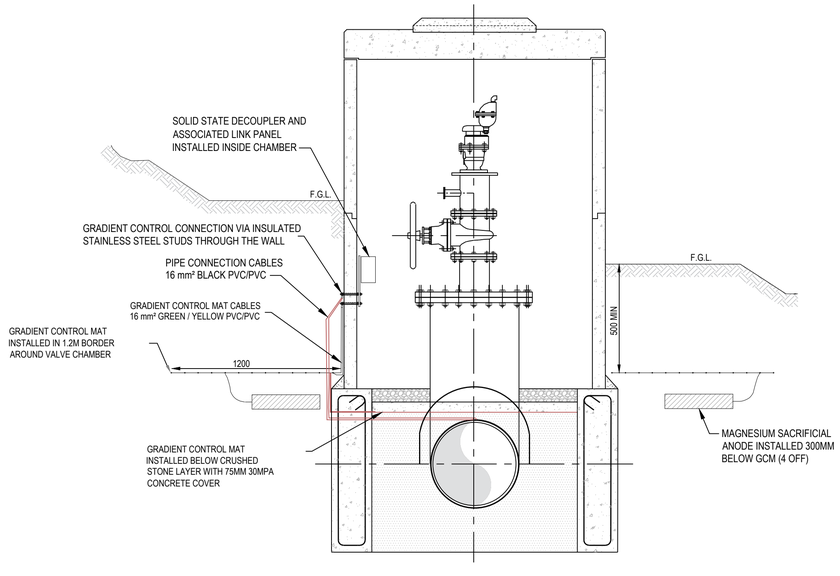

SECTION A-A

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GENERAL NOTES

CATHODIC PROTECTION

1. SEE JOHANNESBURG WATER CATHODIC PROTECTION STANDARD SPECIFICATION SECTIONS 4.10, 5.1.4 & 5.2.2

ELECTRICITY

1. SOLID STATE DECOUPLING DEVICE TO BE OF THE VOLTAGE LIMITING DEVICE (VLD) TYPE.
2. SEE ESKOM GUIDELINE ON THE ELECTRICAL COORDINATION OF PIPELINES AND POWER LINES GL240-66418968 Rev 1. SECTION B4.

SACRIFICIAL ANODE

1. SEE JOHANNESBURG WATER CATHODIC PROTECTION STANDARD SPECIFICATION SECTIONS 4.8.

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Project description:

ENGINEERING SERVICE UNIT - STANDARD DETAIL
TECHNICAL SPECIFICATION FOR CATHODIC PROTECTION
TYPICAL GRADIENT CONTROL MAT AT AIR VALVE

SCALE: AS SHOWN

AMENDMENTS

REV	DESCRIPTION	DATE	BY	APV
A	ISSUED FOR INFORMATION	2024/10/22	T.M	P.M

DRAWING No: JW-23-001-D01

PROJECT No.	DISCIPLINARY	REV.
UR	STD	A

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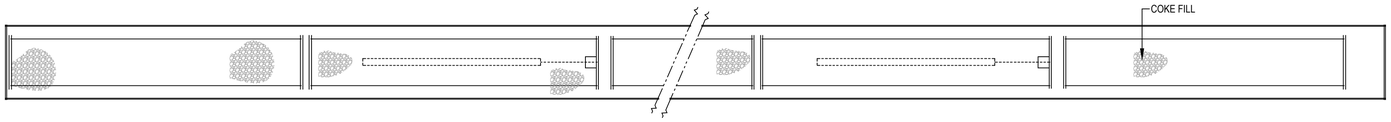

PLAN

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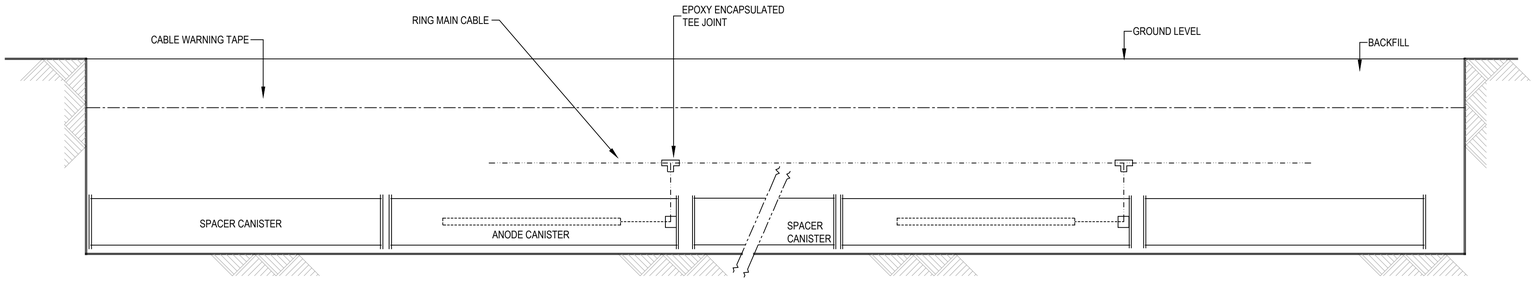

SECTIONAL ELEVATION

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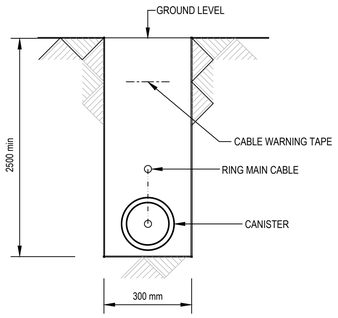

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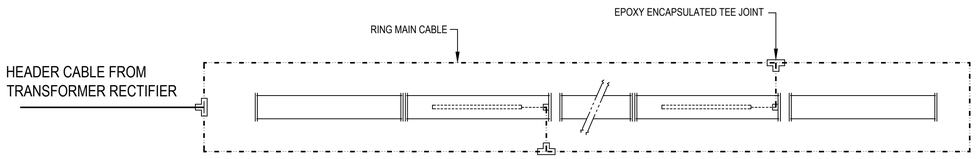

SCHEMATIC CABLE DIAGRAM

SCALE : N.T.S.

NOTES

1. ANODE IN CANISTER TO BE AS SPECIFIED IN THE BILL OF QUANTITIES .
2. FOR NUMBER OF ANODES AND CABLE SEE BILL OF QUANTITIES.
3. RING MAIN ANODE CABLE TO BE DOUBLE INSULTED.

TYPICAL ANODE GROUND BED INSTALLATION

SCALE : N.T.S.

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Project description:

ENGINEERING SERVICE UNIT - STANDARD DETAIL
TECHNICAL SPECIFICATION FOR CATHODIC PROTECTION
TYPICAL ANODE GROUND BED INSTALLATION

SCALE: N.T.S.

AMENDMENTS

REV	DESCRIPTION	DATE	BY	APV
A	ISSUED FOR INFORMATION			

DRAWING No: JW-23-001-D021

PROJECT No.	DISCIPLINARY	REV.
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GENERAL NOTES

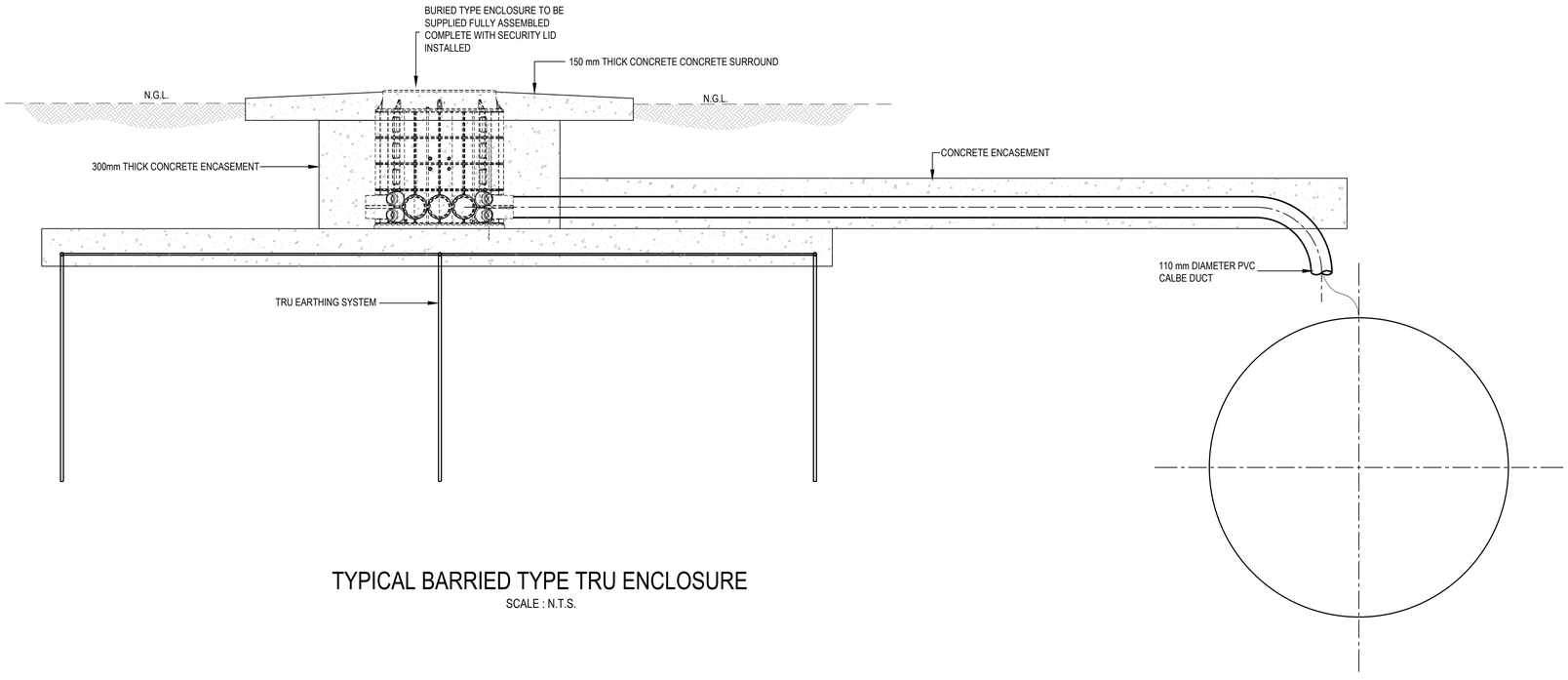
REINFORCED CONCRETE ENCLOSURE TO BE PRE-CAST

1. MINIMUM OPENING TO BE 650mm DIAMETER AND MINIMUM INTERNAL DEPTH TO BE 1000mm.
2. SEE JOHANNESBURG WATER CATHODIC PROTECTION STANDARD SPECIFICATION SECTIONS 4.3.1 AND 5.3.1.

ELECTRICITY

CABLE SIZES AND LENGTHS

1. LENGTHS TO BE QUANTIFIED AS PER SITE REQUIREMENT AND REFERENCED ACCORDINGLY IN THE BILL OF QUANTITIES.
2. SEE JOHANNESBURG WATER CATHODIC PROTECTION STANDARD SPECIFICATION SECTIONS 4.13 & 4.14, 4.15, 5.2.1, 5.12, 5.13 AND 5.14.



TYPICAL BARRIED TYPE TRU ENCLOSURE

SCALE : N.T.S.

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Project description:

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TECHNICAL SPECIFICATION FOR CATHODIC PROTECTION
TYPICAL BARRIED TYPE TRU ENCLOSURE

SCALE: AS SHOWN

AMENDMENTS

REV	DESCRIPTION	DATE	BY	APV
A	ISSUED FOR INFORMATION			

DRAWING No: JW-23-001-D05

PROJECT No.	DISCIPLINARY	REV.
UR	STD	A

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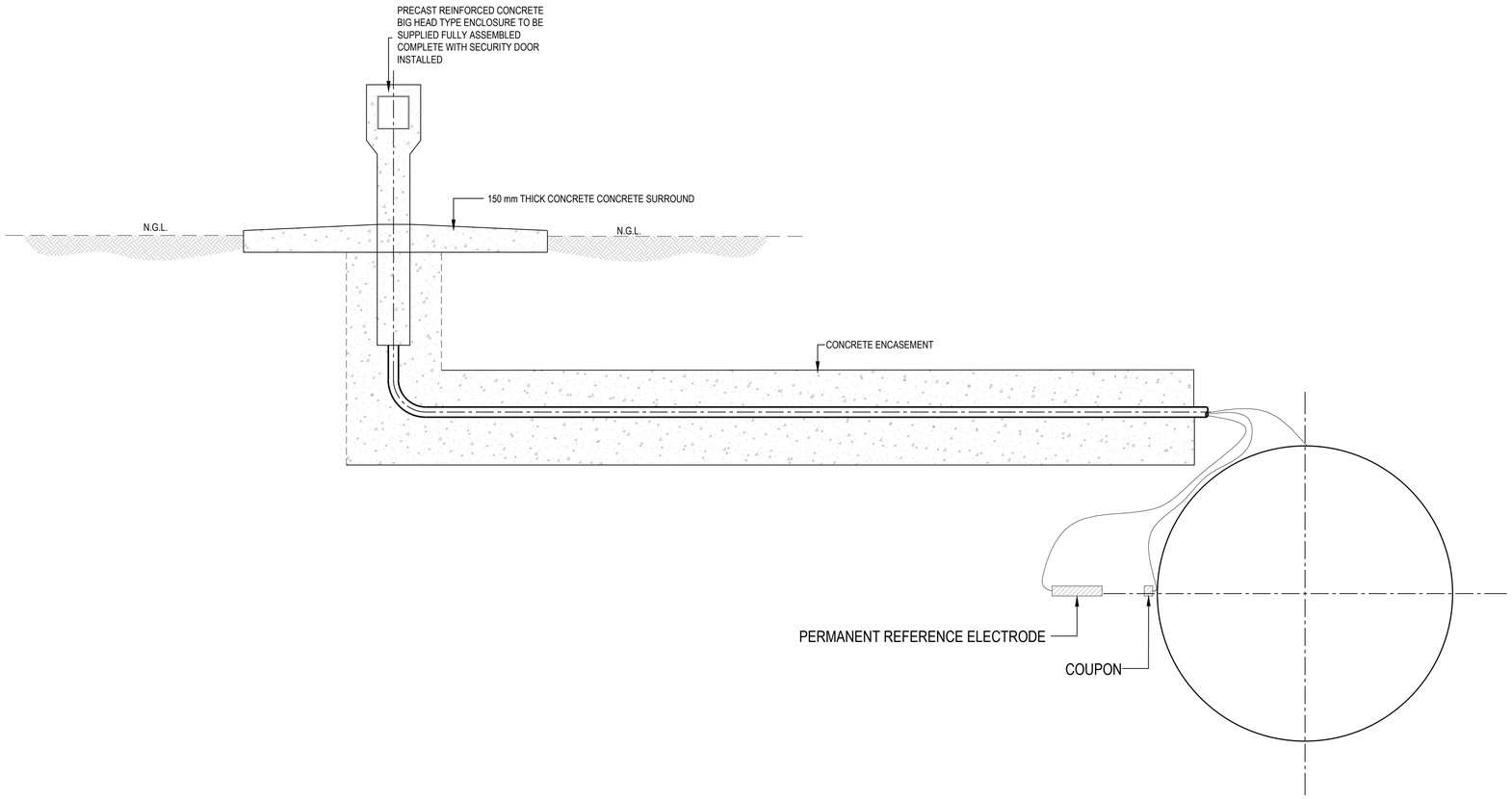

TYPICAL BIG HEAD TYPE MONITORING ENCLOSURE

SCALE : N.T.S.

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GENERAL NOTES

REINFORCED CONCRETE ENCLOSURE TO BE PRE-CAST

1. NORMAL BIG HEAD TYPE : MINIMUM INTERNAL DIMENSIONS OF UPPER ENCLOSURE TO BE (W) 168mm x (H) 160mm x (D) 150mm WITH MINIMUM 65mm WALL THICKNESS AROUND ENCLOSURE, TOTAL TEST POST HEIGHT OF 1400mm. MEGA BIG HEAD TYPE : MINIMUM INTERNAL DIMENSIONS OF UPPER ENCLOSURE TO BE (W) 200mm x (H) 240mm x (D) 160mm WITH MINIMUM 90mm Wall THICKNESS AROUND ENCLOSURE, TOTAL TEST POST HEIGHT OF 1600mm.
2. SEE JOHANNESBURG WATER CATHODIC PROTECTION STANDARD SPECIFICATION SECTIONS 4.5.2, 4.5.3 AND 5.3.4.

ELECTRICITY

CABLE SIZES AND LENGTHS

1. LENGTHS TO BE QUANTIFIED AS PER SITE REQUIREMENT AND REFERENCED ACCORDINGLY IN THE BILL OF QUANTITIES.
2. SEE JOHANNESBURG WATER CATHODIC PROTECTION STANDARD SPECIFICATION SECTIONS 4.13 & 4.14, 4.15, 5.2.1, 5.12, 5.13 AND 5.14.

ELECTRODE AND COUPON

1. BAGGED DIMENSIONS APPROXIMATELY 460mm IN LENGTH BY 200 mm DIAMETER.
2. SEE JOHANNESBURG WATER CATHODIC PROTECTION STANDARD SPECIFICATION SECTIONS 4.4 AND 5.4 .

ISSUED FOR INFORMATION

CONSULTING ENGINEERS
CAPEX - ENGINEERING SERVICE UNIT
TURBINE HALL - 3RD FLOOR
65 NTEMI PILISO STREET
NEWTOWN
JOHANNESBURG
2113

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	SIGNATURE:	ECSA REG. No:	

Johannesburg Water

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FAX: +27(0)11 688-1528

Municipality:

Joburg
a world class African city

Project description:

ENGINEERING SERVICE UNIT - STANDARD DETAIL
TECHNICAL SPECIFICATION FOR CATHODIC PROTECTION
TYPICAL BIG HEAD TYPE MONITORING ENCLOSURE

SCALE: AS SHOWN

AMENDMENTS

REV	DESCRIPTION	DATE	BY	APV
A	ISSUED FOR PRELIMINARY DESIGN REPORT	2024/10/22	T.M	P.M

DRAWING No: JW-23-001-D08

UR	STD	-	A
PROJECT No.	DISCIPLINARY		REV.

A1 ORIGINAL PAGE SIZE | SHEET 1 OF 1

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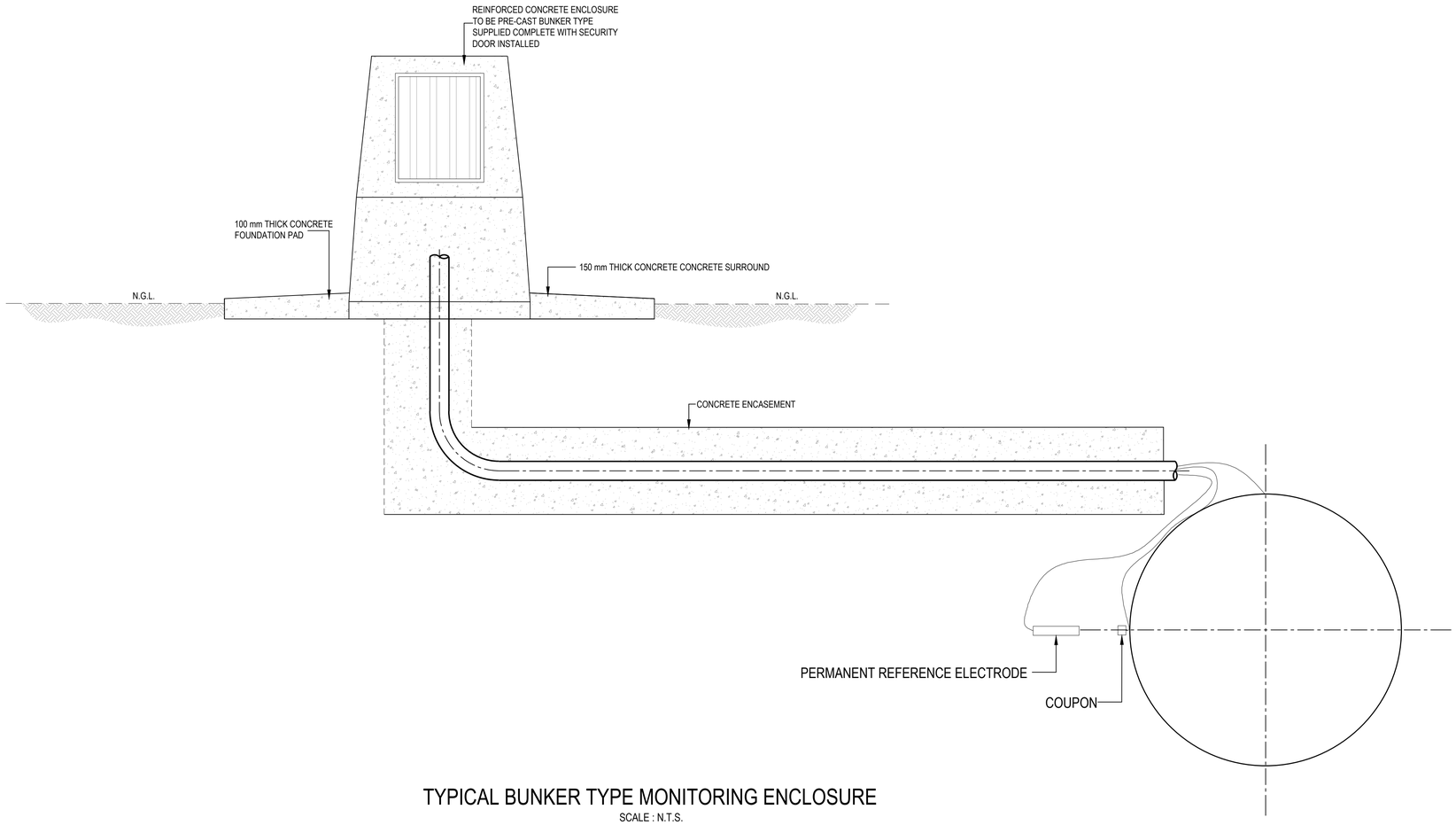

TYPICAL BUNKER TYPE MONITORING ENCLOSURE

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GENERAL NOTES

REINFORCED CONCRETE ENCLOSURE TO BE PRE-CAST

1. MINIMUM INTERNAL DIMENSIONS OF UPPER ENCLOSURE TO BE (W) 480mm x (H) 860mm x (D) 385mm, WALL THICKNESS OF 150mm. MINIMUM OVERALL UNIT HEIGHT OF 1400 mm.
2. SEE JOHANNESBURG WATER CATHODIC PROTECTION STANDARD SPECIFICATION SECTIONS 4.3.3 AND 5.3.3.
3. SEE JOHANNESBURG WATER CATHODIC PROTECTION STANDARD SPECIFICATION SECTIONS 4.13 & 4.14, 4.15, 5.2.1, 5.12, 5.13 AND 5.14.

ELECTRICITY

CABLE SIZES AND LENGTHS

1. LENGTHS TO BE QUANTIFIED AS PER SITE REQUIREMENT AND REFERENCED ACCORDINGLY IN THE BILL OF QUANTITIES.
2. SEE JOHANNESBURG WATER CATHODIC PROTECTION STANDARD SPECIFICATION SECTIONS 4.13 & 4.14, 4.15, 5.2.1, 5.12, 5.13 AND 5.14.

ELECTRODE AND COUPON

1. BAGGED DIMENSIONS APPROXIMATELY 460 mm IN LENGTH BY 200 mm DIAMETER.
2. SEE JOHANNESBURG WATER CATHODIC PROTECTION STANDARD SPECIFICATION SECTIONS 4.4 AND 5.4 .

ISSUED FOR INFORMATION

CONSULTING ENGINEERS
CAPEX - ENGINEERING SERVICE UNIT
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65 NTEMI PILISO STREET
NEWTOWN
JOHANNESBURG
2113

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Johannesburg Water

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NEWTOWN
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2113
TEL: +27 (0)11 688 1400
FAX: +27(0)11 688-1528

Municipality: Joburg — a world class African city

Project description:

ENGINEERING SERVICE UNIT - STANDARD DETAIL
TECHNICAL SPECIFICATION FOR CATHODIC PROTECTION
TYPICAL BUNKER TYPE MONITORING ENCLOSURE

SCALE: N.T.S.

AMENDMENTS

REV	DESCRIPTION	DATE	BY	APV
A	ISSUED FOR INFORMATION			

DRAWING No: JW-23-001-D06

UR (PROJECT No.) — STD (DISCIPLINARY) – A (REV.)

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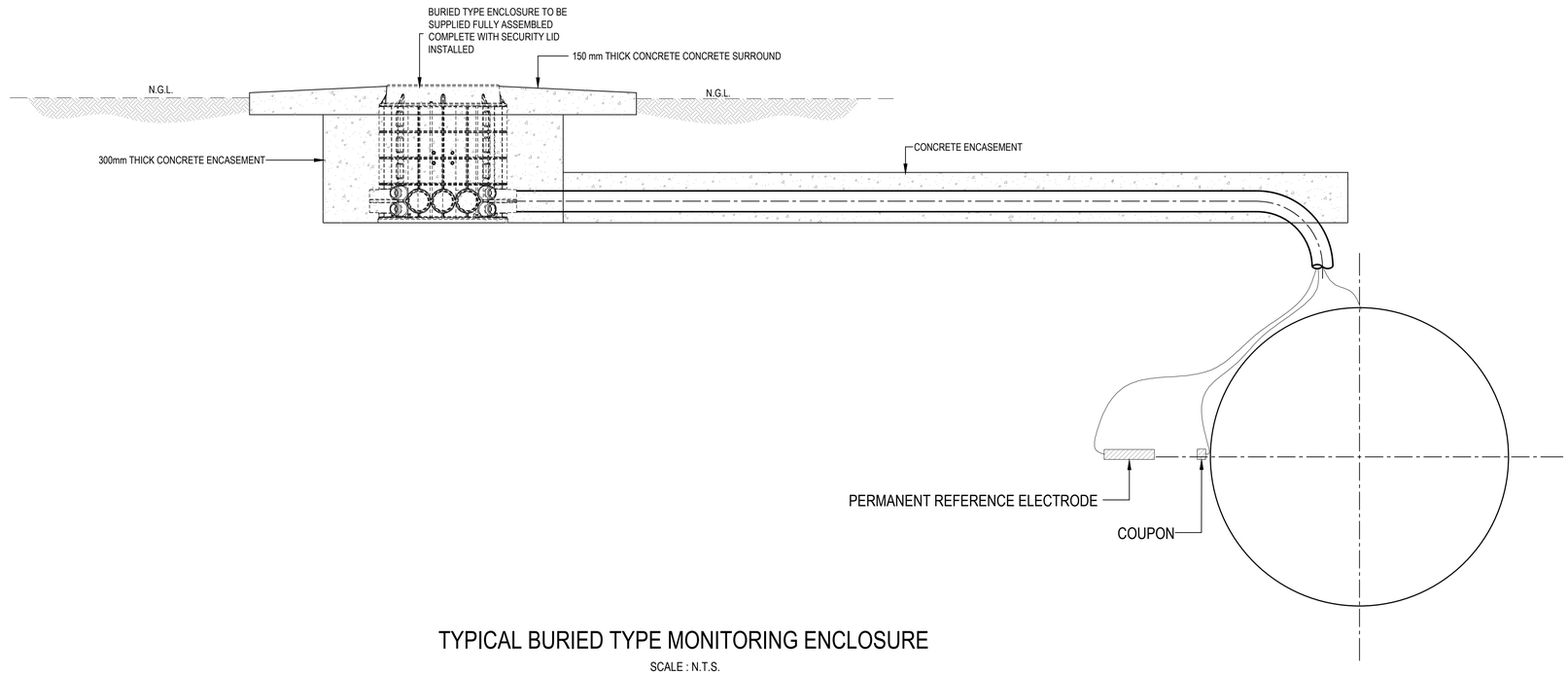

TYPICAL BURIED TYPE MONITORING ENCLOSURE

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GENERAL NOTES

REINFORCED CONCRETE ENCLOSURE TO BE PRE-CAST

1. MINIMUM OPENING TO BE 650mm DIAMETER AND MINIMUM INTERNAL DEPTH TO BE 1000mm.
2. SEE JOHANNESBURG WATER CATHODIC PROTECTION STANDARD SPECIFICATION SECTIONS 4.3.1 AND 5.3.1.

ELECTRICITY

CABLE SIZES AND LENGTHS

1. LENGTHS TO BE QUANTIFIED AS PER SITE REQUIREMENT AND REFERENCED ACCORDINGLY IN THE BILL OF QUANTITIES.
2. SEE JOHANNESBURG WATER CATHODIC PROTECTION STANDARD SPECIFICATION SECTIONS 4.13 & 4.14, 4.15, 5.2.1, 5.12, 5.13 AND 5.14.

ISSUED FOR INFORMATION

CONSULTING ENGINEERS
CAPEX - ENGINEERING SERVICE UNIT
TURBINE HALL - 3RD FLOOR
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Johannesburg Water

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TEL: +27 (0)11 688 1400
FAX: +27(0)11 688-1528

Municipality: Joburg — a world class African city

Project description:

ENGINEERING SERVICE UNIT - STANDARD DETAIL
TECHNICAL SPECIFICATION FOR CATHODIC PROTECTION
TYPICAL BURIED TYPE MONITORING ENCLOSURE

SCALE: AS SHOWN

AMENDMENTS

REV	DESCRIPTION	DATE	BY	APV
A	ISSUED FOR PRELIMINARY DESIGN REPORT			

DRAWING No: JW-23-001-D07

PROJECT No.	DISCIPLINARY	REV.
UR	STD	A

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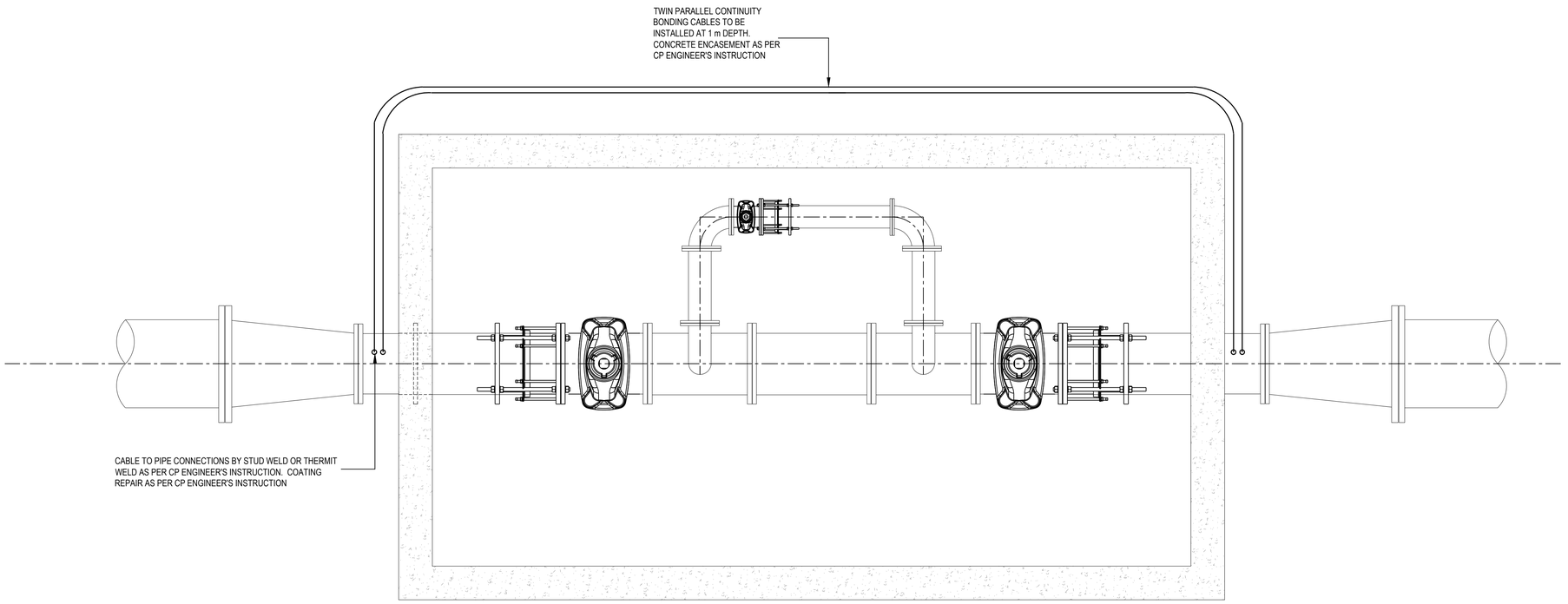
FILE No.



TYPICAL CHAMBER CONTINUITY BOND (EXTERNAL)

SCALE : N.T.S.

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GENERAL NOTES

CATHODIC PROTECTION

1. GRADIENT CONTROL MAT TO BE 100mm x 100mm x 4mm HOT DIP GALVANIZED WELD MESH.
2. SEE JOHANNESBURG WATER CATHODIC PROTECTION STANDARD SPECIFICATION SECTIONS 4.10, 5.1.4 & 5.2.2

ELECTRICITY

1. SOLID STATE DECOUPLING DEVICE TO BE OF THE VOLTAGE LIMITING DEVICE (VLD) TYPE.
2. SEE ESKOM GUIDELINE ON THE ELECTRICAL COORDINATION OF PIPELINES AND POWER LINES GL240-66418968 Rev 1, SECTION B4.

SACRIFICIAL ANODE

1. SACRIFICIAL ANODES TO BE 14.5KG HIGH POTENTIAL MAGNESIUM PACKAGED IN COTTON BAG WITH CHEMICAL BACKFILL (70% GYPSUM, 25% BENTONITE AND 5% SODIUM SULPHATE, IN A FINELY POWDERED FORM)
2. SEE JOHANNESBURG WATER CATHODIC PROTECTION STANDARD SPECIFICATION SECTIONS 4.8.

ISSUED FOR INFORMATION

CONSULTING ENGINEERS
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65 NTEMI PILISO STREET
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Municipality: Joburg — a world class African city

Project description:

ENGINEERING SERVICE UNIT - STANDARD DETAIL
TECHNICAL SPECIFICATION FOR CATHODIC PROTECTION
TYPICAL CHAMBER CONTINUITY BOND (EXTERNAL)

SCALE: N.T.S.

AMENDMENTS

REV	DESCRIPTION	DATE	BY	APV
A	ISSUED FOR INFORMATION			

DRAWING No: JW-23-001-D012

PROJECT No.	DISCIPLINARY	REV.
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GENERAL NOTES

CATHODIC PROTECTION

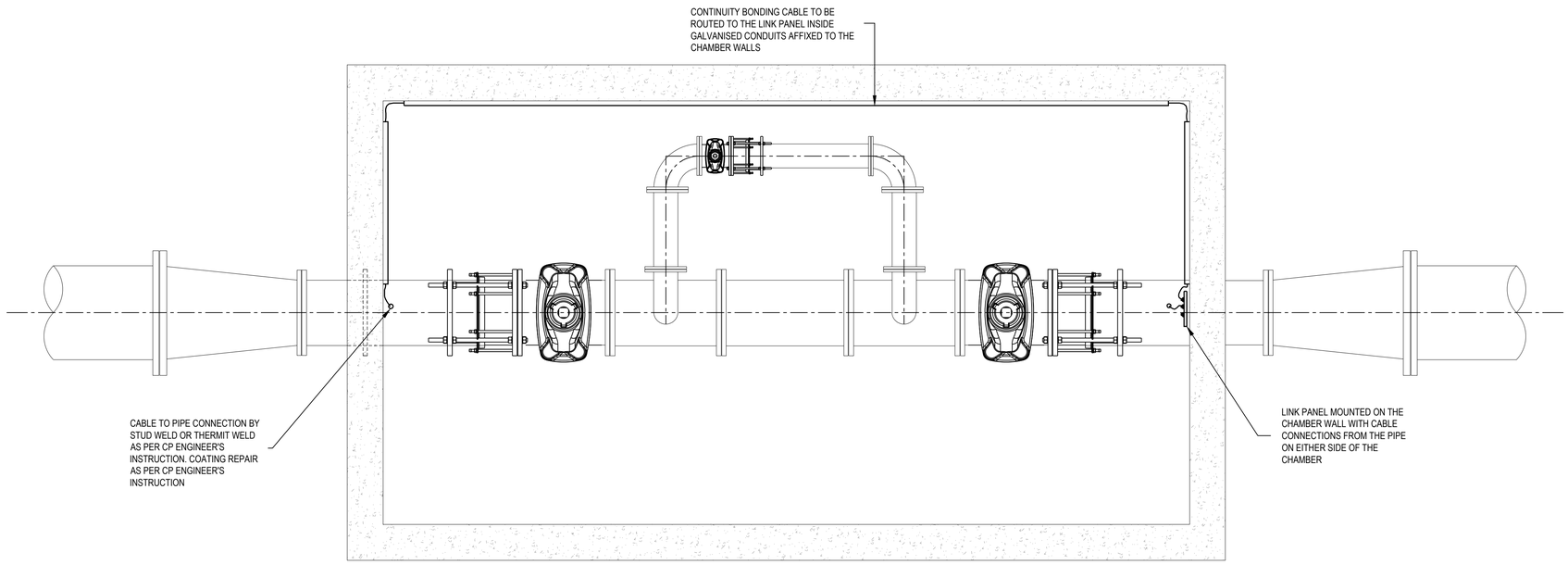
1. GRADIENT CONTROL MAT TO BE 100mm x 100mm x 4mm HOT DIP GALVANIZED WELD MESH.
2. SEE JOHANNESBURG WATER CATHODIC PROTECTION STANDARD SPECIFICATION SECTIONS 4.10, 5.1.4 & 5.2.2

ELECTRICITY

1. SOLID STATE DECOUPLING DEVICE TO BE OF THE VOLTAGE LIMITING DEVICE (VLD) TYPE.
2. SEE ESKOM GUIDELINE ON THE ELECTRICAL COORDINATION OF PIPELINES AND POWER LINES GL240-66418968 Rev 1, SECTION B4.

SACRIFICIAL ANODE

1. SACRIFICIAL ANODES TO BE 14.5KG HIGH POTENTIAL MAGNESIUM PACKAGED IN COTTON BAG WITH CHEMICAL BACKFILL (70% GYPSUM, 25% BENTONITE AND 5% SODIUM SULPHATE, IN A FINELY POWDERED FORM)
2. SEE JOHANNESBURG WATER CATHODIC PROTECTION STANDARD SPECIFICATION SECTIONS 4.8.



TYPICAL CHAMBER CONTINUITY BOND (INTERNAL)

SCALE : N.T.S.

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CONSULTING ENGINEERS
CAPEX - ENGINEERING SERVICE UNIT
TURBINE HALL - 3RD FLOOR
65 NTEMI PILISO STREET
NEWTOWN
JOHANNESBURG
2113

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Johannesburg Water

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Municipality: Joburg — a world class African city

Project description:

ENGINEERING SERVICE UNIT - STANDARD DETAIL
TECHNICAL SPECIFICATION FOR CATHODIC PROTECTION
TYPICAL CHAMBER CONTINUITY BOND (INTERNAL)

SCALE: N.T.S.

AMENDMENTS

REV	DESCRIPTION	DATE	BY	APV
A	ISSUED FOR INFORMATION			

DRAWING No: JW-23-001-D011

UR (PROJECT No.) — STD (DISCIPLINARY) – A (REV.)

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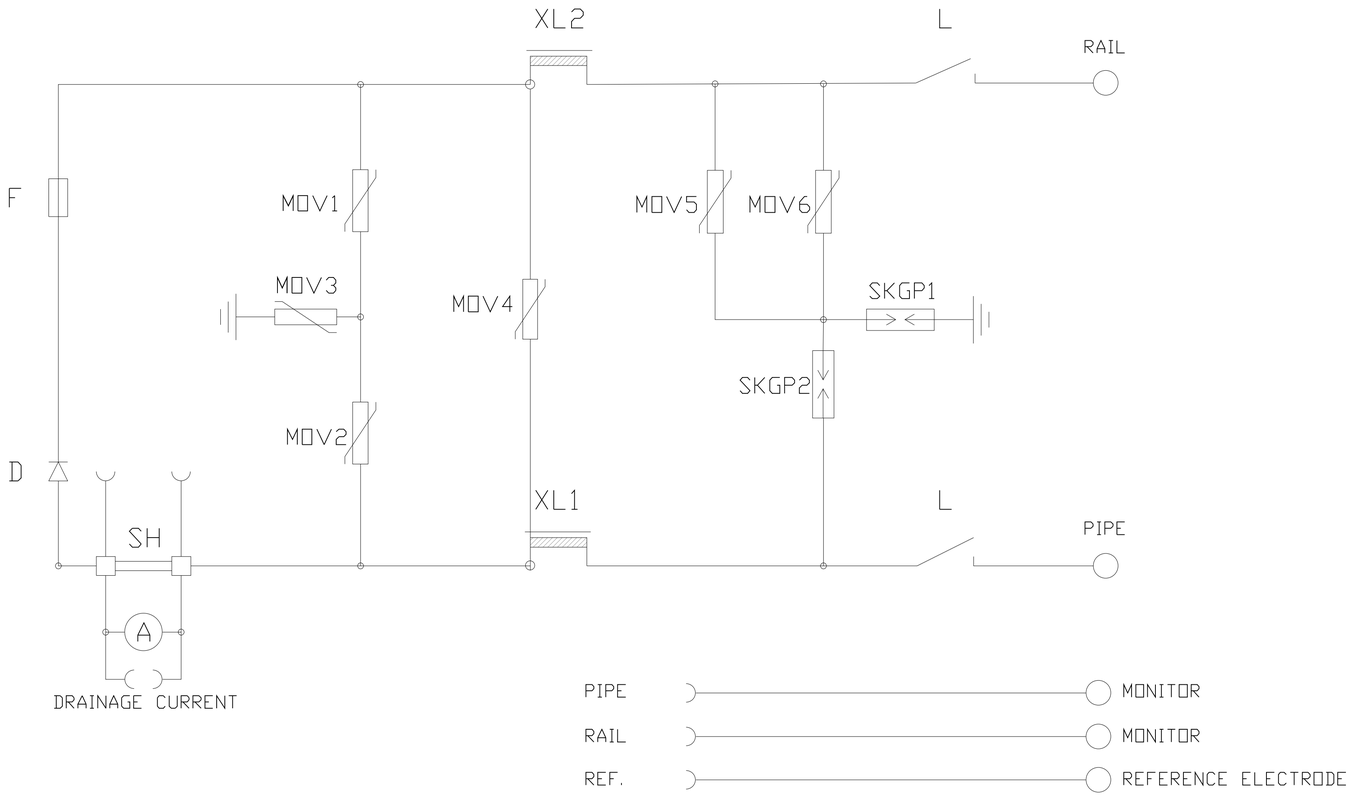

TYPICAL ELECTRICAL SCHEMATIC OF NATURAL DRAINAGE UNIT

SCALE : N.T.S.

ISSUED FOR INFORMATION

CONSULTING ENGINEERS
CAPEX - ENGINEERING SERVICE UNIT
TURBINE HALL - 3RD FLOOR
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2113

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Johannesburg Water

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Municipality: Joburg — a world class African city

Project description:

ENGINEERING SERVICE UNIT - STANDARD DETAIL
TECHNICAL SPECIFICATION FOR CATHODIC PROTECTION
TYPICAL ELECTRICAL SCHEMATIC OF NATURAL DRAINAGE UNIT

SCALE: N.T.S.

AMENDMENTS

REV	DESCRIPTION	DATE	BY	APV
A	ISSUED FOR INFORMATION			

DRAWING No: JW-23-001-D020

PROJECT No.	DISCIPLINARY	REV.
UR	STD	A

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GENERAL NOTES

REINFORCED CONCRETE ENCLOSURE TO BE PRE-CAST

1. MINIMUM EXTERNAL DIMENSIONS OF (w) 2040mm x (h) 2260mm x (d) 2040mm WITH 90 mm WALL THICKNESS.
2. SEE JOHANNESBURG WATER CATHODIC PROTECTION STANDARD SPECIFICATION SECTIONS 4.3.3 AND 5.3.3.
3. SEE JOHANNESBURG WATER CATHODIC PROTECTION STANDARD SPECIFICATION SECTIONS 4.13 & 4.14, 4.15, 5.2.1, 5.12, 5.13 AND 5.14.

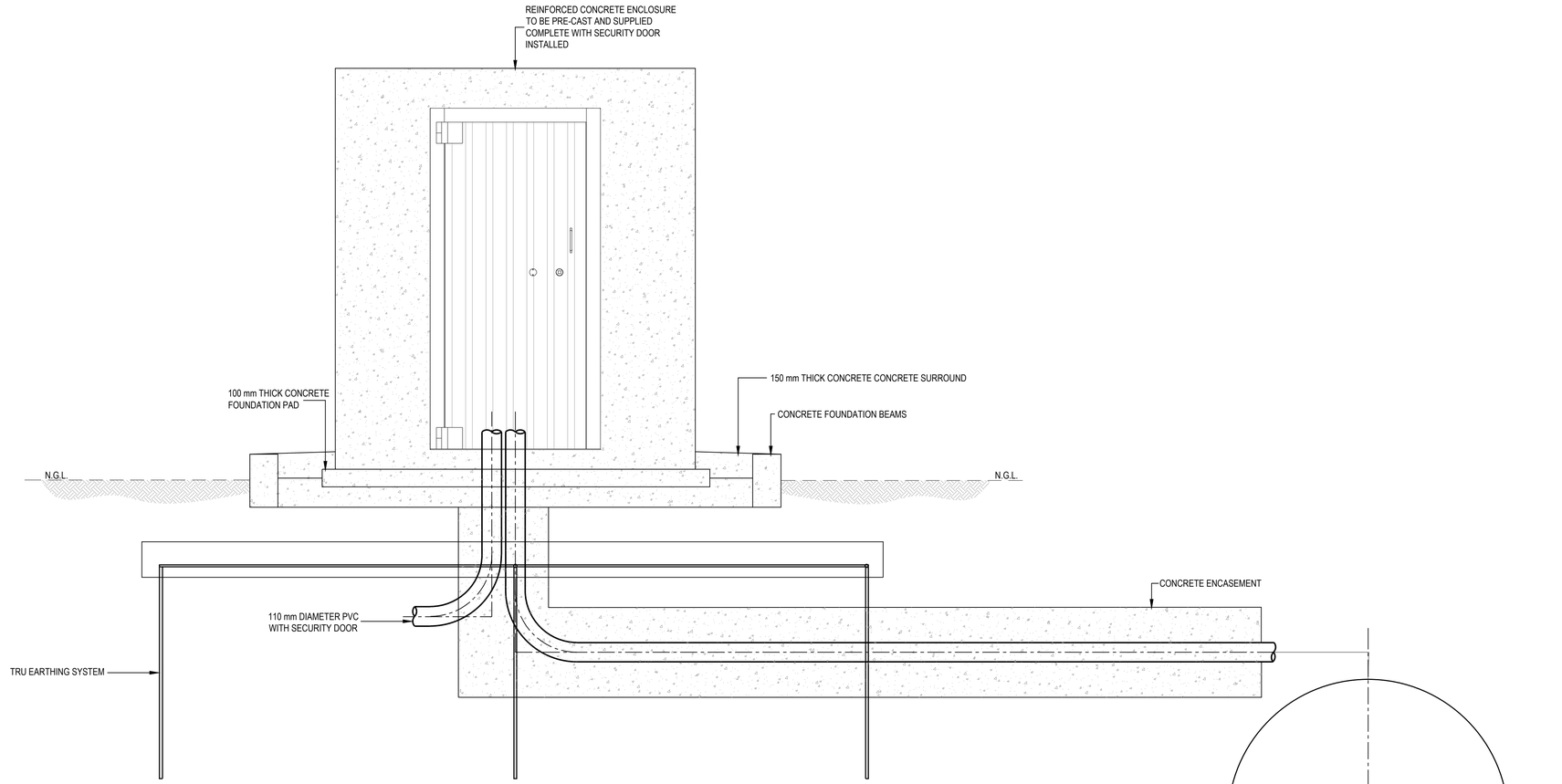
ELECTRICITY

CABLE SIZES AND LENGTHS

1. LENGTHS TO BE QUANTIFIED AS PER SITE REQUIREMENT AND REFERENCED ACCORDINGLY IN THE BILL OF QUANTITIES.
2. SEE JOHANNESBURG WATER CATHODIC PROTECTION STANDARD SPECIFICATION SECTIONS 4.13 & 4.14, 4.15, 5.2.1, 5.12, 5.13 AND 5.14.

ELECTRODE AND COUPON

1. BAGGED DIMENSIONS APPROXIMATELY 460mm IN LENGTH BY 200 mm DIAMETER.
2. SEE JOHANNESBURG WATER CATHODIC PROTECTION STANDARD SPECIFICATION SECTIONS 4.4 AND 5.4 .



TYPICAL EQUIPMENT SHELTER TYPE ENCLOSURE

SCALE : N.T.S.

ISSUED FOR INFORMATION

CONSULTING ENGINEERS CAPEX - ENGINEERING SERVICE UNIT TURBINE HALL - 3RD FLOOR 65 NTEMI PILISO STREET NEWTOWN JOHANNESBURG 2113	DESIGNED: -- Date: SIGNATURE: DRAWN: --- Date: SIGNATURE: CHECKED: -- Date: SIGNATURE: APPROVED BY: --- Date: SIGNATURE: ECSA REG. No:	Johannesburg Water	JOHANNESBURG WATER SOC Ltd TURBINE HALL 65 NTEMI PILISO STREET NEWTOWN JOHANNESBURG 2113 TEL: +27 (0)11 688 1400 FAX: +27(0)11 688-1528

Municipality: Joburg — a world class African city

Project description:

ENGINEERING SERVICE UNIT - STANDARD DETAIL
TECHNICAL SPECIFICATION FOR CATHODIC PROTECTION
TYPICAL EQUIPMENT SHELTER TYPE ENCLOSURE

SCALE: N.T.S.

AMENDMENTS

REV	DESCRIPTION	DATE	BY	APV
A	ISSUED FOR INFORMATION			

DRAWING No: JW-23-001-D03

UR (PROJECT No.) — STD (DISCIPLINARY) - A (REV.)

A1 (ORIGINAL PAGE SIZE) SHEET 1 OF 1

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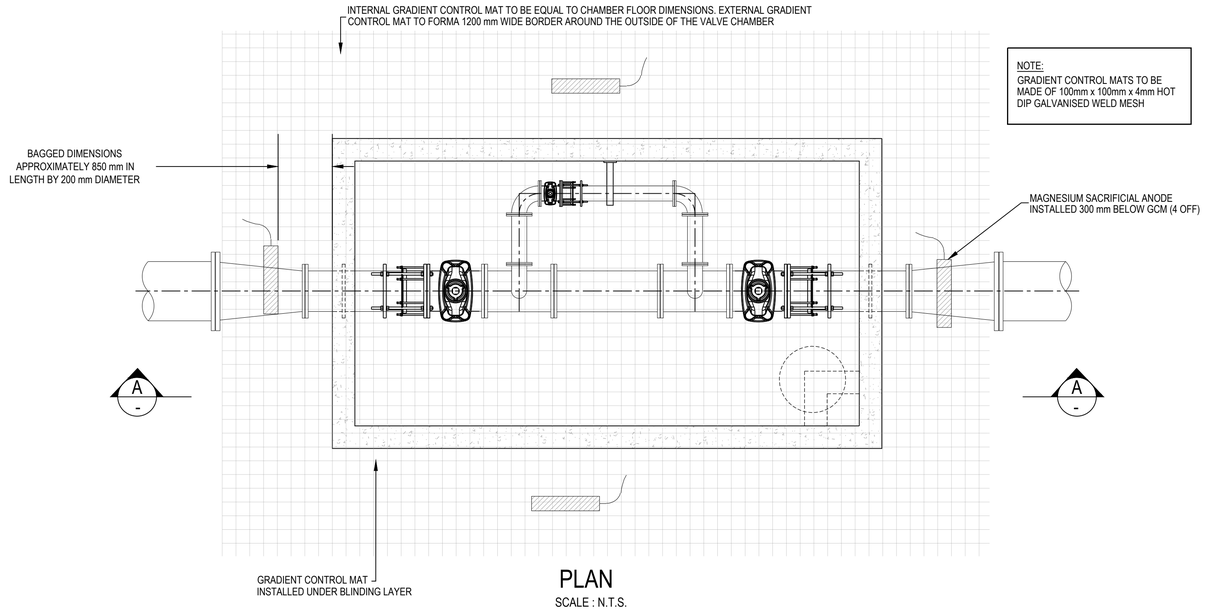
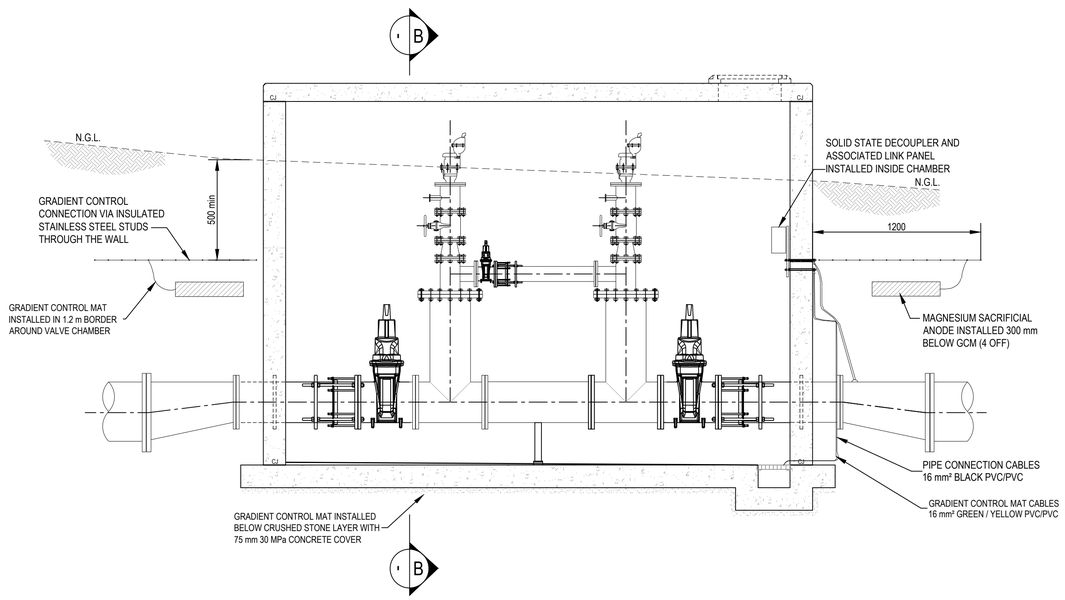
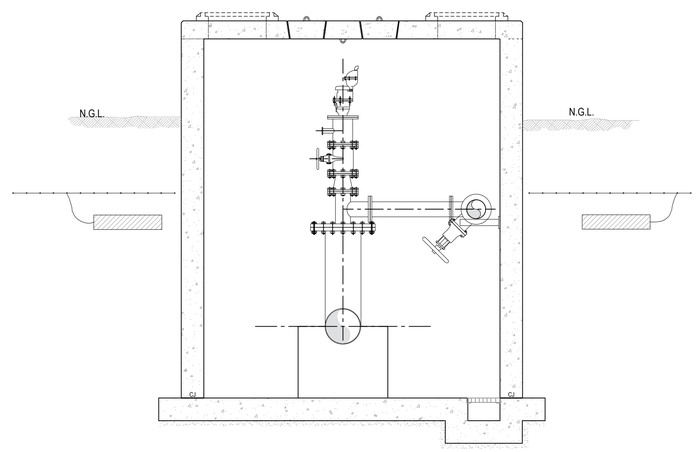


PLAN
SCALE : N.T.S.



SECTION A-A
SCALE : N.T.S.



SECTION B-B
SCALE : N.T.S.

TYPICAL GRADIENT CONTROL MAT AT LARGE CHAMBER
SCALE : N.T.S.

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GENERAL NOTES

CATHODIC PROTECTION

1. GRADIENT CONTROL MAT TO BE 100mm x 100mm x 4mm HOT DIP GALVANIZED WELD MESH.
2. SEE JOHANNESBURG WATER CATHODIC PROTECTION STANDARD SPECIFICATION SECTIONS 4.10, 5.1.4 & 5.2.2

ELECTRICITY

1. SOLID STATE DECOUPLING DEVICE TO BE OF THE VOLTAGE LIMITING DEVICE (VLD) TYPE.
2. SEE ESKOM GUIDELINE ON THE ELECTRICAL COORDINATION OF PIPELINES AND POWER LINES GL240-66418968 Rev 1. SECTION B4.

SACRIFICIAL ANODE

1. SACRIFICIAL ANODES TO BE 14.5KG HIGH POTENTIAL MAGNESIUM PACKAGED IN COTTON BAG WITH CHEMICAL BACKFILL (70% GYPSUM, 25% BENTONITE AND 5% SODIUM SULPHATE, IN A FINELY POWDERED FORM)
2. SEE JOHANNESBURG WATER CATHODIC PROTECTION STANDARD SPECIFICATION SECTIONS 4.8.

ISSUED FOR INFORMATION

CONSULTING ENGINEERS
CAPEX - ENGINEERING SERVICE UNIT
TURBINE HALL - 3RD FLOOR
65 NTEMI PILISO STREET
NEWTOWN
JOHANNESBURG
2113

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Johannesburg Water

JOHANNESBURG WATER SOC Ltd
TURBINE HALL
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NEWTOWN
JOHANNESBURG
2113
TEL: +27 (0)11 688 1400
FAX: +27(0)11 688-1528

Municipality: Joburg — a world class African city

Project description:

ENGINEERING SERVICE UNIT - STANDARD DETAIL
TECHNICAL SPECIFICATION FOR CATHODIC PROTECTION
TYPICAL GRADIENT CONTROL MAT AT LARGE CHAMBER

SCALE: N.T.S.

AMENDMENTS

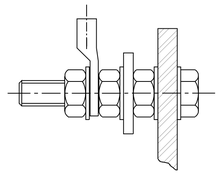
REV	DESCRIPTION	DATE	BY	APV
A	ISSUED FOR INFORMATION			

DRAWING No: JW-23-001-D09

PROJECT No.	DISCIPLINARY	REV.
UR	STD	A

ORIGINAL PAGE SIZE: A1 — SHEET 1 OF 1

FILE No.



SECTION B-B
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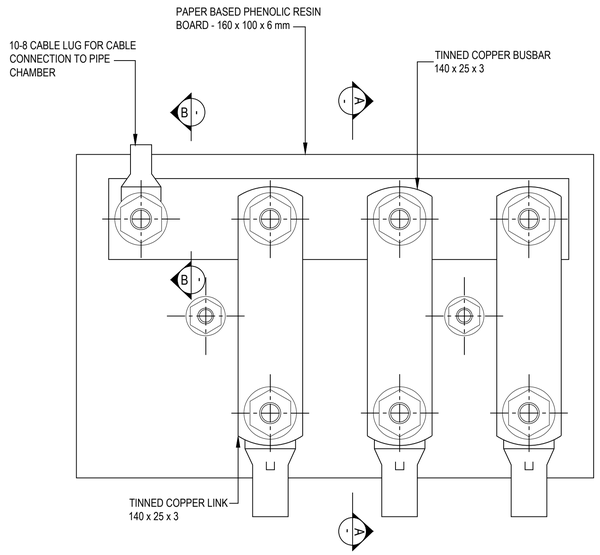
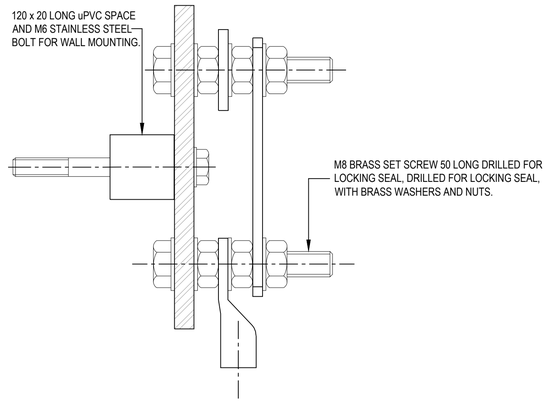


FRONT ELEVATION
SCALE : N.T.S.



SECTION A-A
SCALE : N.T.S.

TYPICAL LINK PANEL
SCALE : N.T.S.

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GENERAL NOTES

ELECTRICITY

1. SOLID STATE DECOUPLING DEVICE TO BE OF THE VOLTAGE LIMITING DEVICE (VLD) TYPE.
2. SEE ESKOM GUIDELINE ON THE ELECTRICAL COORDINATION OF PIPELINES AND POWER LINES GL240-66418968 Rev 1. SECTION B4.
3. SEE JOHANNESBURG WATER CATHODIC PROTECTION STANDARD SPECIFICATION SECTIONS 4.6, 4.13, 4.14, 4.15 AND 5.5.1.2.1.

ISSUED FOR INFORMATION

CONSULTING ENGINEERS
CAPEX - ENGINEERING SERVICE UNIT
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JOHANNESBURG
2113

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Johannesburg Water

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Municipality: Joburg — a world class African city

Project description:

ENGINEERING SERVICE UNIT - STANDARD DETAIL
TECHNICAL SPECIFICATION FOR CATHODIC PROTECTION
TYPICAL LINK PANEL

SCALE: N.T.S.

AMENDMENTS

REV	DESCRIPTION	DATE	BY	APV
A	ISSUED FOR INFORMATION			

DRAWING No: JW-23-001-D013

PROJECT No.	DISCIPLINARY	REV.
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GENERAL NOTES

REINFORCED CONCRETE ENCLOSURE TO BE PRE-CAST

1. MINIMUM EXTERNAL DIMENSIONS OF (w) 2040mm x (h) 2260mm x (d) 2040mm WITH 90 mm WALL THICKNESS.
2. SEE JOHANNESBURG WATER CATHODIC PROTECTION STANDARD SPECIFICATION SECTIONS 4.3.3 AND 5.3.3.
3. SEE JOHANNESBURG WATER CATHODIC PROTECTION STANDARD SPECIFICATION SECTIONS 4.13 & 4.14, 4.15, 5.2.1, 5.12, 5.13 AND 5.14.

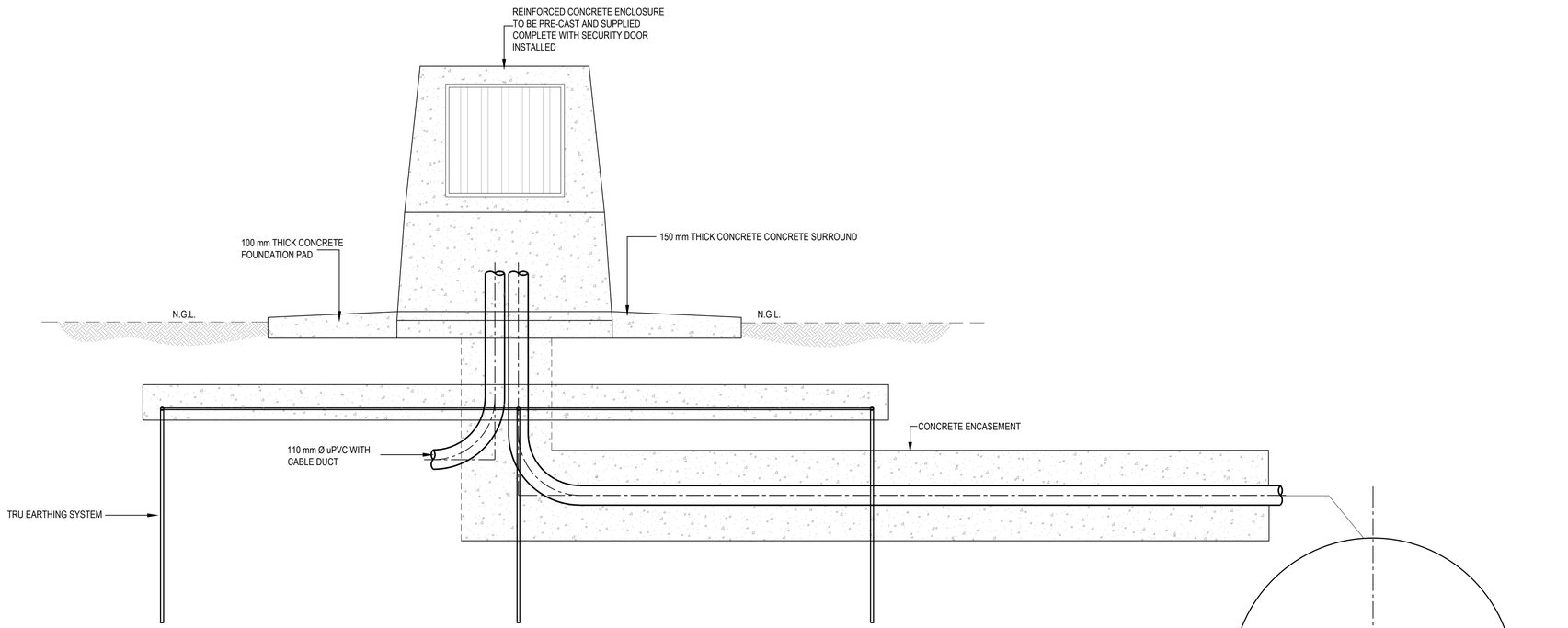
ELECTRICITY

CABLE SIZES AND LENGTHS

1. LENGTHS TO BE QUANTIFIED AS PER SITE REQUIREMENT AND REFERENCED ACCORDINGLY IN THE BILL OF QUANTITIES.
2. SEE JOHANNESBURG WATER CATHODIC PROTECTION STANDARD SPECIFICATION SECTIONS 4.13 & 4.14, 4.15, 5.2.1, 5.12, 5.13 AND 5.14.

ELECTRODE AND COUPON

1. BAGGED DIMENSIONS APPROXIMATELY 460mm IN LENGTH BY 200 mm DIAMETER.
2. SEE JOHANNESBURG WATER CATHODIC PROTECTION STANDARD SPECIFICATION SECTIONS 4.4 AND 5.4 .



TYPICAL MEGA BUNKER TYPE ENCLOSURE

SCALE : N.T.S.

ISSUED FOR INFORMATION

CONSULTING ENGINEERS
CAPEX - ENGINEERING SERVICE UNIT
TURBINE HALL - 3RD FLOOR
65 NTEMI PILISO STREET
NEWTOWN
JOHANNESBURG
2113

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Johannesburg Water

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TEL: +27 (0)11 688 1400
FAX: +27(0)11 688-1528

Municipality: Joburg — a world class African city

Project description:

ENGINEERING SERVICE UNIT - STANDARD DETAIL
TECHNICAL SPECIFICATION FOR CATHODIC PROTECTION
TYPICAL MEGA BUNKER TYPE ENCLOSURE

SCALE: AS SHOWN

AMENDMENTS

REV	DESCRIPTION	DATE	BY	APV
A	ISSUED FOR INFORMATION			

DRAWING No: JW-23-001-D04

UR	STD	-	A
PROJECT No.	DISCIPLINARY		REV.

A1 ORIGINAL PAGE SIZE — SHEET 1 OF 1

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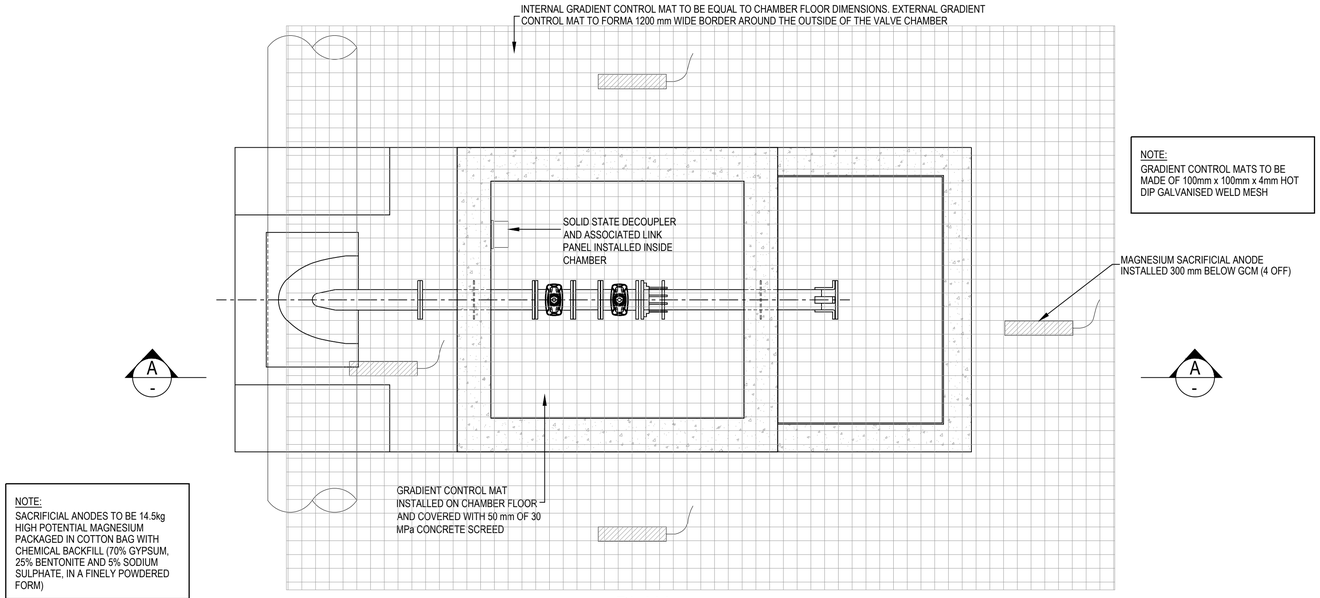
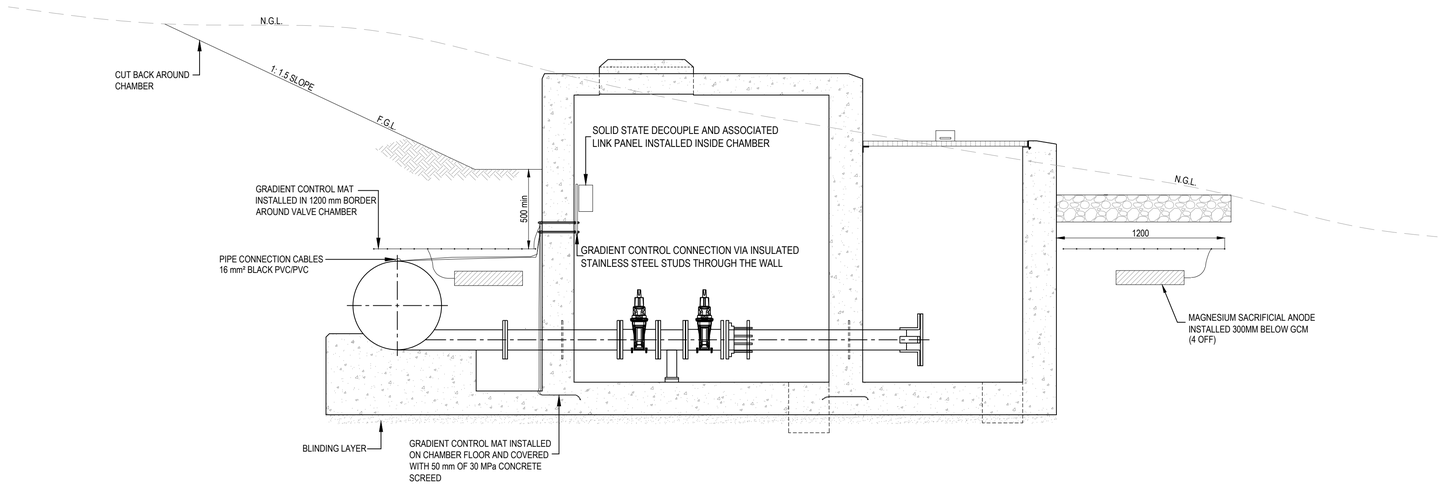


NOTE:
GRADIENT CONTROL MATS TO BE MADE OF 100mm x 100mm x 4mm HOT DIP GALVANISED WELD MESH

NOTE:
SACRIFICIAL ANODES TO BE 14.5kg HIGH POTENTIAL MAGNESIUM PACKAGED IN COTTON BAG WITH CHEMICAL BACKFILL (70% GYPSUM, 25% BENTONITE AND 5% SODIUM SULPHATE, IN A FINELY POWDERED FORM)

PLAN

SCALE : N.T.S.



SECTION A-A

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GENERAL NOTES

CATHODIC PROTECTION

1. SEE JOHANNESBURG WATER CATHODIC PROTECTION STANDARD SPECIFICATION SECTIONS 4.10, 5.1.4 & 5.2.2

ELECTRICITY

1. SOLID STATE DECOUPLING DEVICE TO BE OF THE VOLTAGE LIMITING DEVICE (VLD) TYPE.
2. SEE ESKOM GUIDELINE ON THE ELECTRICAL COORDINATION OF PIPELINES AND POWER LINES GL240-66418968 Rev 1. SECTION B4.

SACRIFICIAL ANODE

1. SEE JOHANNESBURG WATER CATHODIC PROTECTION STANDARD SPECIFICATION SECTIONS 4.8.

ISSUED FOR INFORMATION

CONSULTING ENGINEERS
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Johannesburg Water

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Municipality: Joburg — a world class African city

Project description:

ENGINEERING SERVICE UNIT - STANDARD DETAIL
TECHNICAL SPECIFICATION FOR CATHODIC PROTECTION
TYPICAL GRADIENT CONTROLMAT AT SCOUR VALVE

SCALE: AS SHOWN

AMENDMENTS

REV	DESCRIPTION	DATE	BY	APV
A	ISSUED FOR INFORMATION	2024/10/22	T.M	P.M

DRAWING No: JW-23-001-D02

PROJECT No.	DISCIPLINARY	REV.
UR	STD	A

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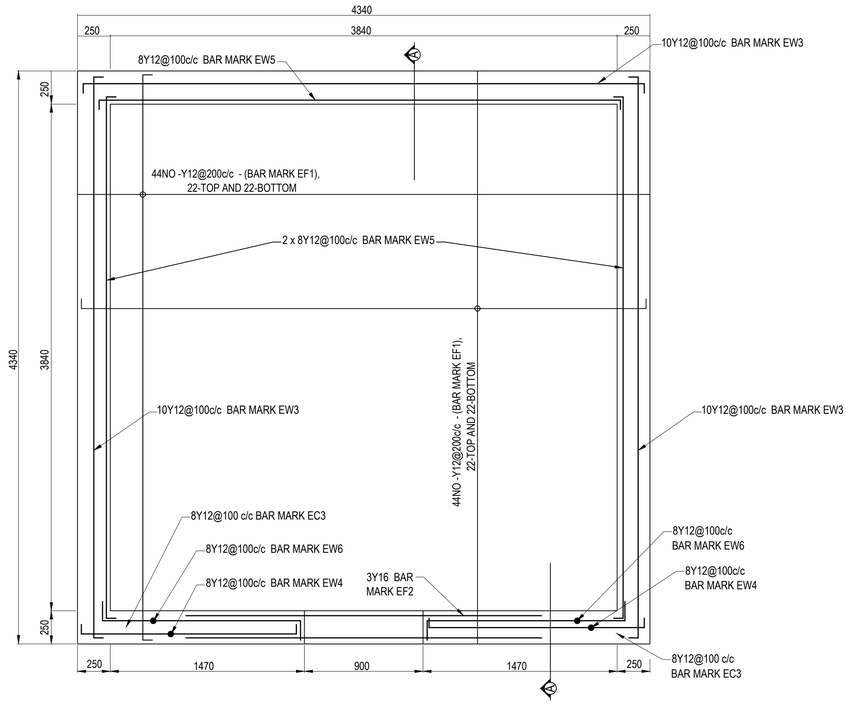
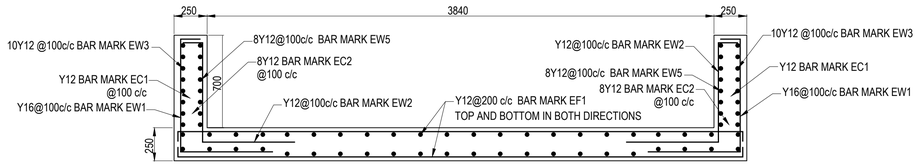
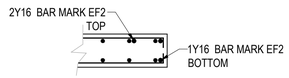


PLAN



SECTION A - A



SECTION THROUGH
DOOR OPENING

TYPICAL TRU ENCLOSURE PERIMETER SECURITY CONCRETE FOUNDATION DETAIL

SCALE : N.T.S.

ISSUED FOR INFORMATION

CONSULTING ENGINEERS CAPEX - ENGINEERING SERVICE UNIT TURBINE HALL - 3RD FLOOR 65 NTEMI PILISO STREET NEWTOWN JOHANNESBURG 2113	DESIGNED	--	Date:
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Johannesburg Water

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TEL: +27 (0)11 688 1400
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Municipality: Joburg — a world class African city

Project description:

ENGINEERING SERVICE UNIT - STANDARD DETAIL
TECHNICAL SPECIFICATION FOR CATHODIC PROTECTION
TYPICAL TRU ENCLOSURE PERIMETER SECURITY CONCRETE FOUNDATION DETAIL

SCALE: N.T.S.

AMENDMENTS

REV	DESCRIPTION	DATE	BY	APV
A	ISSUED FOR INFORMATION			

DRAWING No: JW-23-001-D023

PROJECT No.	DISCIPLINARY	REV.
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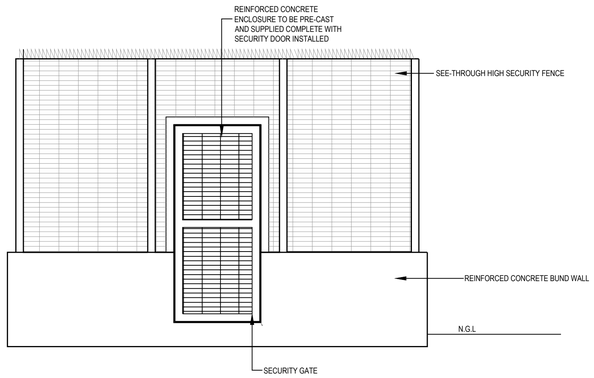
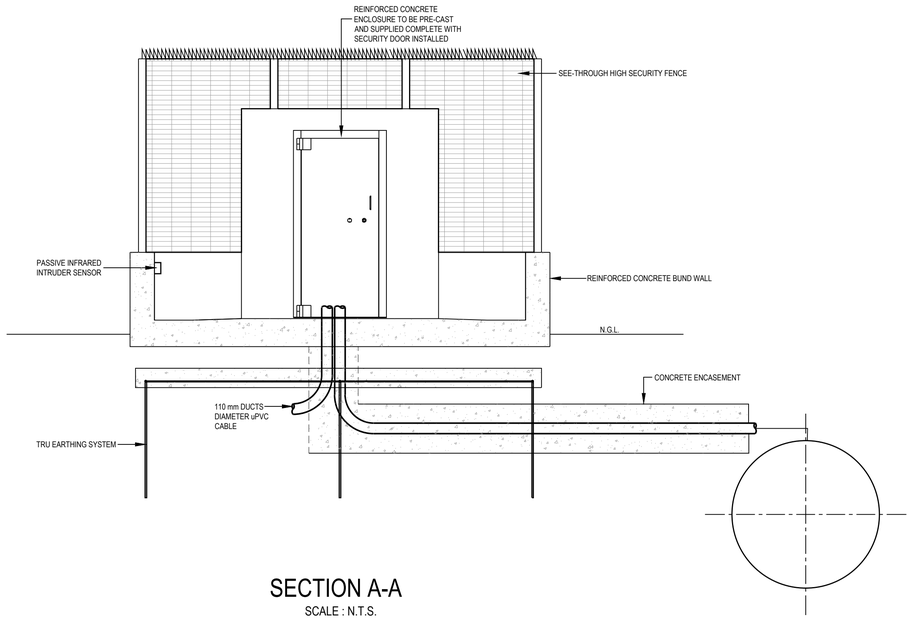


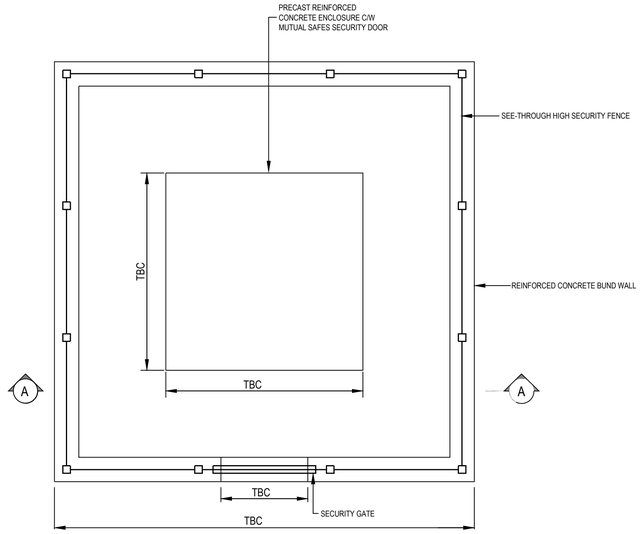
ENCLOSURE FRONT VIEW

SCALE : N.T.S.



SECTION A-A

SCALE : N.T.S.



ENCLOSURE PLAN VIEW

SCALE : N.T.S.

TYPICAL TRU ENCLOSURE PERIMETER SECURITY

SCALE : N.T.S.

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GENERAL NOTES

REINFORCED CONCRETE ENCLOSURE TO BE PRE-CAST

1. MINIMUM EXTERNAL DIMENSIONS OF (W) 2040mm x (H) 2260mm x (D) 2040mm WITH 90mm WALL THICKNESS.
2. SEE JOHANNESBURG WATER CATHODIC PROTECTION STANDARD SPECIFICATION SECTIONS 4.5.2, 4.5.3 AND 5.3.4.

ELECTRICITY

CABLE SIZES AND LENGTHS

1. LENGTHS TO BE QUANTIFIED AS PER SITE REQUIREMENT AND REFERENCED ACCORDINGLY IN THE BILL OF QUANTITIES.
2. SEE JOHANNESBURG WATER CATHODIC PROTECTION STANDARD SPECIFICATION SECTIONS 4.13 & 4.14, 4.15, 5.2.1, 5.12, 5.13 AND 5.14,

ELECTRODE AND COUPON

1. BAGGED DIMENSIONS APPROXIMATELY 460mm IN LENGTH BY 200 mm DIAMETER.
2. SEE JOHANNESBURG WATER CATHODIC PROTECTION STANDARD SPECIFICATION SECTIONS 4.4 AND 5.4 .

ISSUED FOR INFORMATION

CONSULTING ENGINEERS
CAPEX - ENGINEERING SERVICE UNIT
TURBINE HALL - 3RD FLOOR
65 NTEMI PILISO STREET
NEWTOWN
JOHANNESBURG
2113

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Johannesburg Water

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TEL: +27 (0)11 688 1400
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Municipality: Joburg — a world class African city

Project description:

ENGINEERING SERVICE UNIT - STANDARD DETAIL
TECHNICAL SPECIFICATION FOR CATHODIC PROTECTION
TYPICAL TRU ENCLOSURE PERIMETER SECURITY

SCALE: N.T.S.

AMENDMENTS

REV	DESCRIPTION	DATE	BY	APV
A	ISSUED FOR INFORMATION			

DRAWING No: JW-23-001-D022

PROJECT No.	DISCIPLINARY	REV.
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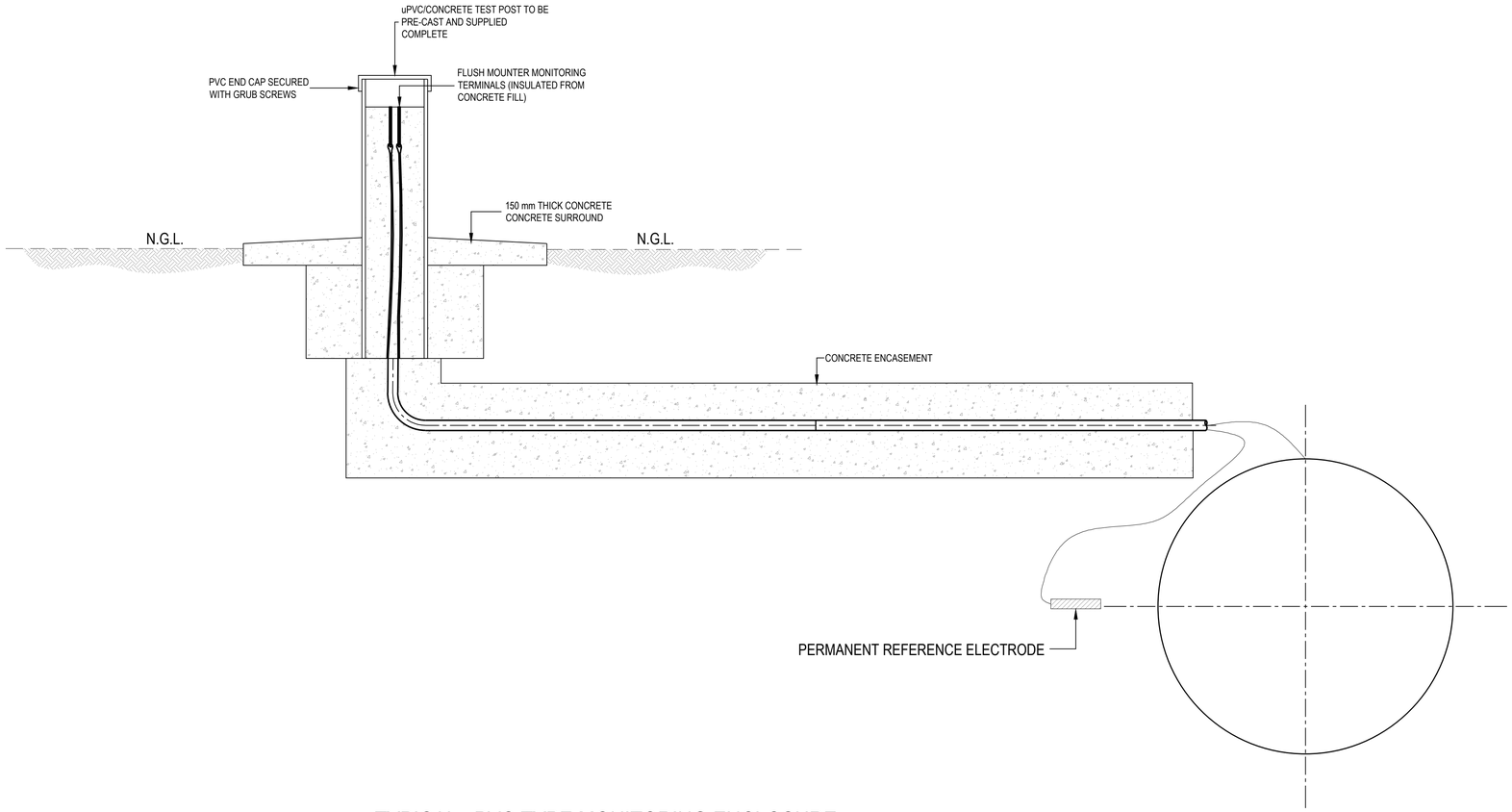

TYPICAL uPVC TYPE MONITORING ENCLOSURE

SCALE : N.T.S.

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GENERAL NOTES

REINFORCED CONCRETE ENCLOSURE TO BE PRE-CAST

1. MINIMUM DIMENSIONS TO BE 315mm OUTER DIAMETER BY 1500mm IN LENGTH. INTERNAL CAVITY TO BE 150mm DEEP.
2. SEE JOHANNESBURG WATER CATHODIC PROTECTION STANDARD SPECIFICATION SECTIONS 4.5.2, 4.5.3 AND 5.3.4.

ELECTRICITY

CABLE SIZES AND LENGTHS

1. LENGTHS TO BE QUANTIFIED AS PER SITE REQUIREMENT AND REFERENCED ACCORDINGLY IN THE BILL OF QUANTITIES.
2. SEE JOHANNESBURG WATER CATHODIC PROTECTION STANDARD SPECIFICATION SECTIONS 4.13 & 4.14, 4.15, 5.2.1, 5.12, 5.13 AND 5.14.

ELECTRODE AND COUPON

1. BAGGED DIMENSIONS APPROXIMATELY 460mm IN LENGTH BY 200 mm DIAMETER.
2. SEE JOHANNESBURG WATER CATHODIC PROTECTION STANDARD SPECIFICATION SECTIONS 4.4 AND 5.4 .

ISSUED FOR INFORMATION

CONSULTING ENGINEERS
CAPEX - ENGINEERING SERVICE UNIT
TURBINE HALL - 3RD FLOOR
65 NTEMI PILISO STREET
NEWTOWN
JOHANNESBURG
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Municipality: Joburg — a world class African city

Project description:

ENGINEERING SERVICE UNIT - STANDARD DETAIL
TECHNICAL SPECIFICATION FOR CATHODIC PROTECTION
TYPICAL uPVC TYPE MONITORING ENCLOSURE

SCALE: N.T.S.

AMENDMENTS

REV	DESCRIPTION	DATE	BY	APV
A	ISSUED FOR INFORMATION			

DRAWING No: JW-23-001-D014

PROJECT No.	DISCIPLINARY	REV.
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GENERAL NOTES

CATHODIC PROTECTION

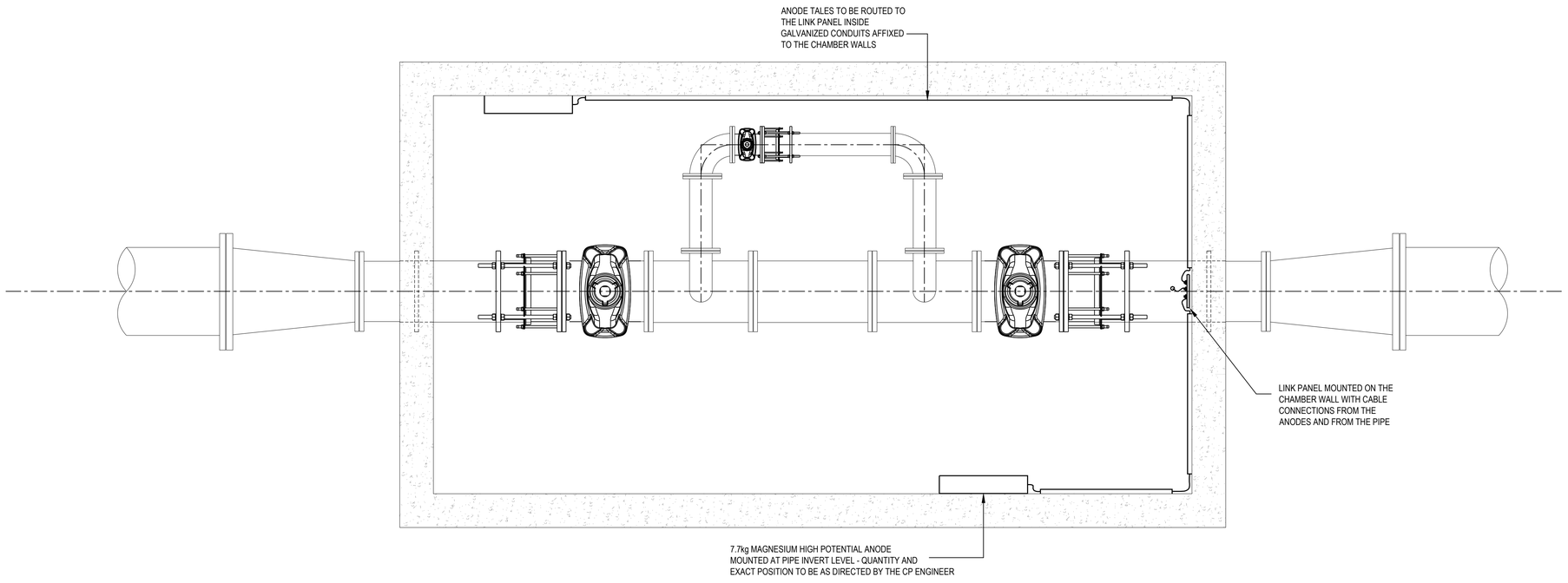
1. GRADIENT CONTROL MAT TO BE 100mm x 100mm x 4mm HOT DIP GALVANIZED WELD MESH.
2. SEE JOHANNESBURG WATER CATHODIC PROTECTION STANDARD SPECIFICATION SECTIONS 4.10, 5.1.4 & 5.2.2

ELECTRICITY

1. SOLID STATE DECOUPLING DEVICE TO BE OF THE VOLTAGE LIMITING DEVICE (VLD) TYPE.
2. SEE ESKOM GUIDELINE ON THE ELECTRICAL COORDINATION OF PIPELINES AND POWER LINES GL240-66418968 Rev 1, SECTION B4.

SACRIFICIAL ANODE

1. SACRIFICIAL ANODES TO BE 14.5KG HIGH POTENTIAL MAGNESIUM PACKAGED IN COTTON BAG WITH CHEMICAL BACKFILL (70% GYPSUM, 25% BENTONITE AND 5% SODIUM SULPHATE, IN A FINELY POWDERED FORM)
2. SEE JOHANNESBURG WATER CATHODIC PROTECTION STANDARD SPECIFICATION SECTIONS 4.8.



TYPICAL VALVE CHAMBER ANODE INSTALLATION

SCALE : N.T.S.

ISSUED FOR INFORMATION

CONSULTING ENGINEERS
CAPEX - ENGINEERING SERVICE UNIT
TURBINE HALL - 3RD FLOOR
65 NTEMI PILISO STREET
NEWTOWN
JOHANNESBURG
2113

DESIGNED	--	Date:	
	SIGNATURE:		
DRAWN	---	Date:	
	SIGNATURE:		
CHECKED	--	Date:	
	SIGNATURE:		
APPROVED BY:	---	Date:	
	SIGNATURE:	ECSA REG. No:	

Johannesburg Water

JOHANNESBURG WATER SOC Ltd
TURBINE HALL
65 NTEMI PILISO STREET
NEWTOWN
JOHANNESBURG
2113
TEL: +27 (0)11 688 1400
FAX: +27(0)11 688-1528

Municipality: Joburg — a world class African city

Project description:

ENGINEERING SERVICE UNIT - STANDARD DETAIL
TECHNICAL SPECIFICATION FOR CATHODIC PROTECTION
TYPICAL VALVE CHAMBER ANODE INSTALLATION

SCALE: N.T.S.

AMENDMENTS

REV	DESCRIPTION	DATE	BY	APV
A	ISSUED FOR INFORMATION			

DRAWING No: JW-23-001-D010

UR	STD	-	A
PROJECT No.	DISCIPLINARY		REV.

A1 ORIGINAL PAGE SIZE — SHEET 1 OF 1

FILE No.

C4 PROJECT SPECIFICATIONS

A. GENERAL

PROJECT SPECIFICATIONS

A: GENERAL

PS1 CONSTRUCTION WORKS SPECIFICATIONS

PS1.1 APPLICABLE NATIONAL STANDARDS

For the purposes of this Contract, SABS 1200 or SANS 1200 Standardised Specifications applicable to this Contract is listed under B: STANDARDISED SPECIFICATIONS

As from 8 November 2002, all South African standards that were previously published by the South African Bureau of Standards with the prefix “SABS” have been re-designated as South African National Standards and will henceforth be published by Standards South Africa (a division of SABS) with the prefix “SANS” (see Government Notice No. 1373 of Government Gazette 24002).

Note that all standards in existence before 8 November 2002 may be referred to indefinitely, in any context, by either their “SABS” number or by their “SANS” number, both of which will be equally valid.

The prefix "PSA" indicates an amendment to SABS 1200 A General, "PSG" to SANS 1200G Concrete Works Structural, etc. The numbers following these prefixes are the relevant Clause numbers in the relevant SANS 1200 specification. These variations are included under section C3.6 of this document.

VARIATIONS AND ADDITIONS TO STANDARDISED SPECIFICATIONS

Variations and additions to the Standardised specifications are described under VARIATIONS AND ADDITIONS TO STANDARDISED SPECIFICATIONS.

PS1.2 OTHER APPLICABLE SANS STANDARDS

The following SANS specifications are also referred to in this document and the Contractor is advised to obtain them from Standards South Africa (a division of SABS) in Pretoria.

SANS 1921-1 (2004): Construction and Management Requirements for Works Contracts Part 1: General Engineering and Construction Works

PS1.3 DISCREPANCIES BETWEEN DIFFERENT SECTIONS OF THE DOCUMENTATION

For the purpose of resolving ambiguities or inconsistencies after award of the tender, the authority of documents shall be:

a) The General conditions of Contract for Construction Works (2015);

b) Contract specific data;

c) Variations to the General Conditions of Contract;

d) Additional Conditions of Contract;

e) The Contract Drawings.

f) The Schedule of Quantities and Rates (the Bill of Quantities);

g) Project Specifications;

h) Particular Project Specifications;

i) Standardized Specifications with variations, additions and omissions;

PS1.4 CERTIFICATE BY RECOGNISED BODIES

Wherever possible items and materials for construction of the Works shall comply with the relevant South African Bureau of Standards Specifications and with the British Standards where these are applicable in the absence of local standards.

The Contractor shall be responsible for the supply of all equipment, labour and materials for the Works.

PS1.5 EQUIPMENT, LABOUR AND MATERIALS SUPPLIED BY THE EMPLOYER

The Contractor shall be responsible for the supply of all equipment, labour and materials for the Works.

PS1.6 REQUIREMENTS FOR EQUIPMENT

All equipment and machinery shall be fit for purpose and able to perform the intended work safely and at the production tempos stated in the approved project plan. The Contractor is under obligation to have all lifting equipment as well as all machinery equipped with pressure vessels, regularly tested in terms of the OHS Act and Regulations.

PS1.7 EXISTING SERVICES

- **TREATMENT OF EXISTING SERVICES**

  The contractor will be required to contact the relevant statutory undertakings, service providers or local authorities to ascertain the location of all services.

- **DETECTION EQUIPMENT**

  No detection equipment is available to determine the depth of existing pipe work prior to the commencement of excavations.

- **DAMAGE TO SERVICES**

  The contractor shall be liable for all costs incurred in the repair of any known service damaged by his works or machinery. An item has been included in the schedule of quantities in which the contractor is to include all costs that may occur as a result of any of the known services which may require relocation. Such costs are to include for

attendance by the service authority's personnel and plant, materials used for the relocation of the service, and possible delays in the construction of the works.

PS1.10 SITE ESTABLISHMENT

- **ADVERTISING RIGHTS**

  No advertising by the Contractor will be allowed on site. All advertising rights will vest in the Employer.

- **NOTICE BOARDS**

  The contractor will be responsible to supply and erect two Johannesburg Water notice boards at the entrance to the works and close to the main road passing by.

- **SOURCE OF WATER SUPPLY FOR DOMESTIC AND CONSTRUCTION PURPOSES**

  The Contractor is responsible for any temporary connection required, whether on site or elsewhere and shall pay all installation and consumption charges. He shall also be responsible for transporting the water from the connection point to the point of use on the site. Johannesburg Water is the water supply authority in the area.

- **SOURCE OF POWER SUPPLY**

  Application must be made to CITY POWER for a temporary power supply to the site. The Contractor will have to apply for a temporary connection for construction purposes, the cost of which will be for his account. All power used for construction purposes as well as the safe onsite distribution will be for the Contractor's account. The tender will be held to include for all such costs and charges.

- **CONTRACTOR'S CAMP AND DEPOT**

  The contractor shall provide all his office accommodation and all associated facilities required for the adequate supervision, control and execution of the works. The contractor may use the site to establish his camp, offices and precast facilities subject to approval by the employer and the local municipal authority. However, should the contractor be required to move his camp during the contract period, the cost will be deemed to have been included in the tender rates. The contractor must not cut down or damage any trees or make any excavation without the written permission of the engineer.

  The area occupied shall be neatly fenced off to denote its limit. The provision of security for the contractor's site establishment and activities for the duration of the contract shall be his own responsibility and no claims for additional security measures taken during the currency of the contract will be considered.

  All buildings, latrines etc. shall be in accordance with the local authority and state health regulations, and shall be kept in a clean and sanitary condition to the satisfaction of the engineer. The contractor shall be responsible for the proper upkeep and control of the area for the duration of the contract and all structures and buildings shall be kept in good repair.

The contractor shall provide screened latrines as necessary for his employees, including local labour, the siting of which shall be to the satisfaction of the engineer. They shall be constructed and maintained by the contractor to the satisfaction of the engineer and in accordance with the requirements of government, provincial and/or local authority. All applicable fees and charges due under any health by-law or any or all of the above authorities shall be paid by the contractor.

Chemical toilets, or where possible, flush units shall be used and these shall be kept in a thoroughly clean and sanitary condition. Chemical toilets shall be serviced at least once a week. There is no municipal sewerage service available and flush units may only be used if connected to a regularly serviced conservancy tank. The effluent may only be discharged at a municipal waste water treatment plant.

A separate latrine shall be provided at the site camp for the sole use of the engineer and the engineer's representative and shall meet all of the requirements described above.

All these facilities shall be provided within 14 days of the engineer's instruction to commence with execution of the the works and the contractor shall strictly enforce their use.

On completion of the works and removal of the depot, the site shall be cleaned and restored to its natural condition immediately when it is vacated.

- **DISPOSAL OF REFUSE**

  The contractor shall be responsible for disposal of refuse and waste generated by his staff on a daily basis. The site is to be kept clean, neat and tidy, to the employer's satisfaction. The contractor shall locate nearest solid waste disposal site at his own cost for the disposal of refuse. The permission of the waste site operator has to be obtained prior to any material being spoiled on this site. The contractor is responsible for all costs relating to disposal of material at any refuse site.

- **TELEPHONE**

  This facility will be required and the Contractor is to make his own arrangements in this regard.

- **HOUSING FACILITIES**

  The Contractor will not be required to provide housing facilities for the Engineer's staff. Accommodation for the Contractor's employees will not be permitted on site.

- **PARKING FACILITIES**

  A single 3m x 6m shade cloth covered parking bay will be required for the Engineer.

- **TEMPORARY OFFICES**

  Site facilities in the form of a $20m^2$ office with a window, lockable door and air-conditioning will be required for the Engineer. It must be provided with two 15A double plug points, 2X1.2m fluorescent lights, plan table 1.8mX1m, desk with 3 drawers and 2 chairs. Survey assistants and the use of survey and measuring equipment will be required.

- **LABORATORIES AND STORES**

  None will be required by the Engineer.

- **SITE USAGE**
- **WORKS AREA**

The Contractor shall ensure that all the works, temporary works, plant, equipment, stores and personnel are confined to the limits of the site as defined in Clause 2,0.1.29 in the General Conditions of Contract, and no encroachment onto private property shall be permitted without the owner's written consent.

Should any encroachment or damage occur, the Contractor shall immediately remove such encroachment or repair such damage, at his own expense, to the satisfaction of the Engineer and/or the Employer.

- **WORKING SPACE**

In certain cases working space may be limited. The method of construction in these restricted areas will depend largely on the Contractor's plant. However, the Contractor must note that measurement and payment will be according to the specified cross-sections and dimensions irrespective of the method used to achieve these cross-sections and dimensions, and that the rates and prices tendered shall be deemed to include full compensation for any difficulty encountered while working in poor ground conditions and that no extra payment will be made, nor will any claim for payment due to these difficulties be considered.

The Contractor will not be allowed to transgress onto adjacent private property without the express approval of both the land owner and the Engineer. All adjoining properties will be inspected by the Contractor, the Engineer and the respective land owners, prior to the commencement of the Works.

- **PERMITS AND WAYLEAVES**

The Contractor is to ensure that all wayleaves required by the applicable authorities are in place, prior to the commencement of any construction. The contractor shall further liaise with
the local authorities and local property owners to arrange for access to the site and all temporary works.

It is the Contractor's responsibility to obtain final permit and wayleave approval according to applicable procedures and specifications. Permits and wayleave associated costs shall be deemed to have been included in the scheduled rates for excavation and location of existing services.

PS2 MANAGEMENT

PS2.1 APPLICABLE SANS 1921 STANDARDS

The following SANS 1921 Construction and management requirements for works contracts, standards and associated specification data are applicable:

SANS 1921-1 General Engineering and Construction Works

The specification data applicable to the SANS 1921 standards mentioned above are as follows:

PS2.2 STANDARD: SANS 1921-1

Clause	Specification Data
ESSENTIAL DATA	
4.2.1	The responsibility strategy assigned to the Contractor for the Works is A
4.3	The planning, programme and method statements are to comply with the following: 1. Programme is to show all activities, critical path, approval of documentation after commencement, all long lead items, allow for normal rainfall and Public Holidays. 2. The Contractor is to programme the Works to show all shutdowns for tie-in and temporary bypass purposes and advance warning requirements. 3. The Method Statement provided for the temporary bypass is indicative only of the estimated scope of work. The Contractor is to refine the logic sequencing and task durations to minimise the possible shut down periods.
4.4	The Contractor will be solely responsible for the production of work that complies with the Specifications to the satisfaction of the Engineer. To this end, it will be the full responsibility of the Contractor to institute an appropriate Quality Assurance (QA) system on site. The Contractor shall ensure that efficient supervisory staff, the required transport, instruments, equipment and tools are available to control the quality of his own workmanship in accordance with his QA-system. His attention is drawn to the fact that it is not the duty of the Engineer or the Engineer's Representative to act as foreman or surveyor.
4.12.2	The samples of materials that the Contractor is to provide and deliver to the employer are as stated in the Standard and Project Specifications:
4.12.2	The fabrication drawings that the Contractor is to provide and deliver to the Employer are as stated in the Standard and Project Specifications:
4.14.3	The office accommodation, equipment, accommodation for site meetings and other facilities for use by the Employer and his Agents are: 1) One office as per SABS 1200 A or AB, whichever is referred to in this document, if such facilities are specified in the Bill of Quantities. 2) Safety helmets, gumboots and other necessary safety equipment for the sole use of the Employer and his Agents. 3) Survey equipment as per PSAB 4.2 4) No testing laboratory is required on site for use by the Engineer.
4.14.5	The Employer and his Agents will make use of toilet facilities to be provided by the Contractor for the Engineer as specified in C3.4.6.5 above.

Clause	Specification Data
4.17.3	The Contractor will be required to confirm the locations and status of all services irrespective of whether they are shown on the drawings or not. Where public services must be interrupted on account of the Works, it shall be the Contractor's responsibility, in conjunction with the appropriate Authority to ensure that all users affected by the interruption are given due and sufficient notice of the date, time and duration of the interruption.
4.17.4	The requirements for detection apparatus are: NIL
4.17.7	Existing services, which are damaged by the Contractor, shall be repaired by the service provider and all costs of the repair shall be borne by the Contractor.
4.18	The additional Health and Safety requirements of the Employer are as specified in the Health and Safety Specification included in the Particular Specifications.
VARIATIONS	
4.2,0 o)	Record drawings are to be provided electronically on CD in AutoCAD format and at least one copy is to be provided on paper.
ADDITIONAL CLAUSES	
4.6 (e)	The Contractor is to ensure that storm water runoff or any groundwater seepage is controlled in terms of the approved Environmental Management Plan.
4.9.5	It will be necessary for the Contractor to liaise closely with the Local Authorities, the Local Community and the Engineer's Representative regarding any disruption of the water or electrical supply or access as a result of his construction activities. The Contractor shall advise all parties in writing at least seven (7) days in advance of any such operation, the time for which the supply will be disrupted and the area that will be affected. Disruption of water supplies to any area shall not exceed eight (8) hours in duration. It is recommended that connections to existing pipework be undertaken during weekends or during night time when the water consumption is at a minimum. The Contractor is to ensure that access is maintained at all times to all parts of the Works. The Contractor is to programme the Works to show all shutdowns for tie-in purposes and advance warning requirements.
4.9.6	The provision of security for the Contractor's site establishment, plant and personnel is the sole responsibility of the Contractor and no claims for payment for additional security measures taken during the currency

Clause	Specification Data
	of the Contract will be entertained.
4.17.8	The Contractor shall so carry out all his operations as not to encroach on, or interfere with, trespass on, or damage adjoining land, buildings, properties, road structures, pipelines, places and things, in the vicinity of the Works, without the written approval of the Engineer.

PS2.3 STANDARD: SANS 1921-6

Clause	Specification Data
ADDITIONAL DATA	
4.2.1 a)	A qualified service provider is one that appears on the list of recommended service providers, which is available from all regional offices of the Department of Public Works.

PS2.4 MANAGEMENT MEETINGS

The Contractor and such other persons as may be nominated by the Engineer shall be required to attend monthly site meetings, the date and place for which will be set by the Engineer in consultation with the Employer and Contractor.

PS2.5 Reports AND forms

The Contractor is expected to submit forms relating to plant, rainfall readings, labour, safety statistics, etc. to the Engineer during the monthly site meetings.

Templates of these forms are available electronically and may be requested from the Engineer.

PS2.6 CONTRACTOR'S SITE AGENT

The Contractor shall appoint a suitably qualified and competent Site Agent who shall be on site on a full time basis and at all times when work is being performed, for the full duration of the Contract.

PS2.7 DAILY RECORDS

The Contractor is to provide a Site Diary, which is to be kept on Site, for the purpose of keeping daily records in respect of Work performed on the site, including interruptions w.r.t. plant, labour and materials. Record keeping is to be augmented with date stamped digital photographs.

PS2.8 RECORDING OF WEATHER

The Contractor is to supply and install an accurate rain gauge of modern design and all other necessary equipment within the site camp area, in a position to be confirmed by the Engineer on Site in order to accurately measure rainfall. This area shall be fenced off from the rest of the site camp area and shall have a single pedestrian gate with lock. The Contractor's Site Agent and the Engineer's Representative will have access to the key and will be allowed access to the rain gauge. Rainfall records read at this rain gauge will be kept by the Contractor's Site Agent and the Engineer's Representative. The Engineer's Representative shall use these rainfall records in order to confirm days on which rainfall results in a stoppage of work, critical to the completion of the whole of the Works. The Contractor's tendered rates shall be deemed to include for the supply and installation of the rain gauge, other related equipment, fencing, gate, lock, key, etc.

PS2.9 ABNORMAL RAINFALL

If during the time for completion of the works or any extension thereof abnormal rainfall or wet conditions shall occur then an extension of time in accordance with clause 5.12.2 hereof shall be granted by the Employer calculated in accordance with the formula given below for each calendar month or part thereof.

$$V = (Nw - Nn) + ((Rw - Rn)/X)$$

V	Extension of time in calendar days in respect of the calendar month under consideration.
N_w	Actual number of days during the calendar month on which a rainfall of Y mm or more has been recorded.
Nn	Average number of days, as derived from existing rainfall records, on which a rainfall of Y mm or more has been recorded for the calendar month.
R_w	Actual rainfall in mm recorded for the calendar month under consideration.
Rn	Average rainfall in mm for the calendar month as derived from existing rainfall records.

For purposes of the contract Nn, Rn, X and Y shall have those values assigned to them in the Appendix and/or the Specification.

The total extension of time shall be the algebraic sum of all monthly totals for the period under consideration, but if the total is negative the time for completion shall not be reduced due to subnormal rainfall. Extensions of time for part of a month to be calculated using pro rata values of Nn and Rn.

This formula does not take account of flood damage that could cause further or concurrent delays and will be treated separately as far as extension of time is concerned.

The factor (Nw-Nn) shall be considered to represent a fair allowance for variations from the average number of days during which rainfall exceeds Y mm. The factor (Rw-Rn)/X shall be considered to represent a fair allowance for variations from the average in the number of days during which the rainfall did not exceed Y mm but wet conditions prevented or disrupted work.

The following average rainfall figures are applicable:

INFORMATION SOURCE: South African Weather Service
Pretoria, Tel.: 082 233 8484

Y = 10 mm/24 hour day
X = 20 mm

Table 5.1: Statistical rainfall

STATISTICAL INFORMATION: JOHANNESBURG BOTANICAL GARDENS: 1985-2006		
Month	RAINFALL	
	Nn = Actual number of days during the calendar months in which a rainfall of more than Y-mm has been received	Rn Average monthly rainfall
January	4.1	116.4
February	3.6	121.3
March	2.6	96.0
April	2,0	30.4
May	0.5	15.2
June	0.1	5.9
July	0.0	1.5
August	0.2	8.7
September	0.3	13.2
October	2.0	66.0
November	3.0	84.5
December	3.8	105.4
TOTAL	21.3	664.6

The Contractor shall be permitted to take his own rainfall measurements on site subject to the Engineer's approval, but access to the measuring gauge(s) shall be under the Engineer's control. The Contractor is to provide and install all the necessary equipment for accurately measuring the rainfall as well as to provide, erect and maintain a security fence plus gate, padlock and keys at each measuring station, all at his own cost

PS2.10 Spoil Material

No indiscriminate spoiling of material will be allowed. All surplus or unsuitable material shall be spoiled in designated areas as directed by the Engineer on Site, or beyond the boundaries of the Site, as designated by the Contractor at his risk, or at a regional spoil site. The first priority throughout the duration of the Contract shall be to satisfy any fill requirements under this Contract. Material will only be spoiled with the written approval of the Engineer.

PS2.11 Co-operation with Other Service Agents and Public Authorities

Other contractors and public authorities may be working on the site during the course of this Contract. The Contractor shall co-operate with these workmen and provide reasonable access to the site to enable them to carry out their work.

If the Contractor is obstructed in any way by such work he shall notify the Engineer within 24 hours, otherwise no claim for delay shall be considered.

PS2.12 Courtesy

In all dealings with the public, the Contractor shall bear in mind their right to enjoy the use of the roads and services and access to their properties. The Employer desires to interfere has little as possible with these rights. At all points of contact with the public, the Contractor and is staff are requested to handle discussions and disputes with deliberate courtesy and understanding.

PS2.13 Accommodation of traffic

Where the Works affect the safety or operation of vehicular and/or pedestrian traffic, the Contractor shall provide, erect and maintain such traffic signs, barricades, warning lights and personnel as are necessary or ordered.

The Contractor shall abide by the guidelines and procedures set out in the Safety at Roadworks in Urban Areas site manual as published by the Department of Transport for the National Transport Commission, 1984.

The Contractor may, with the approval of the Engineer, make arrangements with the occupiers of the affected erven, properties and businesses to close off a portion of a street, road, footpath or entrance temporarily, provided the Contractor duly notifies the occupiers of the intended closure and its probable duration and shall, as punctually as possible, re-open the route at the prescribed time.

The road shall be made safe and re-opened to traffic overnight. Any such closure shall be made by arrangement between the Contractor and the occupiers and shall not absolve the Contractor from his obligations under the Contract to provide access at all times. Barricades, traffic signs and drums shall be provided by the Contractor to suit the specific conditions.

It must be noted that services such as telephone and power poles, stay poles and stay wires and fences may be located within close proximity and within the site. The Contractor will be required to take due care for the protection thereof and will be liable for any damage to these services.

PS2.14 Finishing and Tidying and Site Maintenance

During the progress of the Work and upon its completion, the Site of the Works shall be kept and left in a clean and orderly condition. The Contractor shall at all times store materials and equipment for which he is responsible in an orderly manner, and shall keep the site free from debris and obstruction.

Progressive and systematic finishing and tidying will form an essential part of this Contract. On no account must spoil, rubble, materials, equipment or unfinished operations be allowed to accumulate in such a manner as to unnecessarily impede the activities of others, and in the event of this occurring, the Employer shall have the right to withhold payment for as long as may be necessary in respect of the relevant Works in the areas(s) concerned without thereby prejudicing the rights of others to institute claims against the Contractor on the grounds of unnecessary obstruction.

Finishing and tidying must not be deferred to the end of the Contract. The Works will not be certified as complete, until the whole of the Works including all finishing and tidying, has been fully completed to the satisfaction of the Engineer.

All finishing and tidying shall be carried out to the best advantage of the project as a whole and in the closest co-operation with other Contractors.

PS2.15 Length of Trenches

Unless otherwise permitted in writing by the Engineer, not more than 50m of trench in any one place and not more than 50m of trench in total within the project area shall be opened in advance of pipe laying operations. No trench may be left open over the builders' holidays or on extended long weekends. The cost of backfilling any trenches before the shut-down period and the re-opening thereof after the shut-down period shall be for the Contractor's account.

PS2.16 EXCAVATION OF TRENCHES

Machine and hand excavation will be permitted after proving of services.

All requirements of the OSH Act shall be complied with, with respect to shoring for both excavation methods.

PS2.17 Testing and Quality Control

The Contractor shall engage the services of a testing laboratory, to be approved by the Engineer, to carry out all testing of materials and quality control testing as described in the relevant Standardised Specifications, as well as other testing as may be elsewhere described.

No separate payment will be made for such testing by an approved laboratory and the costs thereof will be deemed to be included in the Contractor's tendered rates for the various items of work requiring testing in accordance with the specifications.

The results of all such tests including CBR's, UCS's, densities and all other tests as are described in the specifications and at not less than the prescribed frequency, shall be immediately communicated to the Engineer in writing.

The results of such tests by an approved laboratory shall not be regarded as final and binding upon the Engineer, who shall base his decisions relating to the acceptability of the quality of the work, not only on the basis of such tests by an approved laboratory, but also on the results of any such additional tests as he may decide to carry out. The cost of such acceptable control testing shall be to the Employer's account, with the exception of tests on sections which fail to meet the requirements, where the costs of such tests shall be borne by the Contractor.

PS2.18 Opening Up and Closing Down of Borrow Pits

Only registered local borrow pits may be used.

PS2.19 Survey Beacons

The Contractor shall protect all survey beacons during construction of the Works. The site has been provided with beacons and the Contractor takes full responsibility for the preservation of these beacons.

All beacons must be identified and whitewashed before the construction activities commence and the Contractor shall confirm in writing to the Engineer before commencement of construction that all beacons have been proven.

Any beacons not proven must be listed and the list submitted to the Engineer for referral to the Land Surveyor before commencement of any construction activities. The Land Surveyor will verify the existence of these beacons and if proven to exist, will be entitled to recover from the Contractor, if necessary through deductions from the Contractor's payment certificates, any costs incurred. Beacons the Land Surveyor is not able to prove will be reinstated by him in conjunction with the Contractor's construction activities.

Any beacons that have been disturbed or removed during construction will be replaced at the Contractor's expense. When construction has been completed, the Contractor shall identify and whitewash all beacons for inspection by the Engineer before a certificate of practical completion will be issued.

Where proper execution of the Works necessitates the removal of beacons, the Contractor shall give notice to this effect to the Engineer, allowing sufficient time for the listing and relocation, removal or reference marking of such beacons. On completion of construction, before the Practical Completion Certificate is issued, the Contractor shall expose and whitewash the reference pegs relating to the beacons that were listed and removed or disturbed and arrange for the beacons to be replaced by a Land Surveyor. Only when the Engineer is satisfied that the removal of beacons had been imperative, will payment for the replacement of beacons not be at the Contractor's expense.

PS2.20 Occupational Health and Safety Act No. 85 of 1993 and Regulations

The Contractor shall comply with the requirements of the Occupational Health and Safety Act and the Regulations as well as the safety specification bound into this document. The Contractor shall enter into an agreement with the Employer in the form set out elsewhere in this document.

B. STANDARD SPECIFICATIONS

The standard specifications on which this contract is based are the South African Bureau of Standard Standardized Specifications for Civil Engineering Construction SABS 1200, also now referred to as SANS 1200.

Although not bound in, nor issued with this document, the following sections of the Standardized Specifications of SANS 1200 shall form part of this document.

SABS 1200	A	General
SABS 1200	AB	Engineer's office
SABS 1200	C	Site Clearance
SABS 1200	DA	Earthworks (small works)
SABS 1200	DB	Earthworks (pipe trenches)
SABS 1200	DM	Earthworks (roads, subgrade)
SABS 1200	G	Concrete (structural)
SABS 1200	HA	Structural steelwork (small works)
SABS 1200	HC	Corrosion protection of structural steelwork
SABS 1200	L	Medium pressure pipeline
SABS 1200	LB	Bedding (pipes)
SABS 1200	LD	Sewers
SABS 1200	LE	Stormwater drainage
SABS 1200	ME	Subbase
SABS 1200	MF	Base
SABS 1200	MJ	Segmented paving
SABS 1200	MK	Kerbing and channeling

The following SANS specifications are also referred to in this document and the Contractor is advised to obtain them from Standards South Africa (a division of SABS) in Pretoria.

SANS 1921 – 1 (2004): Construction and Management Requirements for Works
Contracts Part 1: General Engineering and Construction Works

C. VARIATIONS AND ADDITIONS TO THE STANDARDIZED SPESIFICATIONS AND PARTICULAR ADDITIONAL SPESIFICATIONS

The following variations and additions to the SABS 1200 Standardized Specifications apply to this Tender. An amendment to SABS 1200 is indicated by the prefix "PS". The letters and numbers following these prefixes respectively indicate the relevant specification and clause in SABS 1200 to which it applies.

PSA GENERAL (SABS 1200A - 1986)

PSA 3 MATERIALS

PSA 3.1 QUALITY

Add the following:

All material used in the Works shall be new and no second or previously used material shall be allowed. All material shall, where such mark has been awarded for a specific type of material, bear the SABS mark. Alternatively, the Contractor shall furnish the Engineer with Certificates of Compliance of materials, which bear the official mark of the appropriate standard.

Add the following sub clauses:

PSA 3.3 SUPPLY OF MATERIALS

The contractor will be responsible to supply all the materials necessary for the proper execution of the works. The contractor shall also be fully responsible for quality of materials used and/or installed.

The quantities of material set out in the Schedule of Quantities were determined with the best intention of providing the most accurate amounts as possible from the calculations, design drawings and documentation. These quantities must be considered as approximate quantities only and the Contractor must verify the Quantities from site measurements prior to ordering the material. No liability will be attached to the Employer or his representatives in respect of materials ordered incorrectly from the amounts or the specifications as stated in the Schedule of Quantities.

PSA 5 CONSTRUCTION

PSA 5.1 SURVEY

Add the following:

The contractor must note that a limited amount of survey control points have been established. The Contractor will be required to verify the accuracy of such and shall be held responsible for any errors in the setting out of the works which may arise from the usage of this survey control.

PSA 5.2 WATCHING, BARRICATING, LIGHTING AND TRAFFIC CROSSING

Add the following:

TEMPORARY TRAFFIC SIGNS

The Contractor shall provide, erect and maintain on the site and at such positions on the approaches to the site all traffic signs necessary for the direction and control of traffic.

The details of all such signs, which shall conform to the current Road Traffic Ordinance and the departmental publication entitled “Safety in Road Construction”, must be approved by the Engineer before erection.

The signs shall be reflectorised or adequate; illuminated at night in a manner approved by the Engineer and kept clean and legible at all times. The Contractor shall reposition, cover or remove signs as required during the progress of the works.

PSA 6.2 DEGREE OF ACCURACY (SUB CLAUSE 6.2)

Degree of accuracy II will apply to all work on this project, except on the tower columns, beams and tank wall where a degree of accuracy I will apply.

PSA 7 TESTING (SUB CLAUSE 7)

The onus rests on the Contractor to produce work, which conforms in quality and accuracy of the detail to the requirements of the Specifications and Drawings and the Contractor must at his own expense, institute a quality control system and will provide experienced Engineers, foremen, surveyors, material technicians and other technical staff, together with all the instruments and equipment, to ensure adequate supervision and positive control on works.

The cost of all the supervision and process control, including testing, so carried out by the Contractor, shall be deemed to be included in the rates rendered for the related items of work.

The Contactor’s attention is drawn to the provisions of the various sections of the Specifications regarding the minimum frequency of the testing that will be required for process control. The Contactor shall at his own discretion increase the frequency where necessary to ensure adequate control.

The Contactor shall submit to the Engineer the results of all relevant tests, measurements and levels indicating compliance with the specifications on completion of every part of the work for examination.

Should the results of any of these tests fall below the required standards as specified in the specifications, the cost of any additional tests required by the Engineer will be to the account of the Contractor.

PSA 7.2 LABORATORY (SUB CLAUSE 5.2)

A laboratory for the use of the Engineer’s representative is not required on site. A commercial laboratory approved by the Engineer and appointed by the Contractor shall do all acceptance control tests required in terms of the Contract. All tests must be done according to the tests prescribed in the SABS 1200 under the relevant sections.

PSA 8 MEASUREMENT AND PAYMENT

PSA 8.2.2 TIME RELATED ITEMS

Add the following:

An extension of time granted will not necessarily or automatically entitle the Contractor to additional payments of time related items. Additional payments for specific time related items after the granting of an extension of time must be motivated and substantiated by the Contractor and shall be subject to approval by the Engineer.

PSAB ENGINEER'S OFFICE (SABS 1200AB)

PSAB 3.1 NAMEBOARDS

The nameboards shall be according to Joburg Water's standard nameboard detail. No other name boards other than stated above shall be allowed. On completion of the works, the Contractor shall obliterate all particulars on the name board and remove the board from the site, prior to the release of retention money.

PSAB 3.2 OFFICE BUILDING

The Contractor shall provide and furnish an office for exclusive use by the Engineer and his representative, as well as a dedicated toilet for use by the Engineer's staff, as descriped in SABS 1200 AB clause 3.2

In addition to the standard requirements:

a) The location of the office unit shall be selected in consultation with the Employer's Agent.

b) The Employer's Agent must approve all internal furniture.

c) Carport's shall be provided and shall cover not less than 24 m², with the ground surfaceconsisting of a layer of crushed gravel (no larger than 9 mm) to combat dust and mud. The carport shall be easily accessible, and be such that cars are protected from direct sunlight all times of day, and against inclement weather.

d) Electrical power from the local authority that is adequate for operating a computer, an air conditioning unit, a heater and a refrigerator.

e) The Contractor shall, in addition to his facilities, further provide at the site camp a meeting roomfor the Employer's Agent. The meeting room shall have adequate seating and table to hold site and other meetings, for 15 people.

PSAB 4 EQUIPMENT

PSAB 4.1 Telephone

Add the following:

A telephone will not be required for the sole use of the Employer's Agent. However, the Contractor shall be responsible for the payment of calls related to the contract made by the Employer's Agent's Representative, on his own mobile phone, during the course of the contract.

Add the following:

PSAB 4.2 Computer Facilities

The Contractor shall, for the duration of the Contract, provide the computer equipment complete with printer, telephone connection and internet connection (ADSL or 4G) together with the software specified hereunder, for the exclusive use of the Employer's Agent and his staff:

a) 1 computer
b) 1 printer
c) 1 Scanner

The computers shall comply with the following minimum specifications:

- Intel Core i3 3.30Ghz CPU
- 4Gb ddr3 memory module
- 500Gb hard drive
- Midi tower case + 550w power supply
- Dvd/Rw drive - internal
- Usb keyboard
- Usb optical mouse
- 18.5" or 19' Led/Lcd wide monitor
- Internet connection (ADSL or 4G)

Printers shall, unless otherwise approved by the Employer's Agent, be Hewlett-Packard Desk Jet printers or equivalent compatible. Printer to be able to scan, and print both A4 and A3 documents , in monochrome and colour

All computer hardware shall be provided complete with the requisite connecting cables and all interfacing devices and software necessary for its efficient operation as an integral system.

The following software shall be properly installed on the computer, and the original license agreements and disks shall be provided to the Employer's Agent for safekeeping:

- MS Windows Latest Edition
- MS Office Home and Business Latest Edition
- MS Projects Latest Edition

All computer equipment provided shall be kept fully serviceable at all times by the Contractor. The Contractorshall have any defective equipment repaired or replaced at his own cost within 12 hours of notification by theEmployer's Agent's staff.

The Contractor shall further provide at his own cost, all paper, ink cartridges and other consumables reasonably required by the Employer's Agent.

PSC SITE CLEARANCE (SABS 1200C)

PSC 1 SCOPE

Add the following:

"Where labour intensive construction methods are applied, the maximum boulder size for removal under this specification will be 50kg. Boulders between 50kg and 0.15 m^3 (i.e. approx 450kg) will be deemed to be removable by other methods under this specification.

PSC 3 MATERIALS

PSC 3.1 DISPOSAL OF MATERIAL

Add the following:

"Materials arising from clearing and grubbing shall be disposed of as maybe ordered by the Engineer. Trees and stumps necessarily removed shall not be burnt unless authorised by the Engineer, but shall be cut and stacked at areas designated by the Engineer.

The Contractor shall locate and obtain his own dumping site for the disposal of material. The Contractor shall comply with the requirements of any by-law, statute, ordinance, regulation and local authority requirements. The Employer will not accept any responsibility or liability in this regard.

No overhaul will be payable on the disposal of material arising from "clearing and grubbing".

PSC 5 CONSTRUCTION

Add the following:

"Where labour intensive methods are applied, the Contractor shall be expected to adhere to the following:

- Hand tools shall be utilized.
- The use of motorised vehicles (trucks, etc) will only be permitted in cases where the distance of the cleared material is to be transported further than 150m. Provided always that such material must be loaded and off-loaded by labour.
- The use of pneumatic hand held breaking equipment will be allowed to break down hard material to an acceptable size suitable for labour intensive construction methods"

PSC 5.1

Add the following:

"The areas to be cleared and grubbed will be indicated by the Engineer. Should a portion or the whole of the site have been cleared and grubbed by nature or by others prior to the start of construction, then no clearing and grubbing will be ordered or payment made with respect to the applicable portion of the site.

Where not specifically stated, pipeline routes shall be cleared to a distance of 1.5m on both sides of the pipeline centre line. Route markers or bench marks may not be disturbed by these actions".

PSC 5.2.3 PRESERVATION OF TREES

Add the following:

"The penalty in respect of every individual tree and shrub designated as a tree or shrub to be preserved that is damaged or removed unnecessarily by the Contractor, shall be R1 000. Trees that fall within areas upon which the Works are to be constructed or within areas that the Contractor must occupy for the proper construction of the Works will not be designated for preservation.

PSD EARTHWORKS (SABS 1200D)

PSD 5 CONSTRUCTION

PSD 5.1.2 EXISTING SERVICES

Known existing services are shown on the Drawings. The Contractor shall, however, continually be on the lockout for the unknown services and he shall immediately notify the Engineer if such a service should be located.

If the existing services are not shown on the drawings but the existence thereof can be reasonably expected, the Contractor shall, in conjunction with all the relevant authorities, determine the exact depth and location of such services before the commencement of construction. After locating the exact position of services and the Contractor shall be liable for all costs and the subsequent costs arising from the damage thereof as a result of the contractor's activities. The Contractor must also indicate these services in the "As Built" drawings.

All existing services where new connections are proposed must be located and opened by the hand excavation for inspection by the Engineer before commencing trench excavation. Any costs or losses suffered by the Contractor as a result of not abiding by this specification will be for the Contactor's account.

5.2.3.2 BACKFILLING OF TRENCHES AND BACKFILLING OR FILLING AGAINST STRUCTURES

Add the following to D 5.2.3.2:

Excavated material which is suitable for backfilling shall be stockpiled whilst all other materials from excavations shall be disposed off site. Backfilling to structures and embankments shall comply with the requirements indicated on the drawings and shall be compacted to 93% and 95% modified AASHTO density respectively.

Contractors are to note that no overhaul of backfill material will be measured and backfill quantities will only be measured up to the pay lines as indicated on the drawings. The Contractor shall be responsible for backfilling any working space and excavation slopes, over breaking, battery etc, beyond the indicated pay lines.

No backfilling behind the reservoir will be allowed until the hydraulic test has been completed.

PSDB 5CONSTRUCTION

PSDB 5.1 Precautions

PSDB 5.1.1 General

Add the following to this sub-clause:

The Contractor shall programme his activities in such a way that long sections of trenches do not lie open forundue periods of time, as this poses a safety risk. The pipes shall be laid as soon as possible after excavation of the trenches and the

trenches then backfilled. Under no circumstances will trenches be left open for more than 1 week.

The Contractor shall inform the Johannesburg Road Agency (JRA) at least 2 days in advance of the actual date on which he proposes to excavate in any road or footway.

PSDB 5.1.4 Existing services that intersect or adjoin trenches

Add the following to this sub-clause:

Where it is necessary for a pipeline to pass under existing drains, the Contractor shall carefully excavate and backfill around them. During the course of the work, the drains shall be adequately supported to the satisfaction of the Engineer. Any damage shall be reported without delay and shall be made good by the Contractor before backfilling.

PSDB 5.4 Excavation

Add the following to this sub-clause:

Where the pipe trench crosses surfaced roads the Contractor shall neatly cut four parallel grooves into and through the "black top" before excavating between the inside 2 grooves. The outside 2 grooves should be 100 from the inside ones. The cost of this operation, where not scheduled separately, will be deemed to have been included in the general rates for excavation.

PSDB 5.5 Trench Bottom

Add the following to this sub-clause:

In waterlogged conditions and/or where so instructed by the Engineer, a 100mm thick layer of 20mm to 6mmgraded stone shall be laid under the pipes.

PSDB 5.6 Backfilling

PSDB 5.6.1 General

Add the following to this sub-clause:

Notwithstanding the requirements of sub-clauses PSDB 5.6.1 and 5.6.6, no pipe joint or pipe-fitting shall be covered by either the blanket or the backfill prior to the successful completion of the visual inspection and thepressure testing of the relevant section of the pipeline and without the written permission of the Engineer.

PSDB 5.6.2 Material for backfilling

Add the following to this sub-clause:

No backfilling may be done unless it is authorised by the Engineer. Trenches must be backfilled and compacted to 90% modified AASHTO to at least 300mm above the pipe soffit in layers of 150mm around and above the pipe and care should be exercised to prevent damage to the pipe. Subsequent layers may be compacted in 175mm layers. Except where backfill material is in the opinion of the Engineer moist enough, water must be added to facilitate compaction.

In the event of no suitable material being available around the pipe for backfilling the trench in question, the Contractor must obtain suitable material from other excavations, transport it to the site and remove the unsuitable material to an approved dumping site. If no suitable material is thus obtainable, the Contractor must sift the material obtained from the trench through a sieve with a 10mm mesh, but, if above mentioned procedure is not practical, the Engineer may instruct the Contractor to import suitable material from approved sources and the Contractor will be under obligation to remove the unsuitable material to a dumping site.

If any settlement occurs during the Construction Period or before the end of the defects liability period, the Contractor must rectify such settlement to the satisfaction of the Engineer.

After all the excavations and backfilling have been completed, the surplus material and all additional material must be removed from the site to the satisfaction of the Engineer.

PSDB 5.6.3 Disposal of soft excavation material

Add the following to this sub-clause:

Surplus material or unsuitable material which is not disposed of within the trench servitude shall, on the instruction of the Engineer, be disposed of at approved tipping sites to be located by the Contractor.

The prior approval of the Engineer must be obtained before surplus material may be deposited, spread and levelled at agreed sites within the area of the works.

PSDB 5.6.4 Disposal of intermediate and hard rock material

Add the following to this sub-clause:

Surplus intermediate and hard rock material from trench excavations shall, on the instruction of the Engineer, be disposed of at approved tipping sites to be located by the Contractor.

The prior approval of the Engineer must be obtained before surplus material may be deposited, spread and levelled at agreed sites within the area of the works.

PSDB 5.6.5 Deficiency of Backfill Material

Add the following to this sub-clause:

All haul distances shall be freehaul distances.

PSDB 5.7 Compaction

PSDB 5.7.2 Areas subject to traffic loads

Add the following to this sub-clause:

In areas subject to traffic loading and in constructed footways compaction shall be done as directed by theEngineer or JRA specifications.

PSG CONCRETE STRUCTURAL (SABS 1200 G)

PSG 2 INTERPRETATIONS

PSG 2.1 SUPPORTING SPECIFICATIONS

Add the following:

SABS 1491 Part 1	:	Ground granulated blast furnace slag (GGBS)
SABC 1491 Part 11	:	Pulverised Fly Ash (PFA)
SABC 1491 Part 111	:	Condensed Silica Fume (CSF)

PSG 3 MATERIALS

PSG 3.1 APPROVAL OF MATERIALS

Add the following:

If during the progress of the work, the contractor desires to use materials of proportions other than those originally approved, or if in the opinion of the Engineer or his representative, the materials from the sources originally approved change in characteristics, he shall provide evidence satisfactory to the Engineer that the new materials and/or new combination of materials will produce concrete meeting the requirements of the specification and will not bring about unacceptable changes in the appearance or other characteristics of the structure.

When any changes are made in terms of this sub clause, they shall be made at the contractor's expense, and no extra payment will be allowed by reason of such change.

PSG 3.2 CEMENT

PSG 3.2.1 APPLICABLE SPECIFICATIONS

Add the following:

Ground granulated blast furnace slag (GGBS) used on the Works shall be from a source to be approved by the Engineer and shall comply with the requirements of SABS 1491 Part 1, as amended.

Pulverised Fly Ash (PFA) used on the works shall be from a source to be approved by the Engineer and shall comply with the requirements of SABS 1491 Part 11, as amended.

Condensed Silica Fume (CSF) used on the Works shall be from a source to be approved by the Engineer and shall comply with the requirements of SABS 1491 Part 111, as amended.

Cement types to be used under certain specific conditions of environment or geographic location are given in Table 1 – "selection of cement type". A minimum amount of 375 kg/m³ and a maximum amount of 450kg/m3 of cementitious material will be required in the concrete irrespective of the type of cement used.

Table 1 – Selection of cement type

Location of Structure	Temperature of concrete	Type of Cement
	< 20°C	CEM11 A – S 42.5 CEM11 B – S 42.5 CEM11 A – M42.5
	20°C – 30°C	CEM11 A – S 42.5 CEM11 B – S 42.5 CEM11 A – M42.5 CEM11 A – V (or W) 32.5 CEM11 B – V (or W) 32.5
	>30°C	CEM11 A – S 42.5* CEM11 B – S 42.5* CEM11 A – M42.5* CEM11 A – V (or W) 32.5 CEM11 B – V (or W) 32.5

PSG 3.2.3 STORAGE OF CEMENT

No cement shall be stored on the site for a longer period than 28 days. After this period the Engineer may call for tests to be carried out in accordance with SABS 471, 831 or 626 and if the cement complies it may be used. Lumpy cement, broken pockets and sweepings shall not be used. The cement sacks shall be closely stocked, not more than 12 sacks high, and shall not be stacked against the walls. The arrangements of stacking shall be such as to facilitate the cement being used in the same order in which it is received.

PSG 3.3 WATER

Add the following:

Water shall be obtained from the city water supply where possible and shall be taken from any other source only on the approval of the Engineer. Where there is reason to suspect the presence of harmful impurities, the Engineer may require the contractor to submit the results of approved tests.

PSG 3.4 AGGREGATES

PSG 3.4.1 APPLICABLE SPECIFICATION

Replace the entire contents of the clause with the following:

Grading of fine aggregate: The grading of fine aggregate must comply with the requirements of Table 2 – "Grading of fine aggregate". It should be noted that it is unlikely that a single sand with this grading will be available in the region under the control of Johannesburg Water and that two or more sands will have the to be blended.

Table 2 – Grading of fine aggregate

Sieve Size	Percentage Passing
4 750 µm	90 - 100
2 360 µm	75 - 100
1 180 µm	60 - 90
600 µm	40 - 60
300 µm	20 - 35
150 µm	5 - 12
75 µm	0 - 5
FM	2.03 – 3.00

Grading of coarse aggregate: Coarse aggregate in structural concrete will have a maximum nominal size of 26.5mm as specified in SABS 1083 with due cognisance of the spacing of the reinforcing bars.

Water demand of sand: Sand with a water requirement in excess of 200L /m³ when made up into concrete with the intended mix proportions (including admixtures, if any) will not be allowed.

PSG 3.5 ADMIXTURES

PSG3.5.1 APPROVAL OF ADMIXTURES REQUIRED

Add the following:

For waterproofing and durability of the concrete, Penetron Admix crystalline water proofing additive with tracing agent shall be used. Minimum dosage shall be of 0,8% by weight of cementitious content in the concrete mix and shall carry a 20 year warranty. Penetron shall be added and used strictly according to the manufacturer's specifications.

Other admixtures in the design of concrete mixes to modify the properties of the plastic concrete, may only be used with the approval of the Engineer. The use of admixtures, which have a retarding effect on the rate of hydration of the cement, may not be used when the concrete temperatures are below 20° C. When the concrete temperature exceeds 30° C, the use of retarding admixtures will be mandatory with cements that have a strength class 42.5R or 42.5. Admixtures containing chlorides shall not be used.

PSG 4 PLANT

PSG 4.1 GENERAL

Add the following:

When considered necessary by the Engineer, stand-by equipment shall be available at short notice.

PSG 4.2 BATCHING PLANT

Add the following:

The site batching of concrete shall be carried out by mass batching only.

PSG 4.3 MIXING PLANT

PSG 4.3.1 GENERAL REQUIREMENTS FOR MIXING PLANT

Add the following:

When considered necessary by the Engineer, a spare mixer shall be held in readiness to run on 15 minutes notice in case of breakdown of the mixer.

PSG 4.5 FORMWORK

PSG 4.5.1 DESIGN

Add the following:

The design of the formwork and supports shall be the responsibility of the Contractor and shall be designed and detailed by a registered Professional Engineer, if required by the special conditions of contract, and submitted for approval by the Engineer. All joints shall be either horizontal or vertical. Chamfer strips shall be provided on all exposed edges.

The design of all proposed formwork shall be subject to the approval of the Engineer. Such approval shall in no way relieve the Contractor of his responsibility under the contract.

PSG 4.5.3 TIES

Add the following:

The ends of any embedded ties shall have cover equal to that required for reinforcement. The gap left from the end of the tie to the face of the concrete shall be effectively sealed on both sides of the structure to ensure water tightness.

PSG 5 CONSTRUCTION

PSG 5.1 REINFORCMENT

PSG 5.2,0 BENDING

PSG 5.2,0.4 Add the following:

All welding of mild steel, where permitted, shall be in accordance with BS 5135.

PSG 5.1.2 FIXING

Add the following:

All reinforcement placed in structures within 5km of the sea should be washed with clean, fresh water after placement in the formwork and not longer than 24hrs prior to the casting of concrete.

The placing of bars on fresh layers of concrete, as work progresses will not be permitted. No concrete shall be placed until the Engineer or his representative has stated that he is satisfied that the reinforcement is correctly positioned as shown on the drawings.

PSG 5.1.3 COVER

Replace clause 5.1.3 with the following:

All concrete cover blocks used shall be of semi-spherical shape. The concrete cover blocks used shall have the same characteristic 28-day compressive strength as that specified for the respective structural concrete elements. The reinforcing tie wire used in the manufacture of the cover blocks shall be hot dip galvanised. A minimum cover of 30mm must be maintained between the reinforcing tie wire and the conical end of the block.

The minimum clear cover to concrete over all reinforcement shall be as indicated in the following Table 3 unless otherwise specified on the drawings. Correct cover shall be maintained by concrete spacers whose strength is not less than that of the concrete specified. Suitable plastic spacers are permitted if approved by the Engineer.

Type of Construction	Min Cover mm
1. Slabs and Walls	
a) Plastered and unplastered internal work	The greater of 20 or d
b) Exposed to water pressure	40
c) External walls	40
2. Columns	The greater for 40 or d
3. Beams	
a) End cover beyond hooks	The greater of 40 or 2d
b) All other surfaces	The greater of 40 or d
4. Piles	
a) Precast piles and on faces poured against formwork	40
b) On unformed faces poured against ground	75
	50

5. All structures in sea water or in marine atmosphere 6. Structures in contact with backfilling or corrosive atmosphere 7. Footings a) Members cast on a blinding layer b) Members cast in contact with the ground	40 50 75

Note: In the above table “d” refers to the largest reinforcing bar diameter.

PSG 5.5.16 BLINDING CONCRETE:

Binding concrete shall be measured per square metre and shall include for a steel trowel finish true to falls.

PSG 5.2 FORMWORK

The surface of the blinding layer, the floor, the internal upper surface of the all footings and the upper surface of the roof end the slabs over the valve chamber shall be finished in accordance with clause PSG 5.2.1 class 4 – steel Float Finish.

The internal surfaces of all walls, columns and the underside of the roof and all exposed surfaces shall be finished in accordance with clause PSG 5.2.1 class 3a – Smooth Finish.

All surfaces in contact with backfill material may be finished in accordance with clause PSG 5.2.1 class 1 – Ordinary Surface Finish.

PSG 5.2.1 CLASSIFICATION OF FINISHES

Replace the entire Clause with the following:

Surface finishes to formed concrete faces shall be classified as hereunder –

Class 1: ordinary finish;

Class 2: rubbed finish;

Class 3: off the form finishes;

(a) Smooth finishes,
(b) Board marked finishes,
(c) Special patterned finishes.

Class 4: exposed aggregate finishes;

(a) brushed en washed finishes,
(b) Tooled finishes,
(c) Sand blasted finish,
(d) Aggregate transfer finishes.

Class 5: applied finishes:

(a) Rendered finishes,
(b) Painted finishes.

Class 1 – Ordinary Surface Finish

This is the finish left on a concrete surface after the removal of the forms and the filling of all holes left by shuttering bolts en the repairs of all defects. The surface shall be true end even, free from stone pockets, depressions and projections.

Class 2 – Rubbed Finish

Immediately after removal of the shuttering all defects shall be made good and the rubbed finish shall be applied within three days as follows:

Before starting this work the concrete shall be kept thoroughly saturated with water for a minimum period of 3 hours. Sufficient time shall have elapsed before the wetting down to allow the mortar used in the pointing of the bolt holes and defects to set properly. Surfaces to be finished shall be rubbed with a medium coarse carborundum stone, using a small amount of mortar on its face. The mortar shall consist of cement and fine sand mixed in the proportions used in the concrete being finished. Rubbing shall be continued until all projections and irregularities have been removed, all voids filled and a uniform surface has been obtained. The paste produced by this rubbing shall be left in place for at least five days. The surface shall be smoothed by being rubbed lightly with a fine carborundum stone.

Class 3 – Off the Form Finishes

Off the form finishes require a very high standard in concrete quality, formwork and technique. The intention is that no after treatment other than treatment of bolt-holes (which should be placed with regulatory and precision) should be required. Forms shall be unblemished and panels regular. Joints shall be a feature of the pattern and shall be handled with care. Reinforcement cover blocks shall be of semi-spherical shape to minimise their appearance on the finished surface.

(a) Smooth finishes may be obtained from non-absorptive linings to forms, form plywood, shutter board, or plastic faced board in new condition.
(b) Boardmarked finishes shall be obtained from the use of timber planks, which shall be dressed and thicknessed unless otherwise specified. When unplanned timber is specified, boards with a strong grain shall be mixed with boards with a less pronounced grain and not grouped together. The Engineer shall indicate if all boards are not to be horizontal and a patterned panel effect is required.
(c) Special patterned finishes are required to reflect without blemish the surface of patterned hardboard, rubber, thermoplastic or other lining as specified.

Class 4 – Exposed Aggregate Finishes

The purpose of these finishes is to relieve the uniform colour and texture of the concrete by exposing the aggregate, which shall be normal size concrete aggregate except where otherwise specified. Attention is directed to the necessity for allowing for the material to be removed and ensuring that the requisite cover to reinforcement is maintained.

(a) Brushed and washed finishes are obtained by stripping and scrubbing the concrete surface with a stiff wire brush. Unless forms can be stripped at a very early age (approximately 16 hours as 20°C) this method cannot be used unless the formwork has been treated with a retarding agent. Care shall be taken to ensure that concrete is not deposited against the face of treated forms, which should be stripped as early as possible. Where scrubbing with water is not effective, a solution of hydrochloric acid in the proportion of 1 part of acid to 4 parts of water shall be thoroughly and evenly scrubbed into the surface until the desired texture is obtained. The complete surface shall then be neutralised by washing thoroughly with water to which a small amount of ammonia has been added. When acid is used, special precautions shall be taken to protect workmen, underlying materials and persons passing.

(b) Tooled finishes may be carried out by the use of bush-hammers, light mechanical chisels or other approved tools, preferably mechanically operated. No tooling shall be done until the concrete has attained an age of at least 14 days after casting when normal Portland cement has been used and 7 days when rapid hardening cement has been used, or longer as may be necessary to prevent the aggregate particles from being dislodged.

The final finish shall show a surface of evenly distributed coarse aggregate particles set in a matrix of mortar, each aggregate particle being in slight relief. After the tooling has been completed, the surface so treated shall be scrubbed down with a stiff brush and washed with water.

(c) Sand blasted finishes shall be obtained by sand blasting the thoroughly cured concrete surface of the same ages as given under (b) Tooled Finishes with hard sharp sand to produce an even, fine clean surface in which the mortar has been cut away, leaving the coarse aggregate exposed.

(d) Aggregate transfer finishes may be effected by sticking a single layer of selected aggregate onto ply board or other suitable form liners which have been cut to size and coated with a layer of water soluble cellulose adhesive mixed with plaster sand. This layer should be just thinner than half the average least dimension of the aggregate. When the glue is set the liners are placed in the forms which are then concreted, care being taken to protect the forms when placing and compacting. Liners shall be stripped after at least 3 days and the adhesive and sand covering the aggregate removed by scrubbing and washing.

Class 5 – Applied Finishes

It is essential that all surfaces on which applied finishes are to be used shall be sound, clean and free of mould oil.

Defects shall first be made good.

(a) Rendered finishes require a good key. Unless otherwise specified this may be provided by flicking on to the previously soaked and still moist surface of 1 part cement to 2 parts of sharp sand. This shall be left untouched apart from curing.

The render coat shall consist of 1 part Portland cement, or Portland 15, ½ part slaked lime, 4 to 4½ parts of sand by volume and shall not be less than 5mm or more than 16mm in thickness.

If a second coat is required because of the irregularity of the concrete, the surface of the first coat shall be combed with uniform wavy lines to provide a key after it

has begun to harden. The second coat may be applied the next day. If a scraped finish is specified the rendering shall be lightly scraped to achieve the desired affect with an old tenon saw blade or similar implement, after it has attained a biscuit like crispness. It shall then be lightly brushed and washed to remove loose particles.

All rendered finishes shall be cured.

(b) Painted finishes of the type specified shall be applied strictly in accordance with the paint manufacturer's instructions. Very smooth surfaces shall be acid washed, lightly sand blasted or rubbed with abrasive stones before being painted. Painting shall be delayed as long as possible and two coats applied unless otherwise specified.

Concrete Upper surface Finishes

Classification

Surface finishes to exposed (non-formed) concrete faces shall be classified as hereunder –

Class 1 – screeded finish
Class 2 – broomed finish
Class 3 – wood float finish
Class 4 – steel trowel finish

Class 1 – Screeded Finish

Immediately after placing, the concrete shall be screed with a true edged wooden board working between forms or other guides set accurately to line and level. No mortar shall be added and noticeable surface irregularities caused by the displacement of coarse aggregate shall be made good by re-screeding after removing or tamping down the interfering aggregate.

Class 2 – Broomed Finish

Immediately after placing, the concrete shall be screed as in Class 1. Thereafter, when the concrete has begun to dry, the surface shall be broomed with a stiff broom or brush to expose the aggregate. Dust and loose particles shall be gently washed away once the desired relief has been obtained.

Class 3 – Wood Float Finish

Immediately after placing, the concrete shall be screeded as in Class 1. Thereafter, when the concrete has begun to dry, the surface shall be brought to a smooth and even finish using a wood float and including any additional 4:1 sand and cement as necessary.

Class 4 – Steel Float Finish

Immediately after placing, the concrete shall be screeded as in Class 1. Thereafter, when the concrete has begun to dry, the surface shall be brought to smooth and even finish using a steel float and including any additional 4:1 sand and cement as necessary.

PSG 5.2.2 PREPERATION OF FORMWORK

Add the following:

Shutter release oil or any other contaminants will not be permitted on any of the reinforcing steel.

Wedges and clamps shall be used in preference to nails for securing the form components and wire ties or tie bolts in reinforced concrete must be capable of complete removal after use, except as otherwise specified. Where oil is used it shall be applied before any reinforcement is placed in position.

PSG 5.2.5 Removal of Formwork

PSG 5.2.5.2` Replace the entire contents with the following:

Where test cubes to determine stripping times are not made, the minimum periods, which shall elapse between the time of the placing of the concrete and the time of removal of the forms shall, unless otherwise agreed with the Engineer, be in accordance with the table hereunder, where each day covers a full 24 hour period.

Minimum stripping time in days:

	CEM 1	CEM 1	CEMII/A & CEMII/B (max 29% extender)	CEMII/A & CEMII/B (max 29% extender)	CEMII/B (30-35% extender)	CEMII/B (30-35% extender)
TYPE OR STRUCTURAL MEMBER OR FORMWORK	Normal weather (Above 15°C)*	Cold weather (Below 5°C)*	Normal weather (Above 15°C)	Cold weather (Below 5°C)	Normal weather (Above 15°C)	Cold weather (Below 5°C)
Beam sides, wall or unloaded columns	1	2	2	4	2	6
Slabs, with props left underneath	4	7	5	8	6	10
Beam soffits, props left under	7	12	8	14	10	17
Removal of slab props	10	17	10	17	12	21
Removal of beam props	14	21	14	21	18	28

*Average daily temperature of the atmosphere adjacent to the concrete as measured by a maximum and minimum thermometer. When the average daily temperature is between 5°C the minimum stripping times shall be interpolated from the table.

The table assumes that the member concerned is not subjected to any heavy construction loads and that the total force to be supported is not more than half the design load. Where heavier loads are to be carried, no stripping of soffits shall be permitted until the concrete has attained its full strength. Any days during which the average temperature was below 2°C shall be completely disregarded.

In the case of walls and columns the stripping times shall be determined by means of cube test results in the first instance, so as to ensure that no damage is caused to the structures by removing formwork.

PSG 5.2.5.6 THERMAL SHOCK AND THERMAL CONTRACTION CRACKING

When it is possible that a temperature differential of 20°C or more may exist within the concrete or between the concrete surface and its surroundings, special precautions shall be taken by the Contractor to avoid thermal shock or thermal contraction cracking. The advice of specialists in the field of concrete technology will be sought and their recommendations regarding the peculiar set of circumstances will be implemented.

PSG 5.4 PIPES AND CONDUITS

Add the following:

The clear space between pipes of any kind embedded in reinforced concrete and the clear space between such pipes and reinforcement shall not at any point be less than 40mm or 5mm plus the maximum size of coarse aggregate, whichever is the greater.

The puddle flanged inlet, outlet, drainage and scour pipes shall be fixed in line and position under and in the walls by the Contractor as shown on the drawings. All pipe work shall be cast into walls at the time of pouring. The use of “windows” to cast in pipe work at a later date shall only be permitted upon approval by the Engineer.

PSG 5.5 CONCRETE

PSG 5.5.1 QUALITY

PSG 5.5.2,0 GENERAL

Add to G 5.5.2,0

The concrete shall also comply with the requirements for Durability stated in PSG 7.3.8

PSG 5.5.1.4 CHLORIDE CONTENT

Replace the entire contents of the clause with:

The chloride content, measured as Cl^- of all concrete in the structure as measured by BS 1881: 124: 1988 shall not exceed 0.2% mass cement.

The maximum chloride of the fine aggregate shall be 0.2% by mass as Cl^- as measured by SABS Method 830: 1976.

PSG 5.5.1.7 Strength Concrete

Add to G 5.5.1.7:

The cubes from the trial concrete mix are to be tested at a nominated concrete design laboratory, and only the results of these tests will be considered for approval.

The minimum content of combined cementitious material shall not be less than 375kg/m³, maximum content 450kg/m3 and the maximum water/cement ratio shall be 0,5. The Contractor shall also submit for approval the proposed slumps and the proportions in which he proposes to use the materials for each grade of concrete in each type of construction. In addition he shall state the minimum cement/water ratio in terms of total water in the mix for each grade of concrete, and the use of any admixtures.

No structural concrete shall be placed on the job until the contractor has satisfied the Engineer as to the suitability of the mixes concerned.

The Contractor shall be deemed to have satisfied himself, before tendering, of his ability to produce concrete of the required quality with available materials conforming to the specification.

Add:

PSG 5.5.1.8 BLEEDING

Concrete shall be so proportioned and the materials so selected that bleeding is kept below 0.30mm/cm² as measured by the ASTM C232 – 99 test.

Add:

PSG 5.5.1.9 SHRINKAGE

Concrete shall be so proportioned by the selection of materials that shrinkage as measured by the SABS 1085 test is kept below 0.06% when batched at the maximum slump allowed.

Add:

PSG 5.5.2,00 TEMPERATURE OF CONCRETE

The temperature of the concrete shall be measured when it is delivered to site from a batch plant or a concrete supplier and shall be within the range 10°C and 30°C. Concrete which has a temperature outside of that range shall not be place in the structure.

Add:

PSG 5.5.2,01 RATE OF HYDRATION

The rate of hydration of the cement in the concrete shall be such that the concrete can be placed and properly compacted, 2 hours after the addition of water to the mix even in hot weather. Conversely, the initial set of the concrete must not be unduly delayed by low temperature, inappropriate use of admixtures or cement type, so that bleeding is promoted.

PSG 5.5.2 BATCHING

PSG 5.5.2.1 For grade 35/26 concrete, only cement types CEM 1 (OPC, Duratech), CEM 11/A (Eagle Plus) or CEM 11/B (Structcrete, Durastruct, Surecrete) shall be used. No site blending of cement extenders will be permitted.

PSG 5.5.2.2 WATER

Replace entire contents with the following:

Dependable equipment shall be provide for measuring the mixing water either by mass or by volume to an accuracy within 3%

The accuracy of the measuring device provided shall be checked whenever required by the Engineer or his representative by allowing it to discharge into vessels of accurately known capacity.

The total quantity of water allowed for shall include the free water present in the aggregates. The moisture content of the fine aggregate shall be determined at the beginning and half way through each concreting shift, after showers of rain or at such other intervals as may be required by the Engineer.

PSG 5.5.2.3 AGGREGATES

Replace entire contents with the following:

Each size of aggregate shall be measured separately by weighing to an accuracy of 2% except where other methods are authorised or ordered by the Engineer.

Where suitable volumetric methods of measuring proportions of aggregates are permitted, these shall be checked at regular intervals, and shall take full account of bulking of the fine aggregate as delivered to the mixer. These methods shall be designed in such a manner that the consistency of the mix shall be as readily controlled as for mechanical batching.

All measuring devices shall be maintained in good order and condition, and no build-up of material on any part of the equipment shall be permitted.

PSG 5.5.3 MIXING

PSG 5.5.3.1 MIXING AT CONSTRUCTION SITE.

Add the following:

Mixing shall continue until there is a uniform distribution of the materials and the mixture is uniform in colour. The minimum period of mixing shall be not less than that recommended by the manufactures at the recommended speed and not more than 30 minutes. The entire contents of the mixer shall be removed from the drum before the materials for the succeeding batch are loaded.

Where hand mixing is permitted, the quantities of cement used shall be increased by not less than 10% over those determined for the appropriate mix design. The concrete shall be mixed on a clean and watertight platform.

PSG 5.5.3.2 READY MIXED CONCRETE

Add the following:

The concrete batching plant is to be inspected by the Engineer for compliance with SABS tolerances and his approval is to be obtained in writing before commencement of the concrete works.

A maximum delivery period of 90 minutes from the time water is added to the concrete mix to the actual discharge of concrete on site shall be permitted. The discharge period (including placing the concrete) shall not exceed 30 minutes.

The concrete slump of every truck shall be measured on delivery and shall comply with Clause SABS 1200 G 5.5.1.2 prior to any concrete from that truck is placed.

A detailed computer printout of the constituents of the concrete mix from the batching plant is to be handed over to and retained by the Engineers representative on site on arrival (i.e. truck registration, mix proportions and the time water was added to the mix). The masses of the concrete constituents of each truck shall be checked against that of those submitted with the trial mix, subject to the batching accuracy as specified in SABS 0100-2: 1992. The arrival time of each truck on site and the time that the concrete discharge is completed shall also be recorded by the Engineers representative.

Before any ready-mixed concrete is used on the job, the contractor shall furnish the Engineer with a copy of his letter to the suppliers in which he specified –

(i) The type of cement;
(ii) The nominal maximum size of aggregate;
(iii) The cement / water ratio;
(iv) The required compressive strength;
(v) The required slump at the time and place of delivery; and
(vi) The type of additive.

All these properties shall be as specified in the contract documents.

When required the contractor shall satisfy the Engineer that acceptable alternative means of supplying concrete have been arranged to be brought into operation in the event of disruption in the supply of concrete. In this connection, the Engineer may require that the alternative means of supply shall commence it the disruption in the supply of ready-mixed concrete has lasted for and elapsed period in time of 1½ hours.

The use of ready-mixed concretes shall in no way relieve the contractor of any of his responsibilities for providing concrete complying with the specifications.

For grade 35/26 concrete, a CEM I or CEM II cement may be blend with pulverised fly cash (PFA) or ground granulated blast furnace slag (GGVS) and/or condensed silica fume (CSF), such that the combined cementitious material comprises not less than 65% cement clinker and a maximum of 35% of extender and/or other additional constituents by mass. The minimum content of combined cementitious material shall not be less than 375kg/m^3 and the maximum water/cement ratio shall be 0,5.

The concrete mixes for the abovementioned grades of concrete shall be designed by an approved concrete design laboratory. At least four weeks before placing any structural concrete on the site, the Contractor shall supply and deliver to the laboratory, at his own cost, samples of the aggregates and the concrete mix design he proposes to use for the works. The Contractor shall include in his tender all fees and charges levied as well as all other costs incurred in designing the required strength concrete mix.

PSG 5.5.4 TRANSPORTATION

Add the following:

Containers for transporting concrete shall be cleaned of all hardened concrete and foreign material.

During transportation the concrete shall be protected from wind and sun; shall be prevented from drying out or losing moisture and shall not be subjected to excessive jarring or jolting. Drying out may be prevented by the provision of covers and / or other protective devices.

PSG 5.5.5 PLACING

Add the following:

Where plums are permitted they shall be deposited by hand.

Freshly placed concrete shall be protected from rain damage.

No concrete shall be placed if the air temperature in the shade is below 8°C. Concreting shall not commence if the air temperature in the shade is above 35°C. The temperature of the concrete at the point of placing shall not exceed 30°C unless otherwise specified.

PSG 5.5.5.10 STRUCTURAL CONCRETE

During the whole or any time that the placing of concrete is being carried out, the concreting operation shall be under the supervision of a suitably experienced person.

The wall footings shall be cast with wall starters to form a horizontal wall construction joint as shown on the drawings. The construction joint between footing bays shall also be as shown on the drawings. At least 3 days shall elapse between pouring adjacent wall footings.

After the wall footings have attained a minimum strength of 18 MPa, but not later than 7 days, each bay of the wall section shall be cast to full height on the same day and vertical construction joints between bays shall be formed as shown on the drawings. At least 3 days shall elapse between the pouring of adjacent wall panels.

As soon as possible after the removal of the formwork in vertical joints or after the concrete has set in horizontal joints the surface laitance of the concrete shall be removed in order to expose the large aggregate and leave a solid surface.

Openings may be left in the formwork on the outside face only for pouring and vibrating of the concrete provided they are closed properly and do not impair the concrete finish.

When concreting walls, care shall be taken to ensure that there is no loose matter on the concrete surface and that it is slightly wetted in order to assist the new concrete adhering to the existing concrete.

The Contractor’s attention is particularly drawn to the fact that the walls form part of a water retaining structure and that no honeycombing will be tolerated. In order to ensure this, the mix proportions of the first 250mm depth of concrete placed in contact with the horizontal joint may be adjusted, with the approval of the Engineer, by reducing the amount of coarse aggregate. The Engineer’s representative may instruct the use of trunking in placing the concrete to avoid losses of fines due to adherence to reinforcement and formwork. The concrete shall be place evenly over the surface to be covered without reliance on vibration to transport is horizontally. Special care shall be given in order to ensure full compaction at water stops.

The floor shall e cast in panels as detailed on the drawings. Consecutively cast panels shall not adjoin one another. The floor panels shall be cast in a checkerboard pattern with a minimum of 3 day between the pouring of adjacent panels.

The column and column head shall be cast in one lift. The base of the column may be cast first provided a centrally placed starter is incorporated.

The contractor may alternative means of construction which shall be subject to the approval of the Engineer. If the Engineer accepts any alternative means of construction it shall in no way result in increased costs.

PSG 5.5.6 COMPACTION

Add:

PSG 5.5.6.5 If required by the Engineer, the concrete shall be re-worked by re-vibration 1 to 3½ hours after placing. The time shall be decided by the Engineer, taking cognisance of the mix, the ambient temperature and the workability of the concrete.

PSG 5.5.7 CONSTRUCTION JOINTS

PSG 5.5.7.1 Add the following:

Any additional construction joints required by the contractor shall be approved by the Engineer. Where “off the form” finishes are specified, joints shall be arranged to coincide with the edges of boards or panels wherever possible.

Only those construction joints shown on the drawings shall be measured and paid for. The contractor shall allow in his pricing for any additional construction joints that he may require.

PSG 5.5.7.3(b) Construction Joints when concrete is more than 24 hours but not more than 3 days old.

Delete and replace with the following:

The surface of the concrete shall be sandblasted or chipped with a light hammer, swept clean and thoroughly wetted. In addition, the first layer of concrete placed in walls over a depth of approximately 250mm shall be made richer by reducing the amount of coarse aggregate by 25%.

PSG 5.5.7.4

Add the following:

a) All horizontal and vertical construction joints shall be cleaned of all dirt and loose particles and shall be prepared to the satisfaction of the Engineer. Formed keys shall be provided if shown on the drawings or if instructed by the Engineer. All intersections of construction joints with concrete surfaces which will be exposed to view shall be made straight and level or plumb and shall be constructed to the details shown on the drawings.
b) The Contractor is to provide a compressor (with oil traps) on site for the whole period during which concreting is in progress, and this must be available for cleaning concrete faces prior to placing fresh concrete or pouring joints. The cost of this plant and operation is to be allowed for in the Contractors rate for concrete.
c) “Blowing-off” may generally be carried out on horizontal surfaces but, under special circumstances approved by the Engineer, it may be carried out on vertical surfaces.

The surface concrete to be prepared shall be between 4h and 8h old after completion of placing and shall be blown of using a mixture of air and water under a pressure of at least 500kPa or by using a high pressure water jet until all dirt, laitance, etc is removed and particles of clean coarse aggregate are exposed sufficiently to produce a rough surface. Any loose particles of coarse aggregate shall also be removed. The success of this method of preparation depends on selecting the correct time (dependant om the type of cement and atmospheric conditions) so that the concrete has set to just the necessary degree of hardness. The operation may therefore require to be undertaken outside normal wordking hours and at night. When the surfaces are at least 12h old any remaining loose or fine aggregate particles shall be washed off.

d) The removal of all surface laitance plus roughening the concrete surface with hand tools in order to expose the coarse aggregate in a uniform patter, is to be carried out on both horizontal and vertical surfaces. These areas should then be cleaned with a stiff brush under running water. The surfaces to be prepared in this manner shall be at least 12 hours old after mixing the concrete. At least 35% of the roughened surface area shall consist of exposed coarse aggregate.

e) All prepared surfaces shall be kept continuously wet until the next lift of fresh concrete is to be placed against them; the minimum time being 12 hours.

f) No fresh concrete shall be placed on the top surface of concrete which is laterally restrained (e.g. by formwork or by in-situ earth) while the bottom layer of concrete is between 3 hours and 12 hours old after mixing. No fresh concrete shall be place on top of the concrete with an unrestrained lateral surface while the bottom layer of concrete is between 2 hours and 12 hours old after mixing.

The internal surface of joints in the reservoir floor and walls shall be sealed with a surface mounted “Hypalon” bandage system having an epoxy fixing system, all materials and procedures conforming to the “Sikadur-Combiflex” surface sealing system as produced by Sika (Pty) Ltd, or similar approved. The Contractor must ensure that where one Hypalon joint intersects another (at right angles or otherwise that the two layers of intersecting Hypalon are not epoxied to each other and thereby restrained from moving. i.e. The Hypalon inside an intersecting joint must not be restrained by the epoxy adhesive and the full intended width should be free to move in the intended directions.

A 1mm thick Hypalon bandage is to used on walls less than 6.5m and a 2mm thick bandage is to be used on walls greater than 6.5m.

The construction joints on the top (and sides where detailed on the drawings) of the reservoir roof slab are to be sealed with a 75mm wide self adhesive aluminium foil strip (Bostik “Ditsit” or similar approved) which shall be installed in accordance with the manufacturer’s instructions. The “Ditsit” is to be taken over the edge of the roof slab and down the side of the wall for a distance of 500mm.

The construction joints on the soffit of reservoir roof slab are to be sealed with 2 coats of a 75mm wide application of Sika Top-Seal 107 (or similar approved) applied in accordance with the manufacturer’s recommendations. The soffit of the reservoir is to be ground down 1.5 to 2mm with an angle grinder and then wire brushed and sprayed clean with water. The slurry is to be applied to a damp surface.

PSG 5.5.7.5 WATER STOPS

Water stops are to be placed in all wall and floor construction joints to the manufacturer’s specification. The waterstop in the floor joints will be “rearguard” type “Expandite Supercast Rearguard R” or similar approved and in the walls will be

"dumbbell" type "Expandite Supercast Watafoil" or similar approved as specified on the drawings.

Water stops, where specified, shall be placed or kept in position as shown on the drawing. Care shall be taken during concreting to ensure that waterstops are not displaced, bent over or punctured.

All waterstops shall be manufactured from virgin polyvinyl chloride that complies with the following minimum performance requirements:

Tensile strength	12,2Mpa	(min)
Elongation at break	250%	(min)
Water soluble content	0,15%	max)
Softness (BS 2571)	38 to 50	

They shall be of the dumb-bell type and eyeleted or supplied with metal clips for the purpose of accurately fixing the waterstops between the reinforcement.

In each construction joint 150mm wide PVC waterstops shall be placed as shown on the drawings.

All intersection points shall be factory made pieces.

All joints in straight lengths and between straight lengths and intersection places shall be hot welded in accordance with the manufacturer's instructions. Jointing other than by hot welding will not be permitted.

Waterstops shall be carefully positioned and tied to the reinforcement to prevent displacement. Every precaution shall be taken to ensure maximum compaction around the waterstop. The waterstops shall then be returned to their horizontal positions ensuring that no voids are formed beneath them.

PSG 5.5.8 CURING AND PROTECTION

Add to G 5.5.8 (d):

Free from rents and tears and lapping by not less than 150mm, the surface being resprayed whenever any sign of drying out is evident.

Replace entire contents of G 5.5.8 (e) with:

Covering with an inner hessian membrane and an outer plastic membrane. The hessian membrane is to be kept continuously damp by an independent automatic sprinkler system. The hessian and plastic membranes are to be firmly secured and kept flush to the concrete surface at all times.

Add the following:

PSG 5.5.8 (f) Retaining forms in place

PSG 5.5.8 (g) Steam curing may be used on approval as specified by the Engineer, provided that the rate of increase in temperature does not exceed more than 20°C per hour. Steam curing at higher than atmospheric pressure shall not be permitted if the concrete contains limestone aggregate. Humidity shall be kept between 90% and 100%.

PSG 5.5.8 (h) the use of curing compounds will not be permitted

Delete the last two sentences of G 5.5.8 and replace with:

The minimum period of curing various types of cement shall be as follows from the date and time of casting:

(a) CEM 1	-	7 DAYS (168 hours)
(b) CEM 11 (max.29(% extender)	-	8 days (192 hours)
(c) CEM 11 (30-35%)	-	10 days (240 hours)

During periods of extreme temperatures, these periods may be increased at the discretion of the Engineer. The temperature of concrete shall be retained above 5°C for a period of 3 days after placement. Should the environment in which the concrete is placed be such that temperatures drop below 5°C in the concrete, then use shall be made of insulated formwork to retain the heat generated by cement hydration within the concrete.

Curing methods to be utilised for water retaining structures

Concrete Element	Curing Method
Reservoir floor slab	G 5.5.8 (a), (b) or (d)
Reservoir walls	G 5.5.8 (e)*
Top surface of the reservoir roof slab	G 5.5.8 (d)
Soffit of the reservoir roof slab	G 5.5.8 (f)
Reservoir columns	G 5.5.8 (e)*

*-As amended

The rates for “Curing of Concrete” in the Schedule of Quantities will be paid to the Contractor on the successful outcome of the durability tests.

PSG 5.5.9 ADVERSE WEATHER CONDITIONS

PSG 5.5.9.2 Delete reference to 32° and replace 30°C.

PSG 5.5.9.4 WEATHER STATION

The Contractor is to provide equipment to monitor the wind speed, humidity, temperature and hence calculate evaporation rates at the site. If the rate of evaporation in site exceeds 0,5kg/m²/hour, exposed concrete surfaces shall be protected to prevent plastic cracking. I should be noted that plastic cracking may occur in cool weather with high wind velocities as well as in warmer weather conditions. If in the opinion of the Engineer, the weather conditions are too extreme and run the risk of adversely affecting the concrete, he may instruct the Contractor not to pour any more structural elements that day. The Engineer may call for protection against the wind to be provided, or the finished concrete to be covered with a plastic sheet or a fog spray to be utilised.

Similarly, if it appears likely to rain, the Engineer may instruct the Contractor not to pour any further concrete. An extension of time (without P and G costs) may be allowed at the Engineers discretion for delays incurred due to inclement weather. Any additional costs for these delays and/or protective measures are to be allowed for in the Contractors rates for concrete word.

PSG 5.5.10 CONCRETE SURFACES

Add:

PSG 5.5.10.4 The Contractor shall make every effort to prevent blowholes from appearing on the off the form smooth finish. All noticeable defects shall be repaired to the Engineer's satisfaction.

PSG 5.5.14 DEFECTS

Add the following to G 5.5.14.1

Water retaining concrete shall be as dense as possible and no honeycombing will be permitted. If honeycombing is found to be a problem the Contractor shall re-assess the concrete mix proportions and his concrete placing methods. No additional payment shall be made for using this mix.

Add the following to G 5.5.14.2

All concrete repair work will be carried out as described below. Repair mortars containing PVA Latexes shall not be used in any water retaining structures.

1. Honeycombing:
   The area to receive patch material shall be primed with a bonding slurry (e.g. Sika Mono Top 610 or similar approved). The patch will then be built up while the slurry coat is still tacky by means of an approved cementious polymer modified mortar (e.g. Sika Mono Top 615 HB Prostruct 528 or similar approved).
2. Shrinkage cracks:
   A low viscosity solvent free structural epoxy resin is to be used to fill the cracks (e.g. Sikadur 52, ABE Epidermix 365/389 or similar approved).

PSG 5.5.14.3 PATCHING AND REPAIR

Where defects do not warrant the removal of defective concrete, one or more of the following procedures shall be required by the Engineer:

(a) Where the structural strength might be affected and must be restored, repairs may be effected by the application of either pneumatically-placed mortar or of a mortar made of silica sand and an approved epoxy formulation mixed and applied in accordance with the manufacturer's recommendations.
(b) Where there are no fears as to structural strength, all defective material shall be chipped away until a dense uniform surface of concrete exposing solid coarse aggregate is obtained. Feathered edges shall be cut away to from surfaces perpendicular to the concrete face. Seized shutter bolts shall be cut back to at least 35mm into the concrete. All loose material shall be hosed away and the surface of the cavity shall be saturated with water for at least 3 hours, after which a thin layer of neat cement mortar shall be applied to the surface. The cavity then shall be filled with stiff mortar mixed in the same proportions of cement to sand as

that used in the original concrete. The mortar shall be thoroughly tamped into place in layers. The use of up to 30% white cement in place of the normal cement may be required to reduce the darker appearance of a patch. An interval of thirty minutes shall then elapse before a final surface tamping in given to the patch, after which the surface shall be treated to resemble the surrounding concrete as closely as possible. Board marks may be reproduced by striking a suitable piece of timber held against the plastic concrete. The patch shall be neat and workmanlike in appearance an after completion it shall be kept wet for a period of at least three days.

The cost of repairing any defective concrete shall be to the Contractors account.

The preparation, application and curing of the above repair materials shall all be in strict accordance with the Manufacturer's instructions.

Add the following Clause:

PSG 5.5.16 NO-FINES CONCRETE

Only sufficient water shall be added to the mix to produce a smooth grout to completely cover each and every particle of aggregate.

Proportions may be varied on site with the approval of the Engineer to obtain a more satisfactory result. The upper surface on the no-fines is to be finished off with a wood float to provide a smooth working surface while adding just sufficient dry mix cement-sand mortar 1 to 8 ratio to close the upper surface of the voids in order to prevent ingress of foreign matter and concrete from the blinding/floor concrete into the interstices.

Mixing shall be carried out in a mechanical batching plant and the hopper shall first be charged with the aggregate to which a small quantity of water has been added to moisten aggregate particles. The cement shall then be added followed by the remainder of the water.

The no-fines concrete shall be placed within 20 minutes of having been mixed and shall be rodded and hand tamped into position. The use of vibrators will not be permitted.

No traffic shall be permitted to traverse the surface of the no-fines concrete during the three days following upon placing and thereafter only over planks or boards placed for that purpose.

No-fines drains shall be measured per metre and shall include for the porous concrete pipe and the encasement in no-fines concrete.

No-Fines Concrete

General

Unless otherwise specified, no-fines concrete shall only be used for non-structural work.

Grading of Aggregate

Aggregates for no-fines concrete shall be graded so that not more than 10% by mass of aggregate is retained on a sieve having 19mm square openings and not more than 5% by mass passes a sieve having 9,5mm square openings.

Mix proportion

No-fines concrete shall be mixed with one part of cement to 9 parts of aggregate.

PSG 6 TOLERANCES

PSG 6.2 PERMISSIBLE DEVIATIONS

PSG 6.2.3(a) Replace with the following:

Description	Permissible Deviation in mm	
	Degree	
	lll and ll	1
Spacing between two adjacent bars	± 20	± 15
Dimensional position of bar	± 20	± 10
Longitudinal location of bends and ends of bars	± 30	± 20
Cover to reinforcement	-0 + 10	-0 + 5

PSG 6.2.3(h) Add:

Tolerances for bow or camber, twist, squareness and for silos and skip form concrete, pre-stressed concrete and precast concrete will be stated in Part Project Specification wherever applicable.

PSG 7 TESTS

PSG 7.1 FACILITIES AND FREQUENCY OF SAMPLING

PSG 7.1.2 FREQUENCY OF SAMPLING

PSG 7.1.2.2 Replace the entire contents of the clause with:

The Contractor shall provide the following number of sets of three standard metric 150mm metal cube moulds for the volume of concrete pour as per the table below:

Table 4 - Frequency of compressive strength tests

Volume of pour (m3)	Number of sets

0 – 25	2
26 – 50	4
51 – 100	6
101 – 200	8
+ 201	10 (or as required by the Engineer)

These sets of concrete cubes will be crushed when they are 7 and 28 days old.

Provide sufficient extra cube moulds for 3 days, 7 days, etc, crushing tests to be made as he so requires for his own purposes i.e. for shutter stripping, post-stressing cables.

Make and cure all cubes on site under the supervision of the Engineer, in accordance with SABS Method 863.

Be represented at the crushing test if he so wishes.

Transport all cubes to the nominated laboratory between 7:30am and 11am on the last working day prior to the date of test. Only the results from this laboratory will be considered and will be the sole basis on which concrete is accepted or rejected.

PSG 7.3 ACCEPTANCE CRITERIA FOR STRENGTH CONCRETE

Delete the entire contents of G 7.3.1 and G 7.3.2 and replace with:

PSG 7.3.1 The Contractor is hereby advised that the basis, on which concrete will be accepted or rejected, is on the 28-day cube strength obtained from cubes crushed at the nominated laboratory. Unless the conditions of sampling, cube manufacture, cube curing and record keeping are strictly adhered to, the test results will be meaningless. To this end it is emphasised that the Contractor must strictly comply with all the concrete test methods specified in SABS Method 861.

Table 5 - Acceptance criteria for concrete strength

Acceptance Category	Strength Cs = Average minimum strength for 3 cubes at 28 days (Mpa)
Characteristic strength for water retaining structures	35
Full acceptance	Cs ≤ 37
Conditional acceptable	33 ≥ Cs > 37
Rejection	33 < Cs

The descriptions given in the “Acceptance Categories” column above shall have the following meanings.

Full acceptance - Concrete shall be accepted unconditionally, subject to the concrete meeting the durability and cover criteria.

Conditional acceptance - Concrete shall be accepted with a warning that construction methods should be examined to improve the strength. A financial penalty of up to R75/m³ will be applied on a pro rata sliding scale for all concrete poured where the average strength (for 3 cubes at 28 days) test results fall within the conditional acceptable range.

Rejection - At the discretion of the Engineer, the concrete shall be removed and replaced at the expense of the Contractor.

Core holes - That test cores shall be drilled from the concrete and tested in accordance with the SABS Method 865 to determine the estimated actual strength and the estimated potential strength of the concrete.

If the results of the core tests show that the concrete meets the test requirements, the structure shall be accepted. If the cores tests show that the concrete does not meet the strength requirements, an appropriate full-scale load test, as determined by the Engineer, shall be applied on the structure containing the defective concrete.

If load tests are, in the opinion of the Engineer, impracticable, or where the portions of the structure subjected to such test fail to pass the test specified, he shall have the right to require strengthening or replacement of the portions of the structure concerned.

Upon removal of the core the hole is to be dampened and filled with a stiff mix of an expanding cementitious grout (Sika Grout G.P. or similar approved). Thereafter, an external slurry coat (0,25 x 0.25m) of a polymer modified cementitious coating (Sika Top-Seal 107 or similar approved) is to be applied over the exposed surface of the core hole.

PSG 7.3.5 REPLACEMENT OR STRENGTHENING OF CONCRETE

Delete after the words “the Contractor shall”, and insert

“make adjustments in order to meet the specified requirements.”

Add:

PSG 7.3.6 Table 8 – Acceptance criteria for concrete cover

Acceptance Category	Concrete Cover (mm) (for specified cover of 50mm)
Full Acceptance	70 > Cd ≥ 50
Conditional acceptance	45 ≥ Cd > 50
Acceptance with remedial measures	40 ≥ Cd > 45
Rejection	Cd < 40, Cd > 70

The descriptions given in the “Acceptance Categories” column above shall have the following meanings.

Full acceptance - Concrete shall be accepted unconditionally, subject to the concrete meeting the strength and durability criteria.

Conditional acceptance - Concrete will be accepted with a warning that construction methods should be examined to improve the cover. A financial penalty of up to R15/m² will be applied on a pro rata sliding scale for each structural element where the average test results fall within the conditional acceptable range .

Acceptance with remedial measures - Concrete will be accepted if the Contractor undertakes remedial work at his expense, as approved by the Engineer, to improve the durability of the concrete to the criterion described as “full acceptance”.

Rejection - At the discretion of the Engineer, the concrete shall be removed and replaced at the expense of the Contractor.

Notwithstanding Clause 29.1 of the General Condition of Contract (Removal of improper work and materials) and Clause 30 of GCC (Contractor to search), the onus will be on the Contractor to prove to the Engineer the extent of the concrete for which the durability and cover values fall below the Specified Values (in the above tables), and the cost of this searching is to be included in the Contractor’s rates for concrete.

An item has been included in the Schedule of Quantities for the making good of core holes as directed by the Engineer.

Where the Engineer or his representative has reason to doubt whether the concrete cover over the reinforcement is not in accordance with the requirements of clause PSG 5.1.3, the cover shall be tested with a cover meter. If necessary, the Engineer or his representative shall then indicate toe the contractor where he must expose the reinforcement to prove the depth of cover.

Add:

PSG 7.3.7 COSTS OF TESTS

The costs of all tests required by the Engineer or his representative shall be borne by the Employer except that costs of tests as set out hereunder shall be borne by the contractor -

(a) Preliminary tests on materials and of mix proportions;
(b) All tests as may be made necessary by reason of the provisions of clause SABS 1200 G 7.3.5;
(c) Such tests, including concrete coring and load tests, as may in the opinion of the Engineer be made necessary by failure on the part of the contractor to meet the requirements of this specification.

Add:

PSG 7.3.8 DURABILITY INDEX TESTS

To ensure that the concrete has been placed, compacted and cured correctly, a number of tests will be carried out by a nominated laboratory on the concrete after curing has been completed ie 26 to 30 days after placing of the concrete.

1) A set of four 68mm diameter cores, 75mm in length will be drilled at each test location through the covercrete (being the concrete layer between the outermost layer of steel reinforcement and the exposed outer surface of the concrete element) from the constructed concrete element when the concrete has reached 28 days of age. A slice (30mm thick) will then be cut from the outer surface of this core such that the slice is representative of the middle layer of the covercrete (ie the middle layer being a 30mm thick slice of concrete, 15mm form the exposed outer surface extending in towards the reinforcement) and tested for: -

   1.1) Water sorbtivity,
   1.2) Oxygen permeability (tested in the Ballim apparatus), and
   1.3) Chloride conductivity

   The positions at which the cores will be extracted will be indicated by the Engineer.

   The oxygen permeability and water sorptivity, and chloride conductivity test procedures shall be carried out in accordance with the following references:

   (1) Guide to the use of durability indexes for achieving durability in concrete structures. (Research Monograph No. 2)
   (2) Concrete durability index testing manual (Research Monograph No. 4)

2) The depth of concrete cover achieved will e measured to ensure that the specified values have been achieved.

   The cost of these tests will be borne by the Employer if the results are equal to or exceed the specified value. The Contractor will pay for the tests if the results fall below the conditional acceptance range.
   N.B. The employer will pay for one set of tests per test.

Table 7 – Acceptance criteria for durability testing structural element.

Acceptance Category	Oxygen permeability index (log scale)	Water sorptivity (mmh)	Chloride Conductivity
Full acceptance	Op ≥ 9.15	Ws ≤ 8	Cc ≤ 0.75
Conditional acceptance	9.0 ≥ Op > 9.15	8 < Ws ≤ 12	0.75 < Cc ≤ 1.50
Acceptance with remedial measures	8.75 ≥ Op > 9.0	12< Ws ≤ 15	1.50 < Cc ≤ 2.50
Rejection	Op < 8.75	Ws > 15	Cc > 2.50

The descriptions given in the “acceptance Categories” column above shall have the following meanings.

Full acceptance - Concrete shall be accepted unconditionally, subject to the concrete meeting the strength and cover criteria.
Conditional acceptance - Concrete will be accepted with a warning that construction methods should be examined to improve the durability. A financial penalty of up to R75/m^3 will be applied on a pro rata sliding scale for each structural element where the average test results within the conditional acceptable range.

Acceptance with remedial measures - Concrete will be accepted if the Contractor undertakes remedial work at his expense, as approved by the Engineer to improve the durability of the concrete to the criterion described a “full acceptance”.
Rejection - At het discretion of the Engineer, the concrete shall be removed and replaced at the expense of the Contractor.

PSG 7.3.9 WATER TIGHTNESS TESTING

A hydraulic test shall be undertaken on the reservoir structure before backfilling and no backfilling will be permitted before this test and the acceptance of the structure for watertightness.

All interior surfaces of the reservoir shall be broomed, cleaned and hosed down and the cleaning water run to waste.

The reservoir shall then be filled slowly at a rate not exceeding 2m in 24 hours, and allowed to stand for 7 days to allow absorption to take place. The Contractor shall allow for adding chemicals supplied by the Client to sterilize the reservoir.

The water level will be taken thereafter every 24 hours for 7 days. A maximum drop in surface level of 12mm will be permitted over the full period of 7 days. Should the structure not stand this test the Engineer may order a second test and should this fail, the Contractor shall be responsible for finding the leaks and taking such measures as necessary and approved by the Engineer to produce a satisfactory test.

Water for the second and subsequent tests will be charged to the Contractor at current tariff rates.

The lump sum price for the hydraulic testing of the reservoir shall for cleaning all internal surfaces, adding chemicals and testing.

PSHA STRUCTURAL STEELWORK

PSHA 1 APPLICABLE SPECIFICATIONS:

SABS 1200 H: STRUCTURAL STEELWORK

SABC 1200 HC: CORROSION PROTECTION OF STRUCTURAL STEELWORK

PSHA 2 AMENDMENTS TO SUBCLAUSES OF SABS 1200 H:

PSHA 2.1 SUBCLAUSE 3.1: STRUCTURAL STEEL

The steel shall be Grade 350W for hot rolled steel sections (I, H, C, L). All members shall carry the Grade 350W steel symbol to identify steel grade prior to manufacturing, unless otherwise shown on the drawings.

All other structural elements, tubular profiles, flat bars, squares, rounds, checker ("vastrap") floor plate shall be Grade 43 or as specified on the drawings. The thickness of a checker ("vastrap") floor plate, is the under-pattern thickness.

All stairs, ladders and handrails shall be SS 304L or as indicated on the drawings.

PSHA 2.2 SUBCLAUSE 5.1 AND SUBSUBCLAUSE 5.1.2: CONTRACTOR PROVIDES SHOP DETAILS

The contractor shall furnish the Engineer with shop-detail drawings within two weeks of having received the design drawings. The Engineer will check the drawings for conformity with design requirements and will return the drawings with additions and corrections, if any, within one week of having received them. Detailed checking of shop details for dimensional accuracy and installation fit, will not be done by the Engineer.

PSHA 2.3 SUBSUBCLAUSE 5.2.3: CUTTING

The edges of flame-cut plates shall be ground smooth.

PSHA 2.4 SUBSUBCLAUSE 5.6.1: GROUTING RESPONSIBILITY

Grouting shall not be done by the steel contractor.

PSHA 2.5 SUBSUBCLAUSE 5.3.4: WELDING

(a) All welders shall be coded welders.
The contractor shall submit welding procedures by an approved welding authority for approval and shall produce evidence acceptable to the Engineer that welding procedures and welders have been tested in accordance with the requirements of SABC 044, Parts III and IV.
Approved splicing of members will be subject to non-destructive testing. The cost of testing shall be borne by the contractor.

(d) The Engineer may at his discretion identify welds for non-destructive testing by an approved authority the cost of which will be borne by the Contractor.

PSHA 2.6 SUBSUBCLAUSE 8.3.6: MEASUREMENT OF AND PAYMENT FOR PROTECTIVE COATING

Surface preparation, priming, shop and site painting shall be measured in m^2 of surface treated.

PSHA 2.7 SUBCLAUSE 7.1: TEST CERTIFICATES

Test certificates pertaining to the steel to be used shall be submitted to the Engineer by the contractor before fabrication commences.

The Engineer reserves the right to inspect all structural steel in the workshop before it is delivered to the site.

PSHA 2.8 SUBSUBCLAUSE 7.2: INSPECTION

Third party inspections will be executed by an independent Inspectorate appointed by the Employer on behalf of the Engineer, in accordance with the proposed detailed Quality Control Plan (QCP). Inspections will be carried out at the Manufactorer's factory during and after manufacturing, during coating, storage & handling and installation on site. The frequency of inspection is permanent on the project unless relaxed by the Corrosion and Coating Engineer (CCE) of Johannesburg Water.

PSHA 2.8 SUBSUBCLAUSE 6.2.2: OTHER TOLERANCES

Degree of accuracy II shall apply unless indicated otherwise elsewhere.

PSHA 3 ADDITIONAL CLAUSES:

PSHA 3.1 PROTECTIVE TREATMENT AND PAINTING

PSHA 3.2,0 All paint shall be delivered at the workshop as well as on the site in the original containers that display the manufacturer's name and trademark as well as the SABS mark. The Engineer may, at his discretion, prescribe the manufacturer and the type of paint.

The coating system shall be from one manufacturer only. The paint manufacturer's instructions shall be strictly adhered to.

PSHA 3.2,0.2 Surfaces in contact with each other after assembly or erection shall receive the primer beforehand, except for faying surfaces for friction-grip fasteners.

PSHA 3.2,0.3 The application of the final coats of paint before erection will be permitted by the Engineer only in special circumstances or where specified elsewhere.

PSHA 3.2,0.4 After erection of the steelwork, the specified paint system shall be reinstated in all area where it has been damaged. All fasteners shall also be treated in accordance with the specified paint system.

PSHA 3.2,0.5 No painting on the site shall be done in inclement weather or when humidity or frost is liable to cause wet or damp conditions on the surface to be painted.

PSHA 3.2,0.6 No painting shall be done if the temperature falls below 7°C.

PSHA 3.2,0.7 Welded seams shall be thoroughly steel-brushed before painting. Permission shall be obtained from the Engineer before slag residue may be neutralized with acids or alkalis.

PSHA 3.1.2 SURFACE PREPARATION IN THE WORKSHOP

SIS 05 59 00 or ISO 8501 shall apply and shall be referred to in respect of this clause.

PSHA 3.1.2.1 MANUAL SCRAPING AND WIRE BRUSHING

This treatment shall normally be applied in all circumstances except if and where blast cleaning is specified.

- Prior to treatment, the steel surface shall be cleaned of dirt and grease.
- Heavier layers of rust shall be removed by chipping.
- All loose mill scale, rust and foreign matter shall be removed by very thorough scraping, wire-brushing, machine-brushing, grinding, etc.

- Finally the surface shall be cleaned by vacuum cleaner, with clean dry compressed air, or with a clean brush.
- The surface shall have a pronounced metallic sheen with an appearance equal to or better than that shown on the prints designated ST 3 IN sis 05 59 00 or ISO 8501.

PSHA 3.1.2.2 BLAST-CLEANING

This treatment may be used but is not obligatory unless so specified hereinafter. If blast cleaning is preferred to normal scraping and wire brushing, the final surface shall be equal to or better than that specified in sub-sub clause 3.1.2.1.

PSHA 3.1.3 PAINT SYSTEM

The paint system shall be applied in accordance with the specifications given in table 3.1 below. Application may be by brush, roller or sprayed. Red lead may not be used.

All structural steel which is not visible, eg purling, rafters and trusses, shall receive only the primer coat. All visible steel shall receive the full appropriate paint system treatment.

In all cases the manufacturer's specification for any paint product must be followed.

Table 3.1 Paint system for new steel surfaces for unpolluted inland environments (not suitable for temperatures above 90°C)

Coat No	Place of application	Time of application	Min thickness in µm	Types	SABS - Specification
1. Primer	Workshop	Within 4 hours of surface treatment	50	Zink phosphate Plascoprime 182 QD (Plascon) or D193-1029 (Dulux)	(None)
2. Two final coats; colour as specified elsewhere	Site	After erection. 2nd coat within 48 hours of 1st	Each coat 25 to 40	High-gloss enamel or structural steel paint	630 Type 1 684 Type A

PSHA 3.2 PAINT SYSTEM FOR NEWLY GALVANIZED SURFACES

PSHA 3.2.1 RECOMMENDED SURFACE PREPARATION:

- Degrease with Plascon Aquasole Degreaser GR 1 or similar approved. Any cement or foreign material must also be removed from the metal surface.
- Rinse with clean running water while protecting the floors and walls.
- Wash with Galvanised Iron Cleaner GIC 1 by Plascon, or similar approved.
- Rinse with clean running water and allow to dry. Protect the floors and walls.

PSHA 3.2.2 Apply one coat of Plascon Aquafast Etch Primer no EMS 18 or similar approved to a total dry thickness of 35 micron. Must be overcoated within 72 hours to avoid excessive hardening.

PSHA 3.2.3 TWO FINAL COATS AS SPECIFIED IN TABLE 3.1

PSHA 4 HOT DIPPED GALVANIZING (See also subclause 5.9 in SABS 1200H)

Steelwork described as "hot dipped galvanised" shall be galvanised after manufacturing and before delivering to site by means of the hot dipped process complying with the minimum requirements of SABS ISO 1461, 2000 latest amendment. Structural steel members shall be given an 85 micron thick galvanised coating or such other thickness as may be specified in accordance with SABS ISO 1461 (Table 1).

Damaged surfaces must be thoroughly cleaned and if welding has been carried out all slag must be removed preferably by the use of a chisel hammer.

Before galvanising all surfaces of the metalwork shall be thoroughly cleaned of all scale and rust by shot-blasting in accordance with SABS 064 or by pickling and then fluxed ready for galvanising.

The zinc coating shall be even and continuous over all surfaces, free of bare spots, dull or rough patches, blisters or other imperfections. The zinc coating shall show no signs of peeling and shall be uniform in thickness.

All M8 and greater bolts, nuts screws and other threaded components, shall be hot-dip galvanised to SABS ISO 1461 (previously articles type C).

Repairing of damaged coatings

Plant repairs

Should any black spots or uncoated areas greater than 5 mm^2 (individual) or 25mm^2 (collective) per m^2 or per m run be present after galvanizing, the coating shall be repaired. This is to be carried out using abrasive blasting following by zinc metal spray. The zinc metal spray shall be applied at least 25% thicker than that specified and shall overlap the damaged area by 20-25mm. The finished coating shall be wire brushed to remove any excess metal spray.

Hot patch soldering is an alternative at the plant but is seldomly used, as the method needs to be conducted while the product is still hot before quenching.

Site Repairs

Zinc metal spray as set out above.

The recommended alternative is to use a zinc rich paint provided it has at least 90% zinc in the dry film, by mass. The paint should be a zinc rich epoxy in conformance with SABS 926. A single pack zinc rich paint such as Plascon's "Plascozinc Polygalv Primer" or equal can be applied.

PSL MEDIUM-PRESSURE PIPELINES

PSL1 PIPE MATERIALS

PSL1.1 Mild Steel Pipes, Fitting and Specials

Mild steel pipes and specials up to 150 mm nominal diameter shall comply with the requirements of SABS 62. Pipes and specials over 150 mm nominal diameter shall comply with the requirements of SABS 719.

Pipe specials shall be manufactured to the requirements of BS 534.

Mild steel pipes, fitting and specials shall furthermore comply with the following:

a) Grade of pipe material : Grade X52
b) Wall thickness : As specified in Schedules, but with a minimum wall thickness of not less than 4.5 mm
c) End treatment : Plain, machined or flanged as indicated in the Schedule of Quantities and the Schedule of Steel Specials
d) Pipe interiors : Weld reinforcement and upset material on the interior surfaces shall not exceed 1 mm
e) Edges : All edges on pipe specials shall be rounded to a minimum radius of 3 mm prior to corrosion protection
f) Corrosion protection : Refer Clause PSL 12 hereof
g) Welding : Electric fusion welding

PSL1.2 Unplasticised Polyvinyl Chloride Pressure Pipes and Fittings

uPVC pressure pipes and fittings shall conform to the requirements of SABS 966 Part 1.

All pipes and fittings shall have an integrally moulded joint with factory fitted rubber seal ring, unless other specified. Only full length pipes bearing the aforementioned markings will be acceptable. When laying pipes, the markings shall be visible from above.

uPVC Pipes and fittings must be carefully handled and stored and the Contractor must in particular observe the following.

a) Pipes must be carefully off-loaded and under no circumstances may pipes be thrown of vehicles
b) Pipes with socket ends must be stored on timber supports on the ground. The supports may not be placed more than 1.0 m apart
c) Pipes may not be stacked higher than 1.0 m during transport or on stage
d) The storage area must be level and free from stones and sharp objects
e) The storage area must be free from dry grass or any material likely to constitute a fire hazard
f) Pipes and fittings must always be stored in the shade; away from direct sunlight

The cost of cutting and trimming pipes shall be included in the rates for laying and jointing of pipes.

Except for bends up to 250 mm diameter, all fittings for use with uPVC pressure pipes shall be cast iron with wall thickness in accordance with SABS 546 and socket dimensions in accordance with SABS 966.

PSL1.3 High Density Polyethylene Pipes (HDPE)

HDPE pipes shall be type IV in accordance with the requirements of SABS 533 for the working pressure as specified.

Only approved polypropylene compression fittings shall be used with HDPE pipes.

Welding fittings will not be permitted.

PSL2 ISOLATING VALVES AND STOPCOCKS

PSL2.1 Cast iron gate valves

All cast iron gate valves shall be WEDGE TYPE gate valves of the waterworks type in accordance with the requirements of SABS 664. The valves must be able to withstand a hydraulic working pressure of 1600 kPa and shall have plain, flanged or socket ends to suit the pipeline materials and/or fittings as specified.

The valves shall be provided with a straight, unobstructed body passage through the valve and the gate shall be completely clear of the waterway in the fully open position. The sealing and gate guide shall be of substantial design to support the gate until it closes and the gate shall be manufactured of cast iron and covered with bonded vulcanised nitrate rubber. The valve shall have a non-rising stainless steel spindle fitted with a cap top or handwheel and close anti-clockwise.

The valve spindle shall be provided with a lock-seal permitting the replacement of the spindle seals under pressure. The spindle seal shall consist of at least two O-rings located in a corrosion-resistant housing. A further wiper ring to prevent the ingress of dirt shall be provided.

All components shall be interchangeable between valves of the same size and all bolts and nuts in the construction of the valves shall be galvanised standard metric hexagonal bots and nuts.

The valves shall be able to handle flow in both directions and be installed in reversible directions and are required to seal drop-tight from zero to a maximum pressure of 1.5 times the rated working pressure under test and field conditions.

The type and make of the gate valves must be approved by the Engineer prior to ordering thereoff.

PSL2.2 Butterfly valves

Butterfly valves shall have the following features:

Body type	: Water for valves < 250 mm diameter Fully flanged for valve300 mm diameter
Seating	: Replaceable
Dimensions	: Face-to-face dimensions must conform to the requirements
Operation	: Gearbox operation with hand wheel
Pressure rating	: Valves must be able to withstand a maximum hydraulic pressure of 1 600 kPA

Valve components shall be manufactured from the following materials:

Body	:	Cast iron or Ductile iron to SABS 936 GRSG42
Disc and shaft	:	Stainless steel
Seating and rings	:	Replaceable rubber
Bearing	:	Self-lubricating Vesconite

The type and make of the butterfly valves must be approved by the Engineer prior to ordering thereof.

PSL2.3 Brass stopcocks, ballcocks and bibcocks

Cast brass stopcocks, ballcocks and bibcocks shall be used for pipe diameters of 50 mm and smaller where specified on the drawings of Schedule of Quantities. The valves shall comply with the requirements of SABS 776, and shall be capable of withstanding a hydraulic working pressure of 1 600 kPa. The valves shall have screwed ends.

Stopcocks shall have special non-rising stems to prevent dezincification and be fitted with a handwheel for clockwise closing. The direction of the closing shall be marked on the handwheel.

The make of stopcock, ballcock or bibcock must be approved by the Engineer, prior to ordering thereof.

PSL3 SWING CHECK VALVES

Swing check valves shall be single or double door design and conform to the following requirements:

Body type	:	Wafer or flanged as specified
Body materials	:	Cast iron or carbon steel
Disk and hinge	:	Grade 316 stainless steel
O-ring	:	Nitrile rubber
Maximum working pressure	:	1600 kPa
Standard supply features	:	Counterweight and lever on door shaft Torsion spring (lconel) to assist closing before flow reversal with lifting eye bolt.

The type and make of valve must be approved by the Engineer prior to ordering thereof.

PSL7 FIRE HYDRANT VALVES

Fire hydrants shall be tamper proof with a 65 mm diameter double aluminium alloy quick coupling complying with the applicable requirements of SABS 1128, Parts 1 and 2, and equipped with a squire spindle on which the keys of the local fire brigade shall fit. It shall furthermore comply with NBR 85, T-section, no 9613, dated 1 March 1985.

After installation of the fire hydrants they shall be painted with one undercoat of zinc chromate or a similar product complying with the applicable requirements of SABS 679, followed by two coats of medium yellow high-gloss enamel paint such as Plascon Code G6 or an approved similar product which conforms to the requirements of SABS 630.

PSL8 PRESSURE GAUGES

Pressure gauges for monitoring water pressure in pipeline shall be glycerine-filled robust and shall comply with the following requirements.

Case	:	Solid brass forging with integral bottom entry stem and pressure vent in back of case.
Window	:	Non-splintering clear plastic
Dial	:	White aluminium with black lettering
Pointer	:	Black aluminium with black lettering
Bezel ring	:	Roll formed stainless steel ring
Connector	:	½" BSP male bottom entry connector
Scale range	:	0 to 1 600 kPa

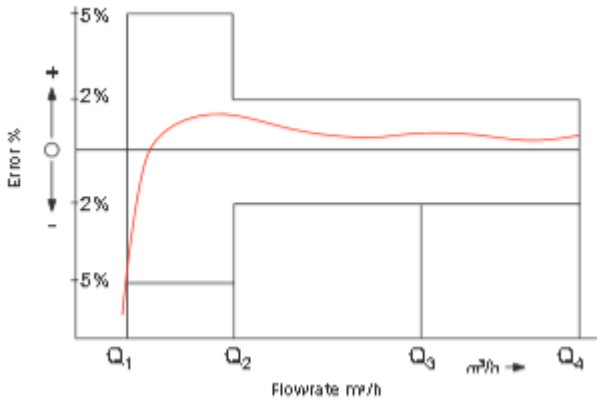
The size of gauge is specified on the drawings and/or in the Schedule of Quantities.

PSL9 WATER METERS

PSL9.1 In-line Full BoreElectromagnetic Field Flow meter

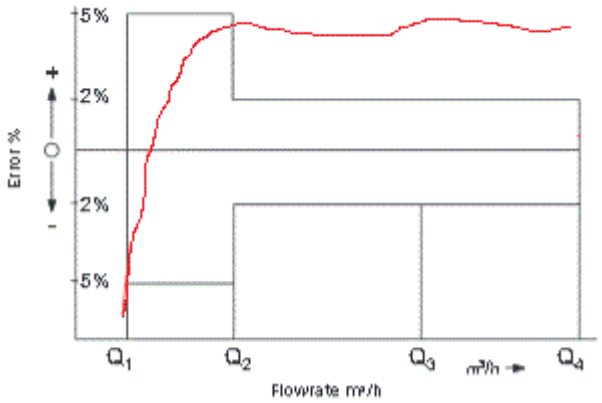
These types of meters are installed in-line using flanges and do not require the use of a strainer. Meters must comply with the following requirements:

1. Meter must be ISO7145, ISO4064|OIML R49 approved and must be delivered with a certificate of calibration.
2. Meter flanges must comply with SABS1123 Table 1600/3.
3. Meter must have a dual pulse (forward and reverse), 4-20mA and must have a Modbus output standard (HART optional add-on).
4. Meter must be able to be installed horizontally and vertically.
5. Meter must be PN16.
6. Meter must be able to work up to 70°C.
7. The enclosure sensor must be IP68 or higher.
8. Meters must comply with Johannesburg Water's metering policy.
9. The meter must be able to measure forward and reverse flow.
10. The meter needs to have an error of less than 0.5%



PSL9.2 Clamp-On Ultrasonic meters

1. Meter must be ISO7145, ISO4064|OIML R49 approved and must be delivered with a certificate of calibration.
2. Meter must have a dual pulse (forward and reverse), 4-20mA and a MODBUS RTU with RS485 output standard (HART optional add-on output).
3. Meter must be able to be installed horizontally and vertically.
4. Meter must be able to work up to 50°C.
5. The meter needs to have an error of less than 5% as shown in the below graph.



6. The transducers need to be IP68 rated.
7. Meters must comply with Johannesburg Water's metering policy
8. Meter Housing needs to be IP68.
9. Meter needs to have a digital display showing totals.
10. Meter needs to be able to run off 24V DC.

Where meter is located in a remote area meter is to be battery operated (refer to section Telemetry)

11. Meter needs to be able to record forward and reverse flow.

PSL10 SURFACE BOXES AND VALVE BOXES

PSL10.1 Cast iron surface boxes

Surface boxes, covers and frames of cast iron for valve chambers shall comply with the requirements of SABS 558.

PSL10.2 Step irons

Step irons shall comply with the requirements for malleable cast iron of BS 1247, figure1 and shall be fully coated with a high density polypropylene cover. The length of the step irons shall be suitable for fixing in brickwork or in situ and precast concrete.

PSL10.3 Precast concrete chambers

Precast concrete chambers shall consist of reinforced concrete chamber sections of circular shape, manufactured in accordance with the requirements of SABS 677 with the following minimum wall thickness:

Nominal diameter (mm)	Wall thickness (mm)
750	60
1 000	65
1 250	75
1 500	90

The circular chamber sections shall be firmly embedded into a class 20/19 MPa cast in situ foundation as specified on the drawings.

The chambers shall be fitted with a precast reinforced concrete slab of thickness not less than 150 mm or as specified on the drawings.

All joints will be sealed with “Prostruct 687” or “Araldite BV1057” epoxy sealant.

PSL11 JOINTING

PSL11.1 Flanged Connections

PSL11.1.1 Flanges

All flanges shall be to SABS 1123 and drilling to Table 1600/3 unless otherwise specified.

PSL11.1.2 Bolts and Nuts

Bolts and nuts (GR4.6) shall be coarse pitch thread with hexagonal head in accordance with the requirements of SABS 136 and shall be hot –dipped galvanised to SABS 763, 6HZe. All bolts must be of equal length and the length of each bolt shall be such that, after the nut has been tightened, the end of the bolt shall project above the nut by not less than one full thread and not more than four threads.

PSL11.1.3 **Flange gaskets**

All gaskets for flanged joints shall be 3 mm thick, full face rubber insertion in accordance with the requirements of BS 3063.

PSL11.2 Flexible Couplings

All flexible couplings for plain-ended steel pipes and fittings shall be of the slip-on type without centre register, such as Viking Johnson or an approved similar product, and shall comply with the relevant requirements of BS 534.

PSL12 CORROSION PROTECTION

The corrosion protection specified hereafter applies to all surfaces (internal and external) unless otherwise stated.

PSL12.1 Steel pipes and Specials

PSL12.1.1 Steel pipes and fittings up to and including 50 mm nominal diameter shall be hot-dipped galvanised to the requirements of SABS 763, unless otherwise specified.

PSL12.1.2 Steel pipes and specials over 50 mm nominal diameter shall receive the following corrosion protection:

a) Surface preparation

Surfaces to be treated shall have all projections, sharp edges, laminations and tool marks removed to provide a smooth surface an shall be cleaned in accordance with section 2, 3 and 4 of SABS Code of Practice 064 to meet the following requirements.

(i) A cleanliness of not less than Sa 2½ when tested according to SABS test method 767.
(ii) A surface profile not exceeding 0.09 mm when tested according to SABS test method 772.
(iii) Free from dust and debris not more than 0.2 % when they are tested according to SABS test method 769.

The Contractor shall furnish the Engineer with the manufacturer's written warranty that the above requirements have been met.

b) Epoxy coatings

Epoxy coatings and linings shall be applied to the surfaces as specified strictly in accordance with the epoxy manufacturer's instructions and shall comply with the requirements of SABS 1217.

The Contractor shall furnish the Engineer with a certificate which confirms that the coatings have been applied to the manufacturer's satisfaction. Such certificate shall be signed by the manufacturer and the Contractor.

The epoxy system to be used will consist of the following as specified on the drawings:

(i) Internal lining:
Fusion Bonded Epoxy (SANS 1217 Type 2A material) with target thickness of 400microns and (± 100micron max.)

(ii) External coating for buried pipework:
Fusion Bonded Epoxy (SANS 1217 Type 2A material) with target thickness of 400microns (± 100micron max.)

(iii) External coating for above ground pipework:

a. Layer 1: Fusion Bonded Epoxy (SANS 1217 Type 2A material) with target thickness of 400microns (± 100microns max.)
b. Layer 2: Top coat layer of re-coatable polyurethane paint with target thicknss of 50microns (± 10microns max.) according to Joburg Water colour code for Waterworks.

c) Inspection of epoxy coatings

After completion of lining and coatings in the factory, the steel pipes and specials shall be inspected by an independent Inspector appointed by the Engineer to confirm the integrity of the coatings as specified. No steel pipes and specials may be delivered to site until such time that the coating system has been inspected and approved in writing by the Engineer.

d) Protection, Handling, Transport and Storage of Shop Lined, Coated Pipes and Specials

After the linings and coatings have passed all inspections and tests, all ends shall be covered and kept covered up until the installation of the pipe or special in the field. End covers shall consist of heavy gauge plastic sheeting or other approved material lapping the ends of the pipe and secured to the outside of the pipe with flat steel binding strips. A single 100 mm long slit shall be cut in the centre of each of the two end covers of each pipe special. End covers to branch ends shall not be slit.

Lined and coated pipes and specials shall be protected against damage at all stages from manufacture to delivery and laying. End covers shall be maintained until ends are jointed. Pipes and specials shall be lifted only by means of broad band slings. During transport pipes and specials shall be supported on padded cradles or saw dust filled bags. Under no circumstances shall coated pipes and specials be placed directly on the ground or unpadded hard surfaces.

PSL12.2 Cast Iron Valves and Fittings

An epoxy coating system as specified in clause PSL12.1.2 above.

PSL12.3 Flexible Steel Couplings

An epoxy coating system as specified in clause PSL12.1.2 above.

PSL12.4 Bolted or Screwed Connections Below Ground Surface

Bolted connections (flanges and flexible steel coupling) or screwed connections buried below ground surface shall be protected by wrapping petrolatum impregnated cloth tape around the complete connection after installation.

PSL12.5 Galvanised Pipes and Fittings Below Ground Surface

Galvanised pipes and fittings buried below ground surface shall be protected by wrapping petrolatum impregnated cloth tape around the full perimeter of the pipes and fittings to a distance of 100 mm above ground level.

PSL12.6 Cast Iron Covers and Frames

Cast iron covers and frames shall be painted with black epoxy-tar paint conforming to the requirements of SABS 801 Type 111 and shall be applied in two coats each with a dry film thickness of 250 micron.

PSL12.7 Mild Steel Lids and Frames (not galvanised)

Mild steel lids and frames shall be provided with two coats of epoxy paint to a total minimum dry film thickness of 250 micron, unless otherwise specified.

PSL13 CONSTRUCTION

PSL13.1 Pipe Cover

The minimum cover of the soffit of pipe couplings shall be 1 000 mm or as otherwise specified. The markings on pipes shall be visible from above after installation.

PSL13.2 Marker Blocks and Markers

Marker blocks and markers indicating the position of pipes and valves shall consist of precast sections of kerbs with a 100 mm high x 75 mm wide x 6 mm deep letter "W" (water main) and/or "V" (valve) recessed into the concrete during manufacture. In cases of existing kerbs, the letter shall be cut into the concrete in a clear legible mark or sandblasted with a template.

PSL14 MEASUREMENT AND PAYMENT

PSL14.1 Materials and Installation

The Contractor will be responsible for measuring the actual lengths of pipeline to be constructed and number of fittings to be installed prior to ordering of materials. Payments will be done for actual work done and materials installed and not in accordance with the quantities as scheduled.

PSL14.2 Jointing

No separate payments will be made for jointing materials and the cost thereof shall be deemed to be included in the rates Contracted for the material or component jointed unless specified otherwise.

PSL14.3 Corrosion Protection

No separate payment will be made for jointing materials and the cost thereof shall be deemed to be included in the rated Contracted for the materials to be corrosion protected.

PSL14.4 Marker Blocks and Markers

Markers shall be measured by number extra over the rate Contracted for kerb units.

D. PARTICULAR SPECIFICATIONS

The following Particular Specifications are included

PE : ELECTRICAL SPECIFICATIONS
PG : GENERATOR SPECIFICATION
PP : PUMP SPECIFICATIONS

PORTION C: PARTICULAR PROJECT SPECIFICATIONS

SECTION W: SOLAR HIGH MAST FOR LIGHTING OF THE RESERVOIR SITE

PSW 1. SOLAR LED FLOOD LIGHT HIGH MASTS LIGHTING

The solar LED high mast lighting shall consist of:-

- 150Watt LED high illumination LED flood lights
- 400W mono crystalline solar PV panels
- Top mounted battery box/cabinet manufactured from 3C12 steel with enclosure
- 5.1kWh lithium LifePO 48-100A batteries
- Solar maximum tracker (MPPT) charge controllers
- Control electronic-interconnecting wire/cables and module mounting structure, at
- a hight of 20 meters above the ground
- 19m/20m high mast pole split in sections, with 2m stubby to be buried in the ground
- in a cemented foundation. 17m/18m mast above the ground.

The solar LED high mast shall be designed in accordance with following requirements: -

- Design life of solar high mast be in excess of 5 to 10 years
- LED Luminaire rating of IP66.
- Die casted durable lamp housing shall be robustly constructed, weatherproof, hail proof, corrosion proof and vandal resistant. It shall be grey in colour.
- Luminaire shall have an operating temperature of -20°C to 55°C. The diffuser lens must be manufactured with polymethyl methacrylate (PMMA). The lamp shall consist of a LED board arrangement with a warranty. Must submit an IEC 60598-1 or IEC 60598-2-3 certification.
- The IP66 ingress protection rating shall ensure that all components are protected against the ingress of dust and moisture, which leads to corrosion and premature

failure. All screws, bolts and metal parts shall be stainless steel and anti-corrosion treated material.

- LED flood light must have a minimum of 22000 lumens (provide supporting lighting simulation results).
- 400W high efficiency mono crystalline silicon solar PV panel with IEC / TUV certification.
- Lithium LifePO battery (48V 100A) with charge-discharge cycles between 3000-6000 with 10 to 15 design life cycle.
- Luminaire shall have a maximum power point tracker (MPPT) controller with a 96% charging efficiency.
- Luminaire weight 6kg per luminaire.
- Luminaire correlated colour temperature (CCT) shall be 5000K with a CRI of >70.
- Luminaire shall be supplied with a galvanized mounting bracket.
- IEC or TUV certification shall be provided for solar panels, lithium battery, and for solar controller.

PSW 2. PHOTOMETRIC REQUIREMENTS

Attach detailed calculations to confirm photometric results, to the tender document. Submit the photometric data based on measurements undertaken by an internationally certified lighting laboratory. The photometric report shall contain:

- Absolute candela values, at an ambient temperature of 24.5°C and humidity of 65.7%
- Description and photograph of the luminaire under test.
- Supply voltage and LED currents during testing.

Calculations shall be based on the following criteria:

- LED lumen depreciation of 80%
- Maintenance factor of 0.9 (allowing for a 10% light loss due to dirt on the protector surface).

PSW 3. SOLAR CONTROLLER UNIT

The solar controller unit shall have ff.

- Charging temperature at daytime shall be between 0°C to 60°C When temperatures goes below 0°C, the control system will automatically stop to protect the battery.

- When temperatures go higher than 0°C, Discharging temperature at night is between -20°C to 60°C.

PSW 4. WARRANTY

- The bidder shall provide a warranty that the goods supplied under the contract are new, unused, of the most recent or current models and incorporate all recent improvements in design and materials. The bidder shall warrant that all goods supplied under this contract shall have no defect, arising from design, materials, or workmanship or from any act or omission of the supplier, that may develop under normal use of the supplied goods under prevailing site conditions.

- The bidder shall warrant that each luminaire supplied under the contract shall have a maximum lumen depreciation of not more than 10% of the original lumen output of the luminaire during the period of warranty.

- The warranty shall remain valid for fifty-four (54) months after the goods or any portion thereof as the case may be, have been delivered.

- The Contractor shall promptly notify the service provider in writing of any claims arising under this warranty.

- Upon receipt of such notice, the service provider shall, within the specified period and with all reasonable speed, repair or replace the defective goods or parts thereof, without costs to JW.

- If the service provider, having been notified, fails to remedy the defect(s) within the specified period, JW may proceed to take such remedial action as may be necessary, at the service provider's risk and expense and without prejudice to any other rights which JW may have against the service provider under the contract.

    - 6x 150W – 132000lm minimum requirements

    - 9x 150W –

PSW 5. SOLAR HIGH MAST POLE SPECIFICATIONS

The solar high mast pole shall be supplied in four sections with flanges at the end of each section to bolt together, to construct a single high mast design.

The total length of 19m/20m – 17m/18m

- 2m mounting stubby with dimensions of 273mm diameter
- 6m 273mm
- 6m 219mm
- 5m 177mm

PSW 5. CONSTRUCTION

- Poles shall be of tubular design with a minimum diameter at the base of 275mm (outer diameter) and constructed in four sections by means of flanges welded to the base of each section.

- The steel used in manufacture of poles shall comply with SABS spec 1431 Grade 355WA with minimum yield strength of 355MPa. Bidder to provide test and analysis certificates. No steel sections shall be less than 3mm wall thickness.

- All welding shall be carried out by coded welders only. Proof that all welders have been tested shall be provided on request.

- Bidder to advise about supply of K-Clamp

PSW 6. DIMENSIONS

- Pole dimensions 127/101/76mm – poles shall be tubular design.

- The poles shall be 19m long with a 2m stubby suitable for planting in the ground, giving a mounting height of 17m.

- The poles shall at the upper end have a diameter of 177mm at the smallest point at the top of the mast.

- Access opening complete with cover, not smaller than 230 x 90 to be provided 2000mm above ground level. To be secured by two 5-sided stainless steel hot dip galvanized allen screws and galvanised mounting / gland plate.

- Earthing.

- The high mast shall be provided with earthing straps and rod which shall be fastened to mast as a safety measure.

PSW 7. CORROSION PROTECTION

All parts of the pole and its associated parts shall be hot dip galvanized to SANS 121 ISO 1461 specifications. Contractor to provide an inspection certificate upon request from JW.

No welding, drilling, punching, bending or removal of burrs shall be carried out after

galvanizing.

PSW 8. SCOPE OF WORK

The scope of work shall include design, manufacture, supply, install and commission of solar LED high mast lighting system including five years comprehensive warranty maintenance in various clusters within JW.

PSW 9. COMPLETE SOLAR HIGH MAST

A complete solar high mast should comprise of the following:

- 9 X 80W LED high illumination luminaires with battery packs and solar panel.
- Minimum 57AH 12,8V Lithium battery packs built into the LED luminaires
- The luminaire shall have an 18V 100W high efficiency mono crystalline silicon solar panel.
- A minimum 20m high (above ground) steel pole capable of mounting all of the above-mentioned LED luminaires, batteries and can withstand the load.
- The successful service provider will be required to assess the identified project sites and provide a layout for the solar high masts.

PSW 10. SOLAR RECHARGEABLE BATTERY

The solar rechargeable battery shall have the following features:

- The battery should be at least 57AH at 12,8VDC lithium LifePO battery packs.
- Battery service Life shall be more than 2000 times, under normal conditions.
- Operate in temperatures of between -30°C and 60°C.
- Have a charged maintenance ability according to IEC standards.
- Be capable of rapid charging in 1 to 6 hours.
- Battery enclosure shall be secured by means of steel tamper-proof allen/hex bolts to minimize theft and vandalism.

PSW 11. SOLAR RECHARGEABLE BATTERY

The solar LED high mast luminaire shall have the following specifications and parameters:

- Photocell
- 10° to 45° tilt angle
- Power output – 150W
- Voltage 48VDC
- Voltage fluctuation – 10% of rated voltage
- IP rating of IP66
- Minimum luminous flux of 22000Lm
- Colour temperature of 5000K
- Mounting height of 17m / 18m
- Working temperatures -30°C to +60°C
- Lighting time of 7 days a week, 12 hours a day/nights
- High efficiency LED > 130 lumens/Watt (bidder to provide proof or evidence)
- Colour rendering index (CRI) of 70/80
- Working lifetime of 50000 hours at 80% lumen maint. (Bidder to provide proof or evidence confirming statistical correlation).
- Warranty period of 5 years

Submit a report for LEDs used in the luminaire, which shall include ff.:

- Measured LED junction temperature for a given test condition and extrapolated for an ambient temperature of 35°C.

- LED drive current.

- LED manufacturer data that clearly correlates LED junction temperature and LED drive current to lumen maintenance.

- Attach proof confirming that failure of one LED will not cause additional LED's to fail.

- Battery enclosure shall be secured by means of steel tamper-proof allen/hex bolts to minimize theft and vandalism.

- Controller must incorporate a temperature sensor which shall reduce the current to protect the LEDs at higher than rated ambient temperatures. The temperature sensor is not to switch off the LEDs at high temperatures.

PSW 12. MOUNTING POLE

The high mast pole to be designed in accordance to SANS 10225 under the ff. criteria and working loads:-

- Terrain category 3
- Design wind speed 40m/s
- Altitude 0m
- Horizontal and vertical deflections shall not exceed the requirements of SANS 10225.

The high mast pole shall be a galvanized steel pole with ff. minimum requirements

- At least 17m above ground level
- Strength of 500KN – withstand total weight of up to 5,000kg.
- Working load of 144km/h cross winds.
- Mechanical winch to hoist up the luminaires up and to lower them to a working
- height that is reachable for maintenance purposes.
- Brackets to be mounted underneath top mounted battery enclosure to support the 150W LED luminaires

PSW 13. BASE

The base shall consist of the following:

- 2600x2600x2000 steel foundation for concrete base.
- The high mast foundations shall be designed and constructed in accordance with SANS 10100 (Pt 1 & Pt 2) to withstand the forces imposed by the mast. The soil conditions and the soil bearing capacity shall be determined by a set of DCP tests for each individual mast. The results of these tests shall be recorded and placed in the project file for each high mast installation.
- The concrete cover of the reinforcing bars shall be not less than 50mm in all cases. The contractor shall provide evidence of the actual concrete cover achieved for the base and the plinth. The concrete shall have a design compressive strength of not less than 25 MPa after 28 days. The concrete strength of the base and the plinth shall be measured after 28 days by the Schmidt Hammer Test method for each foundation. The test results shall be recorded in the high mast project file.
- The plinth shall be designed to have a projection of not less than 300mm above nominal ground level after backfill compaction has been completed.

PSW 14. LIGHTNING CONDUCTOR

Each high mast shall be fitted with a lightning conductor spike at the top point of the luminaire. This spike shall be connected to the highmast earthing system. The steel high mast may be used as the earth path provided that a 70mm^2 flexible copper cable is installed at hinge point to ensure that electrical currents do not pass through the hinge joint. The high mast shall be connected to the earthing system by means of a 16mm diameter stud welded to the inside of the mast.

PSW 15. GEO TECHNICAL SURVEY

The contractor shall be responsible for determining the soil conditions for each high mast location. This information shall be to the satisfaction and approval of the JW to ensure design confidence.

PSW 16. PROCEDURES REGARDS EXISTING SERVICES AND EXCAVATIONS

- The contractor shall be required to take special care to locate existing services that would be affected by the installation of the high mast. The contractor will be responsible for the repair and reinstatement to any services damaged by them or any of their sub-contractors.

- In the event of damage occurring to any existing services, the contractor shall immediately notify JW and the owner of the service.

- All repairs to these services shall be to the satisfaction of the JWand the owner of the service.

- Penalties including consequential damage shall be levied at the sole discretion of JW for damage to existing services caused under the following circumstances.

- Damage due to unauthorized excavation

- Damage due to unauthorized blasting activities.

PSW 17. DESIGN FREEZE

Upon review and acceptance of drawing and calculations by JW the design of each highmast shall be fixed. No modifications, revisions, or changes shall be made to the design and drawings, after this date, without prior written application to JW. The application shall include full technical and commercial motivation for the changes.

PSW 18. THEFT AND VANDALISM

Battery Enclosure and Solar Panels shall be secured by means of steel tamper-proof allen/hex bolts to minimize theft and vandalism.

PSW 19. NORMATIVE REFERENCES

The following table contains provisions that, through reference in the text, constitute requirements of the specifications. At the time of publication, the editions indicated were valid.

All standards and specifications are subject to revision, and parties to agreements based on this specification are encouraged to investigate the possibility of applying the most recent editions of the documents listed below.

SANS / NRS STANDARDS STANDARD DESCRIPTION

NRS 025 Photo Electric Control Units for Lighting (PECU)
ARP 035 Guidelines for the Installation and Maintenance of Street

Lighting
SANS 121 Hot dip galvanized coatings on fabricated iron and steel articles
SANS 1088 Luminaire entries and spigots
SANS 1200 A General
SANS 1200 C Site clearance
SANS 1200 D Earthworks
SANS 1200 G Concrete structural
SANS 1200 H Structural steelwork
SANS 1200 HC Corrosion protection of structural steelwork
SANS 1431 Weldable structural sheets
SANS 2001 – CS1 Construction works : Structural steel works
SANS 10100 The structural use of concrete (Part 1 and 2)
SANS 10162 The structural use of steel : The limit states design of hot rolled steelwork
SANS 10214 The design, fabrication and inspection of articles for hot dip galvanizing
SANS 10225 The design and construction of lighting masts
SANS 60529 Enclosure for electrical equipment (Classified according to degree of protection that the enclosure provides)
SANS 60598-2-3 Luminaires : Particular requirements for road and street lights luminaires
SANS 62305-3 Protection against lightning

PSW 20. PAYMENT ITEMS

PSW 20.1 Fixed-charge items for

Prepare site, Supply and install Solar High Mast lighting, including all civil, structural, electrical and mechanical installation ..... Unit: Prov Sum

PSW 20.2 Overhead, charges and profit for fixed-charge item PSW 20.1

This item will be calculated as a percentage of PSW 20.1.....Unit: %

TECHNICAL SPECIFICATIONS

TYPICAL TELEMETRY OUTSTATION (UHF RADIO)

GENERAL

Materials and Workmanship

All materials and components used in the manufacture and fabrication of equipment to be supplied shall conform to SABS / ISO standards or original equipment manufacturer specifications and shall be new and of the best quality and class suitable for the purpose specified.

Design and Standardisation

All equipment shall be designed and installed to ensure the maximum possible continuity of service occurs, and to facilitate inspection, testing, maintenance, repair and cleaning. Components shall comprise readily obtainable standard items that are ex-local stock.

Environmental Conditions

The incidence of lightning storms during summer is relevant on the Highveld. Atmospheric temperatures vary from below freezing point to more than 40^{o}C. Humidity can also be high and could cause appreciable condensation within equipment not suitably sealed or protected against these conditions. All equipment shall be adequately enclosed, protected, and capable of operating satisfactorily under these conditions.

Layout of Installation

It is imperative that Johannesburg Water maintains a robust modular RTU system. It must be easy to remove, replace and repair any modular unit without opening-up units. All IO, Radio, Power, surge protection and other sub-components shall be self-contained units which shall be easily removable. It shall be easy to expand IO, surge protection, and communication mediums to the RTU i.e. be modular / components.

The outstation must be built with both 20% spare analogues and termination capacity and be housed in Powder Caoted cabinted such as the Perano 204 for inside and 104 fro outside

All wiring shall be contained within conduit or trunking or within metal enclosed equipment. When two or more parallel rows of terminal blocks are used, the clear space between the blocks shall be at least 120 mm.

Where two or more pieces of electrical equipment, in close proximity, have similar signal or supply conditions, the use of a junction box to group the tail cables shall be made in order that a common multi-core cable may be run to the control room.

Cable entries into outdoor junction boxes shall be bottom entry only.

Cables carrying 230 Vac (power or ON/OFF signals) may only be run on the same cable tray as analogue signal cables if the spacing between the cables is at least 100mm, or if individually and overall screened cables are used.

Low voltage signals and power/audio output signals may not be run in the same cable without the permission of JW ESM management.

LV cables shall be laid 600mm and HV cables 1000mm below general ground level. All cables in soil trenches shall be bedded in river sand or sifted ground (no clay) 75mm below and 75mm over the cables before backfilling of excavations.

Installation of Equipment

Equipment shall be mounted for maximum accessibility and visibility. Workmanship shall be of good quality and all cutting, drilling, welding, etc., shall be neatly done. Each completed installation, including supports, brackets and wiring shall present a clean, compact appearance. All fixing hardware for field mounted equipment shall be finished off free from burrs or jagged edges.

REMOTE TERMINAL UNIT (RTU) AND ASSOCIATED COMPONENTS / FUNCTIONS

RTU shall be an intelligent, modular unit capable of data acquisition, local data processing and control program execution. It shall monitor and control local equipment in a stand-alone mode as well as being an intelligent node in a distributed processing network. It shall be microprocessor based and allow software reconfiguration and optimisation to occur both on-site and remotely via communication channels. The RTU must be fully backward compatible with the current SSE Maestro 14-way (RTU) in order to operate on the same telemetry communication platform and support open protocol DNP3 as well.

Installation

To facilitate installation, maintenance and future expansion, all Input-Output (IO), Relay modules shall connect to the master processor module. The RTU shall be based on the newest RTU technology and shall also have advanced PLC functionality fully compliant to IEC standards.
The RTU system shall be of modular design. The various components such as CPU, IO Modules, Radios, Power Supplies, and so forth shall be individual components designed in such a way that the individual components can be tested individually and replaced individually.

The RTU shall be supplied and equipped with the number and type of IO points, that are fully compatible with the RTU, and as indicated in the Bill of Quantities / Pricing Schedule. Future expansion shall be possible by simply plugging in additional IO modules.

A RTU design with CPU, IO Modules, radios, surge protection and so forth all integrated in one unit shall NOT be acceptable. The RTU system shall be of a modular design.

RTU Communication mediums

Various communication ports shall be required at various sites. Both to communicate with local IED and backhaul communication to SCADA and peer-to-peer between devices. Refer to the BoQ / Pricing Schedule for the number of Ports required for this project.

Surge Protection

The RTU IOs need to interface with the existing surge protection units as manufactured previously by SSE in order to ensure standardization of the systems within Johannesburg Water occurs. If other suppliers surge protection products are to be used, then the need to be able to be exchangeable and compatible with the surge protection as used on other existing JW outstations in the system. Surge protection inside the telemetry cabinet is an eight channel unit and at the end point at the instrument a 2 channel unit. The earth Protection units must be grounded with earth spikes and have to be connected with bare copper earth wire

Labelling

All marking and labelling standards of Johannesburg Water shall be maintained. The tenderer may, on request, visit another site to view the layout and labelling standard.

Tag Readers / Biometrics

Integrated in the existing telemetry system are Tag / Biometric readers that is used by JW's Engineers, Technicians, and others authorised users to identify themselves when working at the site. This reader must be compatible with and interface with the existing SCADA system for the operators to identify who is on site in the telemetry control room in real-time.

Change of Events

It is important that the system data gathering from the master shall not be primarily based on a round robin polling method, but primarily on Change of State (Eventing) basis. The remote station RTU shall have the ability to report change of state (event) of user configurable IOs. Thus, the remote RTU shall only initiate communication when a data change event occurred which shall be reported to the master station or peer-to-peer to other sites in the system. These event settings shall be user configurable using the Configuration Toolbox at the master station and be downloadable from the master or any other remote site. All events shall be remotely time stamped at the RTU when it occurred within 10 millisecond accuracy.

All Digital inputs dead times shall be individually configurable. Thus, the Engineer/Technicians shall be able to set re-action times on each input which shall trigger an event when such changes occur.

All Analogues input shall also be individually configurable. The sample timings, number of samples, and sampling triggers shall be configurable and downloadable to the remote station from the master station.

Remote Time Stamping

It is important that the remote RTU system supports remote time stamping of events as close as possible to the source of the event. Thus, the RTU Controller shall be equipped with a real-time clock and remotely time stamp all events, change of states and values. All events shall be time stamped within 2 milliseconds accuracy. These events shall then report the new value with the remote time stamp to the master SCADA station.

COMMUNICATION BACKBONE (DIGITAL RADIO)

The present GE based MDS digital radio platform is used on the existing telemetry outstations. To ensure backwards compatibility to existing communication networks, if new communication

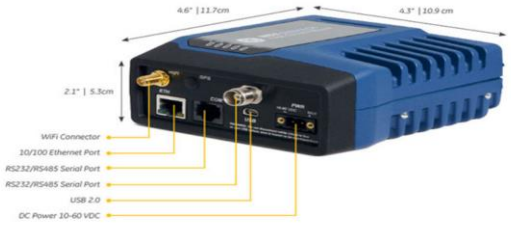
equipment is to be offered then it shall be equal or similar to the GE- MDS Orbit Communication System Range.

All radio equipment to be used for the Telemetry System shall be fully ICASA approved. If an alternate to this brand is to be offered, then the tenderer needs to clearly demonstrate their solution in their proposal, and if required present a formal presentation to JW.

General UHF Radio Characteristics

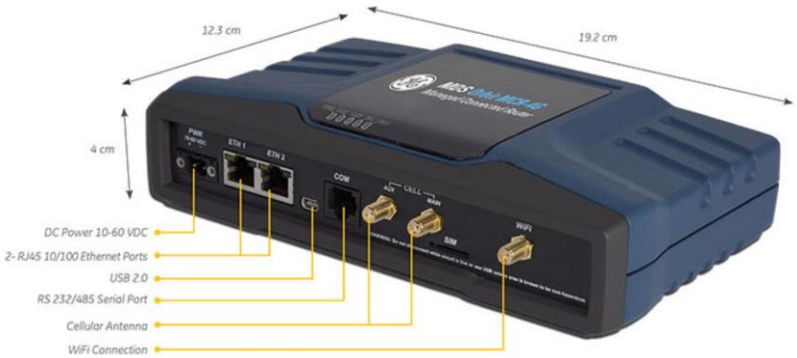
- The device shall operate in the 450-520 MHz narrowband spectrum.
- The device shall support software-enabled frequency selection.
- The device shall support QPSK, 16QAM and 64QAM modulations.
- The device shall support channel sizes of 6.25 KHz, 12.5 KHz and 25 KHz.
- The device shall support Half Duplex/Simplex modes.
- The device shall support CPFSK Digital A-modem for backward-compatible mode connectivity to existing GE MDS SD Series radios.
- The Radio shall operate at over the air data rates from 9600 to 66 KB.sec.
- The radio shall be able to operate in Transparent Mode (Serial Streaming) to natively transport serial data. The radio shall be able to operate in the Packet-with-MAC mode to transport IP data.
- Small Sites - ECR
-

MDS Orbit ECR – An Exterior View



- Base Stations/ High Sites / Repeater sites – MCR

TYPICAL TELEMETRY OUTSTATION (UHF RADIO)



Note: Only radio carrier equipment which is approved by the Independent Communications Authority of South Africa (ICASA) for use in the Republic of South Africa in terms of Radio Act, Act 3 of 1952, shall be offered. The contractor shall, on request, provide JW with a copy of the relevant certificate of approval. (Type approval certificate).

Outstation UHF Antennas

Antennas shall comply with the following:

- The outstation shall be equipped with type Webb HD400 heavy duty dipoles (omni directional unity gain antennas), or similar as approved by Johannesburg Water.
- Where higher gain or directionality is required, a 3 element or 7 element Yagi antenna or type Webb Y425/3 or WEB Y425/7 shall be used, or similar as approved by the System Development Manager (also referred to as the Engineer).
- If high a gain antenna is required, such would be indicated in the Price Schedules.
- Antenna earthing will be a " crow feet configuration " with earth spics 2 meters apart.

Outstation Antenna Masts

- Where outside masts are required, antenna masts shall be similar and equivalent to a Webb ACP 50 / 3 / 5 and fitted to the side of the building with the necessary offset brackets and mounting hardware. These masts shall be earthed / surge protected.. It shall be attempted to mount antennas on the inside of the buildings as far as possible and in such a case, antennas shall be mounted on offset brackets on the inside of the pump station, or other available building.

- The antennas shall be supplied complete with mounting arms, clamps and support. All mounting materials shall be heavy duty galvanized steel or stainless steel or aluminium.

Smart Data Loggers

Johannesburg Water (JW) requires a range of Compact Robust Battery-Powered Data Loggers that are remotely downloadable and programmable (Smart) for primary use of logging: flow, level, pressure readings, in various combinations, on selected sites. The Contractor / Service Provider / Supplier may source the various remote (smart) data logger units and or transmitters (when required) from one or multiple manufacturers as long as the original equipment manufacturer (OEM) and or Agent of the products proposed are within South Africa.

NOTE: The Brand Name and Model / Part number of each product priced for shall be indicated next to the item when quoting and the relevant Datasheets or Operating Manuals included with the RFQ submission. This is to allow JW Technical Team the opportunity to evaluate the products offered to ensure they meet these Technical Specifications below.

Functionality of Remote (Smart) Data Logger

The Data Loggers shall be compatible with the following inputs in various Channel Combinations:

- Electronic or Mechanical **Pulse** sources with intelligent sensing window to eliminate relay bounce errors.
- **Analogue** input (pressure, level, flow) must be 4-20mA, isolated, 24V loop powered, with a sleep mode function for power conservation.
- **Modbus** Port (pressure, level, flow) must be RS485 (2-wire).

Data logger Channel Combinations required by JW:

- **Item 1: 2x Analogue + 1x Digital (Pulse) Remote Data Logger**
- **Item 2: 1x Analogue + 1x MODBUS Port Remote Data Logger**

These remote (smart) data loggers must be microprocessor based to allow reconfiguration and optimisation to occur. The remote data logger must support as a minimum of 4G (LTE) transmission and allow for Bluetooth programming on-site.

Power Supply of Remote (Smart) Data Logger

- The data logger units must by default be battery powered with internally housed batteries that may be replaced by JW personnel without affecting the product warranty. The data logger supplied batteries must provide a minimum of 2-years operation in standard

configuration i.e. 5 (five) minute logging intervals of all channels and 2 (two) data transmissions per day to a dedicated server, be it in the cloud and or on-premises.

- The data loggers shall be supplied (priced) to JW with the battery pack (unit) or batteries required to power the data logger unit included.
- Additional battery pack (unit) / batteries necessary to replace exhausted batteries of the data logger units later must readily be available for Johannesburg Water to procure themselves in the market and not be unique (proprietary) to the type of logger procured.
- The data logger units must also be able to connect to an external power supply: such as Solar PV or 12V DC with an auto changeover to the internal data logger battery when the external power source is insufficient / not available.

Communication / Protocol Technology of the Remote (Smart) Data Logger

- (UDP/IP) and or MQTT(S) connectivity must be supported, allowing connection to any JW server or SCADA system(s).
- Smart data logger units must support automatic real-time clock synchronization of the device with the cellular network for example.
- The modem used in the Remote (Smart) Data Logger units must be as a **minimum** 4G (LTE).
- The remote data logger units must be able to operate on any of the mobile network operators in South Africa who are registered with ICASA.
- Settings and firmware of the units must be updated remotely using the Product Portal, or locally via an embedded webserver.

Data logging interval

- Must be selectable by the user (JW) from typically 1 (one) minute update rate to 24-hours for the smart data logger units.

Data Transmission Interval and Data Storage

- When powered by battery or externally powered the transmission rate must be selectable from 1 (one) minute to 24-hour intervals and anything in between.
- If externally powered, then online streaming of data measurements must be achievable.
- Every measurement must date and time stamped.
- The data loggers must have a memory capacity of at least 100 000 sets of measurements.
- Johannesburg Water must be able to manage from the devices (remote data loggers) to the SQL servers themselves and that the data, that is downloaded on-premise or on cloud servers, must be owned / accessible / managed by the client, in this case JW.
- Should JW decide to discontinue using the remote (smart) data loggers for any reason, JW must be able to access, including report on, the historical data without the need of licensing with the OEM for the remote data logger, portal firmware and or software.

- Access to the product portal / web-based scada for viewing data, remote setup and firmware upgrades must be factored into the price of each unit for a period of 3-years from the purchase date of the logger.
- All data transmission costs on an ICASA registered 4G (LTE) network must be included for 3-years in the purchase price of each smart data logger with no annual licensing fees (if applicable) during this same period.
- Any new product release notes and or software revisions must be made available to JW throughout the duration of the 3-year period.

Remote (Smart) Data Logger Housing

- Must be a minimum rating of IP67.
- The housing material must be UV stable and corrosion resistant.
- Must have a suitable handle to secure the data logger with a chain and padlock to a cat ladder or valve handle for example.
- Operating environment (minimum ranges): -10°C to 60°C. RH less than 85% non-condensing.

Remote (Smart) Data Logger Reporting

- Must be able to integrate seamlessly with a web-based SCADA and designated employees / users must be able to receive automatic (scheduled) emailed reports of flow, pressure, level or other parameters; daily flow totals; water balances etc.

INSTRUMENTATION / EQUIPMENT SPECIFICATION

Instrumentation

- Johannesburg Water makes use of a wide variety of instrumentation which are to connect to the telemetry, The list below is not exhaustive and only provided as guidance to what may be coupled at the outstation:
  - H2O (Hydrostatic) Pressure Transducer for Level
    - Pressure range 350 mbar to 2.5 barG (3.57mWG to 25mWG)
    - Proof pressure 2 x Full scale (FS)
    - Burst pressure 3 X FS
    - Current Output 4-20mA (2 wire)
    - Supply voltage 10-30Vd.c. (Sensitivity: 0.1%FS/Volt)
    - Max loop resistance (Vs-10) x 50 Ohm
  - Conductivity Probe / Capacitive Sensor for Overflow detection
    - Supply Level Conductivity Probe with Stainless Steel electrodes. Output NO/NC potential free (IP 67 rated) contact

- Radar Leave sensors
    - Model: dBR8 and dBR16
    - Dimensions: Nominal 90mm diam x 130mm height (3.54in x 5.11in)
    - Weight: Nominal 1.1kg (2.4lbs)
    - Measurement range: dBR8: 8m (26ft); dBR16: 16m (52.5ft)
    - Frequency: V-band
    - Beam angle: 8º
    - Sensor body material: Valox 357U
    - Cable lengths: Standard: 5m, 10m, 20m or 30m (16.4ft, 32.8ft, 65.6ft or 98.4ft). Optional: up to 150m (492ft) in
    - 10m (32.8ft) increments
    - Maximum separation: 500m (1640ft)
    - Mounting connection: 1" BSP

- Level Switches
    - See conductivity probes
- Electronic Magnetic Flow meters
    - Where there is an inflow from Rand Water the billing meters will be EMF flow meters
- Ultrasonic Flow meters
    - Where there is an outflow to the system , then flow meters Ultrasonic Flow meters or Insertion probe meters can be used

- The exact installation positions for the instrumentations required will need to be determined off the drawings and also verified on site. The tenderer will engage with the Engineering Specialist Technicians (ESTs) of JW or the JW Systems Development Manager to ensure the quantity, types and parameters / technical specifications of the instruments or equipment to be procured are of the same accuracy and reliability of the existing instruments or better.

Warranty

The tenderer will be required to provide a back-to-back warranty to that of the supplier (OEM / Agent) for these instruments or equipment procured in this method. However, Instruments sourced through the contract must hold at least a twelve (12) month warranty.

OUTSTATION EARTHING & CABLING SPECIFICATION

Outstation Earthing

- All outstations shall be earthed in accordance with the Standard Specification. Mast down conductors shall be 25 x 1.6mm galvanised steel.
- An earth bar with at least 5 connections will installed inside the telemetry hut and all earth wires will be connected to the earth bar including instrumentation , antenna, telemetry .
- An additional 10mm^2 copper cable shall be installed between Telemetry box and instrumentation junction boxes.

Outstation Cabling

- RF cabling shall be RG214 or similar. All cabling shall be neatly run inside the masts and be supported with UV stable cable ties.
- All I/O wiring at the outstation shall be done with screened twisted pair wiring of 0,5mm^2 minimum, conductor area. Single core wiring shall not be used. All wiring to be neatly routed in plastic slotted ducting with snap on covers. All wiring shall be marked and numbered to correspond with the information on as-built drawings, to be prepared as part of this Contract.
- Tenderers shall allow for a 5m length of ducting, in their price calculations.
- It can be assumed that the existing I/O status outputs shall be made available on a marked terminal strip, within 5m of the telemetry outstation position. Wiring between these terminals and the outstation terminals, shall form part of this contract.
- All instrumentation cable shall be 12 Core multi strain 0.5mm oval screened with extra neutral wire. Lugs / Ferrules on all cables and all cables shall be clearly marked as per drawing. All surface conduits, fittings and bends shall be at least 20mm galvanized.

Trenching

- All trenches shall be at least 400mm deep, with a minimum of two off 50mm sleeving.
- A bare copper cable will be installed outside the sleeving with earth spikes on both ends
- Not more than 3 cables per sleeve is permitted.
- Instrumentation cable and power cable higher than 24V are not allowed in the same sleeve.
- All sleeves must have at least one draw wire per sleeve.

- Every 20-25 metres there shall be a cable inspection box
- Only soft sand on cable, no rocks in trenches.
- Cable indicators on cable.

Cable Numbering and Marking

- The Contractor shall produce a cable schedule from which all cable identification numbers shall be derived.
- Cables shall be labelled with the cable number at the origin and destination points and at entries/exists to racking/ducting/penetrations, by means of a label, approved by the Systems Development Manager, suitably attached to the cable.
- The cable marking label shall be finished with a “fit-for-purpose “plastic sleeve, approved by the Systems Development Manager, suitably attached to the cable

Field Boxes Numbering and Marking

- The Contractor shall produce a “junction box / panel schedule” from where all field-mounted box identification numbers shall be derived.
- Field boxes shall be identified by means of an engraved label.
- Environmental suitable label holders shall be used such that labels can be removed without damage to the box.
- Attachment of label holders shall not degrade the IP rating of the box
- The box identification plate shall specify, where applicable, the following:
  - Panel Number
  - Equipment / Panel Service
  - Network / Control Systems Unique Identification

Cable Core Marking

- A wire marking systems shall be used to identify all cables cores at both ends in accordance with the wiring diagrams

Screening and Earthing

- Sensors cable screen conductors, used for grounding unwanted signal noise, shall be terminated to an isolated signal earth bar (instrument earth) located in the PLC /

Control / MCC Panel or Remote IO Panels. An isolated earth bar is an earth bar that is isolated from the safety earth and connected to generation origin earth.

- Individual and overall screen wires of all sensors cables shall be terminated at the equipment room side only and shall be left disconnected (floating) and insulated at the instrument in the field.
- All single pair cable screen conductors shall be insulated and tied back at the sensor.
- Analogue single pair cable screen conductors shall be connected to individual terminals in a junction box.
- Overall analogue cable screen conductors and digital cable screen shall be insulated and tied back inside the junction box.
- Under no circumstances shall the screen conductors be utilised for any other purposes than for noise immunity.
- The safety earth (or electrical earth) shall be utilised for the safety earthling of all metal automation equipment and supports.

Field Mounted Boxes

- All C&I panel's degree of protection shall be suitable for environmental conditions of installation according to IEC 529 and EN 60529 (1991). Control / PLC / MCC panels shall be epoxy coated mild steel or other material as dictated by the installation environmental conditions and specifications.
- Door handle shall be suitable for padlocking.
- The box shall be numbered.
- All digital signal wiring shall be SABS Approved stranded, minimum 0.75mm, 200V grade PVC insulated conductors.
- All power wiring, including neutral wiring shall be SABS approved stranded, minimum 1mm, 600v grade PVC insulated copper conductors.
- All data wiring shall be SABS approved stranded, minimum 0.22mm, tinned copper cores, twisted pair, screened cable.
- All analogue signal wiring shall be SABS approved stranded, minimum 0.75mm, 200V grade PVC insulated tinned copper cores, twisted pair, screened cable.
- DC Power shall be fused on the positive leg by appropriate fuse.
- AC Power shall be circuit breaker protected on Live and Neutral legs
- All Conductor Terminal blocks/rails shall be clearly identified

- Notwithstanding the above, the cross-sectional area of all wiring cores shall be calculated to “fit-for purpose”.
- All wires shall be supported in PVC trunking to hold all conductors running horizontally and vertically, Trunking shall be sized so that it is at no stage more than 80% full.
- Where wires travel from fixed to moveable locations, for example from a chassis to a hinged door, the wires shall be bunched together and harnessed by PVC spiral wrapping or braided polyamide sleeving. Harnesses shall be secured on the fixed and moveable section.
- Conductors shall be connected by means of single terminal connector blocks only.
- Double / Triple stack terminal connector build-form shall not be used.
- No ferruled, taped or similar joints shall be made in connecting any conductors.
- Cable and wire marking systems shall be used to identify all cable cores at both ends in accordance with the wiring diagrams. The markers shall be white with black. The markers shall fit securely, without sliding, over the cable core insulation.
- Where cable cores pass through metal holes, suitable non-flammable grommets shall be provided.
- Only crimped connector/lungs shall be used. Soldered lugs shall not be accepted. Crimping tools shall be of a type approved by the connector/lug manufacturer.
- DIN rail mounted components shall be used wherever possible.
- All components shall be so fixed that they may be removed and replace without the aid of special tools. Only fasteners with metric threads shall be used.
- Lightweight components shall be mounted on the chassis plate by means of holes directly drilled and tapped into the chassis. Galvanised or cadmium plated steel screws shall be used.
- Heavyweight components shall be mounted on the chassis plait or cubicle framework either by means of studs welded direct to the chassis or frame, or by means of suitable self-gripping hand bushes with cadmium plated nuts and washers.
- Care shall be taken to ensure that instruments and components are rigidly supported and not susceptible to shock or vibration

Cables and Cable Cores

- All cables shall comply with the relevant SANS specification for the cable application.
- Outer insulation material of cables for in confined spaces shall be fire retardant, non-toxic and Halogen free.

- All cables shall be tested prior to delivery to site. The tests shall establish that the cables dielectric is sound, that all cores are continuous from end to end, and it complies with the cables schedule details and manufacture specifications.
- The cross-sectional area of all cables cores shall be calculated to be “fit for purpose”.
- Unused or spare cables cores shall be strapped together with cable straps should they not be connected to spare terminals.
- The length of spares cores shall exceed the length of the longest used core.
- Consistency in the use of core colours and/or numbers shall be maintained throughout the installation to avoid confusion.
- Colour and/or number coding of cores shall be shown on the relevant drawings.
- Cores passing through holes in chassis or screens shall be fully protected by fitted grommets or bushes.
- Cores carried across a hinged portion of a chassis or door shall be flexible. Sufficient slack shall be provided to obviate tension.
- The insulation of a core shall not be stripped back further than or less than necessary. The conductor shall not be exposed with a crimped insulated terminal lug fitted.
- Not more than one core shall be connected to one side of a connection terminal block.
- Core terminations shall be fitted with interlocking engraved (black letters on white background) plastic cable ferrules, reference numbered to correspond with the related schematic or wiring diagrams. Split or clip-on ferrules or adhesive marking tapes are not acceptable. The marking for horizontal runs shall be from left to right when facing them, and for vertical runs from the bottom upwards.
- The wiring inside panels and junction boxes shall be well planned and neatly arranged in the best possible manner, allowing for forming of cores so that there is no strain on them

Signal Cable Installation

- Cables shall be installed neatly, either saddled or strapped to the panel or supporting steelwork. Where there is not possible or practical, the cable loom shall be strapped together using proprietary type plastic cable available for this purpose. Cotton insulation or thread shall not be used.
- Cables shall be secured and connected at terminations to prevent undue mechanical stresses upon glands, conductors or terminals.

- Signal and communication cables shall be segregated and separated from power cables on separate racking, parallel routes shall be separated by a minimum distance of at least 300mm, space permitting and if physically possible.
- Cables shall not be installed double banked on racks.
- Armoured cables shall be secured to racks or angle-iron supports by 10mm wide stainless-steel strapping and purpose-made buckles.
- Unarmoured cables shall be secured to racks or supports by fit for purpose PVC or nylon.
- The span of strapping shall be such as to prevent bunching of cables, and in any event, should not exceed 1000mm
- Cables running horizontally on cable racks mounted vertically(edgewise)shall be secured to cables racks at 60mm intervals, which shall be reduced as necessary to prevent unsightly sagging of cables.
- Cables laid flat in racks parallel with a slightly inclined ground or floor surfaces need not be secured to the racks more often than is necessary to prevent cables from moving because of expansion, contraction or vibration.
- Any horizontal or vertical cable run that are not strapped or supported in such a way that the cable cannot fall in the event of fire shall be strapped by 10mm wide stainless-steel strapping and purposes-made buckles at 1 metre intervals.
- Holes for cables passing through panel steelwork shall be made smooth or bushed to prevent severing of the cable and fitted with appropriate grommets.
- Joints in cable are prohibited unless the route lengths exceed the maximum lengths the manufacturer can supply. In this eventually, approved proprietary types of junction boxes shall be used. Joints shall only be used the approval from the Employer.
- When stripping insulation from cores, the conductors shall not be nicked or cut.
- All conductors shall be terminated in an insulated double crimped termination lug of the correct size using a crimping tool approved by the manufacturer of the terminal.
- Bare conductor terminations shall not be accepted.
- Pin lugs shall be used for connections using terminal strips and spade lugs when terminating under a screw head.
- Holes into air-conditioned rooms shall be completely sealed off to maintain the air conditioning system performance.

- Cables screens at the unearthed end of the cable are to be tied back and covered with heat shrink sleeve. Cable screens shall not be cut off at the cable sheath.
- Cables shall enter an enclosure from the bottom and shall be formed to relieve stress on the cable end, with a sealing boot fitted over the cable gland.
- Cables to instruments shall be terminated in a locally mounted approved IP65 connection box with a short length of flexible cable with a single 150mm diameter loop strapped to a suitably supported angle iron.
- The connection box can be multiple-way units to accommodate more than one loop, provided the loops are associated. A terminal strip shall be fitted inside the box for core connections
- Sealing boots shall cover the cable glands fitted to connection boxes.
-

SCADA

- Define Tags (I/O)
- Create I/O in OPC and SCADA
- Create Programs in OPC
- Graphic Forms a per JHB Specifications
- Faceplates
- Generator Graphic Forms and interface
- Logging to SQL
- Trending
- Alarming
- ASI- reports
- Data Warehousing\
- Detail Mimics
- Region Mimic
- Update Script programs
- Detail Maps
- Overview Mimics

I/O List

Housekeeping Digitals

Mains Failed	DIN
Telemetry Hut Door 01 Alarm	DIN
Telemetry Tamper Alarm	DIN
Tower Door Alarm	DIN
Solar Door Alarm	DIN
Solar Tamper	DIN
Intruder Alarm Enable/Disabled	DIN
Passive Detector	DIN

Housekeeping Analogs

Battery Voltage 12V	AIN
Battery Voltage 24V	AIN
Solar Voltage 240 V	AIN

Reservoir

Digitals

Reservoir Overflow	DIN

Counters

Reservoir Inflow Counter	CIN
Reservoir Outflow Counter	CIN

Analogs

Reservoir Level 01 Submersible	AIN
Reservoir Level 01 Radar	AIN
Reservoir Level 01 Data Logger	AIN
Reservoir Level 01 Inflow R1-In-01	AIN
Reservoir Level 01 Outflow R1-Out-01	AIN

Tower

Digitals

Tower Overflow	DIN

Counters

Tower Inflow Counter	CIN
Tower Outflow Counter	CIN

Analogs

Tower Level 01 Submersible	AIN
Tower Level 01 Radar	AIN
Tower Level 01 Data Logger	AIN
Tower Level 01 Inflow R1-In-01	AIN
Tower Level 01 Outflow R1-Out-01	AIN

Pump Station

Digitals

Pump station Door	DIN
Pump station Flood Alarm	DIN
Pump station Pump 01 Run (Hard Wired)	DIN
Pump station Pump 01 Trip (Hard Wired)	DIN
Pump station Pump 01 Auto/ Man (Hard Wired)	DIN

Pump station Pump 01 Emergency Stop (Hard Wired)	DIN
Pump station Pump 02 Run (Hard Wired)	DIN
Pump station Pump 02 Trip (Hard Wired)	DIN
Pump station Pump 02 Auto/ Man (Hard Wired)	DIN
Pump station Pump 2 Emergency Stop (Hard Wired)	DIN

Analogs

Pump station Suction Pressure	AIN
Pump station Delivery Pressure	AIN

Note : The above exclude all modbus signals from the PLC and the VSD . A list to be send with available signals to chose from and what EMD would like to see

Generator Interface

- **Deepsea**
    - **Dse 8610 / 7320**

Synchronising & Load Sharing Control Module

- **Digitals**

Fail to start 9 (Hard Wired)	DIN
Trip (Hard Wired)	DIN
Emergency Stop (Hard Wired)	DIN
Fuel Low (Hard Wired)	DIN

Note : The above exclude all modbus signals from the Interface board . A list to be send with available signals to chose from and what EMD would like to see for example:

TECHNICAL SPECIFICATIONS

TYPICAL TELEMETRY OUTSTATION (UHF RADIO)

BOQ Telemetry Outstation

TELEMETRY OUTSTATION BASED ON 16 DIN /16 AIN / 16 DOU				
ITEM	**Telemetry Panel**	**QTY**	**Unit Price**	**Total Price**
1.1	DIN rail mounted Power Supply 10A 12 V	1		R0.00
1.2	Maestro 2500 CPU12 With ASC1 14 Way	1		R0.00
1.3	Maestro 8-Multi I/O Module 14 Way	1		R0.00
1.4	RS 232 Multiplexer 8 Channel	1		R0.00
1.5	ICP Con 485 Convertor	2		R0.00
1.6	8 Channel Differential input without battery monitoring	2		R0.00
1.7	Surge Protection non-isolated 8 channel	1		R0.00
1.8	8-way buffer unit	1		R0.00
1.9	Fused Power Distribution Board	1		R0.00
2.0	12V DC to 24V DC Converter unit 5A	1		R0.00
2.1	220VAC Mains Surge Arrestor	1		R0.00
2.2	220V Circuit Breaker	1		R0.00
2.3	Intruder Switch (MICRO SWITCH LOW TORQUE WIRE LEVER 1C/O 5A)	1		R0.00
2.4	Perano Enclosure 205G – Indoor	1		R0.00
2.5	GE MDS Orbit ECR radio (406-470 MHz)	1		R0.00
2.6	Panel Manufacturing and testing	1		R0.00
	Junction box consists of	**QTY**		**QTY**
2.1	Perano Enclosure 204G – Indoor	1		R0.00
2.2	Panel build up and testing	1		R0.00
	Battery box consists of	**QTY**		**QTY**
3.1	Perano Enclosure 204G – Indoor	1		R0.00
3.2	Lithium Battery 100AH 12V	1		R0.00
3.3	Panel build up and testing	1		R0.00

TECHNICAL SPECIFICATIONS

TYPICAL TELEMETRY OUTSTATION (UHF RADIO)

Access control consists of		**QTY**		**QTY**
4.1	Tag Reader (TRD A3)	1		R0.00
4.2	PIR (Microwave and infrared)	1		R0.00
4.3	Siren 2 Hole Sound Bomb	1		R0.00
4.4	Magnetic door switch	1		R0.00
4.5	Sundries (cable, cable tray)	1		R0.00
	Antenna kit consists of	**QTY**		**QTY**
5.1	Folded Dipole UHF 440MHz HD 440	1		R0.00
5.2	Coax Pigtail RG58, 0.5m, TNC Male to N-Type Male	1		R0.00
5.3	Foam Low Loss - LMR400 (meters)	1		R0.00
5.4	RF Connectors N-Type Male	2		R0.00
5.5	Lipro N Type Surge Bracket Included	1		R0.00
5.6	Wall Mount Bracket - WM45	1		R0.00
5.7	Galvanized mast 50mm x 2mm x 6m	1		R0.00
5.8	Comprehensive Earth Kit (20mx70mm², 10mx10mm², 5x1.2m Spikes, 5 off Earth Clamp & Lugs)	1		R0.00
5.9	Earth Bar 300mm with 5 Holes and brass Bolts and Nuts	1		R0.00
5.1	Sundries (cable, cable tray, rawl bolts)	1		R0.00
	Preliminary & General consists of	**QTY**		**QTY**
6.1	Project Management (hours)	16		R0.00
6.2	Installation Labour (hours)	24		R0.00
6.3	Test & Commission (hours)	8		R0.00
6.4	Travel	500		R0.00
6.5	SCADA and OPC configuration and commissioning (hours)	48		R0.00
6.6	SCADA / Alarm Management configuration a(hours)	48		R0.00
6.7	SCADA and Reporting and commissioning (hours)	48		R0.00
6.8	Drawings and Documentation / Manuals	48		R0.00
			TOTAL	

BOQ PV SOLAR INVERTER WITH BATTERY BANK

Item	Description	Units	QTY	Unit Price	Total Price
1	**Main Solar Distribution Board**				
1.1	3CR12 Powder Coated Distribution Board Including AC & DC DBs	No.	1	R0.00	R -
1.2	Compatible with Sunsynk 5kVA Inverter	No.	1	R0.00	R -

1.3	125A 2P DC Fuse Holder & 125Amp Fuses	No.	1	R0.00	R	-
1.4	Solar panel larger or equal to 450W	No.	8	R0.00	R	-
1.5	Stand for Solar Panel Mounting on top of Reservoir (Anti-theft)	Sum	1	R0.00	R	-
1.6	5kWH C1 Rated Lithium Batteries (Rackmount)	No.	2	R0.00	R	-
2	**Telemetry Hut Distribution Board (230V)**					
2.1	Industrial Type Surface Distribution Board 12-way	No.	1	R0.00	R	-
3	**Bunker**					
3.1	Outdoor Vandal Resistant Steel Enclosure	No.	1	R0.00	R	-
3.2	Complete Chassis	Sum	1	R0.00	R	-
3.3	24v DC Power Supply	No.	1	R0.00	R	-
3.4	DC Surge Arrestor	No.	8	R0.00	R	-
3.5	Signal Surge Arrestors	No.	4	R0.00	R	-
4	**Cables & wires**					
4.1	KBE Solar cable 6mm² red	m	25	R0.00	R	-
4.2	KBE Solar cable 6mm² black	m	25	R0.00	R	-
4.3	10mm² x 3 core Cu PVC SWA Cable (Telemetry Hut)	m	180	R0.00	R	-
4.4	4mm² x 3 core Cu PVC SWA Cable (Guard House)	m	100	R0.00	R	-
4.5	2.5mm² x 3 core Cu PVC SWA PVC cable (Clamp on Flow Meter)	m	50	R0.00	R	-
4.6	1mm² x 1pr Cu PVC SWA Cable (Clamp on Flow Meter)	m	50	R0.00	R	-
4.7	2.5mm² x 3 core Cu PVC SWA PVC cable (Magflow Flow Meter)	m	50	R0.00	R	-
4.8	1mm² x 1pr Cu PVC SWA Cable (Magflow Flow Meter)	m	50	R0.00	R	-
4.9	1mm² x 2pr Cu PVC SWA Cable (Hydrostatic Level Transmitter)	m	120	R0.00	R	-
4.10	1mm² x 2pr Cu PVC SWA Cable (Radar Level Transmitter)	m	120	R0.00	R	-
4.11	1mm² x 16pr Cu PVC SWA Cable	m	155	R0.00	R	-
5	**Cable ends**					
5.1	KBE Solar cable 6mm² red MC4	No.	4	R0.00	R	-
5.2	KBE Solar cable 6mm² black MC4	No.	4	R0.00	R	-
5.3	10mm² x 3 core Cu PVC SWA PVC cable	No.	2	R0.00	R	-
5.4	4mm² x 3 core Cu PVC SWA PVC cable	No.	2	R0.00	R	-
5.5	2.5mm² x 3 core Cu PVC SWA PVC cable	No.	4	R0.00	R	-
5.6	1mm² x 1pr Cu PVC SWA Cable	No.	6	R0.00	R	-
5.7	1mm² x 2pr Cu PVC SWA Cable	No.	12	R0.00	R	-
5.8	1mm² x 16pr Cu PVC SWA Cable	No.	12	R0.00	R	-
6	**Small power & Lighting**					
6.1	22W LED Vapourproof Light Fittings equal and similar to C10 Lascon	No.	2	R0.00	R	-
6.2	34W LED Bulkhead Light Fitting equal and similar to B40-Lascon	No.	7	R0.00	R	-

6.3	USB phone charger	No.	1	R0.00	R	-
6.4	Industrial light switch and enclosure to Johannesburg Water Specification	No.	3	R0.00	R	-
6.5	Light point	No.	10	R0.00	R	-
6.6	Light switch point	No.	3	R0.00	R	-
6.7	Phone charger point	No.	1	R0.00	R	-
6.8	20w LED flood light on reservoir	No.	1	R0.00	R	-
7	**INSTRUMENTATION**					
7.1	Hydrostatic level	No.	1	R0.00	R	-
7.2	Radar level transmitter	No.	1	R0.00	R	-
7.3	Clamp on flow meter	No.	1	R0.00	R	-
7.4	Magflow flow meter meter	No.	1	R0.00	R	-
7.5	Vented radar level sensor support system	No.	1	R0.00	R	-
8	**TELEMETRY**					
8.1	Radio System equal and similar to Johannesburg Water Specification	Sum	1	R0.00	R	-
10	**CABLE SUPPORTS**					
10.1	100mm Galvanised Pipe with Hanger Bolts	m	12	R0.00	R	-
10.2	25mm² gals. conduit	m	32	R0.00	R	-
10.3	25mm² gals. Hospital saddles	No.	32	R0.00	R	-
10.4	25mm² gals. Round Boxes	No.	12	R0.00	R	-
11	**EXCAVATION**					
11.1	Pickable Soil	m^3	80	R0.00	R	-
11.2	Soft Rock	m^3	20	R0.00	R	-
11.3	Hard Rock	m^3	10	R0.00	R	-
11.4	Importation of Soil	m^3	30	R0.00	R	-
11.5	Cable Beneath Tape	m	50	R0.00	R	-
11.6	Cable Route Markers	No.	20	R0.00	R	-
12	**CORE DRILLING**					
12.1	110mm Hole	No.	1	R0.00	R	-
13	**MISCELLANEOUS**					
13.1	CCG Boxes No.0	No.	12	R0.00	R	-
13.2	24V Power Supply Unit	No.	1	R0.00	R	-
13.3	Fuses and Fuse Holder	No.	2	R0.00	R	-
16	P+G's					
16.10	**Fixed**					
16.11	Contractual Obligations	Sum	1	R0.00	R	-
16.12	Manuals	Sum	1	R0.00	R	-
16.20	**Time Related**					
16.21	Contractual Obligations	Sum	1	R0.00	R	-
16.22	Travel	Sum	1	R0.00	R	-
16.23	Company Overhead Costs	Sum	1	R0.00	R	-

TECHNICAL SPECIFICATIONS

TYPICAL TELEMETRY OUTSTATION (UHF RADIO)

16.24	OSHSA	Sum	1	R0.00	R	-
17.0	**Commissioning**	Sum	1	R0.00	R	-
18.0	**Certificate of Compliance**	Sum	1	R0.00	R	-
	Total				**R**	**-**

Solar Hybrid Inverter Specification

Model	SYNK-3.6K-SG03LP1	SYNK-5K-SG03LP1
Battery Input Date		
Battery Type	Lead-acid or Li-Ion	
Battery Voltage Range	48Vd.c (40Vd.c ~ 60Vd.c)	
Max. Charging/Discharging Current	90Ad.c (max.)	120Ad.c (max.)
Charging Curve	3 Stages / Equalization	
External Temperature Sensor	Yes	
Charging Strategy for Li-Ion Battery	Self-adaption to BMS	
PV String Input Data		
Max. DC Input Power	4680W	6500W
PV Input Voltage	370V (125V~500V)	
MPPT Range	150~425V	
Full Load DC Voltage Range	300~425V	
Start-up Voltage	125V	
PV Input Current	13Ad.c + 13Ad.c	
No. of MPPT Trackers	2	
No. of Strings Per MPPT Tracker	1+1	
AC Output Data		
Rated AC Output and UPS Power	3600W	5000W
Max. AC Output Power	3960W	5500W
Peak Power(off grid)	2 times of rated power, 10s	
AC Output Rated Current	16.4/15.7Aa.c	22.7/21.7Aa.c
Max. AC Current	18/17.2Aa.c	25/23.9Aa.c
Max. Continuous AC Passthrough	35A	
Power Factor	0.8 leading to 0.8 lagging	
Output Frequency and Voltage	50/60Hz; 220/230 (single phase)	
Grid Type	Single Phase	
Total Harmonic Distortion (THD)	<3% (of nominal power)	
DC current injection	<0.5% In	
Efficiency		
Max. Efficiency	97.60%	
Euro Efficiency	96.50%	
MPPT Efficiency	>99%	
Protection		
PV Input Lightning Protection	Integrated	
Anti-islanding Protection	Integrated	
PV String Input Reverse Polarity Protection	Integrated	
Insulation Resistor Detection	Integrated	
Residual Current Monitoring Unit	Integrated	
Output Over Current Protection	Integrated	
Output Shorted Protection	Integrated	
Surge Protection	DC Type II / AC Type II	
Over Voltage Category	DC Type II / AC Type III	

Model	SYNK-3.6K-SG03LP1	SYNK-5K-SG03LP1
Certifications and Standards		
Grid Regulation	VDE4105, IEC61727/62116, VDE0126, AS4777.2, CEI 0 21, EN50549-1, G98, G99, C10-11, UNE217002, NBR16149/NBR16150	
EMC/Safety Regulation	IEC/EN 62109-1, IEC/EN 62109-2, IEC/EN 61000-6-1, IEC/EN 61000-6-2, IEC/EN 61000-6-3, IEC/EN 61000-6-4	
General Data		
Operating Temperature Range	-40~60 °C, >45 °C Derating	
Cooling	Smart cooling	
Noise	<30 dB	
Communication with BMS	RS485; CAN	
Weight	20.5kg	
Cabinet size	330W×580H×232D mm (Excluding connectors and brackets)	
Protection Degree	IP65	
Installation Style	Wall-mounted	
Warranty	5 years	

Solar Hybrid Inverter Specification

TECHNICAL SPECIFICATIONS

TYPICAL TELEMETRY OUTSTATION (UHF RADIO)

FEATURES

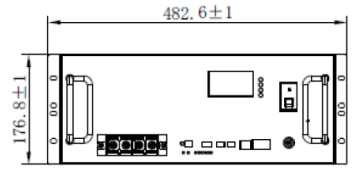
- **Longer Cycle Life -** Offers up to 20 times longer cycle life & 5 times longer calendar life than lead acid batteries, minimizing replacement cost.
- **Superior Safety -** Lithium Iron Phosphate chemistry eliminates explosion risk or combustion due to high impact, overcharging or short circuit situation. First life battery.
- **Higher usable capacity -** Delivers high power, while maintaining cycling of double energy capacity of lead acid battery.
- **Wider Temperature Range -** -20°C ~ 60°C.
- **Lighter Weight -** About 40% of the weight of a comparable lead acid battery. A 'drop in replacement for lead acid batteries.
- **Multi-protocol communication –** Multiple protocols that can be selected via PC with an included RS232 cable.

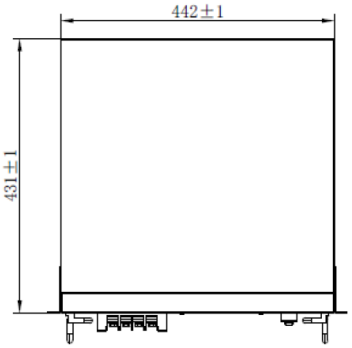
Solar/wind Energy Storage

Caravan power

Power tools

Backup power for UPS systems

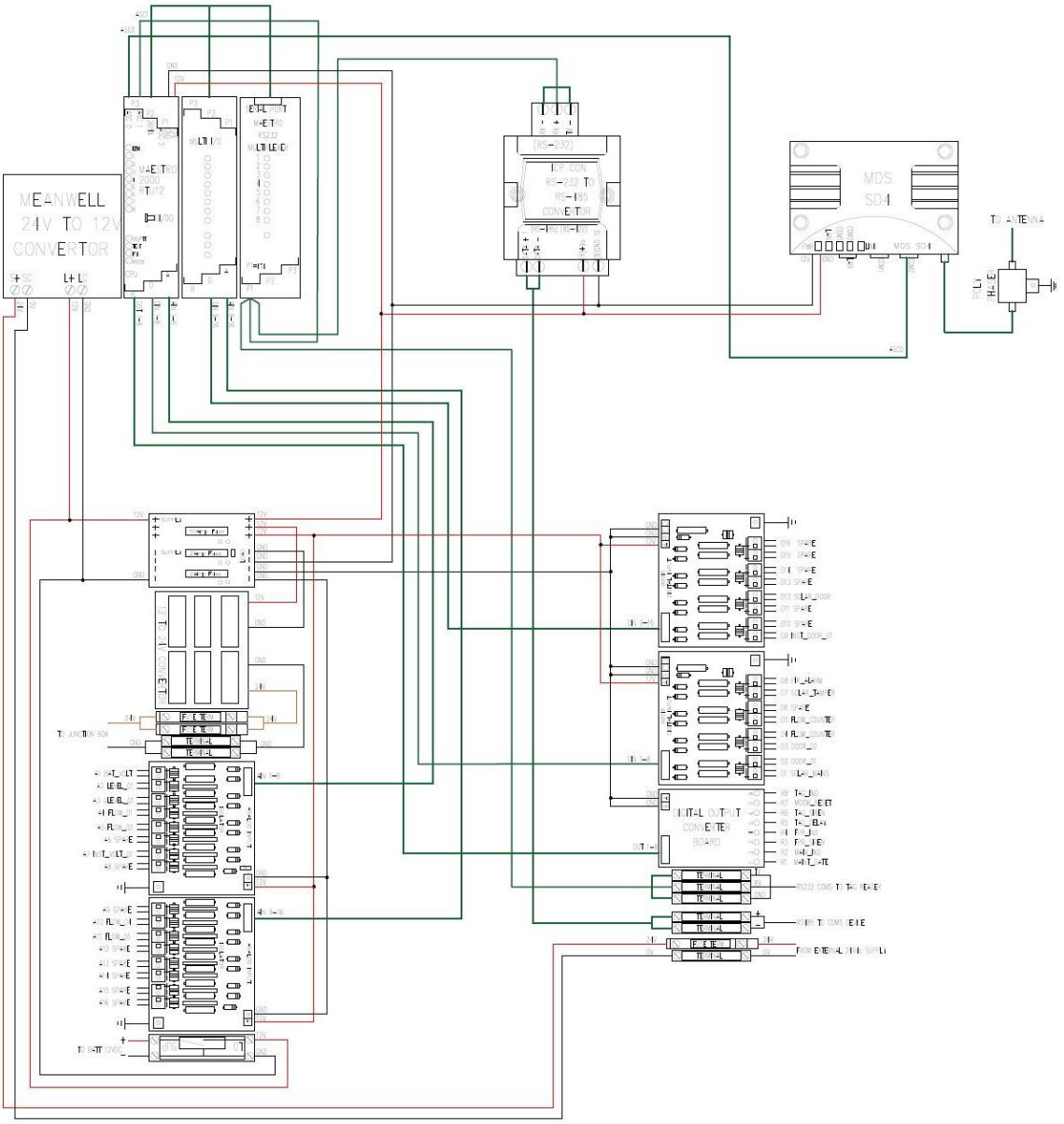




Model:	LFeLi 48100S2
Nominal voltage:	51.2V
Nominal Capacity:	100Ah
Energy:	5120Wh
Voltage range:	48~55V (limit: 45~57.6V)
Internal resistance:	<50mΩ
Cycle life:	>3500 cycles @ 100% DOD 25 °C
Self discharge per month:	<3%
Charge voltage:	57V (±0.6V)
Charge current:	Recommended 20~50A
Max Discharge current:	100A Continuous (120-130A Pulse) [1C]
Communication:	CAN or R485 (+RS232 to USB)
Temperature Range:	-20~60 °C

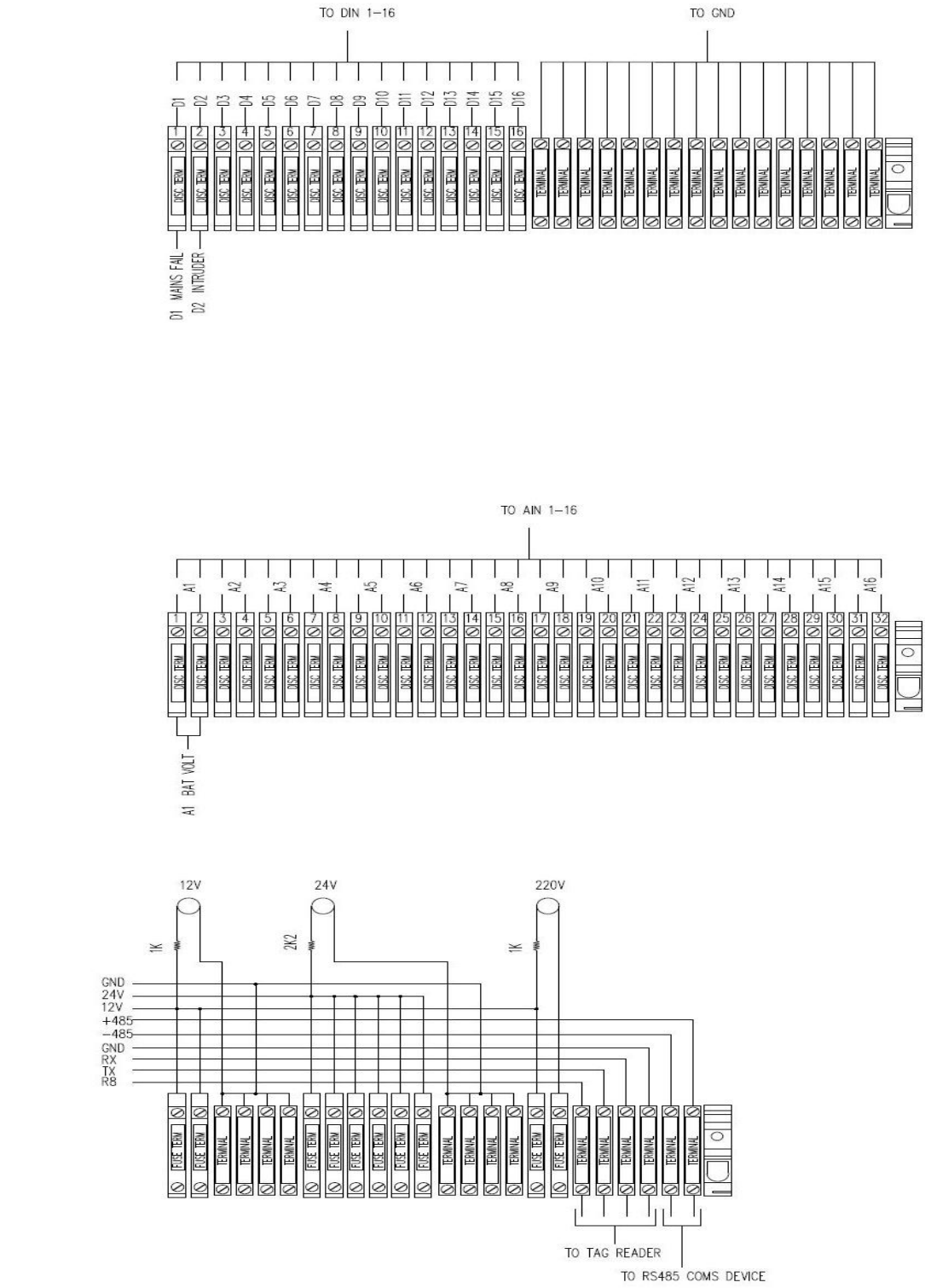
Drawings

Telemetry Cabinet Wiring Diagram



Telemetry Cabinet Wiring Diagram

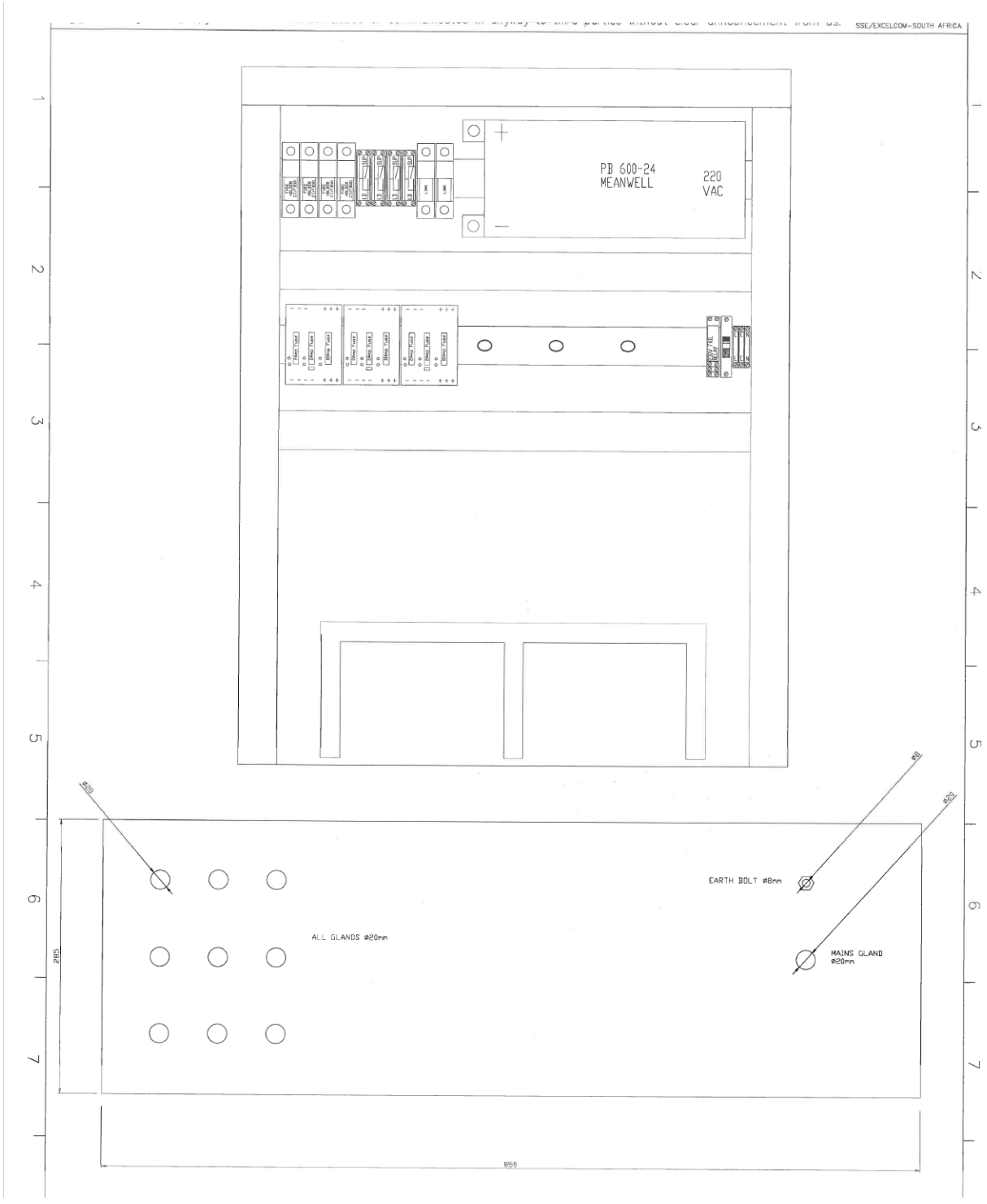
TYPICAL TELEMETRY OUTSTATION (UHF RADIO)



Battey Box 24 V

TECHNICAL SPECIFICATIONS

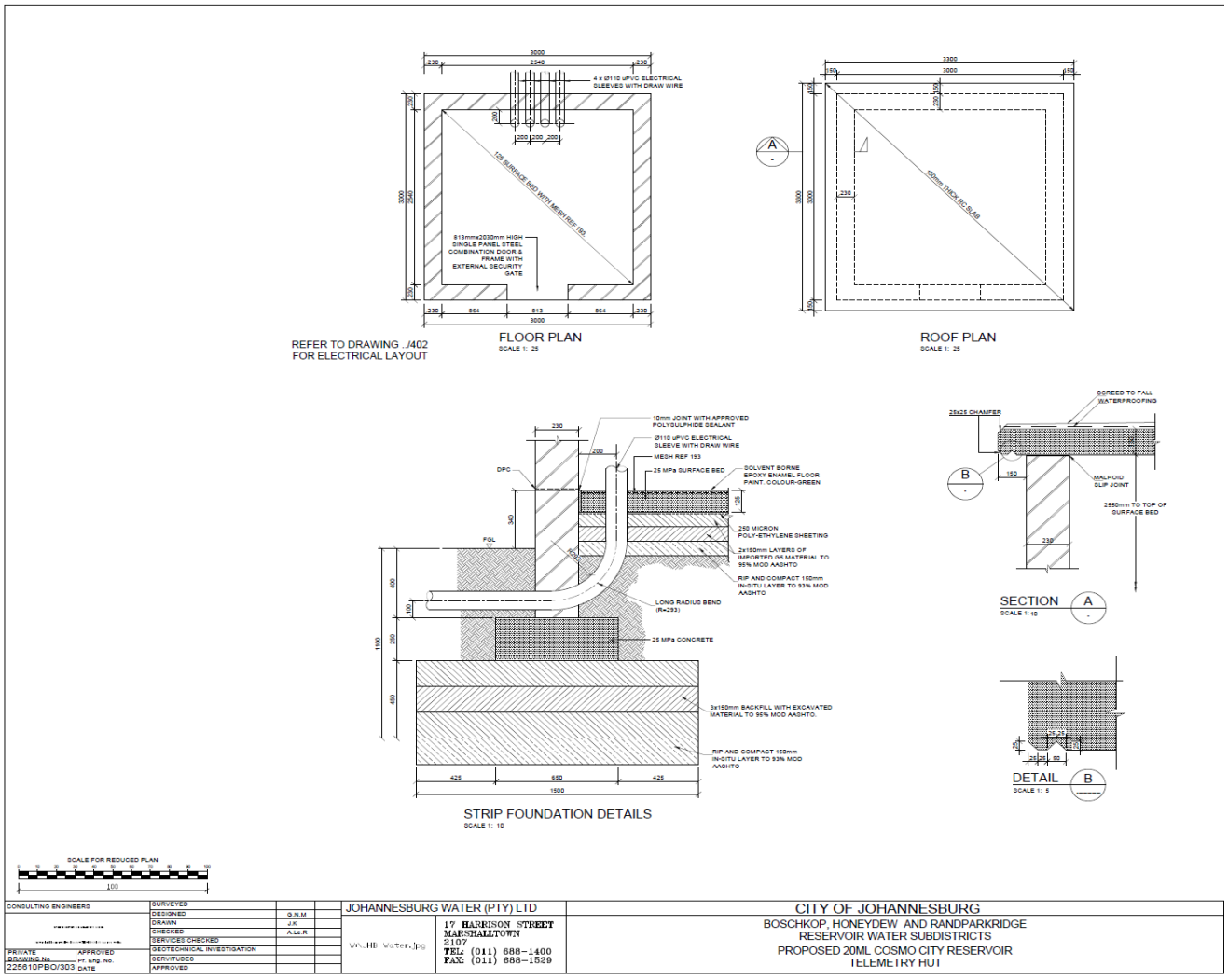
TYPICAL TELEMETRY OUTSTATION (UHF RADIO)



TELEMETRY HUT

TECHNICAL SPECIFICATIONS

TYPICAL TELEMETRY OUTSTATION (UHF RADIO)

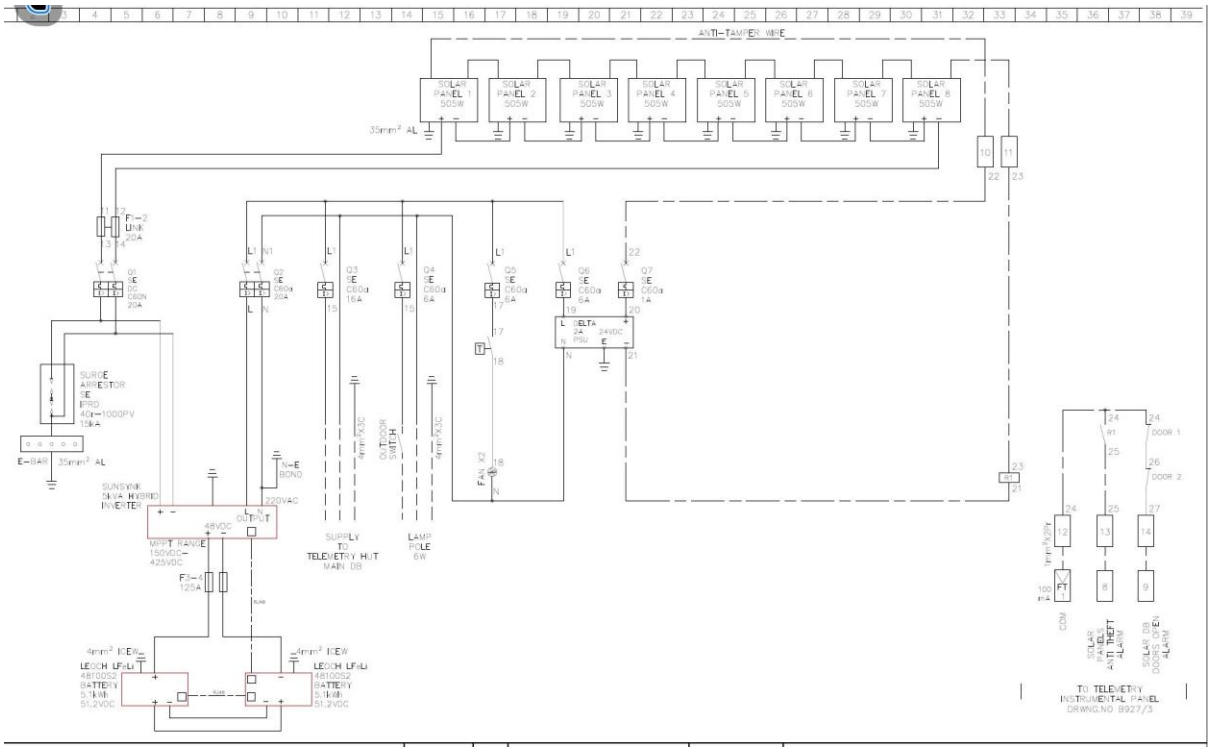


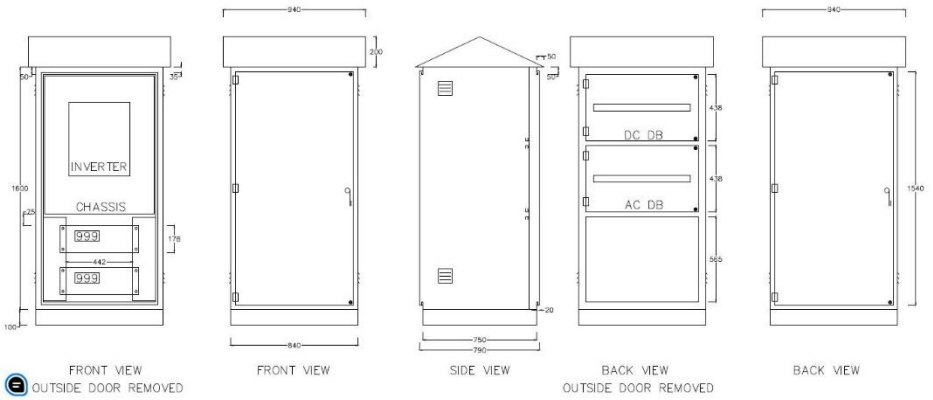
Pictures

SOLAR Drawings

TECHNICAL SPECIFICATIONS

TYPICAL TELEMETRY OUTSTATION (UHF RADIO)





NOTES:

TYPE:
OUTDOOR FLOOR STANDING
MATERIAL:
3CR12
IP54

COLOUR:
GREY

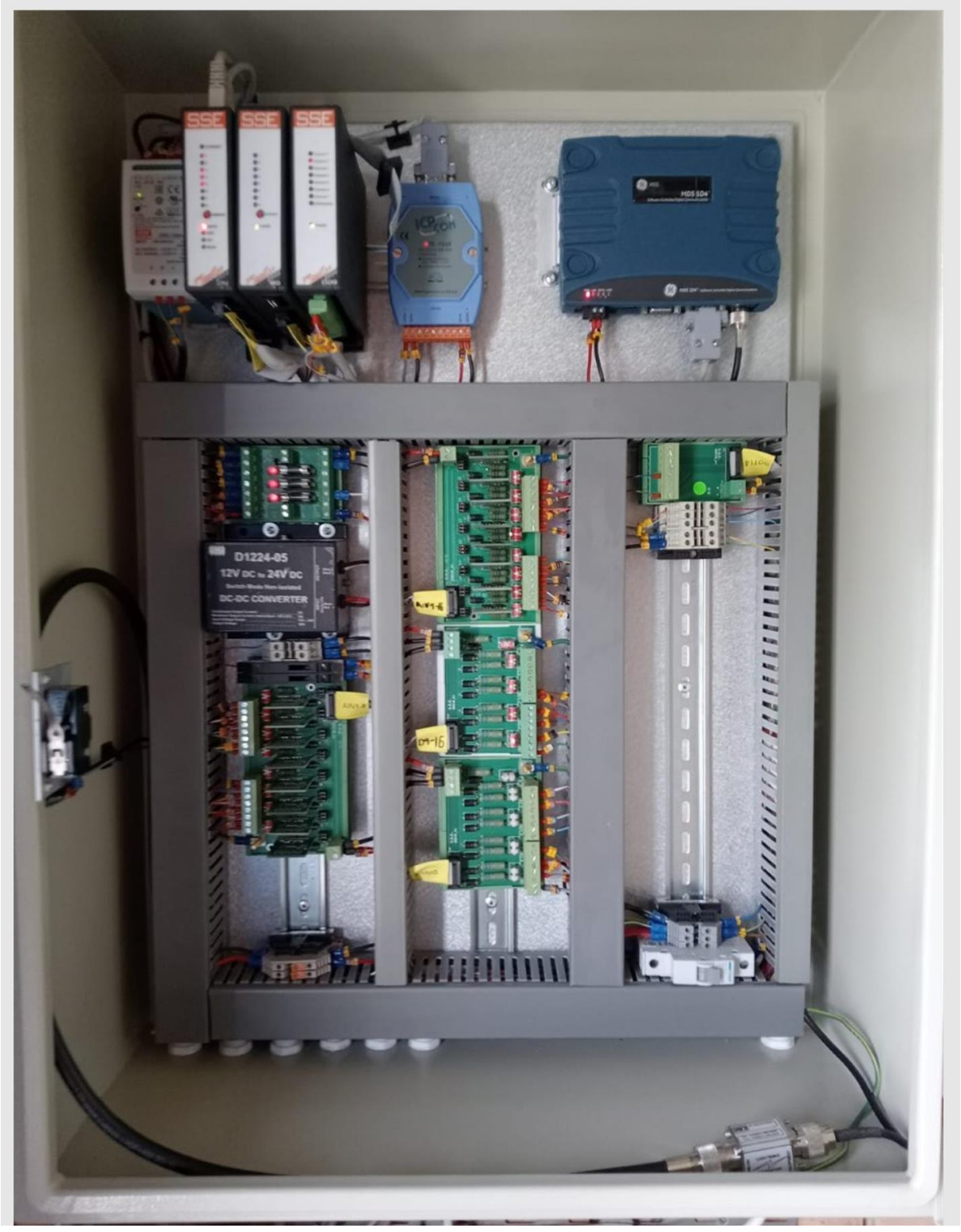
CABLE ENTRY:
BOTTOM

LEGEND

TECHNICAL SPECIFICATIONS

TYPICAL TELEMETRY OUTSTATION (UHF RADIO)

Telemetry Enclosure



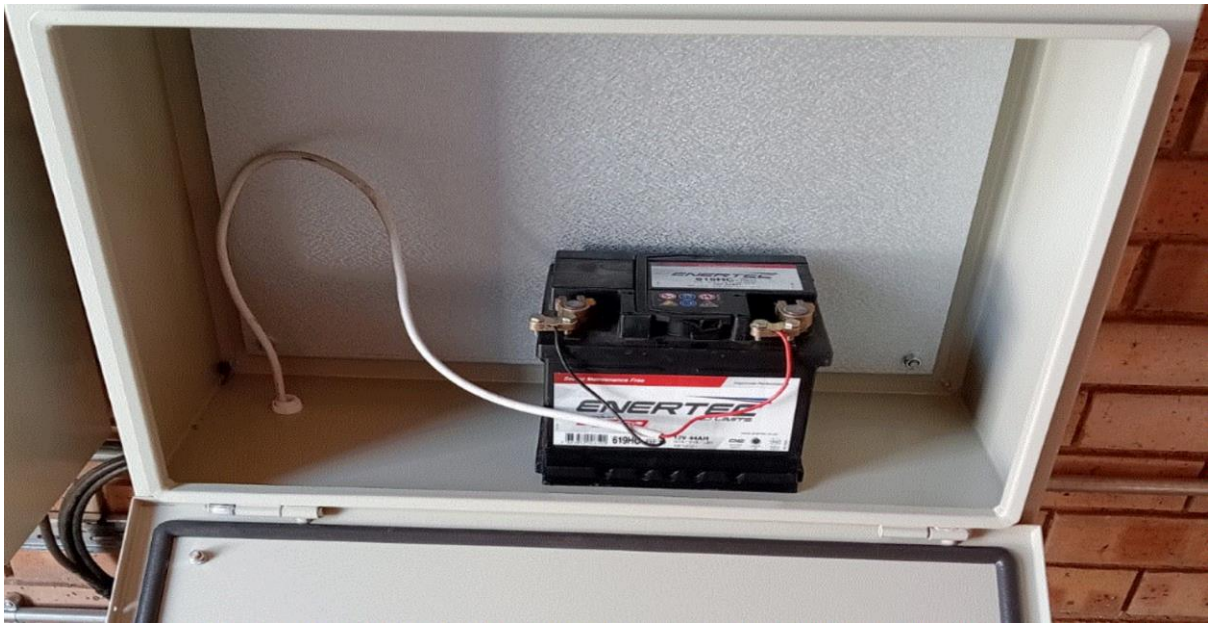
TECHNICAL SPECIFICATIONS

TYPICAL TELEMETRY OUTSTATION (UHF RADIO)

TECHNICAL SPECIFICATIONS

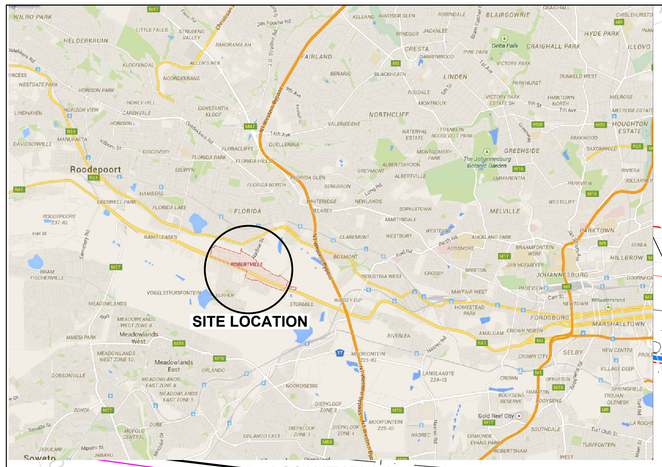
TYPICAL TELEMETRY OUTSTATION (UHF RADIO)

BATTERY BOX



Bar Mark	Bar Type & Diameter (mm)	Cut Length of Bar (mm)	Number of Bars	Total Weight (kg)	Shape code	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)	Radius (mm)
BASE											
1	Y32	14,850	244	23,459	20	14,850					
2	Y25	14,850	152	8,919	20	14,850					
3	R16	5,820	100	942	83	800	1,630	800			
4	Y20	2,725	244	1,682	36	1,000	1,645	1,000			
5	Y25	5,350	186	3,932	38	1,200	4,110				
6	Y20	2,475	96	601	38	1,220	1,215				
7	Y16	6,855	2	20	65	6,855					1,930
8	Y16	7,485	2	24	65	7,485					2,130
9	Y16	8,115	2	26	65	8,115					2,330
10	Y16	8,745	2	28	65	8,745					2,530
11	Y16	9,370	2	30	65	9,370					2,730
12	Y20	10,400	90	2,367	65	10,400					3,050
13	Y20	10,000	90	2,276	65	10,000					2,850
WALL											
14	Y20	6,000	186	2,822	20	6,000					
15	Y16	11,500	186	3,462	20	11,500					
16	Y16	7,330	186	2,207	20	7,330					
17	Y16	10,400	174	2,929	65	10,400					3,050
18	Y16	10,000	174	2,816	65	10,000					2,850
CONE											
19	Y20	2,740	248	1,718	34	2,500	200				
20	Y20	3,550	128	1,149	62	2,500	1,545	1,000			
21	Y20	4300	120	1,305	62	2,500	1,745	1,000			
22	Y20	3550	128	1,149	62	2,500	1,390	1,000			
23	Y20	3260	120	989	62	2,820	2,000	440			
24	Y20	2170	128	702	72	670	750				
25	Y32	9950	4	258	65	9,950					2,650
26	Y32	10600	4	275	65	10,600					2,850
27	Y32	11,200	4	290	65	11,200					3,050
28	Y32	12150	4	315	65	12,150					3,350
29	Y16	3,360	65	353	49	820	820	1800	650	580	
30	Y16	7,440	406	4,894	20	7440					
31	Y16	4,000	287	1,858	20	4000					
32	Y20	4,800	60	728	65	4,800					3,620
33	Y20	5,450	72	992	65	5,450					4,243
34	Y20	6,100	72	1,111	65	6,100					4,866
35	Y20	6,800	72	1,238	65	6,800					5,490
36	Y20	7,450	72	1,357	65	7,450					6,113
37	Y20	8,100	72	1,475	65	8,100					6,737
38	Y20	8,750	72	1,593	65	8,750					7,360
39	Y20	9,400	72	1,712	65	9,400					7,984
40	Y20	10,050	72	1,830	65	10,050					8,607
41	Y20	10,700	72	1,948	65	10,700					9,230
42	Y20	11,250	60	1,707	65	11,250					9,750
OUT TANK WALL											
43	Y12	7150	396	2,578	62	850	600				
44	Y12	7000	405	2,581	62	1,130	792				
45	Y16	2050	405	1,344	62	880	630				
46	Y16	11050	302	5,401	65	11,050	11,050				9,750
47	Y16	10850	302	5,303	65	10,850	10,850				9,575
48	Y10	395	405	65	38	150	175	150			
IN TANK WALL											
49	Y20	2780	60	422	65						1,641
50	Y20	3360	60	510	65						2,135
51	Y20	4130	60	627	65						2,629
52	Y16	12800	61	1,264	62	1214	955				
53	Y16	12450	69	1,390	62	1100	865				
54	Y20	1720	69	300	62	1090	756				
55	Y16	5,360	140	1,215	65						1,450
56	Y16	9,520	140	2,157	65						1,625
57	Y12	4,600	24	101	65						1,700
58	Y12	5,550	24	121	65						2,220
59	Y12	2,040	76	141	74	1,000	100				
ROOF											
60	Y32	10,800	36	2,517	65						9,650
61	Y20	800	304	615	74	240	240				
62	Y12	12,100	81	892	20	12,100					
63	Y12	12,100	81	892	20	12,100					
64	Y16	6,200	48	482	20	6,200					
65	Y16	6,200	36	361	20	6,200					
66	Y16	1,800	40	117	20	1,800					
67	Y16	3,900	45	284	20	3,900					
68	Y16	3,000	48	233	20	3,000					
69	Y16	2,400	56	218	20	2,400					
70	Y16	1,900	48	148	20	1,900					
71	Y16	1,200	28	54	20	1,200					
72	Y16	1,100	40	71	20	1,100					
73	Y16	1,120	28	51	20	1,120					

High Yield Total Weight	**120,951**	**kg**
Mild Steel Total Weight	**942**	**kg**



LOCALITY PLAN
NTS

BENCHMARK COORDINATES - Hartebeesthoek94 (WGS84) Lo27			
Name	Y Lo27	X Lo27	Z
P1	-92 561.640	2 898 621.785	1 715.635
P2	-92 624.024	2 898 643.474	1 714.627
RRBM1	-93 220.879	2 898 889.793	1 704.051
RRBM2	-92 878.442	2 898 762.427	1 709.766
RRBM3	-92 367.490	2 898 488.336	1 717.254

SKAAL OP VERKLEINDE TEKENING
SCALE ON REDUCED DRAWING

100mm OP OORSPRONKLIKE TEKENING
100mm SCALE ON ORIGINAL DRAWING

LEGEND

- BENCHMARKS
- NEW 650mm BULK WATER SUPPLY PIPE
- TOWNSHIP RESERVATION
- POWER LINES
- EXISTING GAS LINE
- NEW WATER PIPES
- ELECTRICAL PYLON
- PROPOSED FENCE
- PROPOSED SEWER CONNECTION
- EXISTING SEWER
- EXISTING ESKOM SERVITUDE

MAIN REEF ROAD

ANVIL ROAD

NADINE STREET

MH11

1/115

NEW PROPOSED 110mmØ SEWER CONNECTION FROM GUARD HOUSE TO EXISTING SEWER NETWORK

EXISTING SEWER

92 300 Y
92 200 Y
92 500 Y
92 400 Y
92 300 Y
-2 898 500 X
-2 898 400 X
-2 898 300 X

76 77 78 79 80 81 82 83 105

1717.000 1717.250 1717.500 1717.750 1718.000

LAYOUT PLAN
1:500

DEPARTMENT DEPARTEMENT	APPROVED GOEDGEKEUR	DESIGNATION AMPSBENAMING	DATE DATUM

CERTIFIED AS BUILT DRAWING
GESERTIFISEER AS SOOS GEBOU TEKENING

FOR NMS CivEc ____ DATE DATUM ____
FOR NMS JOHANNESBURG WATER (PTY) LTD ____ DATE DATUM ____

3/439

CONSULTING ENGINEERS - RAADGEWENDE INGENIEURS

CivEc
Civil Engineering Consultants

MODDERFONTEIN
PHONE (011) 608-1004
FAX (011) 608-1005

PRETORIA
PHONE (012) 998-5463
FAX (112) 998-3619

PRIVATE DRAWING No
PRIVAAT TEKENING Nr
1440a/SE/LAY01RR

APPROVED GOEDGEKEUR
Pr. Eng. No.
Pr. Ing. Nr. 800162
DATE -DATUM

SURVEYED - OPGEMEET		
DESIGNED - ONTWERP	FT	
DRAWN - GETEKEN	FT	
CHECKED - NAGESIEN	HL	
SERVICES CHECKED DIENSLEIDINGS NAGESIEN		
GEOTECHNICAL INVESTIGATION GEOTEGNIESE ONDERSOEK		
SERVITUDES SERWITUTE		
APPROVED GOEDGEKEUR		

JOHANNESBURG WATER (PTY) LTD

Johannesburg Water

TRADUNA HOUSE
58 FREDERICK STREET
MARSHALLTOWN
2107

TEL: (011) 688-1400
FAX: (011) 688-1529

CITY OF JOHANNESBURG

CONSTRUCTION OF A 2.25MI WATER TOWER IN ROBERTVILLE WITH ASSOCIATED PIPE AND PUMP WORKS

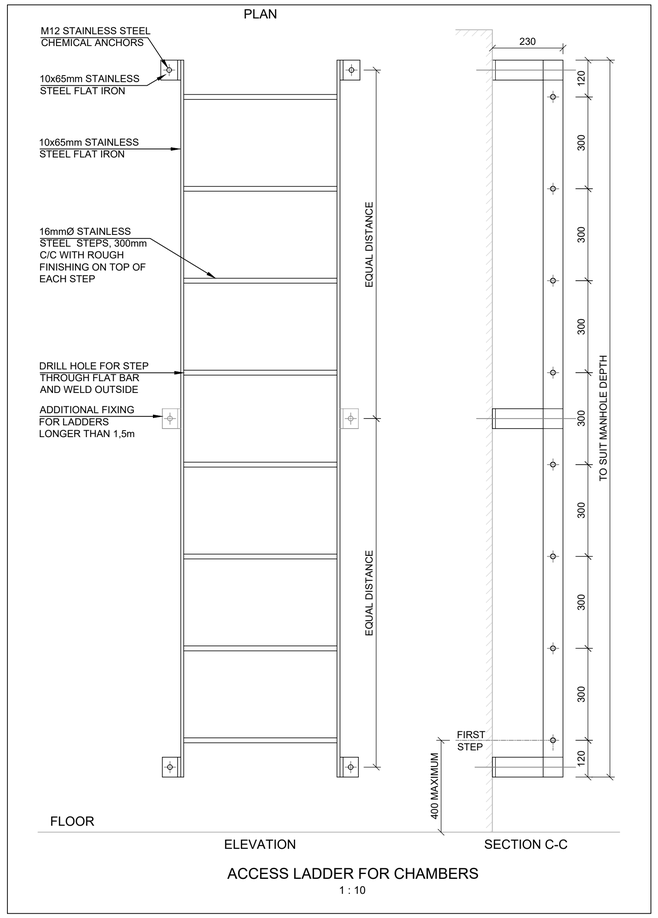
GUARD HOUSE SEWER

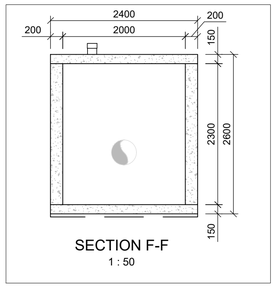
DESIGN MANAGER
BESTUURDER ONTWERP
DATE DATUM

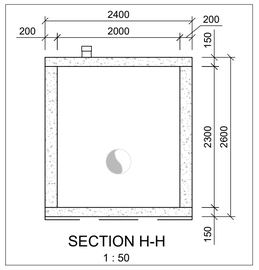
SCALE SKAAL
AS SHOWN

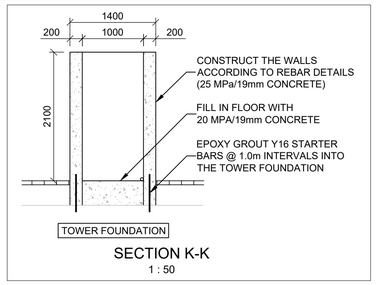
AMENDMENTS - WYSIGINGS	APPROVED GOEDGEKEUR	DATE DATUM

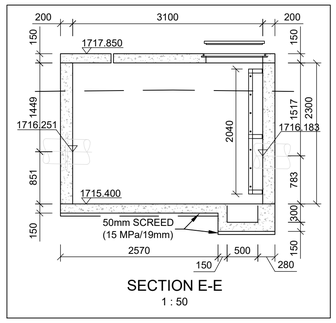
DRAWING No. TEKENING Nr. 1440a/SE/LAY01RR
Revision 1
FILE No LEER Nr

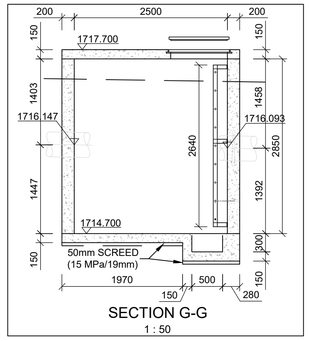


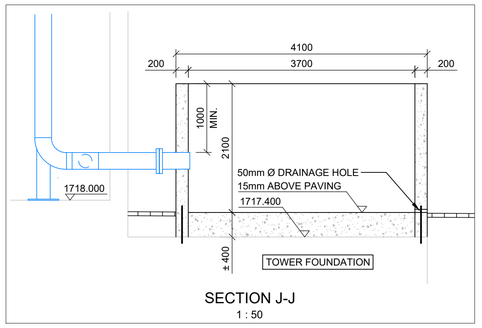


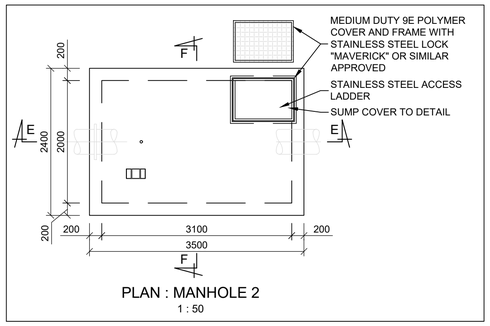


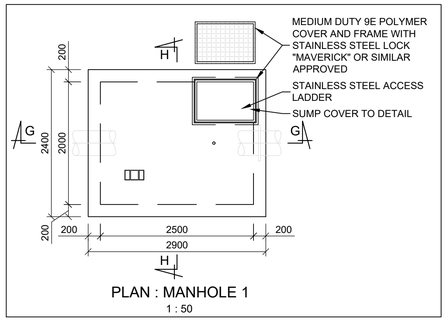


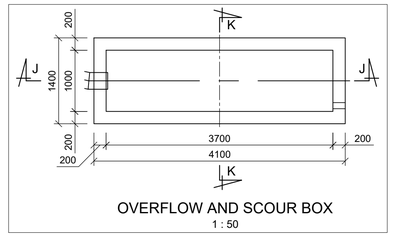






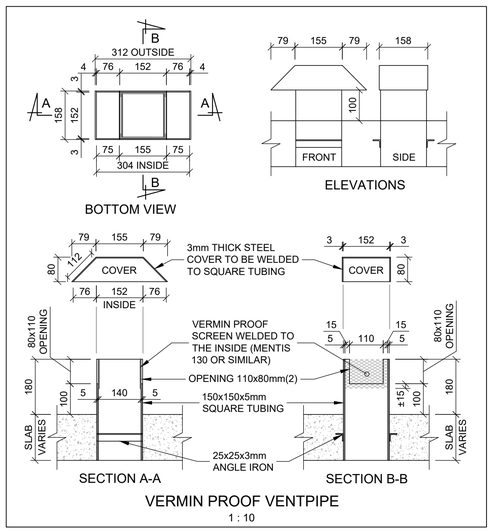


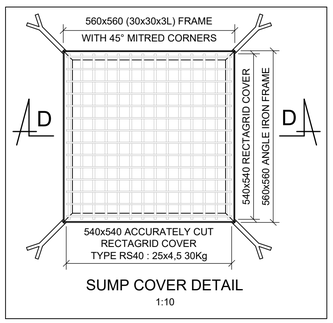


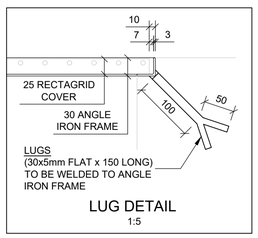


NOTES:

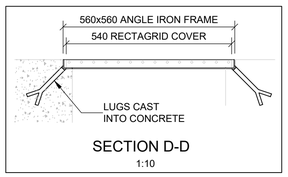
1. ALL REINFORCEMENT TO BE APPROVED BY ENGINEER BEFORE ANY CONCRETE SHALL BE CAST.
2. MIN. CONCRETE COVER 40mm UNLESS SHOWN OTHERWISE.
3. ALL CONCRETE SHALL BE 25 MPa/19mm UNLESS SHOWN OTHERWISE.
4. ALL CAST IN SITU CONCRETE MUST BE CURED FOR AT LEAST 72 HOURS BY COVERING WITH POLYTHENE SHEETING OR BY SPRAYING THE SURFACE WITH WHITE PIGMENTED CURING COMPOUND ACCORDING TO MAASTHO M145 AT A RATE OF 0,3 l/m² WITH A MECHANICAL SPRAYER AFTER SURFACE TEXTURE HAS BEEN APPLIED.
5. ALL STRUCTURAL STEELWORK TO BE PAINTED WITH AN APPROVED COLOUR EPOXY-TAR PAINT TO SABS 801 IN ACCORDANCE WITH SANS 1200 H.
6. ALL STEELWORK TO BE ACCORDING TO BS 4360. ALL WELDING TO BE ACCORDING TO SANS 044.







NOTE:
SUMP COVER AND FRAME TO BE HOT DIPPED GALVANISED



DEPARTMENT DEPARTEMENT	APPROVED GOEDGEKEUR	DESIGNATION AMPSBENAMING	DATE DATUM

CERTIFIED AS BUILT DRAWING
GESERTIFISEER AS SOOS GEBOU TEKENING

FOR NMS CivEc ____ FOR NMS JOHANNESBURG WATER (PTY) LTD ____

DATE DATUM ____ DATE DATUM ____

CONSULTING ENGINEERS - RAADGEWENDE INGENIEURS

CivEc Civil Engineering Consultants

MODDERFONTEIN PHONE (011) 608-1004 FAX (011) 608-1005
PRETORIA PHONE (012) 998-5463 FAX (112) 998-3619

PRIVATE DRAWING No / PRIVAAT TEKENING Nr: 1440a/ST/DET01RR

0 APPROVED GOEDGEKEUR Pr. Eng. No. / Pr. Ing. Nr. 800162 DATE -DATUM

SURVEYED - OPGEMEET		
DESIGNED - ONTWERP	FJH	
DRAWN - GETEKEN	JN	
CHECKED - NAGESIEN	HL	
SERVICES CHECKED		
DIENSLEIDINGS NAGESIEN		
GEOTECHNICAL INVESTIGATION		
GEOTEGNIESE ONDERSOEK		
SERVITUDES		
SERWITUTE		
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GOEDGEKEUR		

JOHANNESBURG WATER (SOC) LTD

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CITY OF JOHANNESBURG

CONSTRUCTION OF A 2.25MI WATER TOWER IN ROBERTVILLE WITH ASSOCIATED PIPE AND PUMP WORKS

MANHOLE DETAILS

DESIGN MANAGER
BESTUURDER ONTWERP
DATE DATUM

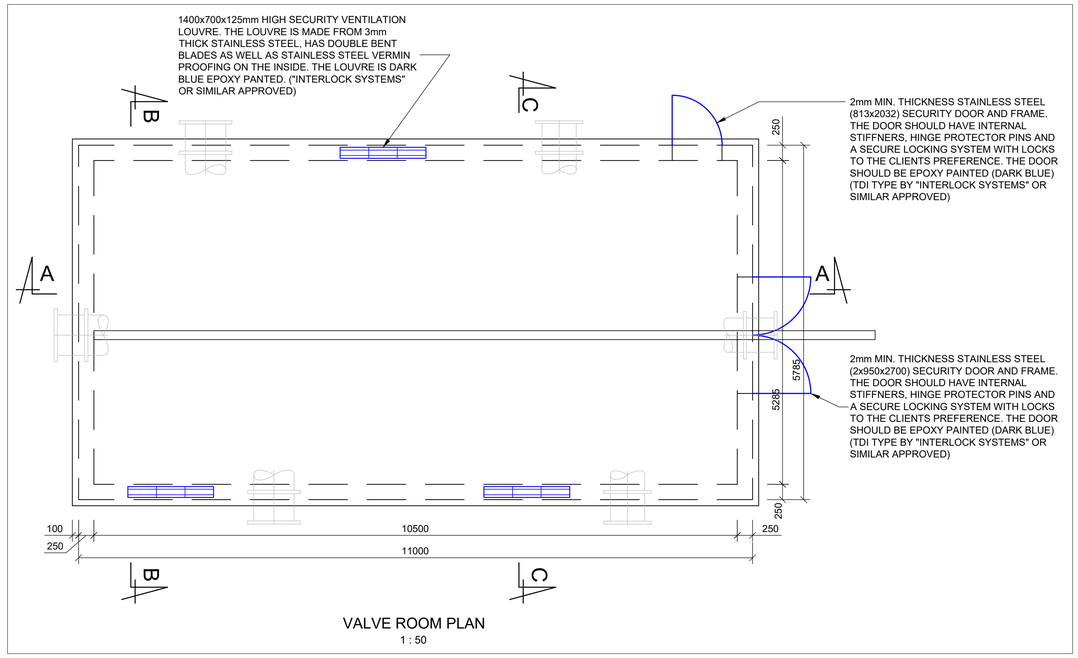
SCALE SKAAL: AS SHOWN

	AMENDMENTS - WYSIGINGS	APPROVED GOEDGEKEUR	DATE DATUM
0	NEW DRAWING	JN	2018-11-29

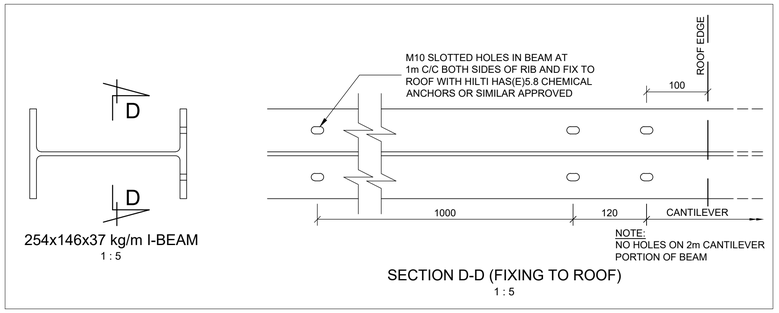
DRAWING No. TEKENING Nr: 1440a/ST/DET01RR

Revision 0

FILE No LEER Nr

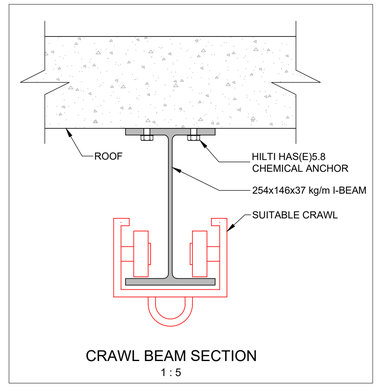


VALVE ROOM PLAN
1 : 50

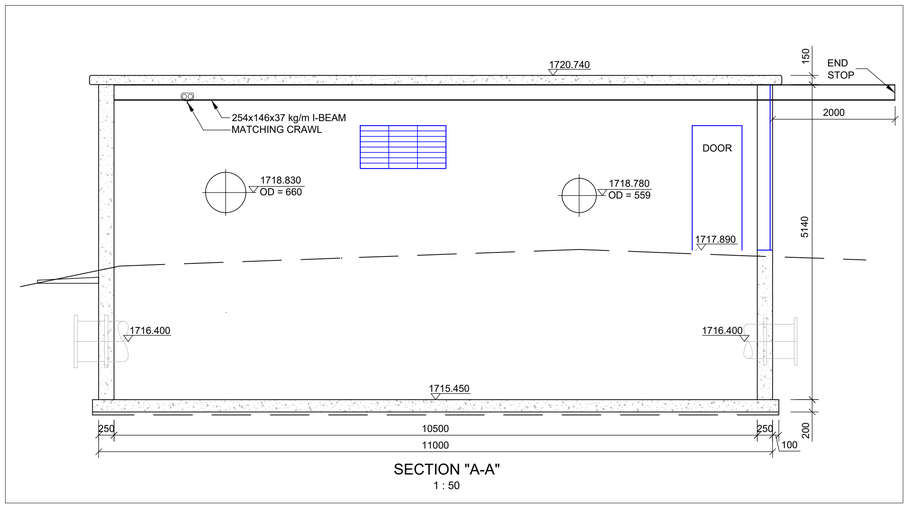


254x146x37 kg/m I-BEAM
1 : 5

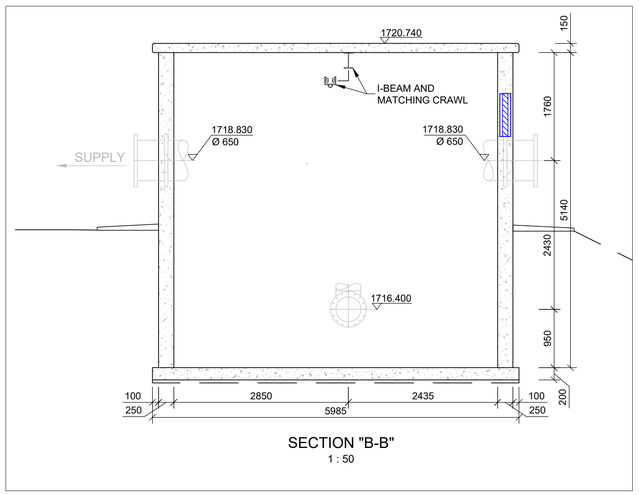
SECTION D-D (FIXING TO ROOF)
1 : 5



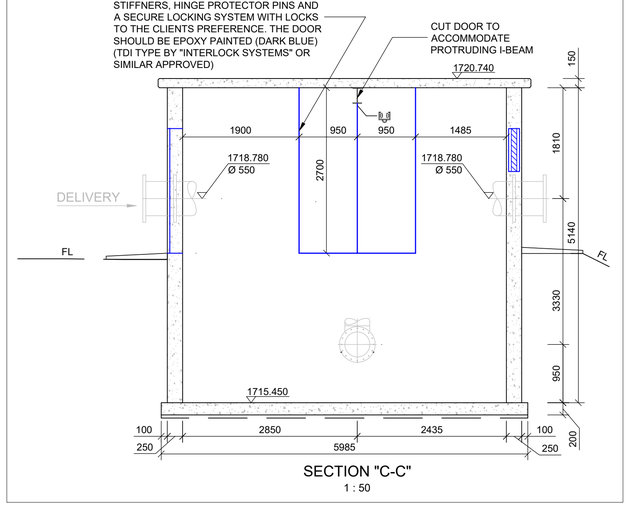
CRAWL BEAM SECTION
1 : 5



SECTION "A-A"
1 : 50



SECTION "B-B"
1 : 50



SECTION "C-C"
1 : 50

NOTES

1. BRICKS ARE TO BE ENGINEERING BRICKS TO SANS 227 OR SIMILAR AND TO BE APPROVED BY THE ENGINEER.
2. BRICKS TO BE WELL WETTED AND BONDED WITH 1 : 3 CEMENT : SAND MORTAR WITH SOLIDLY FILLED JOINTS NOT EXCEEDING 10mm. EXPOSED SURFACES TO BE POINTED AS WORK PROGRESSES.
3. ALL BRICKWORK TO BE ENGLISH BOND AND SEMI-FACE FINISH ON EXPOSED SURFACES.
4. ALL REINFORCEMENT TO BE APPROVED BY ENGINEER BEFORE ANY CONCRETE SHALL BE CAST.
5. MIN. CONCRETE COVER 40mm UNLESS SHOWN OTHERWISE.
6. ALL CONCRETE SHALL BE 25 MPa/19mm UNLESS SHOWN OTHERWISE.
7. ALL CAST IN SITU CONCRETE MUST BE CURED FOR AT LEAST 72 HOURS BY COVERING WITH POLYTHENE SHEETING OR BY SPRAYING THE SURFACE WITH WHITE PIGMENTED CURING COMPOUND ACCORDING TO MAASTHO M145 AT A RATE OF 0,3 l/m² WITH A MECHANICAL SPRAYER AFTER SURFACE TEXTURE HAS BEEN APPLIED.
8. ALL STRUCTURAL STEELWORK TO BE PAINTED WITH AN APPROVED COLOUR EPOXY-TAR PAINT TO SABS 801 IN ACCORDANCE WITH SANS 1200 H.
9. ALL STEELWORK TO BE ACCORDING TO BS 4360. ALL WELDING TO BE ACCORDING TO SANS 044.
10. JUNCTION BOX DETAILS ARE AS FOR MANHOLES WITHOUT 600mm HOLE IN REINFORCED CONCRETE SLAB.

DEPARTMENT DEPARTEMENT	APPROVED GOEDGEKEUR	DESIGNATION AMPSBENAMING	DATE DATUM

CERTIFIED AS BUILT DRAWING
GESERTIFISEER AS SOOS GEBOU TEKENING

FOR NMS CivEc ____ FOR NMS JOHANNESBURG WATER (PTY) LTD ____

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CONSULTING ENGINEERS - RAADGEWENDE INGENIEURS
CivEc Civil Engineering Consultants
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PRIVATE DRAWING No
PRIVAAT TEKENING Nr
1440a/ST/Det02RR

SURVEYED - OPGEMEET		
DESIGNED - ONTWERP	JN	
DRAWN - GETEKEN	JN	
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SERVICES CHECKED DIENSLEIDINGS NAGESIEN		
GEOTECHNICAL INVESTIGATION GEOTEGNIESE ONDERSOEK		
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APPROVED GOEDGEKEUR		

APPROVED GOEDGEKEUR
Pr. Eng. No.
Pr. Ing. Nr. 800162
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JOHANNESBURG WATER (SOC) LTD

Johannesburg Water

17 HARRISON STREET
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CITY OF JOHANNESBURG

CONSTRUCTION OF A 2.25MI WATER TOWER IN ROBERTVILLE WITH ASSOCIATED PIPE AND PUMP WORKS

VALVE ROOM BUILDING DETAILS

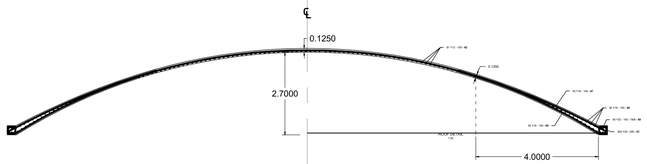
DESIGN MANAGER
BESTUURDER ONTWERP
DATE DATUM

SCALE SKAAL
AS SHOWN

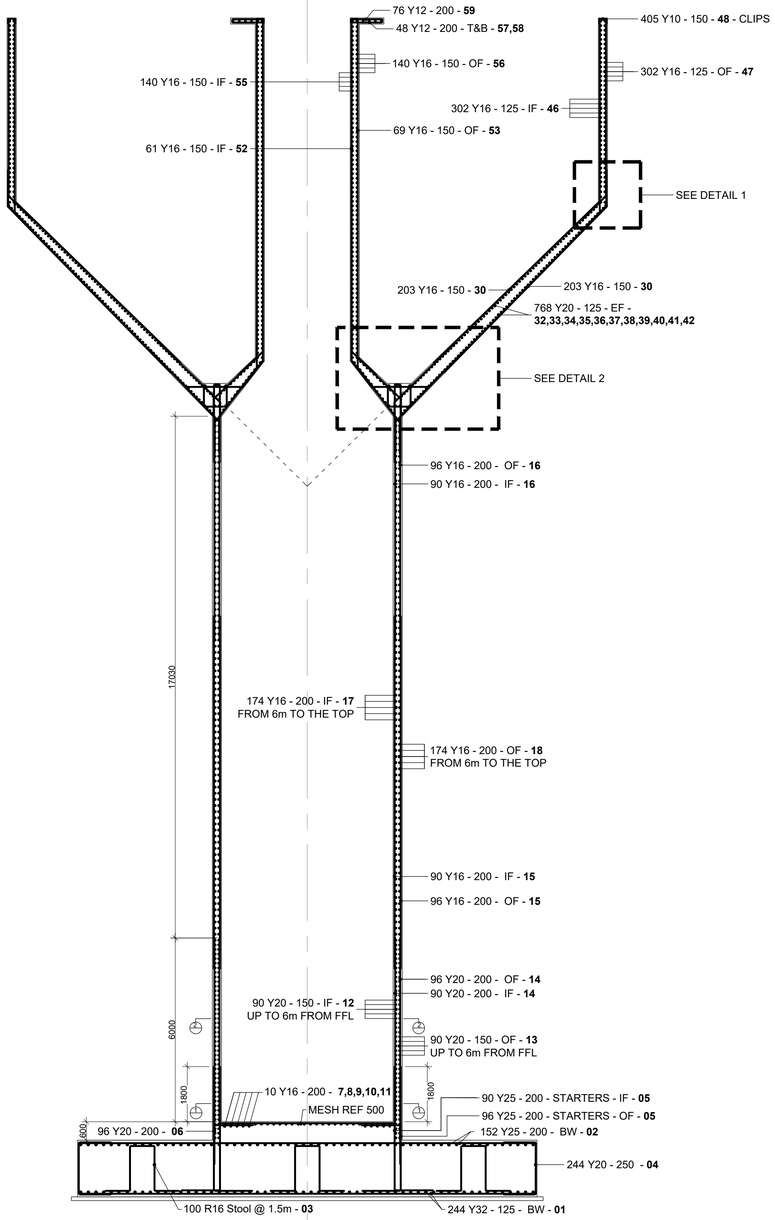
AMENDMENTS - WYSIGINGS	APPROVED GOEDGEKEUR	DATE DATUM

DRAWING No.
TEKENING Nr.
Revision
1440a/ST/DET02RR

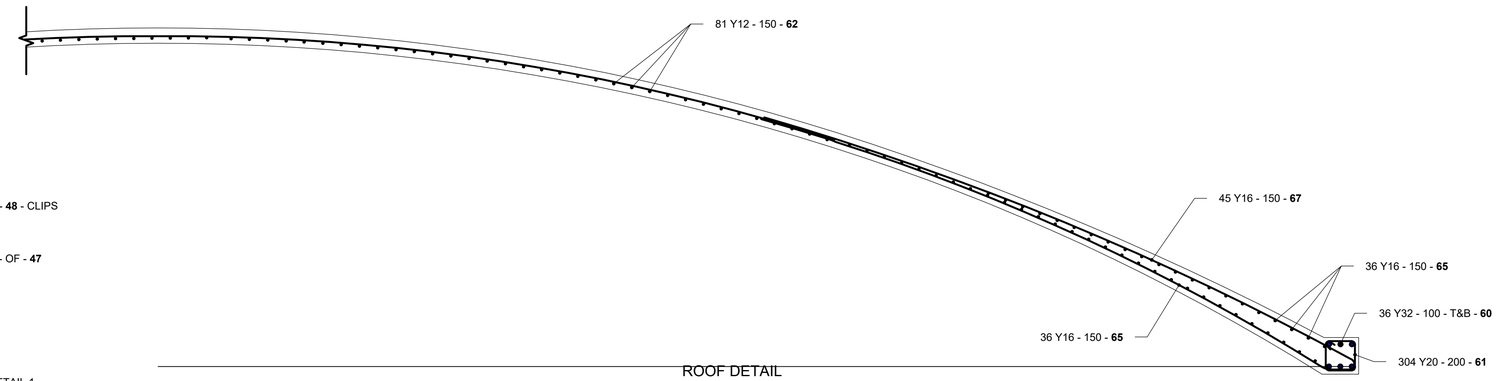
FILE No
LêER Nr



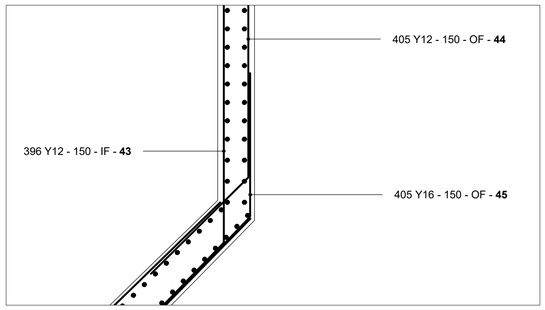
TOWER ROOF STEEL REINFORCEMENT
1:100



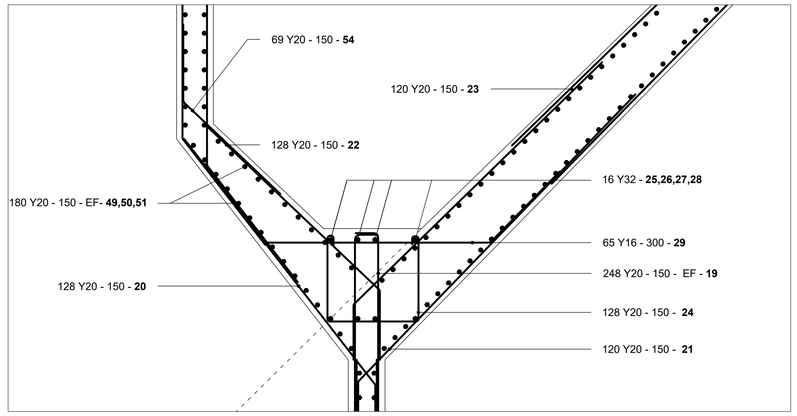
TOWER STEEL REINFORCEMENT
SECTION 3-3
1:100



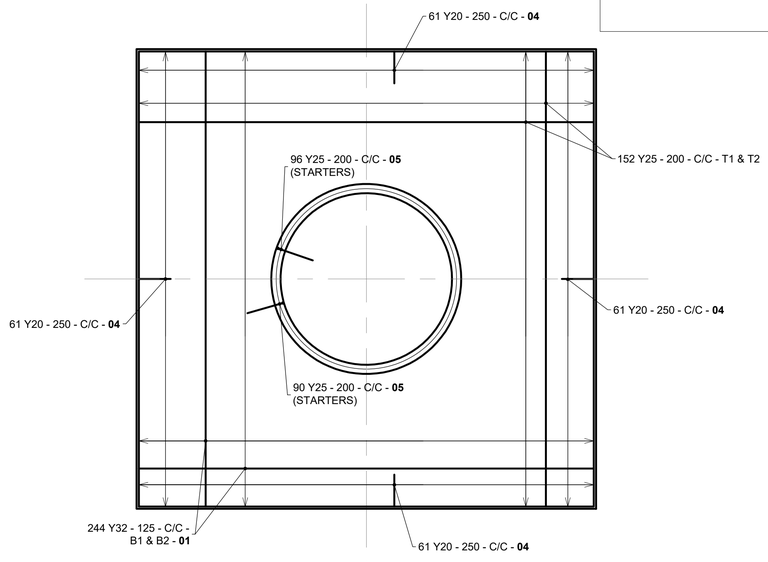
ROOF DETAIL
1:25



DETAIL 1
1:25



DETAIL 2
1:25



PLAN FOUNDATION
1:100

REINFORCEMENT DETAILING

1. The bending of bar reinforcement shall be in accordance with BS4466. The following notation has been adopted on the drawings.

NUMBER OF BARS — NOMINAL BAR DIAMETER (mm)
10 - Y20 - 150 - 01
STEEL GRADE — SPACING(mm) — BAR MARCK

Y	- High yield
R	- Mild steel
T	- Top
B	- Bottom
BW	- Both Ways
EF	- Each Face
IF	- Inner Face
OF	- Outer Face
T&B	- Top & Bottom

2. Lap lengths are to be 50 times the diameter of the smaller bar unless shown otherwise.
3. Unless otherwise mentioned, concrete covers to reinforcement are to be as follows:
   Base (below ground) : 75mm
   Contact with Water : 75mm
   Other : 50mm

- Lengths are in mm
- Reinforced bars' dimensions are in mm

DEPARTMENT DEPARTEMENT	APPROVED GOEDGEKEUR	DESIGNATION AMPSBENAMING	DATE DATUM

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FOR NMS CivEc ____ FOR NMS JOHANNESBURG WATER (PTY) LTD ____
DATE DATUM ____ DATE DATUM ____

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APPROVED GOEDGEKEUR
Pr. Eng. No.
Pr. Reg. Nr. 800162
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DIENSLEIDINGS NAGESIEN		
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GEOTEGNIESE ONDERSOEK		
SERVITUDES		
SERWITUTE		
APPROVED		
GOEDGEKEUR		

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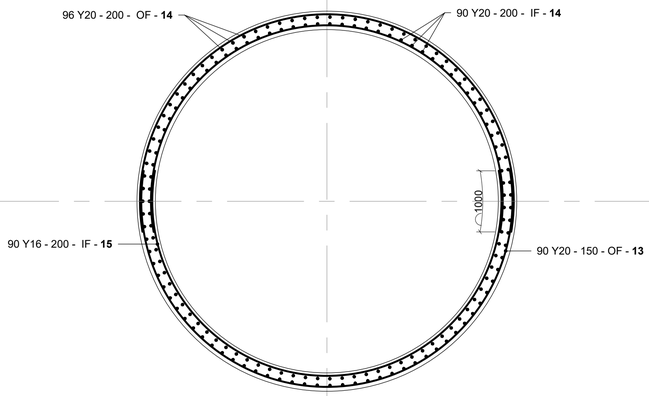
CITY OF JOHANNESBURG

CONSTRUCTION OF A NEW 2.25 Ml WATER TOWER IN ROBERTVILLE

STEEL REINFORCEMENT DETAILS SHEET 01 of 02

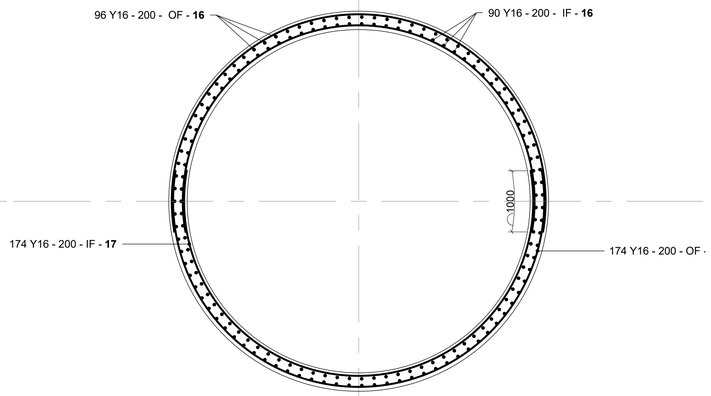
DESIGN MANAGER	SCALE SKAAL	AMENDMENTS - WYSIGINGS	APPROVED GOEDGEKEUR	DATE DATUM
BESTUURDER ONTWERP	AS SHOWN			
DATE DATUM				

DRAWING No. TEKENING Nr. 1440a/ST/DET03RR
Revision 0
FILE No LEER Nr



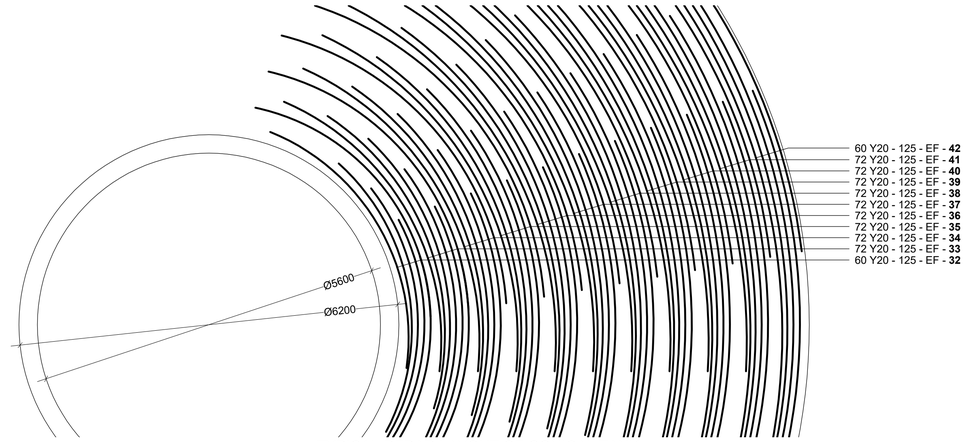
TYPICAL TOWER SHAFT SECTION UP TO 6m

1:50



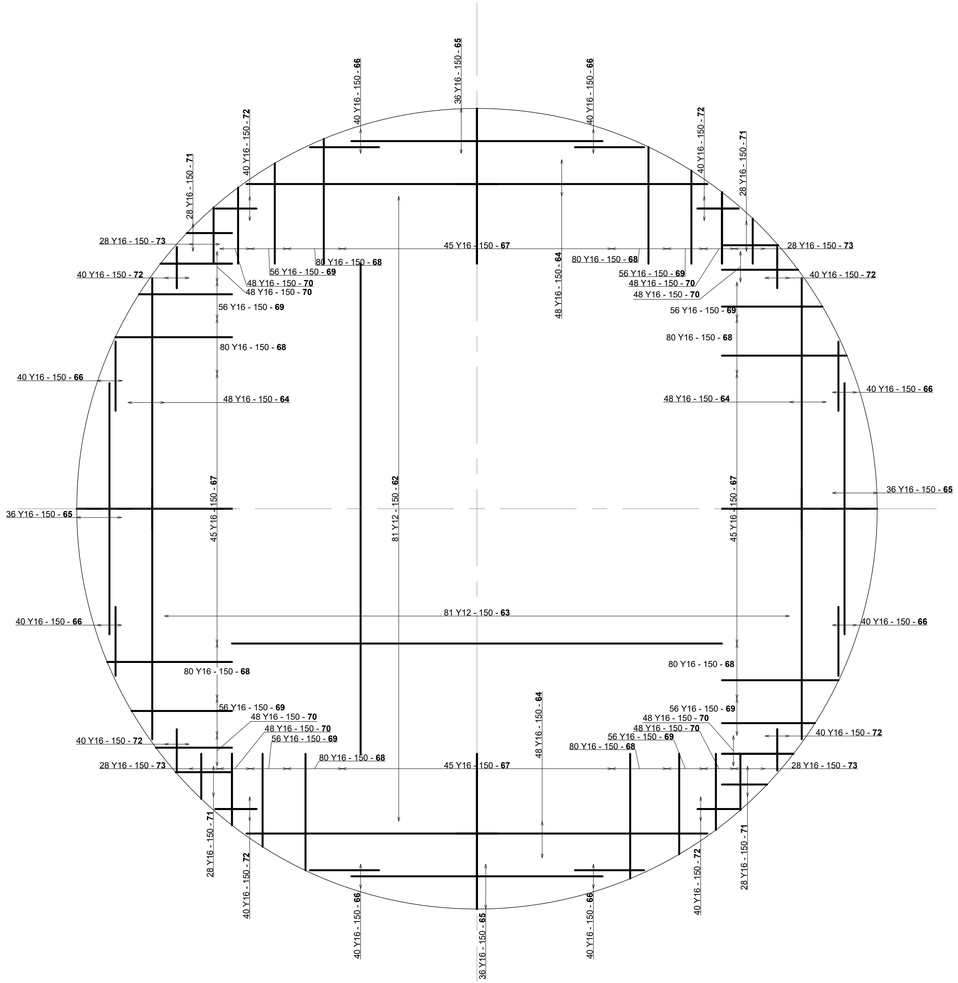
TYPICAL TOWER SHAFT SECTION FROM 6m TO THE TOP

1:50



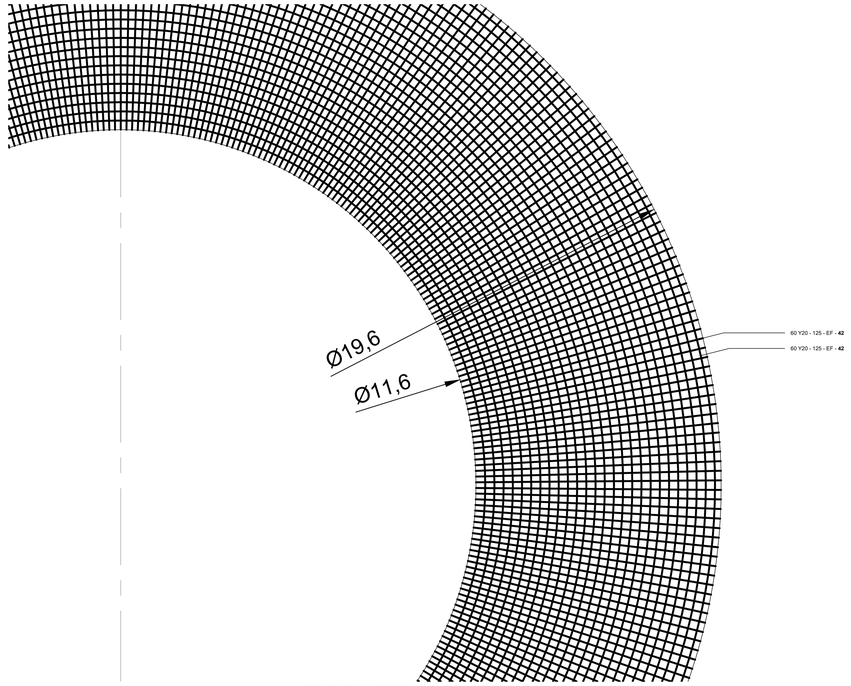
TYPICAL REBAR LAYOUT OF CONICAL TANK

1:50



TYPICAL REBAR LAYOUT OF TANK ROOF

1:75



TYPICAL REBAR LAYOUT OF CONICAL TANK

1:50

DEPARTMENT DEPARTEMENT	APPROVED GOEDGEKEUR	DESIGNATION AMPSBENAMING	DATE DATUM

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FOR NMS JOHANNESBURG WATER (PTY) LTD _____ DATE DATUM _____

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CITY OF JOHANNESBURG

CONSTRUCTION OF A NEW 2.25 Ml WATER TOWER IN ROBERTVILLE

STEEL REINFORCEMENT DETAILS SHEET 02 of 02

DESIGN MANAGER
BESTUURDER ONTWERP
DATE DATUM

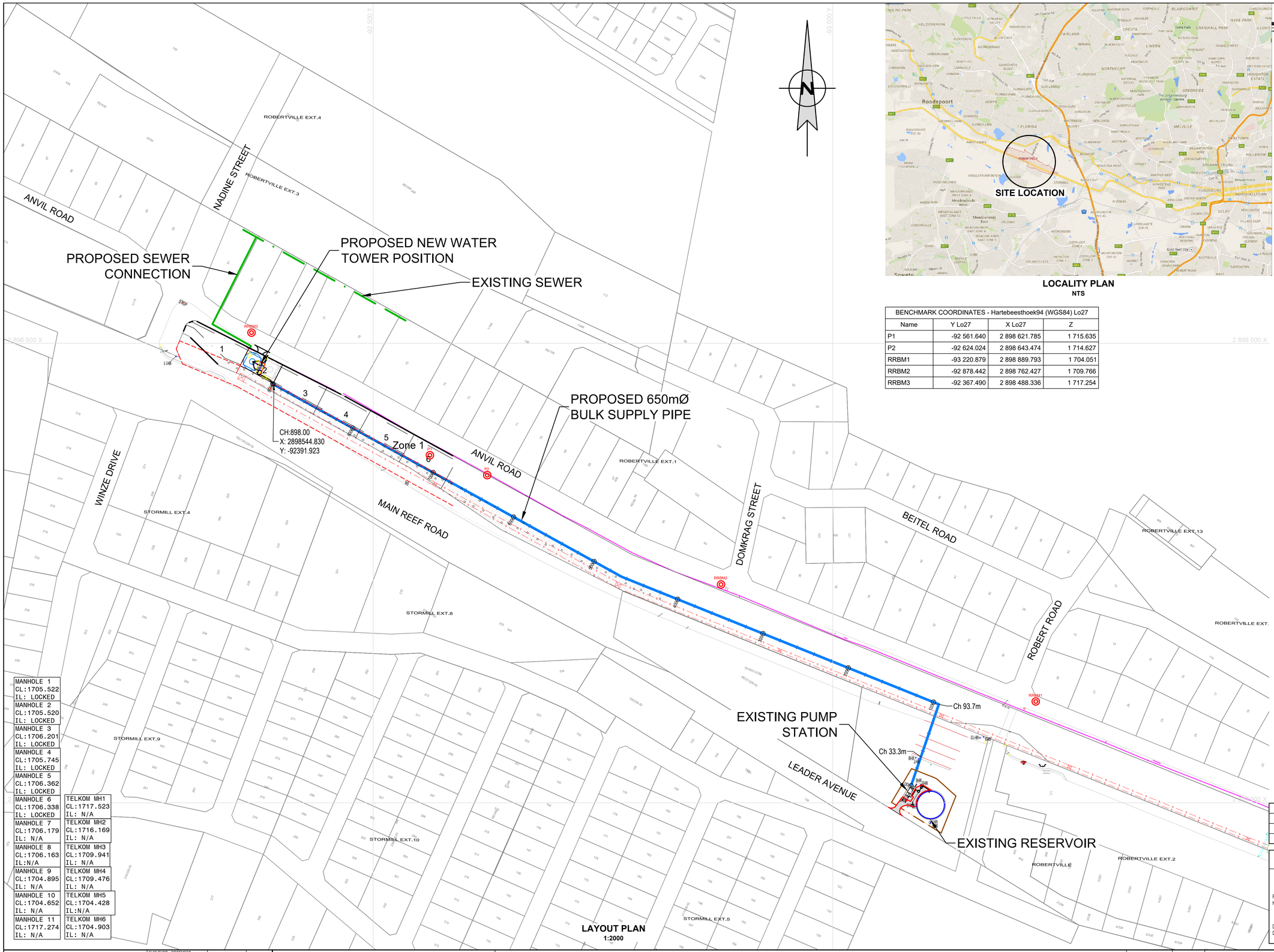
SCALE SKAAL: AS SHOWN

AMENDMENTS - WYSIGINGS	APPROVED GOEDGEKEUR	DATE DATUM

DRAWING No. TEKENING Nr: 1440a/ST/DET04RR

Revision 0

FILE No LEER Nr



LOCALITY PLAN
NTS

BENCHMARK COORDINATES - Hartebeesthoek94 (WGS84) Lo27			
Name	Y Lo27	X Lo27	Z
P1	-92 561.640	2 898 621.785	1 715.635
P2	-92 624.024	2 898 643.474	1 714.627
RRBM1	-93 220.879	2 898 889.793	1 704.051
RRBM2	-92 878.442	2 898 762.427	1 709.766
RRBM3	-92 367.490	2 898 488.336	1 717.254

SKAAL OP VERKLEINDE TEKENING
SCALE ON REDUCED DRAWING

100mm OP OORSPRONKLIKE TEKENING
100mm SCALE ON ORIGINAL DRAWING

GENERAL NOTES :

1. NO PART OF THIS DRAWING MUST BE SCALED
2. ALL DIMENSIONS SHOULD BE CHECKED BEFORE ANY WORK ON THE SITE COMMENCES
3. ANY DISCREPANCIES THAT MAY OCCUR DURING THE CONSTRUCTION PHASE OF THIS
4. DRAWING MUST BE BROUGHT IMMEDIATELY UNDER THE ATTENTION OF THE ENGINEER

NOTES :

1. ALL FLANGES TO BE ACCORDING TO SANS 1123-1977 TABLE 16.
2. ALL M.S. FITTINGS TO BE COPON COATED.
3. ANCHOR BLOCKS TO BE CAST SYMMETRICALLY AROUND CENTRE LINE OF FITTINGS AND AGAINST UNDISTURBED EXCAVATION.
4. COUPLINGS AND FLANGES SHALL BE LEFT CLEAR OF CONCRETE.
5. VALVES AND HYDRANTS MUST BE TREATED AS END CAPS AND SHOULD BE CONCRETED INTO THE THRUST BLOCK.
6. ALL THRUST BLOCKS SHALL BE OF 15MPa CONCRETE
7. THE DIMENSIONS OF THE ANCHOR BLOCKS ONLY APPLY IF THE TEST PRESSURE DOES NOT EXCEED 135M (1350 KPa).
8. ALL PREFABRICATED FITTINGS TO BE COPON EP 2300 COATED AND LINED.
9. FLANGED JOINTS AND V.J. COUPLINGS TO BE WRAPPED WITH DENSO TAPE.
10. ALL PIPE SIZES TO BE CONFIRMED ON SITE PRIOR TO THE ORDERING OF FITTINGS.

LEGEND

- BENCHMARKS
- NEW 650mm BULK WATER SUPPLY PIPE
- TOWNSHIP RESERVATION
- POWER LINES
- EXISTING GAS LINE
- NEW WATER PIPES
- ELECTRICAL PYLON
- PROPOSED FENCE
- PROPOSED SEWER CONNECTION
- EXISTING SEWER
- EXISTING ESKOM SERVITUDE

MANHOLE 1	TELKOM MH1
CL:1705.522	CL:1717.523
IL: LOCKED	IL: N/A
MANHOLE 2	TELKOM MH2
CL:1705.520	CL:1716.169
IL: LOCKED	IL: N/A
MANHOLE 3	TELKOM MH3
CL:1706.201	CL:1709.941
IL: LOCKED	IL: N/A
MANHOLE 4	TELKOM MH4
CL:1705.745	CL:1709.476
IL: LOCKED	IL: N/A
MANHOLE 5	TELKOM MH5
CL:1706.362	CL:1704.428
IL: LOCKED	IL:N/A
MANHOLE 6	TELKOM MH6
CL:1706.338	CL:1704.903
IL: LOCKED	IL: N/A
MANHOLE 7	
CL:1706.179	
IL: N/A	
MANHOLE 8	
CL:1706.163	
IL:N/A	
MANHOLE 9	
CL:1704.895	
IL: N/A	
MANHOLE 10	
CL:1704.652	
IL: N/A	
MANHOLE 11	
CL:1717.274	
IL: N/A	

LAYOUT PLAN
1:2000

DEPARTMENT DEPARTEMENT	APPROVED GOEDGEKEUR	DESIGNATION AMPSBENAMING	DATE DATUM

CERTIFIED AS BUILT DRAWING
GESERTIFISEER AS SOOS GEBOU TEKENING

FOR NMS CivEc — FOR NMS JOHANNESBURG WATER (PTY) LTD
DATE DATUM — DATE DATUM

CONSULTING ENGINEERS - RAADGEWENDE INGENIEURS

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PRIVATE DRAWING No
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APPROVED GOEDGEKEUR
Pr. Eng. No.
Pr. Ing. Nr. 800162
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GEOTECHNIESE ONDERSOEK		
SERVITUDES		
SERWITUTE		
APPROVED		
GOEDGEKEUR		

JOHANNESBURG WATER (PTY) LTD

Johannesburg Water

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CITY OF JOHANNESBURG

CONSTRUCTION OF A 2.25MI WATER TOWER IN ROBERTVILLE WITH ASSOCIATED PIPE AND PUMP WORKS

KEY PLAN AND LIST OF DRAWINGS

DESIGN MANAGER
BESTUURDER ONTWERP
DATE DATUM

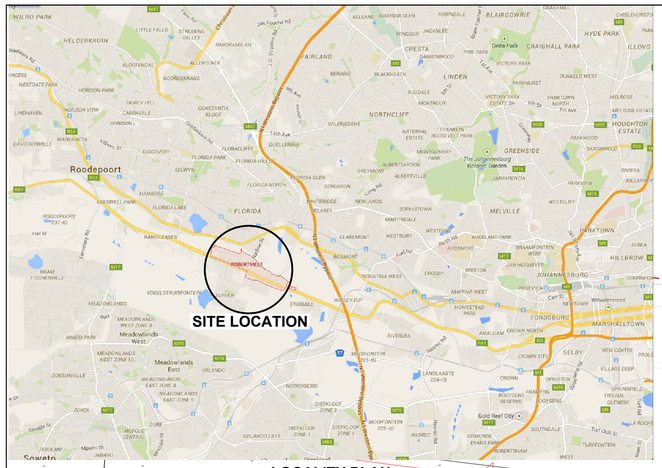
SCALE SKAAL
AS SHOWN

AMENDMENTS - WYSIGINGS	APPROVED GOEDGEKEUR	DATE DATUM

DRAWING No. TEKENING Nr. — Revision 0

1440a/WA/KEY01RR

FILE No
LEER Nr



LOCALITY PLAN
NTS

PAVING AREA SETTING OUT COORDINATES - Hartebeesthoek94 (WGS84) Lo27			
Name	Y Lo27	X Lo27	Z
P1	-92 334.244	2 898 480.636	1 717.593
P2	-92 322.360	2 898 483.478	1 717.662
P3	-92 322.894	2 898 484.638	1 717.670
P4	-92 341.863	2 898 494.248	1 717.790
P5	-92 334.681	2 898 508.429	1 717.900
P6	-92 327.716	2 898 509.210	1 717.250
P7	-92 322.534	2 898 514.537	1 717.935
P8	-92 299.459	2 898 492.088	1 717.250
P9	-92 298.092	2 898 491.473	1 717.250
P10	-92 304.112	2 898 479.609	1 717.770
P11	-92 308.573	2 898 481.868	1 717.740
P12	-92 319.491	2 898 478.016	1 717.675
P13	-92 317.106	2 898 468.028	1 717.620

FENCE SETTING OUT COORDINATES - Hartebeesthoek94 (WGS84) Lo27		
Name	Y Lo27	X Lo27
F1	-92 353.369	2 898 533.197
F2	-92 332.616	2 898 524.345
F3	-92 299.444	2 898 492.073
F4	-92 292.659	2 898 489.065
F5	-92 297.125	2 898 478.283
F6	-92 306.023	2 898 474.972
F7	-92 365.094	2 898 504.890

BENCHMARK COORDINATES - Hartebeesthoek94 (WGS84) Lo27			
Name	Y Lo27	X Lo27	Z
P1	-92 561.640	2 898 621.785	1 715.635
P2	-92 624.024	2 898 643.474	1 714.627
RRBM1	-93 220.879	2 898 889.793	1 704.051
RRBM2	-92 878.442	2 898 762.427	1 709.766
RRBM3	-92 367.490	2 898 488.336	1 717.254

SKAAL OP VERKLEINDE TEKENING
SCALE ON REDUCED DRAWING
100mm OP OORSPRONKLIKE TEKENING
100mm SCALE ON ORIGINAL DRAWING

LEGEND
- BENCHMARKS
- NEW 650mm BULK WATER SUPPLY PIPE
- TOWNSHIP RESERVATION
- POWER LINES
- EXISTING GAS LINE
- NEW WATER PIPES
- ELECTRICAL PYLON
- PROPOSED FENCE
- PROPOSED SEWER CONNECTION
- EXISTING SEWER
- EXISTING ESKOM SERVITUDE

MAIN REEF ROAD

MH11

650mm Ø SUPPLY PIPE

PROPOSED 650mØ BULK SUPPLY PIPE

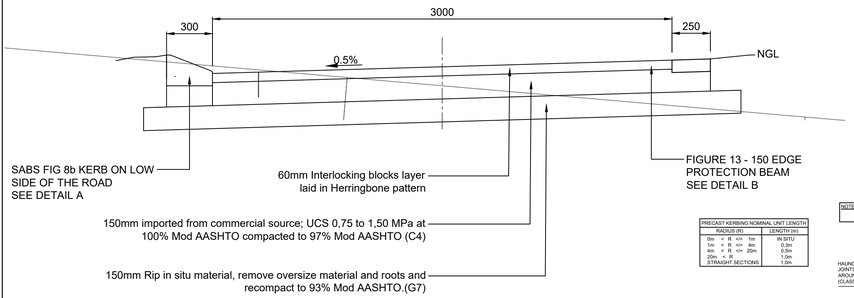
PROPOSED FENCE (SEE DWG 1440a/WA/DET02 FOR DETAILS)

NADINE STREET

FUTURE PROPOSED WATER TOWER

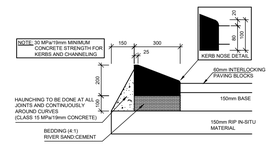
ANVIL ROAD

LAYOUT PLAN
1:200

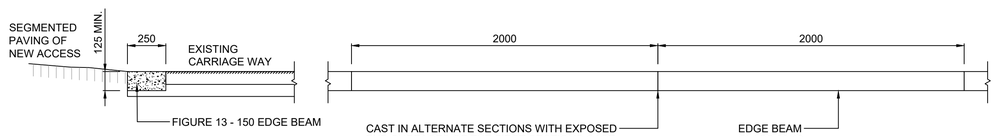


TYPICAL LAYER WORKS CROSS-SECTION
1:50

PRECAST KERBING NOMINAL UNIT LENGTH			
RADIUS (R)			LENGTH (m)
0m	< R </=	1m	IN SITU
1m	< R </=	4m	0.3m
4m	< R </=	20m	0.5m
20m	< R		1.0m
STRAIGHT SECTIONS			1.0m



DETAIL A: SABS FIG 8c KERB FOR NEW CONSTRUCTION
1:10



DETAIL B: EDGE BEAM DETAIL AND CONFIGURATION
1:50

DEPARTMENT DEPARTEMENT	APPROVED GOEDGEKEUR	DESIGNATION AMPSBENAMING	DATE DATUM

CERTIFIED AS BUILT DRAWING
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FOR NMS CivEc ____ FOR NMS JOHANNESBURG WATER (PTY) LTD ____

DATE DATUM ____ DATE DATUM ____

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CITY OF JOHANNESBURG

CONSTRUCTION OF A 2.25MI WATER TOWER IN ROBERTVILLE WITH ASSOCIATED PIPE AND PUMP WORKS

TOWER SITE PLAN

DESIGN MANAGER / BESTUURDER ONTWERP
DATE DATUM

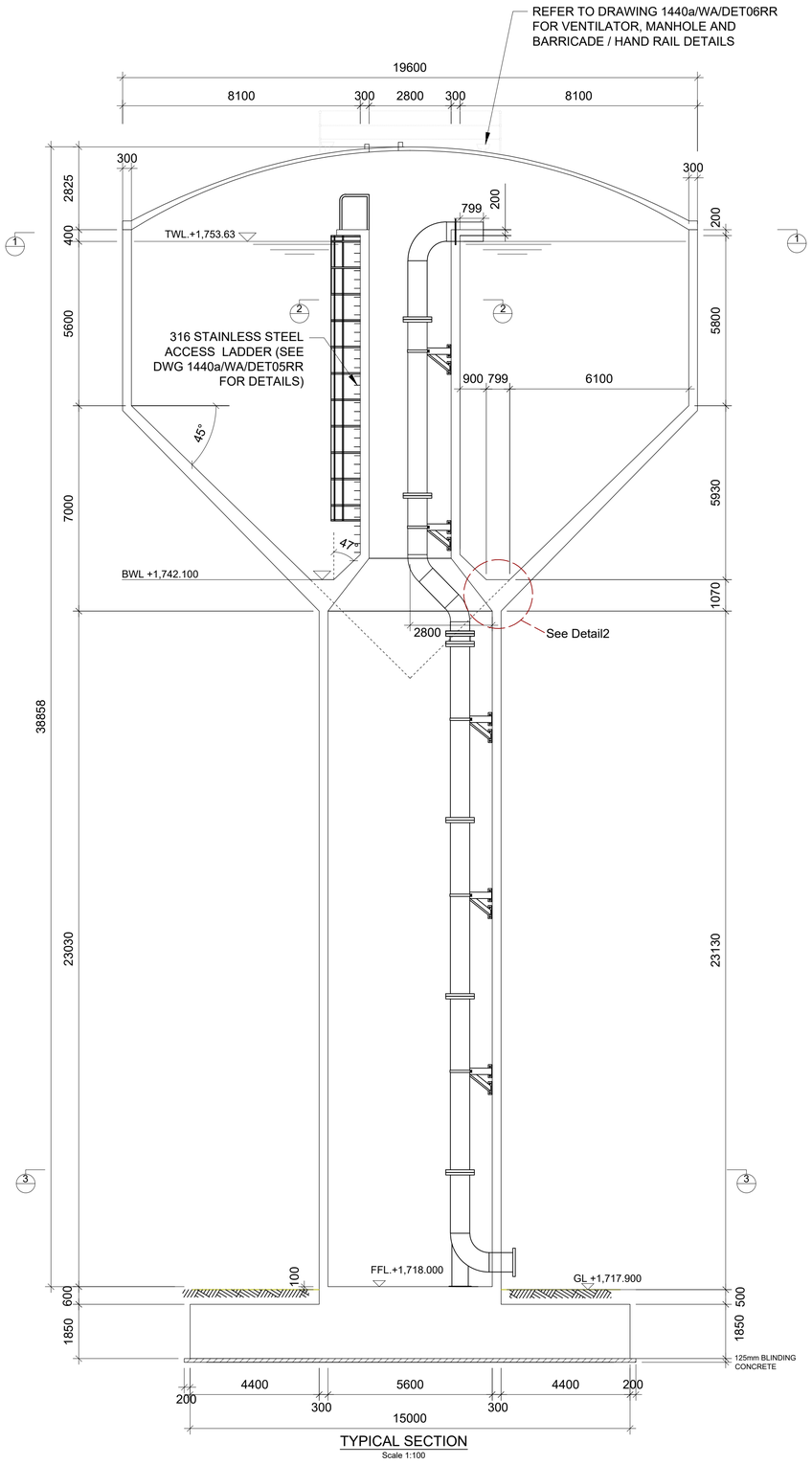
SCALE SKAAL: AS SHOWN

AMENDMENTS - WYSIGINGS	APPROVED GOEDGEKEUR	DATE DATUM

DRAWING No. TEKENING Nr.: 1440a/WA/LAY01RR
Revision: 1
FILE No LEER Nr

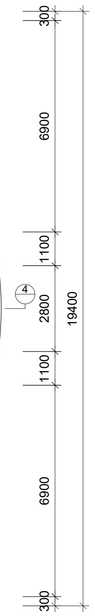
SKAAL OP VERKLEINDE TEKENING
SCALE ON REDUCED DRAWING

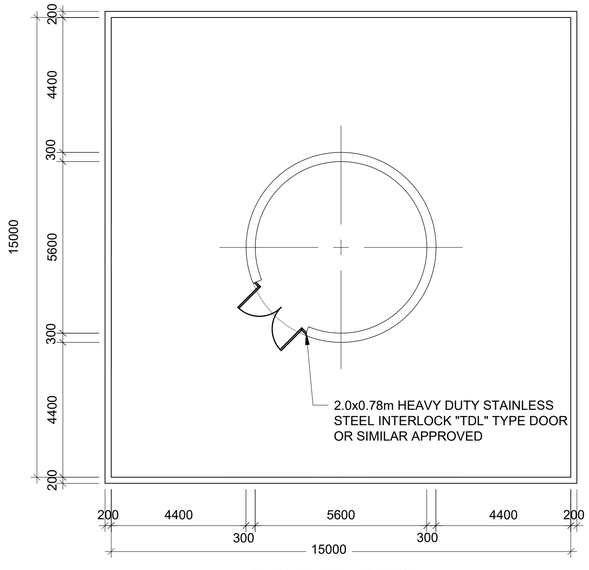
100mm OP OORSPRONKLIKE TEKENING
100mm SCALE ON ORIGINAL DRAWING



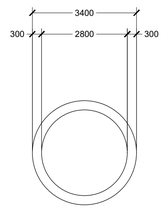
TYPICAL SECTION
Scale 1:100

SECTION 1-1
Scale 1:100



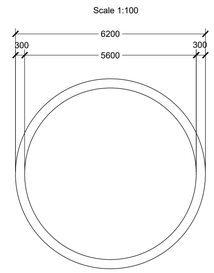


PLAN ON FOUNDATION
Scale 1:100

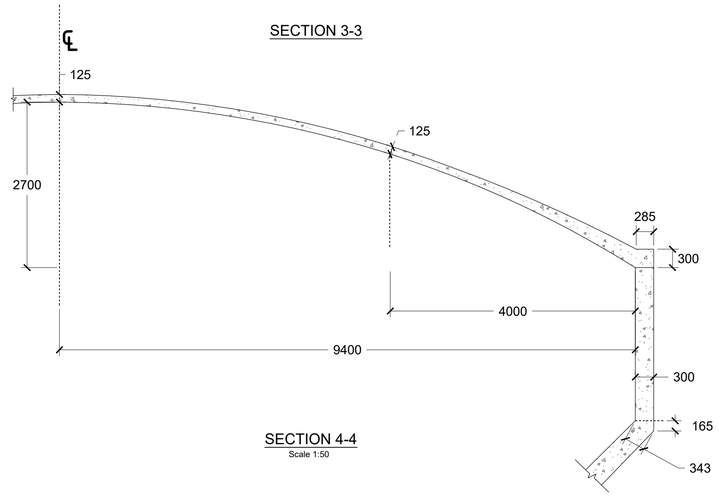


SECTION 2-2

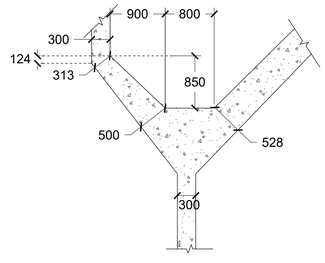
Scale 1:100



SECTION 3-3



SECTION 4-4
Scale 1:50



DETAIL 2
Scale 1:50

DEPARTMENT DEPARTEMENT	APPROVED GOEDGEKEUR	DESIGNATION AMPSBENAMING	DATE DATUM

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FOR NMS JOHANNESBURG WATER (PTY) LTD

DATE DATUM

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JOHANNESBURG WATER (SOC) LTD

Johannesburg Water

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CITY OF JOHANNESBURG

CONSTRUCTION OF A 2.25MI WATER TOWER IN ROBERTVILLE WITH ASSOCIATED PIPE AND PUMP WORKS

TOWER FOUNDATION AND ROOF PLAN

DESIGN MANAGER
BESTUURDER ONTWERP
DATE DATUM

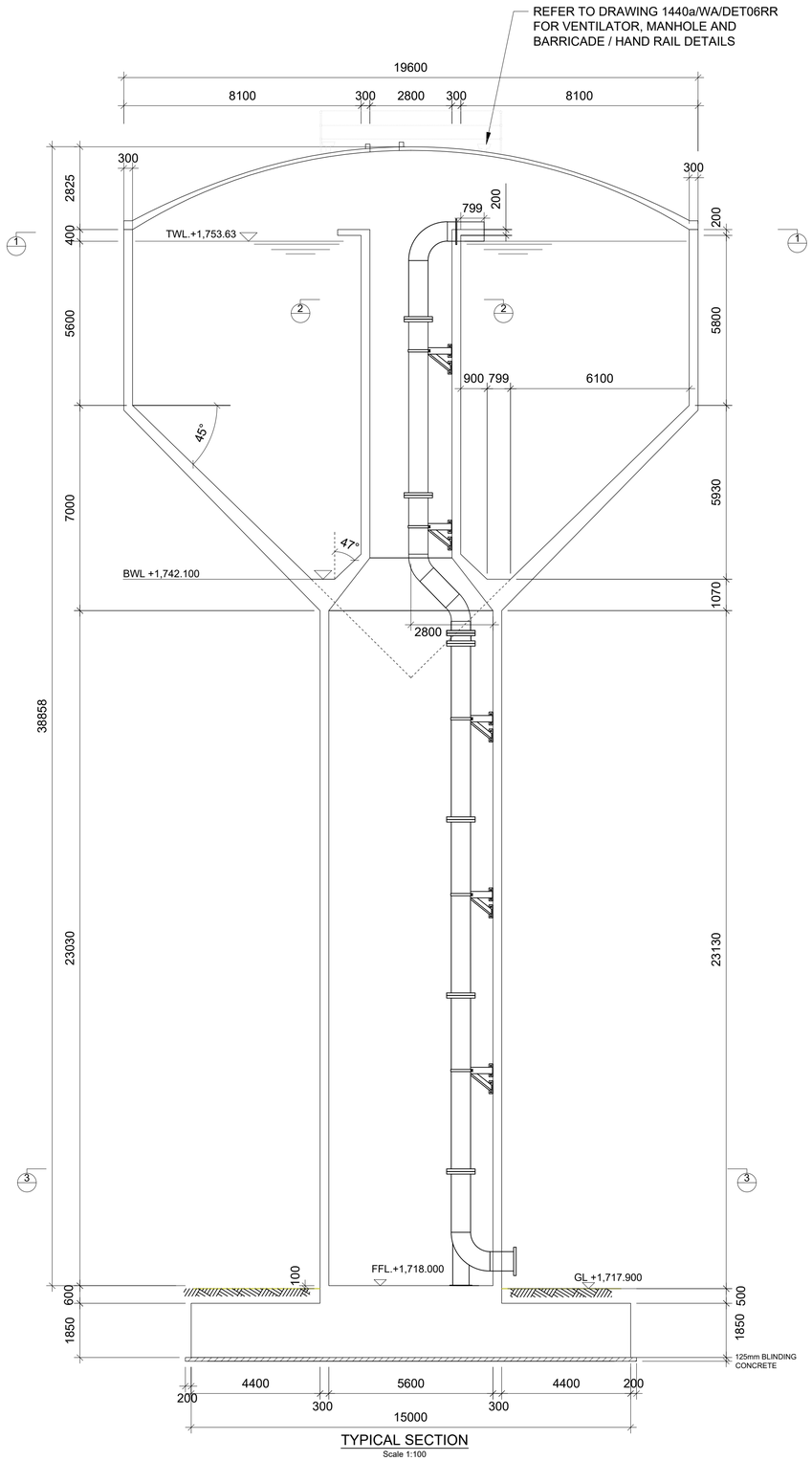
SCALE SKAAL
AS SHOWN

AMENDMENTS - WYSIGINGS	APPROVED GOEDGEKEUR	DATE DATUM
-	-	-

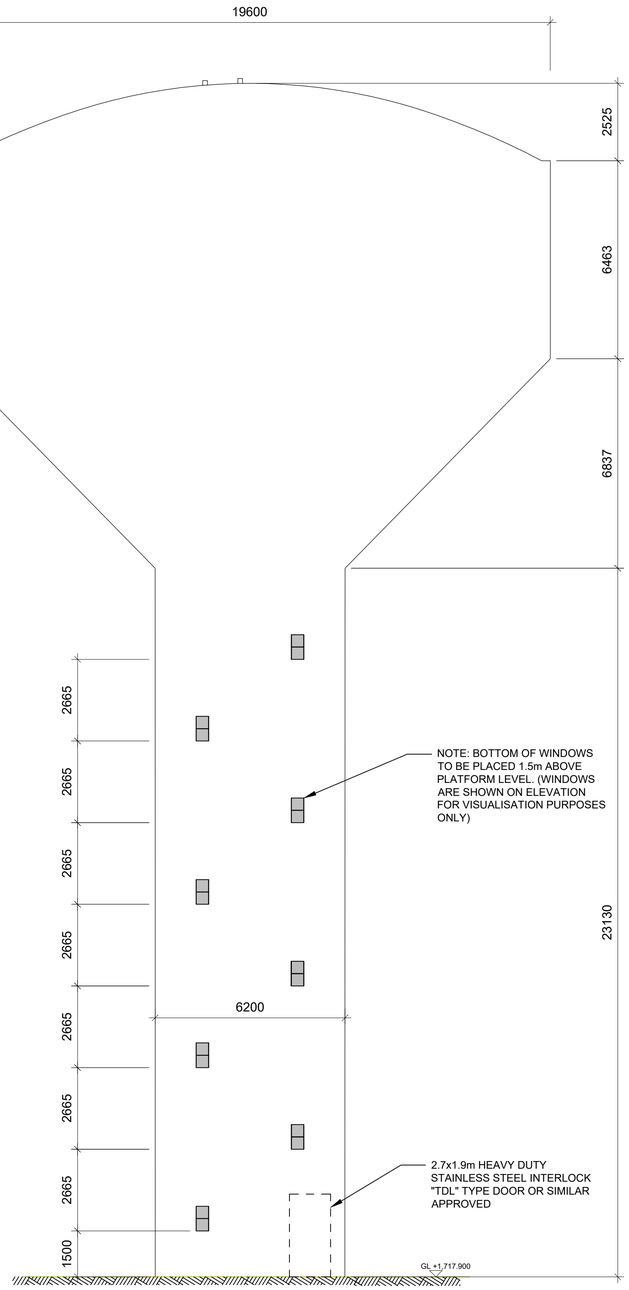
DRAWING No. TEKENING Nr. 1440a/WT/DET01RR

Revision 0

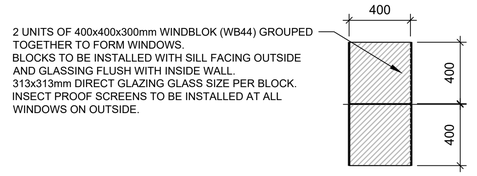
FILE No
LEER Nr



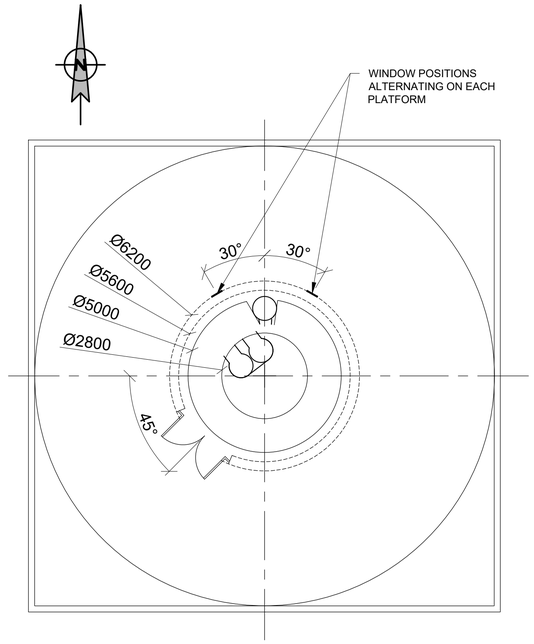
TYPICAL SECTION
Scale 1:100



NORTHERN ELEVATION
Scale 1:100



WINDOW ELEVATION DETAIL
Scale 1:20



POSITION OF WINDOWS
1:100

DEPARTMENT DEPARTEMENT	APPROVED GOEDGEKEUR	DESIGNATION AMPSBENAMING	DATE DATUM

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TOWER SECTION AND ELEVATION

DESIGN MANAGER
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-	-	-

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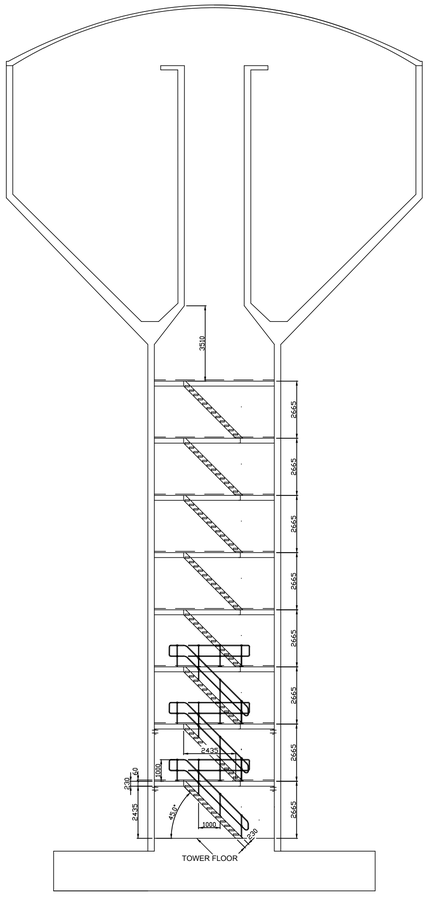
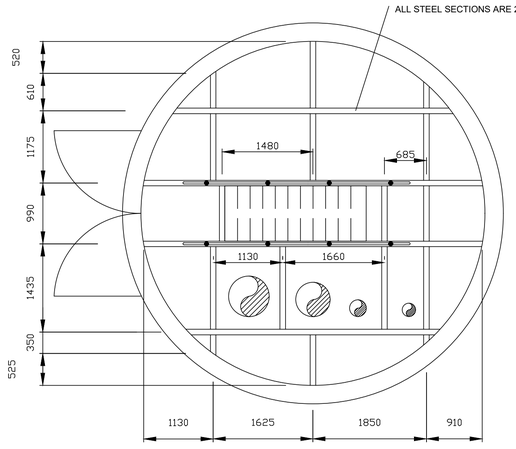
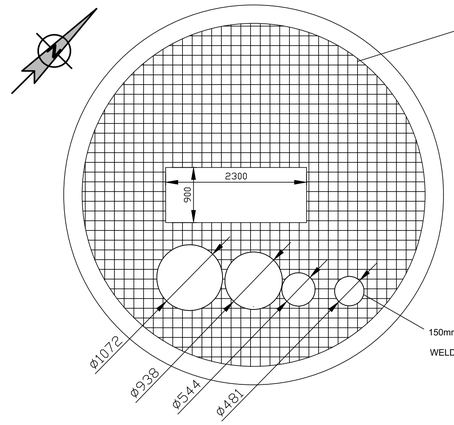
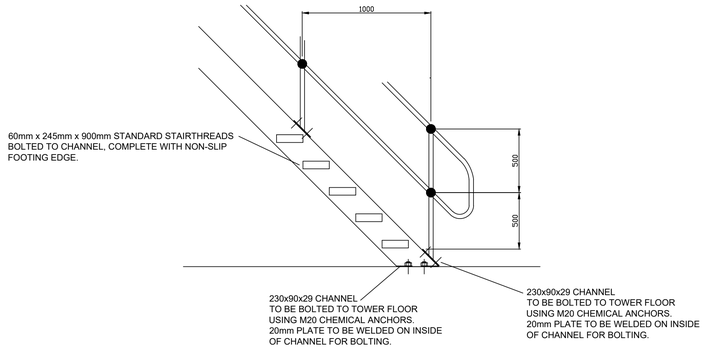




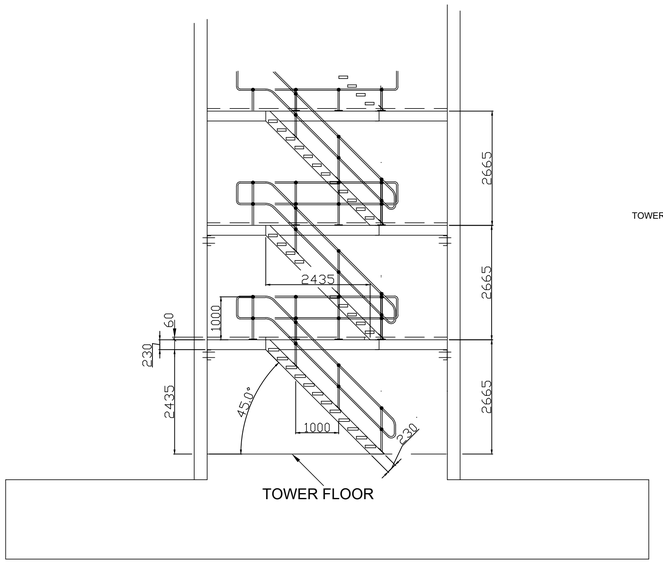
STRUCTURAL STEEL SECTIONS FOR GRATING / HANDRAIL SUPPORT FOR EACH LEVEL / LANDING.

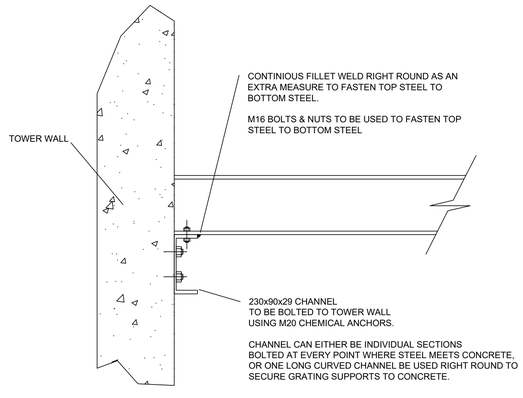


GRATING PROFILE FOR EACH LEVEL / LANDING



TYPICAL DETAIL FOR CONNECTION BETWEEN STEEL & TOWER CONCRETE FLOOR.





TYPICAL DETAIL FOR CONNECTION BETWEEN STEEL & TOWER CONCRETE WALL

NOTES:

1.) STEEL, GRATING & HANDRAILS TO BE MILD STEEL, HOT DIP GALVANIZED.
2.) FINAL DIMENSIONS TO BE VERIFIED, MEASURED AND CHECKED ON SITE PRIOR TO FABRICATION.
3.) ALL WELDING TO BE IN ACCORDANCE TO SABS SANDARDS.
4.) GRATING, HANDRAIL & STAIRTREADS AS PER MENTIS SALES SPECS.

BILL OF QUANTITIES:

TOTAL QTY'S FOR STAIRCASE, QTY'S INCLUDE STEEL LENGTH, HANDRAIL & GRATING QTY'S.

1.) STEEL SECTIONS:
1.1.) 230mm x 90mm STEEL CHANNEL: 185m

2.) STEEL GRATING:
2.1) RECTAGRID RS40 : 130m2

3.) HANDRAILS:
3.1) STANCHIONS:
3.1.1) MT90: 64OFF
3.1.2) MTA45 : 48OFF
3.1.3) ITEM 2M: 32 OFF
3.1.4) ITEM 3: 16 OFF
3.1.5) ITEM 4: 32 OFF
3.1.6) INTERMEDIATE TUBE LENGTH: 230m

DEPARTMENT DEPARTEMENT	APPROVED GOEDGEKEUR	DESIGNATION AMPSBENAMING	DATE DATUM

CERTIFIED AS BUILT DRAWING
GESERTIFISEER AS SOOS GEBOU TEKENING

FOR ____ _____ ____ FOR ____ _____ ____
NMS CivEc NMS JOHANNESBURG WATER (PTY) LTD

DATE _____ _____ DATE _____ _____
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CITY OF JOHANNESBURG

CONSTRUCTION OF A 2.25MI WATER TOWER IN ROBERTVILLE WITH ASSOCIATED PIPE AND PUMP WORKS

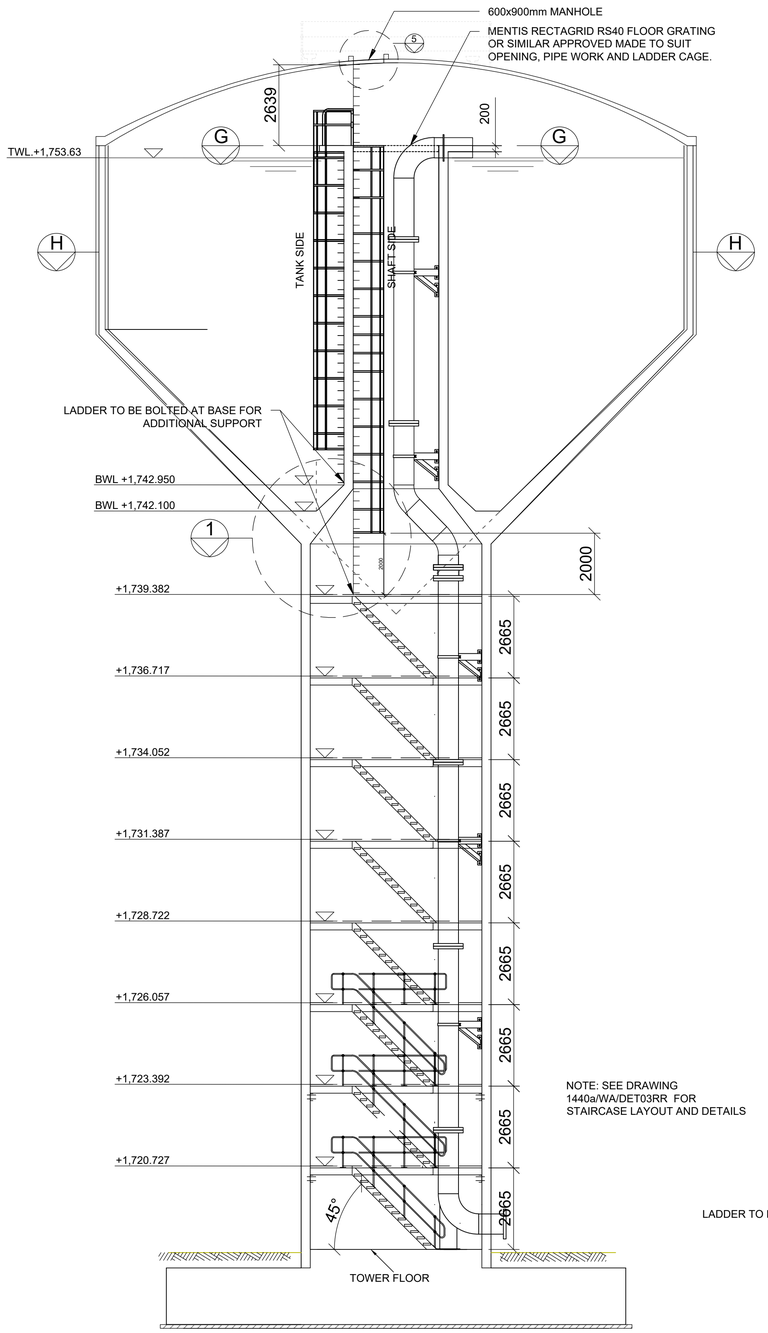
STAIR CASE AND GRATING DETAILS

DESIGN MANAGER
BESTUURDER ONTWERP
DATE DATUM

SCALE SKAAL
AS SHOWN

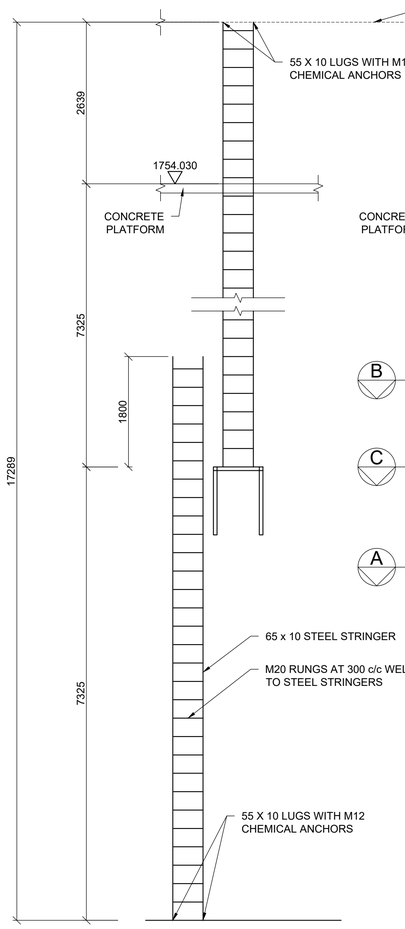
AMENDMENTS - WYSIGINGS	APPROVED GOEDGEKEUR	DATE DATUM

DRAWING No. TEKENING Nr. Revision
1440a/WT/DET03RR
FILE No LEER Nr

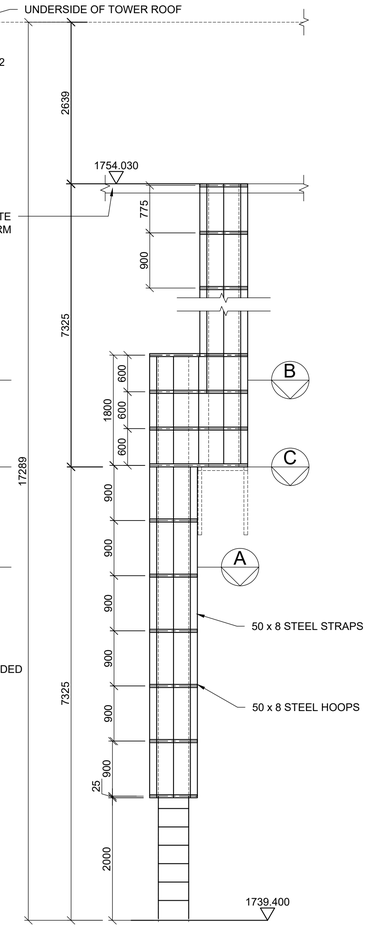


NOTE: SEE DRAWING 1440a/WA/DET03RR FOR STAIRCASE LAYOUT AND DETAILS

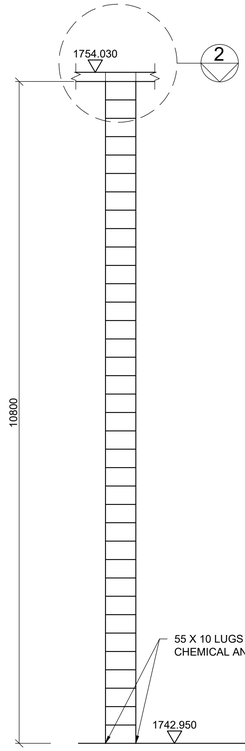
TYPICAL TOWER SECTION WITH STAIRS AND ACCESS LADDER INDICATED
1:100



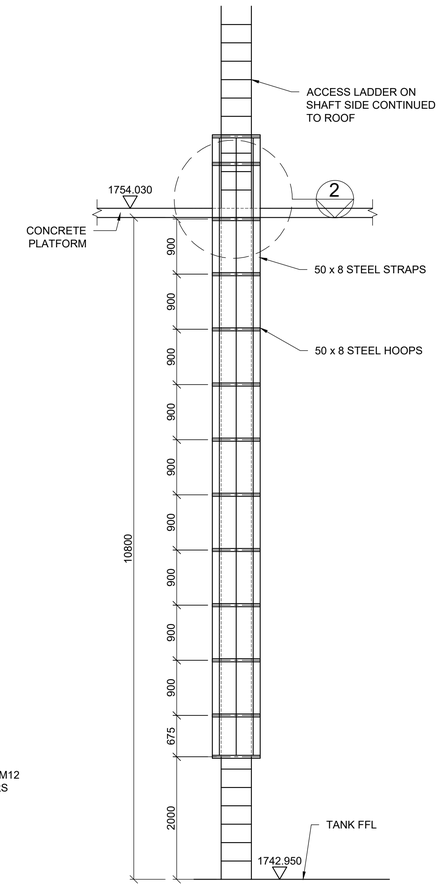
ACCESS LADDER ELEVATION (SHAFT SIDE)
1:50



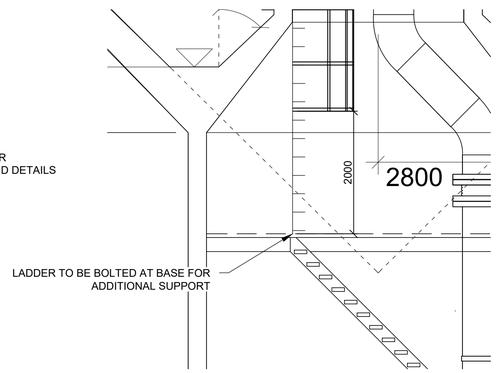
ACCESS LADDER CAGE ELEVATION (SHAFT SIDE)
1:50



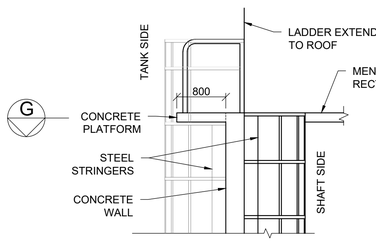
ACCESS LADDER ELEVATION (INSIDE OF TANK)
1:50



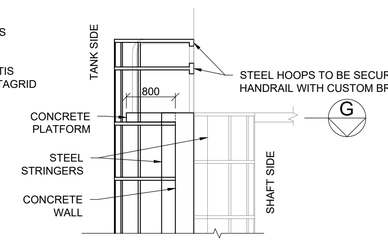
ACCESS LADDER CAGE ELEVATION (INSIDE OF TANK)
1:50



DETAIL 1 - ELEVATION OF CAT LADDER AT FINAL PLATFORM
1:50



DETAIL 2 - ELEVATION (INSIDE OF SHAFT)
1:50



DETAIL 2 - ELEVATION (INSIDE OF TANK)
1:50

NOTE; HAND RAILS TO BE SECURED TO CONCRETE PLATFORM USING 4 x M12 CHEMICAL ANCHORS WITH 16mm THICK BASE PLATE

NOTE:

1. ALL ACCESS LADDERS ARE TO BE MANUFACTURED FROM 316 STAINLESS STEEL.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH 1440a/WA/DET06RR.

DEPARTMENT DEPARTEMENT	APPROVED GOEDGEKEUR	DESIGNATION AMPSBENAMING	DATE DATUM

CERTIFIED AS BUILT DRAWING
GESERTIFISEER AS SOOS GEBOU TEKENING

FOR NMS CivEc _____ DATE DATUM _____

FOR NMS JOHANNESBURG WATER (PTY) LTD _____ DATE DATUM _____

CONSULTING ENGINEERS - RAADGEWENDE INGENIEURS
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PRIVATE DRAWING No
PRIVAAT TEKENING Nr
1440a/WA/DET05RR

SURVEYED - OPGEMEET		
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GEOTEGNIESE ONDERSOEK		
SERVITUDES		
SERWITUTE		
APPROVED		
GOEDGEKEUR		

1 APPROVED GOEDGEKEUR Pr. Eng. No. 800162 DATE -DATUM

JOHANNESBURG WATER (PTY) LTD

Johannesburg Water

TRADUNA HOUSE
58 FREDERICK STREET
MARSHALLTOWN
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CITY OF JOHANNESBURG

CONSTRUCTION OF A 2.25MI WATER TOWER IN ROBERTVILLE WITH ASSOCIATED PIPE AND PUMP WORKS

ACCESS LADDER DETAILS - SHEET 1 of 2

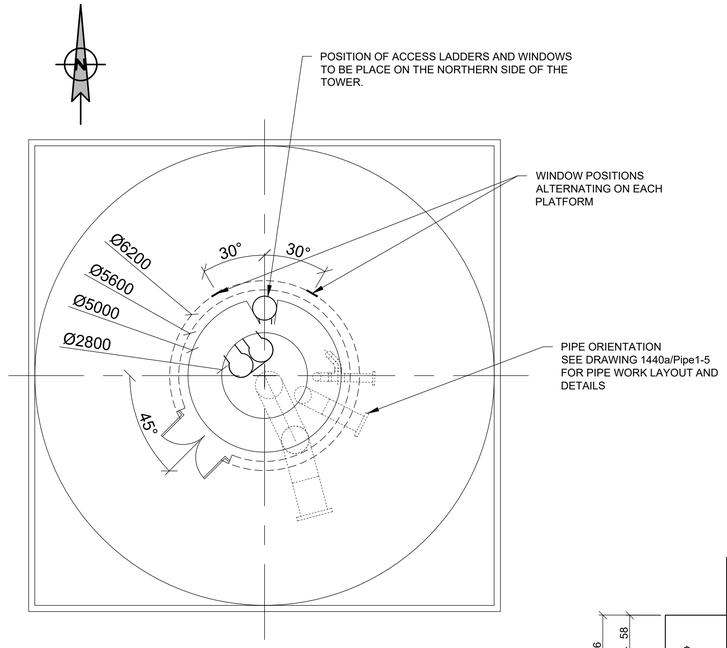
DESIGN MANAGER
BESTUURDER ONTWERP
DATE DATUM

SCALE SKAAL
AS SHOWN

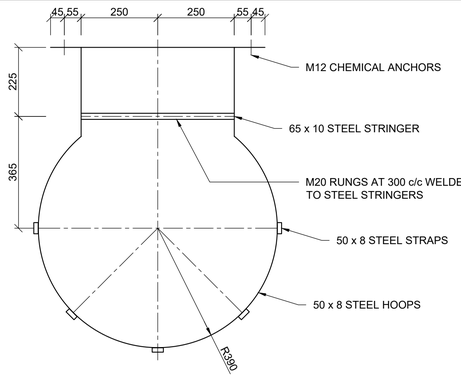
AMENDMENTS - WYSIGINGS	APPROVED GOEDGEKEUR	DATE DATUM

DRAWING No. TEKENING Nr. 1440a/WT/DET04RR
Revision 1

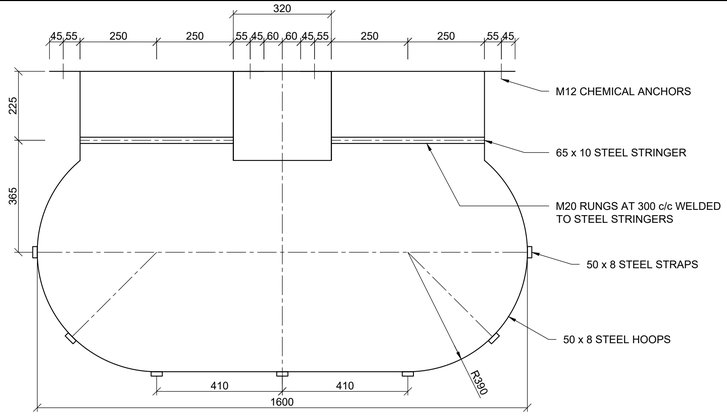
FILE No LEER Nr



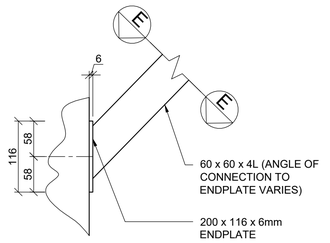
SECTION H - POSITION OF ACCESS LADDERS
1:100



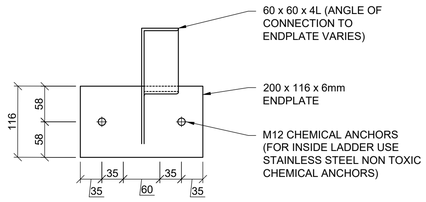
SECTION A
1:10



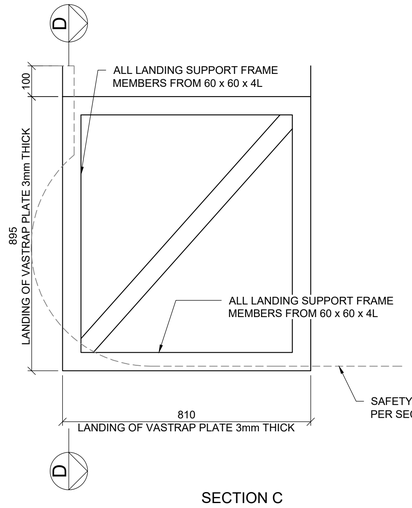
SECTION B
1:10



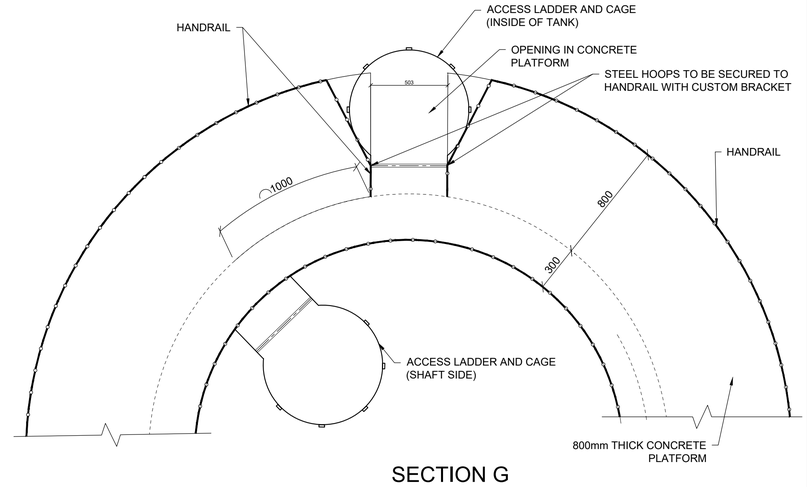
DETAIL 4
1:5



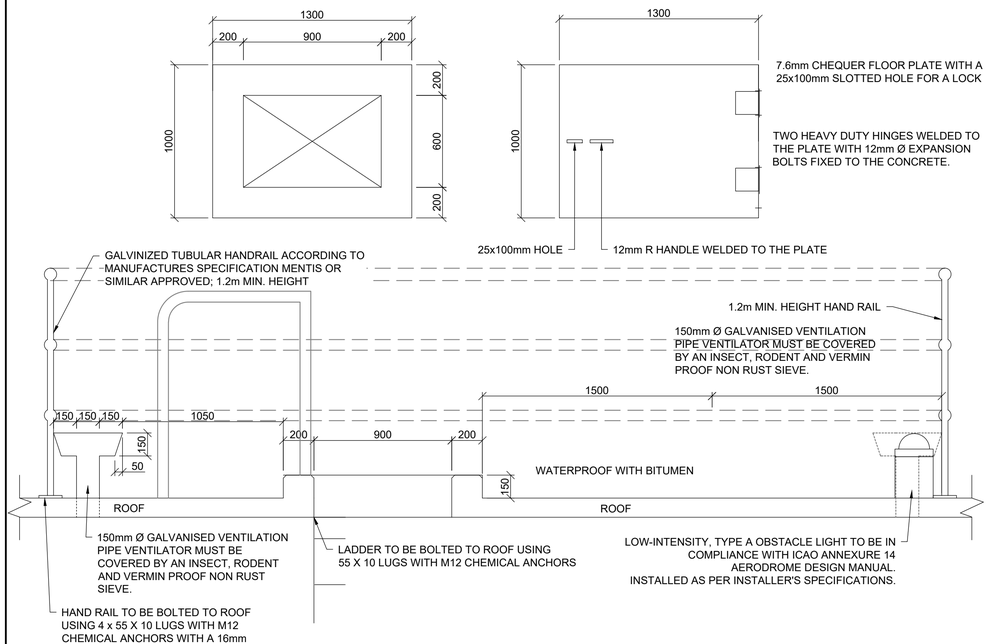
SECTION E
1:5



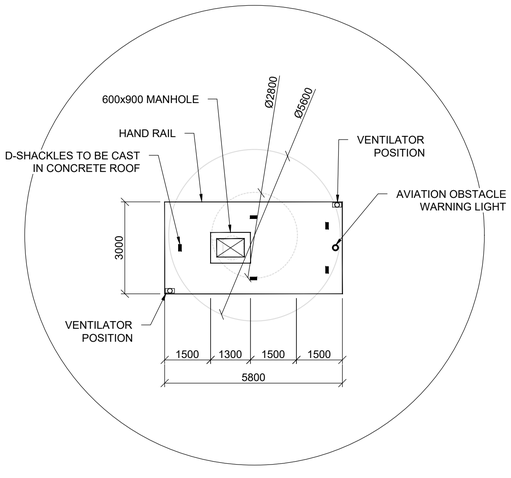
SECTION C
1:10



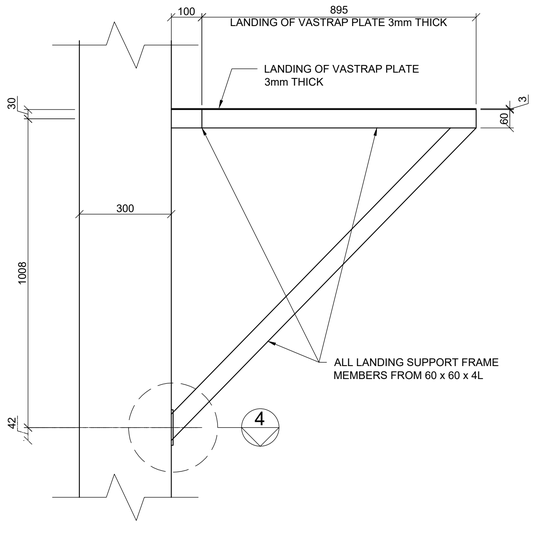
SECTION G
1:20



DETAIL 5 - MANHOLE AND VENTILATOR DETAILS
1:50



MANHOLE & HANDRAIL LAYOUT ON ROOF TOP
1:100



SECTION D
1:10

NOTE:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH 1440a/WA/DET06RR.

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FOR NMS CivEc ____ DATE DATUM ____

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PRIVATE DRAWING No
PRIVAAT TEKENING Nr
1440a/WA/DET06RR

APPROVED GOEDGEKEUR
Pr. Eng. No. 800162
Pr. Ing. Nr.
DATE -DATUM

SURVEYED - OPGEMEET		
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DRAWN - GETEKEN	FT	
CHECKED - NAGESIEN	HL	
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GEOTECHNICAL INVESTIGATION GEOTEGNIESE ONDERSOEK		
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CITY OF JOHANNESBURG

CONSTRUCTION OF A 2.25MI WATER TOWER IN ROBERTVILLE WITH ASSOCIATED PIPE AND PUMP WORKS

ACCESS LADDER DETAILS - SHEET 2 of 2

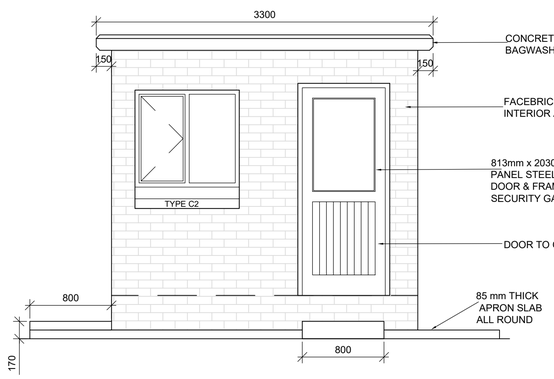
DESIGN MANAGER
BESTUURDER ONTWERP
DATE DATUM

SCALE SKAAL
AS SHOWN

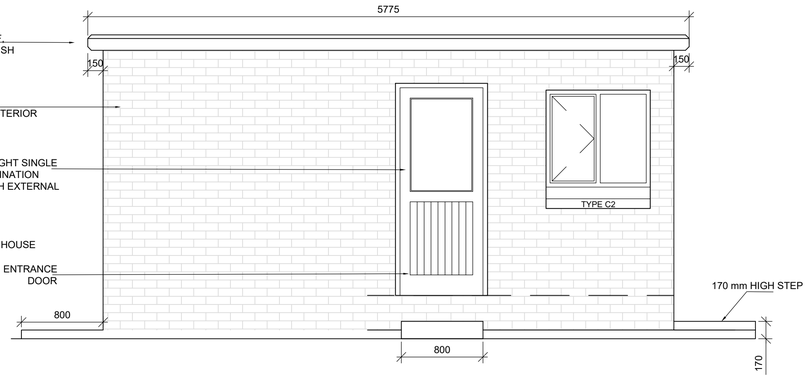
AMENDMENTS - WYSIGINGS	APPROVED GOEDGEKEUR	DATE DATUM

DRAWING No. TEKENING Nr. 1440a/WT/DET05RR
Revision 1

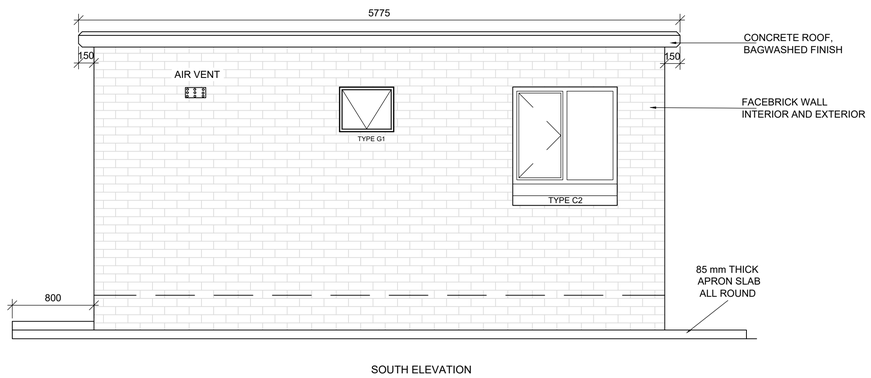
FILE No. LEER Nr.



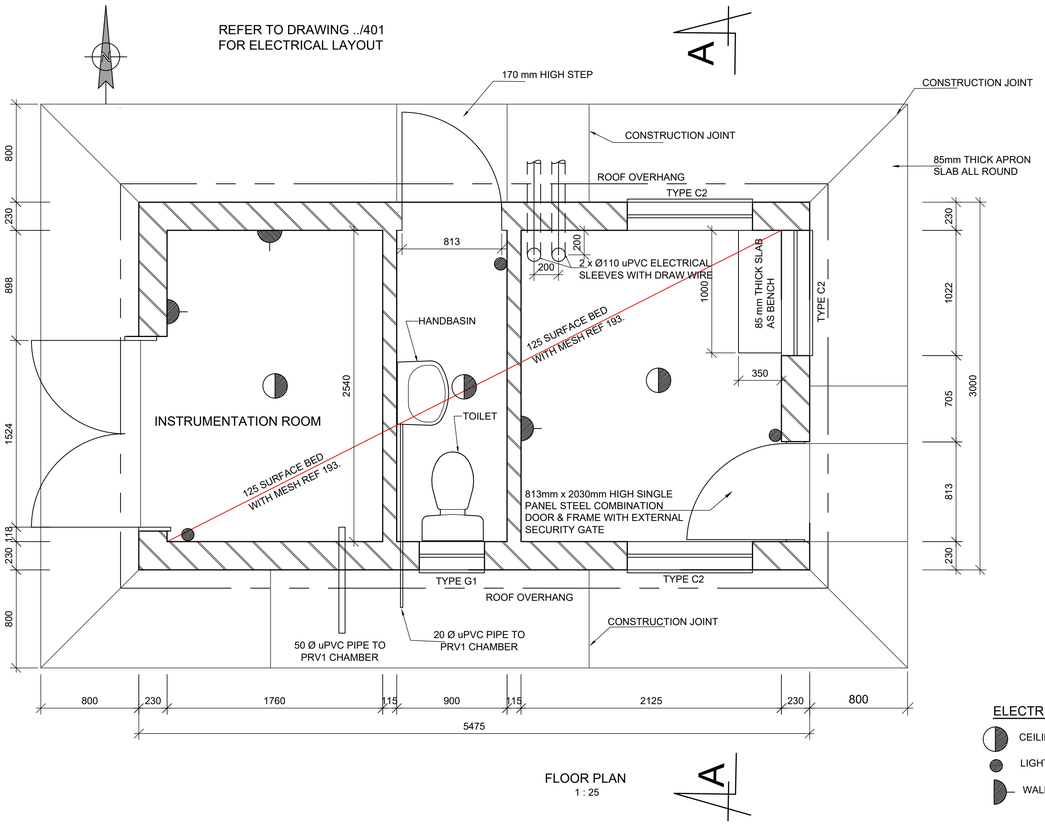
EAST ELEVATION
1 : 30



NORTH ELEVATION
1 : 30



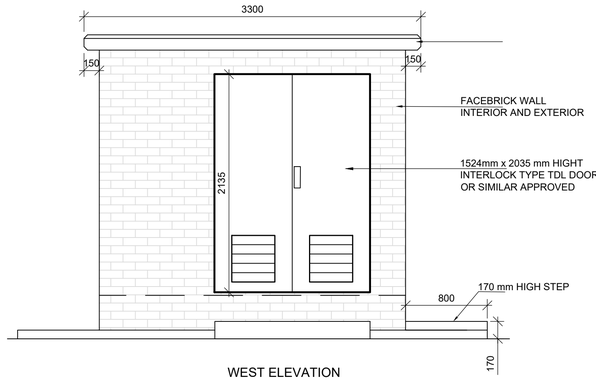
SOUTH ELEVATION
1 : 30



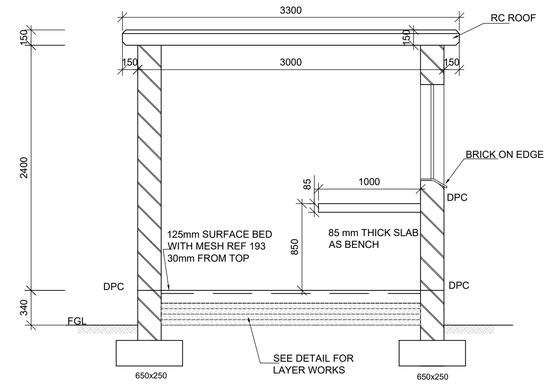
FLOOR PLAN
1 : 25

ELECTRICAL

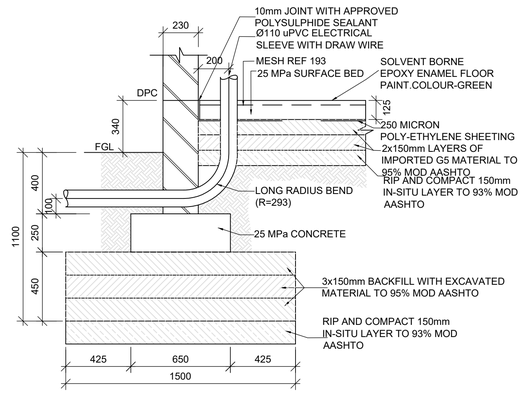
- CEILING LIGHT
- LIGHT SWITCH
- WALL PLUG



WEST ELEVATION
1 : 30



SECTION A - A
1 : 30



STRIP FOUNDATION DETAILS
1 : 20

DEPARTMENT DEPARTEMENT	APPROVED GOEDGEKEUR	DESIGNATION AMPSBENAMING	DATE DATUM

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GESERTIFISEER AS SOOS GEBOU TEKENING

FOR NMS CivEc ____ FOR NMS JOHANNESBURG WATER (PTY) LTD ____

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SERWITUTE		
APPROVED		
GOEDGEKEUR		

0 APPROVED GOEDGEKEUR Pr. Eng. No. Pr. Ing. Nr. 800162 DATE -DATUM

JOHANNESBURG WATER (SOC) LTD
Johannesburg Water
17 HARRISON STREET
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2107
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CITY OF JOHANNESBURG

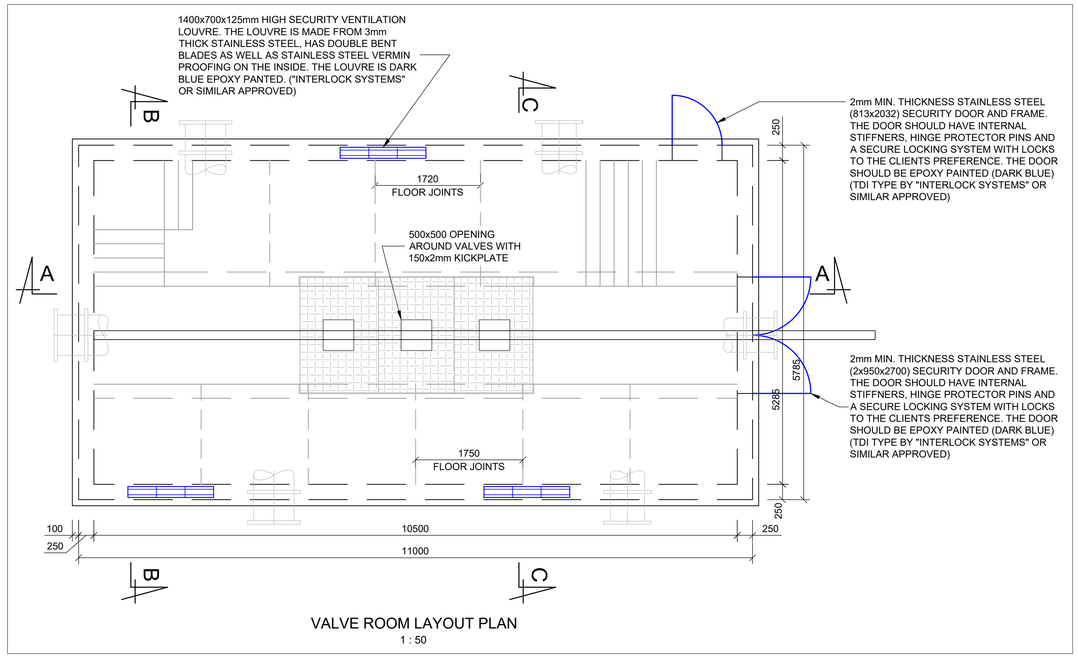
CONSTRUCTION OF A 2.25MI WATER TOWER IN ROBERTVILLE WITH ASSOCIATED PIPE AND PUMP WORKS

GUARDHOUSE DETAIL

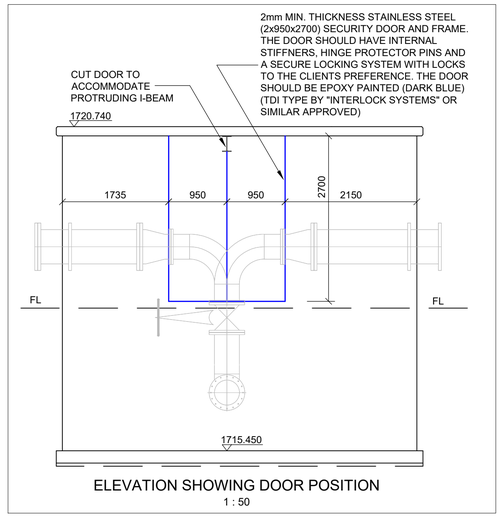
DESIGN MANAGER BESTUURDER ONTWERP	SCALE SKAAL	AMENDMENTS - WYSIGINGS	APPROVED GOEDGEKEUR	DATE DATUM
DATE DATUM	AS SHOWN			

DRAWING No. TEKENING Nr. 1440a/WT/DET06RR Revision 0

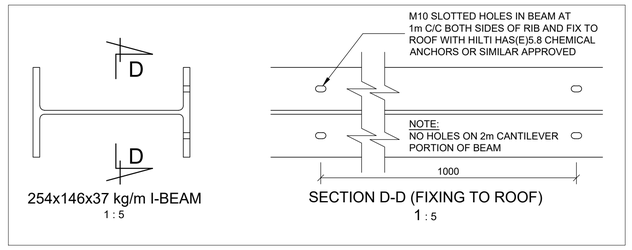
FILE No LEER Nr



VALVE ROOM LAYOUT PLAN
1 : 50

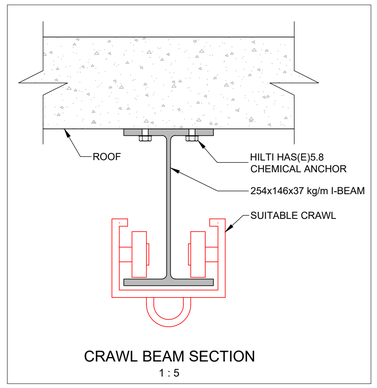


ELEVATION SHOWING DOOR POSITION
1 : 50

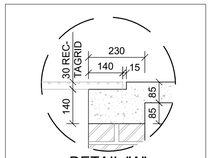


254x146x37 kg/m I-BEAM
1 : 5

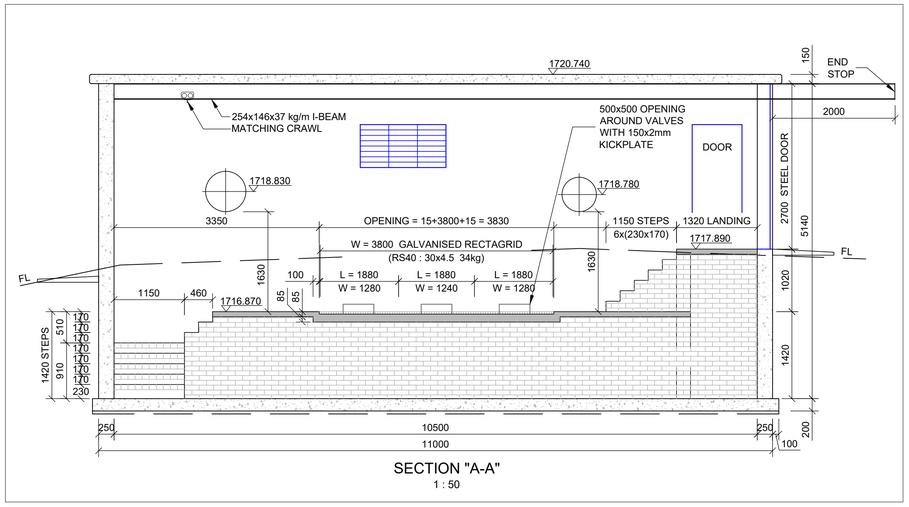
SECTION D-D (FIXING TO ROOF)
1 : 5



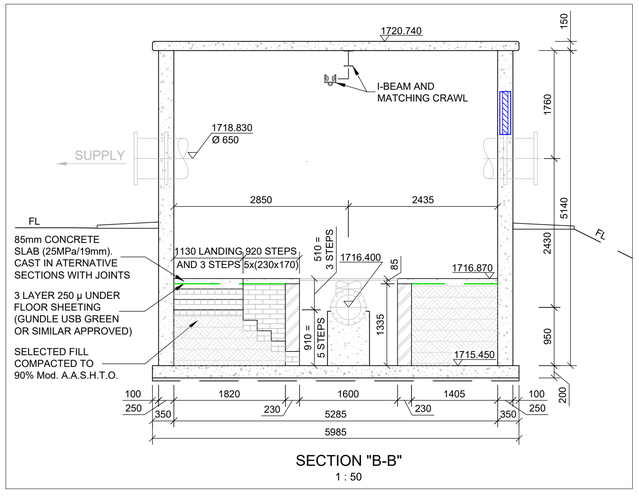
CRAWL BEAM SECTION
1 : 5



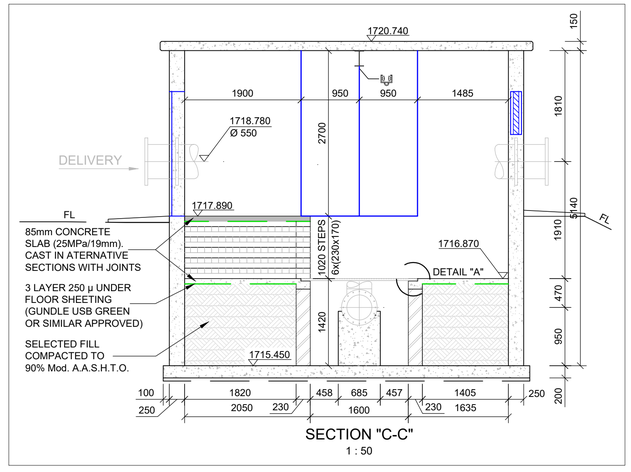
DETAIL "A"
(RECTAGRID SUPPORT)



SECTION "A-A"
1 : 50



SECTION "B-B"
1 : 50



SECTION "C-C"
1 : 50

NOTES

1. BRICKS ARE TO BE ENGINEERING BRICKS TO SANS 227 OR SIMILAR AND TO BE APPROVED BY THE ENGINEER.
2. BRICKS TO BE WELL WETTED AND BONDED WITH 1 : 3 CEMENT : SAND MORTAR WITH SOLIDLY FILLED JOINTS NOT EXCEEDING 10mm. EXPOSED SURFACES TO BE POINTED AS WORK PROGRESSES.
3. ALL BRICKWORK TO BE ENGLISH BOND AND SEMI-FACE FINISH ON EXPOSED SURFACES.
4. ALL REINFORCEMENT TO BE APPROVED BY ENGINEER BEFORE ANY CONCRETE SHALL BE CAST.
5. MIN. CONCRETE COVER 40mm UNLESS SHOWN OTHERWISE.
6. ALL CONCRETE SHALL BE 25 MPa/19mm UNLESS SHOWN OTHERWISE.
7. ALL CAST IN SITU CONCRETE MUST BE CURED FOR AT LEAST 72 HOURS BY COVERING WITH POLYTHENE SHEETING OR BY SPRAYING THE SURFACE WITH WHITE PIGMENTED CURING COMPOUND ACCORDING TO MAASTHO M145 AT A RATE OF 0,3 l/m² WITH A MECHANICAL SPRAYER AFTER SURFACE TEXTURE HAS BEEN APPLIED.
8. ALL STRUCTURAL STEELWORK TO BE PAINTED WITH AN APPROVED COLOUR EPOXY-TAR PAINT TO SABS 801 IN ACCORDANCE WITH SANS 1200 H.
9. ALL STEELWORK TO BE ACCORDING TO BS 4360. ALL WELDING TO BE ACCORDING TO SANS 044.
10. JUNCTION BOX DETAILS ARE AS FOR MANHOLES WITHOUT 600mm HOLE IN REINFORCED CONCRETE SLAB.

DEPARTMENT DEPARTEMENT	APPROVED GOEDGEKEUR	DESIGNATION AMPSBENAMING	DATE DATUM

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GESERTIFISEER AS SOOS GEBOU TEKENING

FOR NMS CivEc ____ FOR NMS JOHANNESBURG WATER (PTY) LTD ____

DATE DATUM ____ DATE DATUM ____

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PRIVATE DRAWING No
PRIVAAT TEKENING Nr
1440a/WT/Det07RR

0 APPROVED GOEDGEKEUR
Pr. Eng. No.
Pr. Ing. Nr. 800162
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CITY OF JOHANNESBURG

CONSTRUCTION OF A 2.25MI WATER TOWER IN ROBERTVILLE WITH ASSOCIATED PIPE AND PUMP WORKS

VALVE ROOM DETAILS

DESIGN MANAGER
BESTUURDER ONTWERP
DATE DATUM

SCALE SKAAL
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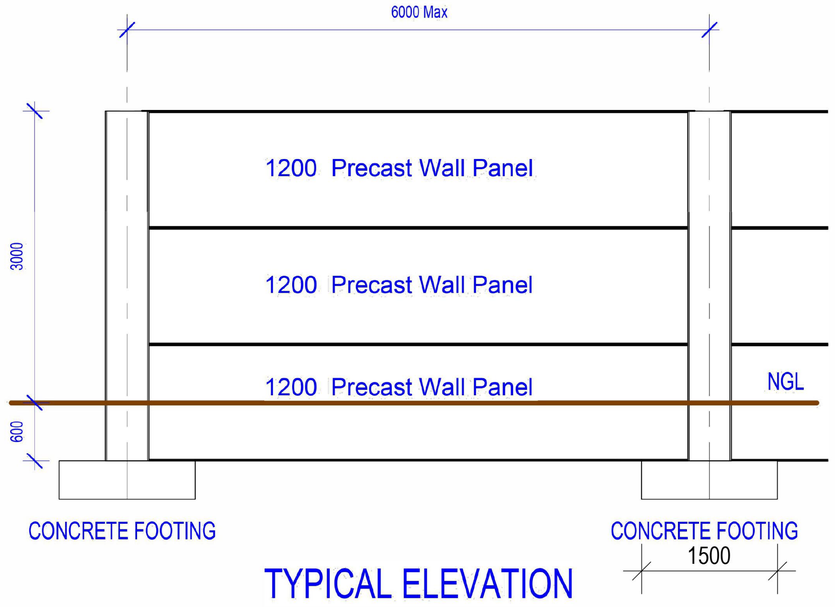
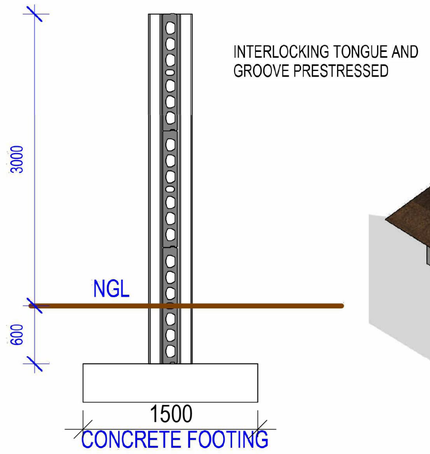
AMENDMENTS - WYSIGINGS	APPROVED GOEDGEKEUR	DATE DATUM

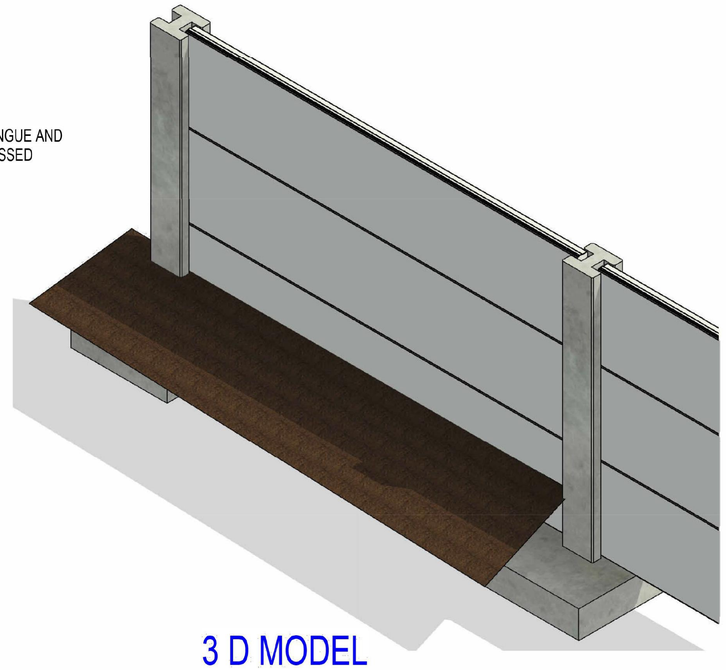
DRAWING No. TEKENING Nr. 1440a/WT/DET07RR
Revision 0
FILE No LEER Nr



TYPICAL ELEVATION



TYPICAL SECTION



3 D MODEL

REINFORCED CONCRETE DRAWING NOTES:

1. REFER TO ALL RELEVANT DRAWINGS AND SPECIFICATIONS, DO NOT SCALE ANY DIMENSIONS.
2. WHERE DISCREPANCIES OCCUR BETWEEN THE PROJECT DRAWINGS OR SPECIFICATIONS, THESE SHOULD BE REPORTED IMMEDIATELY TO THE EMPLOYER'S AGENT.
3. ALL DIMENSIONS AND LEVELS TO BE CHECKED ON SITE
4. MINIMUM BEARING CAPACITY 100 Mpa

FOUNDATIONS:

1. EXCAVATIONS FOR FOUNDATIONS TO BE APPROVED BY THE ENGINEER BEFORE CONCRETE IS CAST.
2. ALL FOUNDATIONS TO BE BUILT ON FIRM IN-SITU SOIL (NOT ON FILL).
3. IN-SITU FOUNDATION MATERIAL IS NOT BE COMPACTED.

CONCRETE:

1. CONCRETE CHARACTERISTIC 28-DAY STRENGTH:
   UNLESS OTHERWISE SPECIFIED:

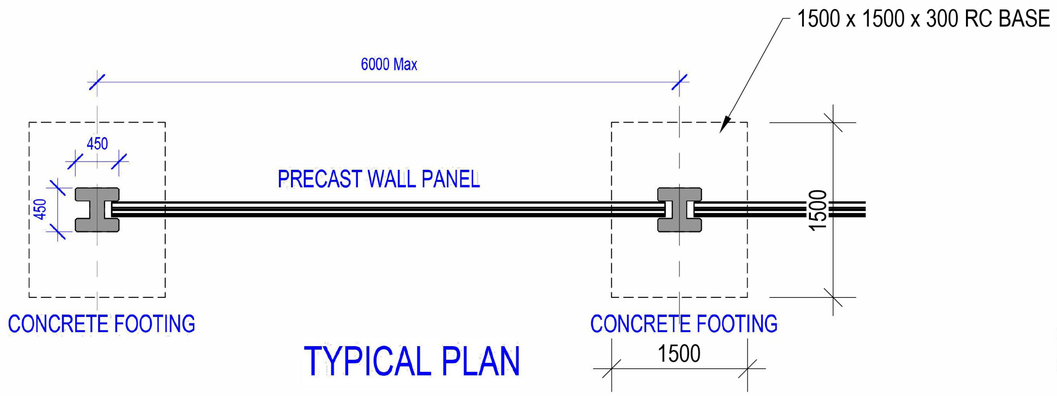
FOUNDATIONS	30 MPa
COLUMNS AND WALLS	30 / 13 MPa
SURFACE BEDS	30 MPa
SUSPENDED SLABS	30 MPa

2. NOMINAL CONCRETE AGGREGATE SIZE... 19mm
3. ALL CONCRETE TO BE PROPERLY CURED BY KEEPING SURFACES CONTINUOUSLY DAMP FOR AT LEAST 7 DAYS AFTER CASTING.

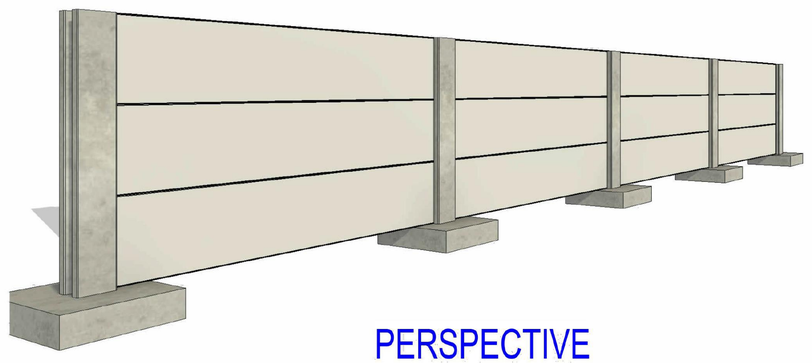
REINFORCEMENT:

1. ALL REINFORCEMENT TO BE CHECKED AND APPROVED BY THE ENGINEER BEFORE CASTING CONCRETE.
2. THE ENGINEER IS TO BE NOTIFIED OF A REINFORCEMENT INSPECTION 24HRS PRIOR.
3. BENDING SCHEDULES AND FIXING DETAILS FOR REINFORCEMENT ARE GIVEN ON SEPARATE SHEETS.
4. MINIMUM COVER TO REINFORCING:

COLUMNS AND SLABS	40mm
FOUNDATIONS	40mm
WALLS	40mm



TYPICAL PLAN



PERSPECTIVE

DEPARTMENT DEPARTEMENT	APPROVED GOEDGEKEUR	DESIGNATION AMPSBENAMING	DATE DATUM

CERTIFIED AS BUILT DRAWING
GESERTIFISEER AS SOOS GEBOU TEKENING

FOR NMS CivEc _____ DATE DATUM _____

FOR NMS JOHANNESBURG WATER (PTY) LTD _____ DATE DATUM _____

CONSULTING ENGINEERS - RAADGEWENDE INGENIEURS

CivEc
Civil Engineering Consultants

MODDERFONTEIN
PHONE (011) 608-1004
FAX (011) 608-1005

PRETORIA
PHONE (012) 998-5463
FAX (012) 998-3619

PRIVATE DRAWING No
PRIVAAT TEKENING Nr
1440a/WT/Det08RR

APPROVED GOEDGEKEUR
Pr. Eng. No.
Pr. Ing. Nr. 800162
DATE -DATUM

SURVEYED - OPGEMEET		
DESIGNED - ONTWERP	FT	
DRAWN - GETEKEN	FT	
CHECKED - NAGESIEN	HL	
SERVICES CHECKED DIENSLEIDINGS NAGESIEN		
GEOTECHNICAL INVESTIGATION GEOTEGNIESE ONDERSOEK		
SERVITUDES SERWITUTE		
APPROVED GOEDGEKEUR		

Johannesburg Water

JOHANNESBURG WATER SOC LTD
TURBINE HALL
65 NTEMI PILISO STREET
NEWTOWN
JOHANNESBURG
2113
TEL: +27 (0)11 688 1400
FAX: +27 (0)11 688 1528

Joburg
a world class African city

CONSTRUCTION OF A 2.25MI WATER TOWER IN ROBERTVILLE
FENCE DETAILS

DESIGN MANAGER
BESTUURDER ONTWERP
DATE DATUM

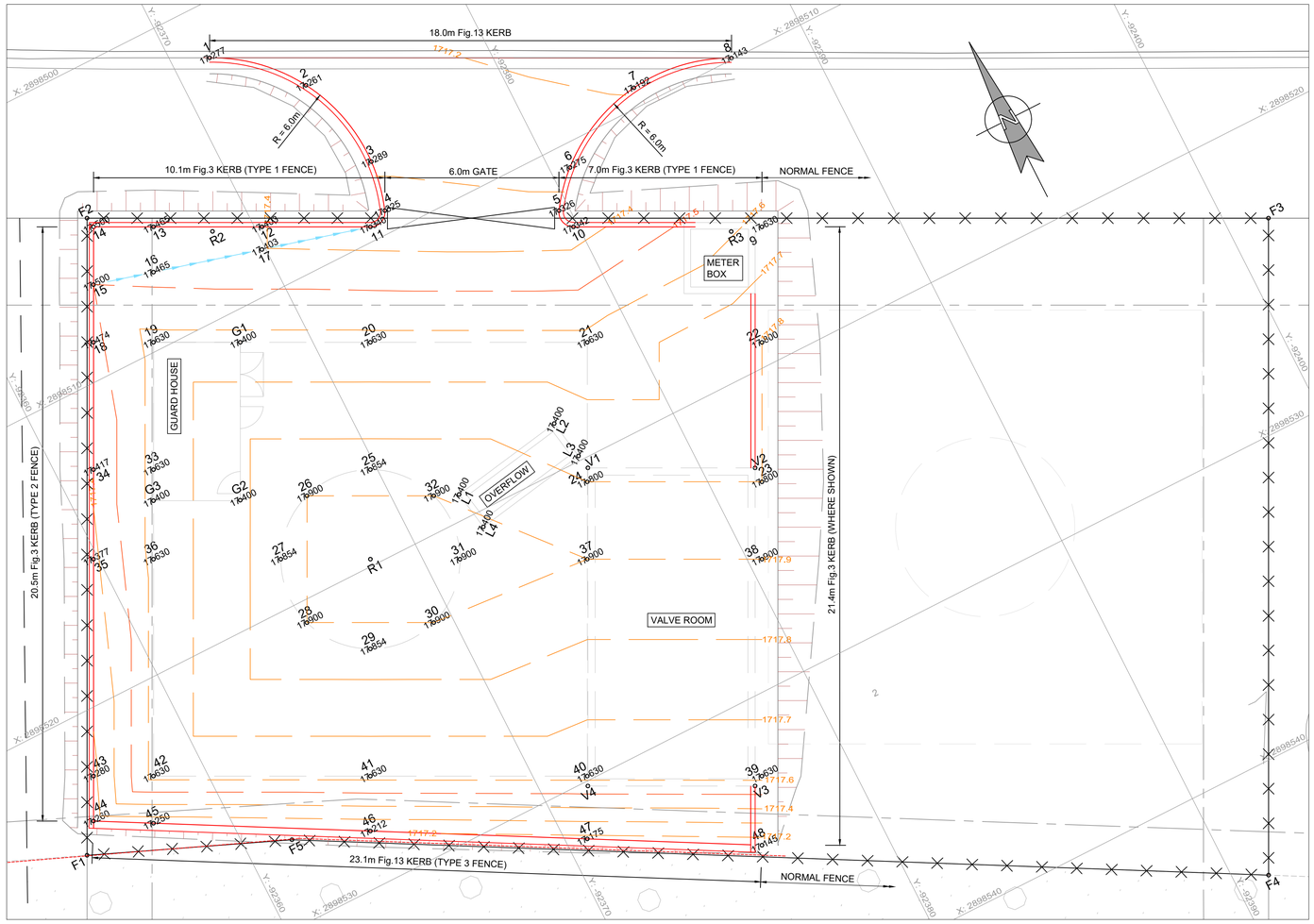
SCALE SKAAL
AS SHOWN

AMENDMENTS - WYSIGINGS	APPROVED GOEDGEKEUR	DATE DATUM

DRAWING No. TEKENING Nr. 1440a/WT/DET08RR
Revision 0

PROJECT NO: JW14040R

ISSUED FOR: TENDER



EARTHWORKS LAYOUT PLAN
1 : 100

POINT CO-ORDINATES (PAVED AREA FINAL LEVELS)

CO-ORDINATES WG 27°

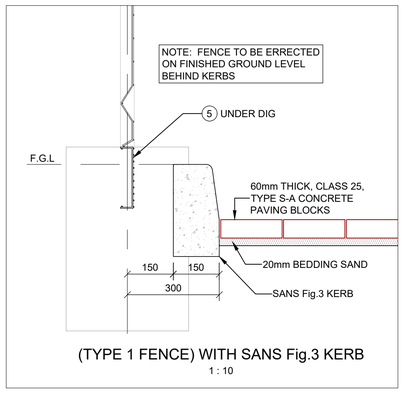
POINT	Y	X	ELEVATION
PAVED AREA			
1	-92371.255	2898501.790	1717.277
2	-92373.805	2898504.141	1717.261
3	-92374.627	2898507.519	1717.289
4	-92374.274	2898509.241	1717.325
5	-92379.523	2898512.163	1717.326
6	-92380.664	2898510.803	1717.275
7	-92383.879	2898509.347	1717.192
8	-92387.355	2898509.950	1717.143
9	-92385.657	2898515.633	1717.630
10	-92379.643	2898512.587	1717.342
11	-92373.578	2898509.516	1717.340
12	-92370.232	2898507.821	1717.403
13	-92366.886	2898506.127	1717.465
14	-92365.035	2898505.189	1717.500
15	-92364.132	2898506.974	1717.500
16	-92366.178	2898507.524	1717.465
17	-92369.878	2898508.520	1717.403
18	-92363.230	2898508.753	1717.474
19	-92365.081	2898509.691	1717.630
20	-92371.772	2898513.079	1717.630
21	-92378.462	2898516.468	1717.630
22	-92383.852	2898519.198	1717.800
23	-92381.673	2898523.499	1717.800
24	-92376.283	2898520.772	1717.800
25	-92369.784	2898517.005	1717.854
26	-92367.418	2898516.824	1717.900
27	-92365.617	2898518.370	1717.854
28	-92365.437	2898520.735	1717.900
29	-92366.982	2898522.536	1717.854
30	-92369.348	2898522.716	1717.900
31	-92371.148	2898521.171	1717.900
32	-92371.329	2898518.805	1717.900
33	-92363.093	2898513.616	1717.630
34	-92361.241	2898512.678	1717.417
35	-92359.841	2898515.444	1717.377
36	-92361.692	2898516.381	1717.630
37	-92375.074	2898523.159	1717.900
38	-92380.463	2898525.889	1717.900
39	-92377.074	2898532.579	1717.630
40	-92371.685	2898529.850	1717.630
41	-92364.994	2898526.461	1717.630
42	-92358.303	2898523.072	1717.630
43	-92356.451	2898522.134	1717.280
44	-92355.749	2898523.520	1717.260
45	-92357.568	2898524.525	1717.250
46	-92364.136	2898528.156	1717.212
47	-92370.704	2898531.787	1717.175
48	-92375.995	2898534.711	1717.145

POINT CO-ORDINATES (SETTING OUT POINTS)

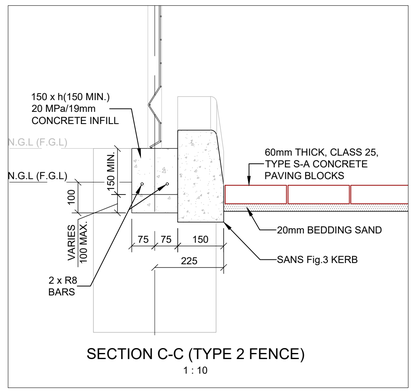
CO-ORDINATES WG 27°

POINT	Y	X	ELEVATION
GUARD HOUSE			
19	-92365.081	2898509.691	1717.400
G1	-92367.757	2898511.046	1717.400
G2	-92365.291	2898515.916	1717.400
G3	-92362.607	2898514.575	1717.400
OVERFLOW			
L1	-92372.134	2898519.159	1717.400
L2	-92376.174	2898518.457	1717.400
L3	-92376.414	2898519.837	1717.400
L4	-92372.374	2898520.538	1717.400
VALVE ROOM			
V1	-92376.519	2898520.350	
V2	-92381.679	2898522.964	
V3	-92376.708	2898532.778	
V4	-92371.548	2898530.165	
CENTRE POINTS			
R1	-92368.383	2898519.770	
R2	-92368.636	2898507.188	
R3	-92384.638	2898515.299	
FENCE			
F1	-92355.013	2898524.475	
F2	-92364.970	2898504.820	
F3	-92401.420	2898523.280	
F4	-92391.158	2898543.550	
F5	-92361.580	2898527.200	

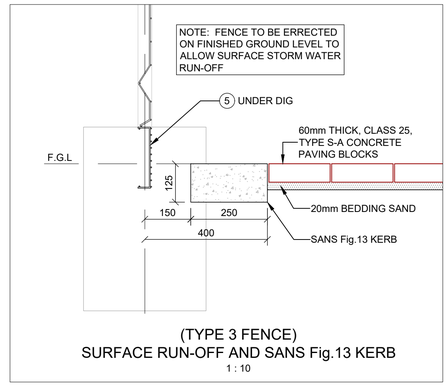
NOTE: FOR FENCE DETAIL SEE DRAWING NUMER 1440a/WA/DET10RR



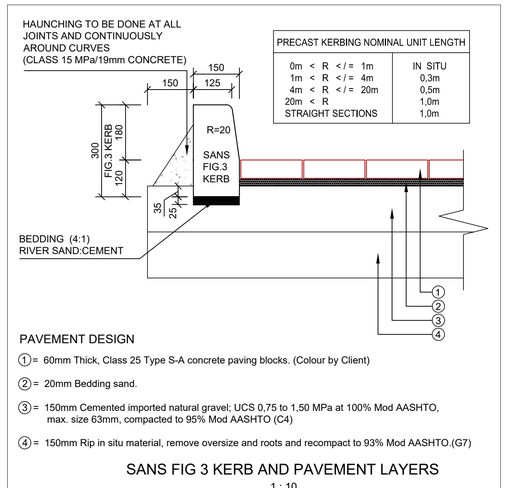
(TYPE 1 FENCE) WITH SANS Fig.3 KERB
1 : 10



SECTION C-C (TYPE 2 FENCE)
1 : 10



(TYPE 3 FENCE)
SURFACE RUN-OFF AND SANS Fig.13 KERB
1 : 10



PRECAST KERBING NOMINAL UNIT LENGTH	
0m < R </= 1m	IN SITU
1m < R </= 4m	0,3m
4m < R </= 20m	0,5m
20m < R	1,0m
STRAIGHT SECTIONS	1,0m

PAVEMENT DESIGN

① = 60mm Thick, Class 25 Type S-A concrete paving blocks. (Colour by Client)

② = 20mm Bedding sand.

③ = 150mm Cemented imported natural gravel; UCS 0,75 to 1,50 MPa at 100% Mod AASHTO, max. size 63mm, compacted to 95% Mod AASHTO (C4)

④ = 150mm Rip in situ material, remove oversize and roots and recompact to 93% Mod AASHTO.(G7)

SANS FIG 3 KERB AND PAVEMENT LAYERS
1 : 10

DEPARTMENT DEPARTEMENT	APPROVED GOEDGEKEUR	DESIGNATION AMPSBENAMING	DATE DATUM

CERTIFIED AS BUILT DRAWING
GESERTIFISEER AS SOOS GEBOU TEKENING

FOR NMS CivEc ____ DATE DATUM ____

FOR NMS JOHANNESBURG WATER (PTY) LTD ____ DATE DATUM ____

CONSULTING ENGINEERS - RAADGEWENDE INGENIEURS

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PRIVATE DRAWING No
PRIVAAT TEKENING Nr
1440a/WT/LAY01RR

SURVEYED - OPGEMEET		
DESIGNED - ONTWERP	FJH	
DRAWN - GETEKEN	JN	
CHECKED - NAGESIEN	HL	
SERVICES CHECKED		
DIENSLEIDINGS NAGESIEN		
GEOTECHNICAL INVESTIGATION		
GEOTEGNIESE ONDERSOEK		
SERVITUDES		
SERWITUTE		
APPROVED GOEDGEKEUR		

1 APPROVED GOEDGEKEUR Pr. Eng. No. 800162 Pr. Ing. Nr. DATE DATUM

JOHANNESBURG WATER (SOC) LTD

Johannesburg Water

17 HARRISON STREET
MARSHALLTOWN
2107

TEL: (011) 688-1400
FAX: (011) 688-1529

CITY OF JOHANNESBURG

CONSTRUCTION OF A 2.25MI WATER TOWER IN ROBERTVILLE WITH ASSOCIATED PIPE AND PUMP WORKS

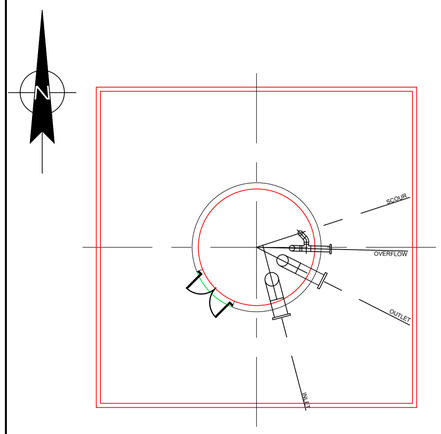
TOWER SITE AND EARTHWORKS PLAN

DESIGN MANAGER
BESTUURDER ONTWERP
DATE DATUM

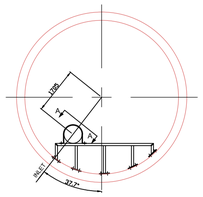
SCALE SKAAL
AS SHOWN

AMENDMENTS - WYSIGINGS	APPROVED GOEDGEKEUR	DATE DATUM

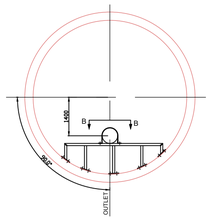
DRAWING No. TEKENING Nr. 1440a/WT/LAY01RR
Revision A
FILE No LEER Nr



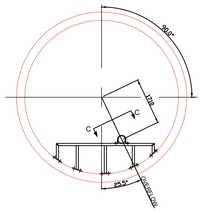
BASE LAYOUT
SCALE 1:100



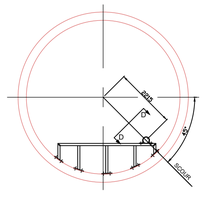
GROUND FLOOR LAYOUT
SCALE 1:85



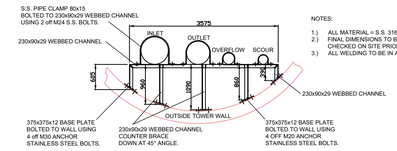
GROUND FLOOR LAYOUT
SCALE 1:85



GROUND FLOOR LAYOUT
SCALE 1:85



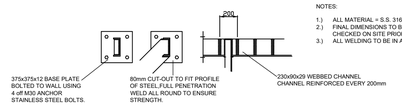
GROUND FLOOR LAYOUT
SCALE 1:85



NOTES:

1.) ALL MATERIAL = S.S. 316 TO BE USED.
2.) FINAL DIMENSIONS TO BE VERIFIED, MEASURED AND CHECKED ON SITE PRIOR TO FABRICATION.
3.) ALL WELDING TO BE IN ACCORDANCE TO SABS SANDARDS.

PIPE SUPPORT DETAIL
SCALE 1:50



NOTES:

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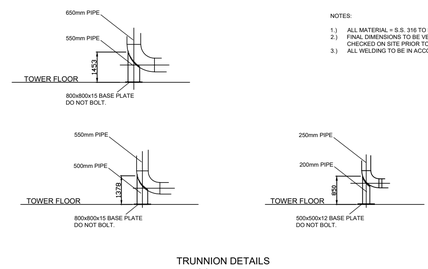
3.) ALL WELDING TO BE IN ACCORDANCE TO SABS SANDARDS.

WEBBED REINFORCED CHANNEL
SCALE 1:20



NOTES:

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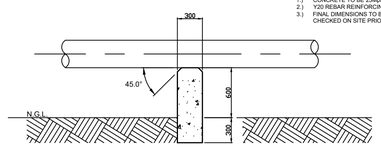
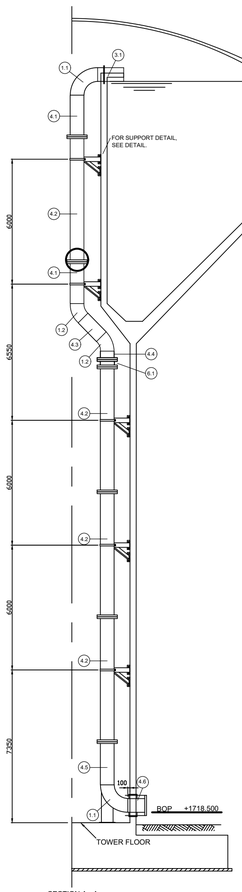
TRUNNION DETAILS
SCALE 1:50



NOTES:

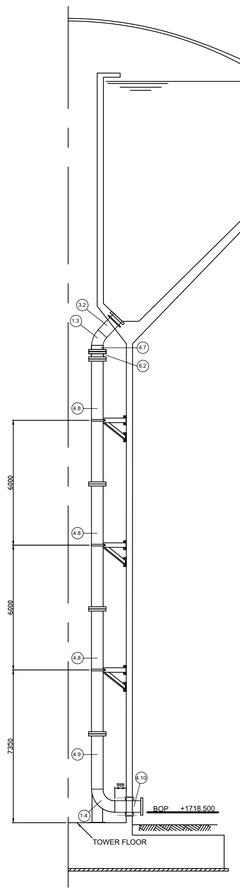
1.) CONCRETE TO BE 25Mpa STRENGTH.
2.) Y20 REBAR REINFORCING AT 200mm INTERVALS.
3.) FINAL DIMENSIONS TO BE VERIFIED, MEASURED AND CHECKED ON SITE PRIOR TO FABRICATION.

SLEEPER DETAIL
SCALE 1:50



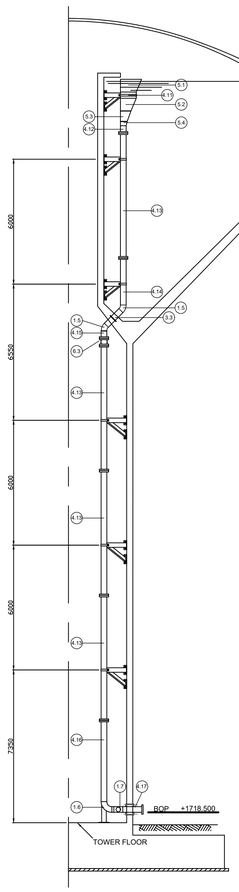
SECTION A - A

650mm INLET
SCALE 1:100



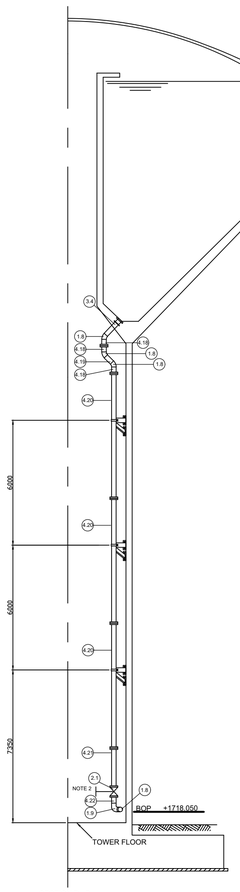
SECTION B - B

550mm OUTLET
SCALE 1:100



SECTION C - C

250mm OVERFLOW
SCALE 1:100



SECTION D - D

200mm SCOUR
SCALE 1:100

DEPARTMENT DEPARTEMENT	APPROVED GOEDGEKEUR	DESIGNATION AMPSBENAMING	DATE DATUM

CERTIFIED AS BUILT DRAWING
GESERTIFISEER AS SOOS GEBOU TEKENING

FOR _____ FOR _____
NMS CivEc NMS JOHANNESBURG WATER (PTY) LTD

DATE _____ DATE _____
DATUM DATUM

CONSULTING ENGINEERS - RAADGEWENDE INGENIEURS

CivEc
Civil Engineering Consultants

MODDERFONTEIN
PHONE (011) 608-1004
FAX (011) 608-1005

PRETORIA
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PRIVATE DRAWING No
PRIVAAT TEKENING Nr
1440aWTPIPE01RR
0
APPROVED GOEDGEKEUR
Pr. Eng. No.
Pr. Ing. Nr. 800162
DATE DATUM

SURVEYED - OPGEMEET		
DESIGNED - ONTWERP	HL	
DRAWN - GETEKEN	JN	
CHECKED - NAGESIEN	HL	
SERVICES CHECKED DIENSLEIDINGS NAGESIEN		
GEOTECHNICAL INVESTIGATION GEOTEGNIESE ONDERSOEK		
SERVITUDES SERWITUTE		
APPROVED GOEDGEKEUR		

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TRADUNA HOUSE
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CITY OF JOHANNESBURG

CONSTRUCTION OF A 2.25MI WATER TOWER IN ROBERTVILLE WITH ASSOCIATED PIPE AND PUMP WORKS

TOWER PIPEWORK LAYOUT (Sheet 1 of 4 sheets)

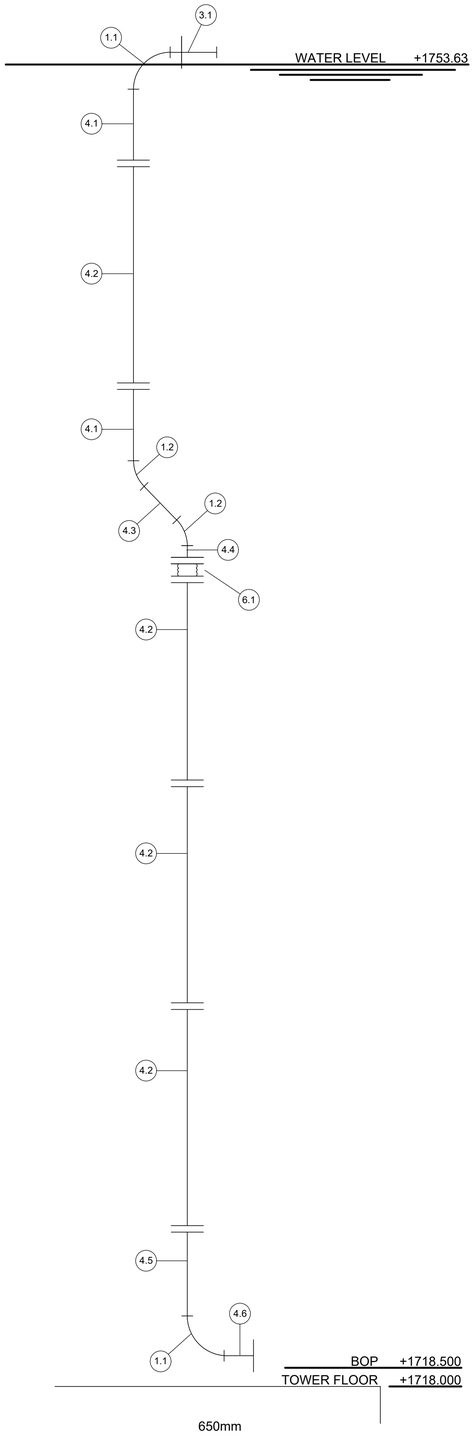
DESIGN MANAGER
BESTUURDER ONTWERP
DATE DATUM

SCALE SKAAL
AS SHOWN

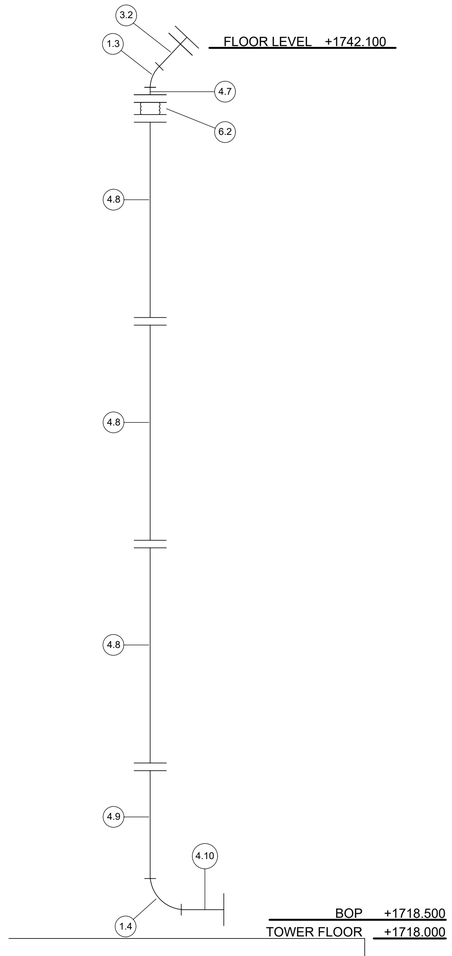
AMENDMENTS - WYSIGINGS	APPROVED GOEDGEKEUR	DATE DATUM

DRAWING No.
TEKENING Nr.
1440a/WT/PIPE01RR
0

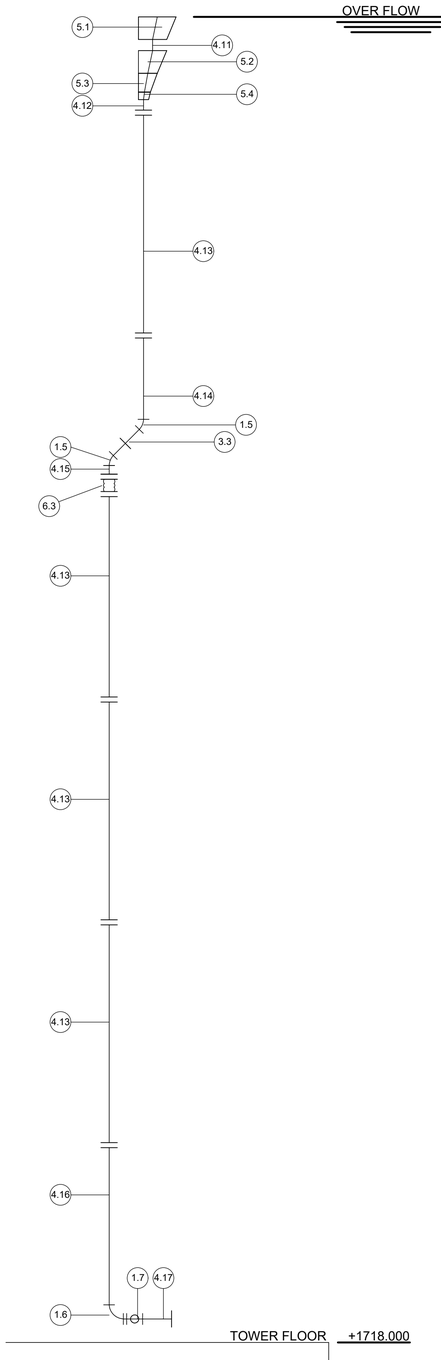
FILE No
LEER Nr



650mm
INLET
SCALE 1:100



550mm
OUTLET
SCALE 1:100



250mm
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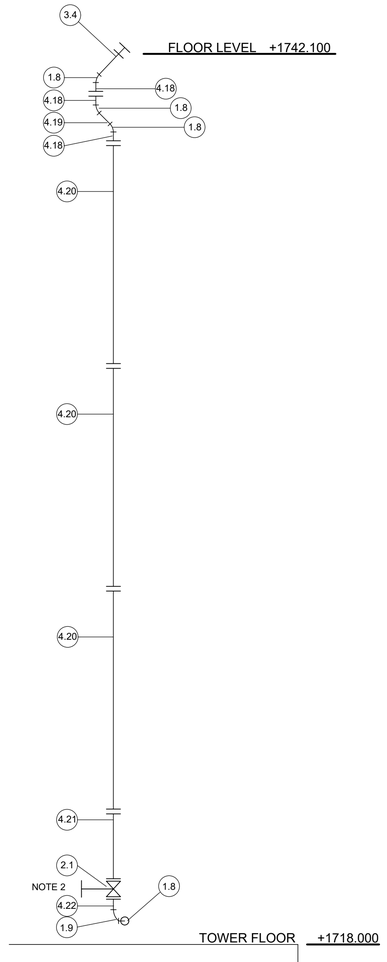

200mm
SCOUR
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DEPARTMENT DEPARTEMENT	APPROVED GOEDGEKEUR	DESIGNATION AMPSBENAMING	DATE DATUM

CERTIFIED AS BUILT DRAWING
GESERTIFISEER AS SOOS GEBOU TEKENING

FOR NMS CivEc _____ DATE DATUM _____

FOR NMS JOHANNESBURG WATER (PTY) LTD _____ DATE DATUM _____

CONSULTING ENGINEERS - RAADGEWENDE INGENIEURS

CivEc
Civil Engineering Consultants

MODDERFONTEIN
PHONE (011) 608-1004
FAX (011) 608-1005

PRETORIA
PHONE (012) 998-5463
FAX (112) 998-3619

PRIVATE DRAWING No
PRIVAAT TEKENING Nr
1440aWTPIPE02RR

APPROVED
GOEDGEKEUR
Pr. Eng. No.
Pr. Ing. Nr.
DATE -DATUM
800162

SURVEYED - OPGEMEET			
DESIGNED - ONTWERP	HL		
DRAWN - GETEKEN	JN		
CHECKED - NAGESIEN	HL		
SERVICES CHECKED DIENSLEIDINGS NAGESIEN			
GEOTECHNICAL INVESTIGATION GEOTEGNIESE ONDERSOEK			
SERVITUDES SERVITUTE			
APPROVED GOEDGEKEUR			

JOHANNESBURG WATER (PTY) LTD

Johannesburg Water

TRADUNA HOUSE
58 FREDERICK STREET
MARSHALLTOWN
2107

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CITY OF JOHANNESBURG

CONSTRUCTION OF A 2.25MI WATER TOWER IN ROBERTVILLE WITH ASSOCIATED PIPE AND PUMP WORKS

TOWER PIPEWORK LAYOUT (Sheet 2 of 4 sheets)

DESIGN MANAGER
BESTUURDER ONTWERP
DATE DATUM

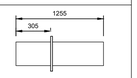
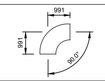
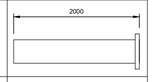
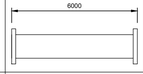
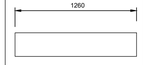
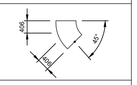
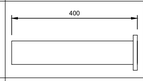
SCALE SKAAL
AS SHOWN

AMENDMENTS - WYSIGINGS	APPROVED GOEDGEKEUR	DATE DATUM

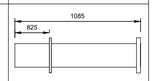
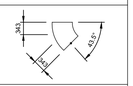
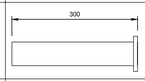
DRAWING No, TEKENING Nr.
1440a/WT/PIPE02RR /0

FILE No
LEER Nr

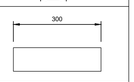
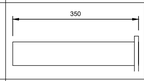
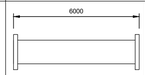
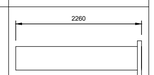
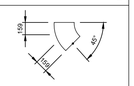
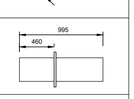
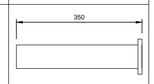
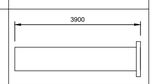
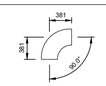
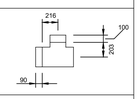
SCHEDULE OF PIPE SPECIALS FOR ROBERTVILLE WATER TOWERS. 650mm INLET.

MARK	DIA.	QTY.	MAT.	DESCRIPTION	SKETCH
3.1	650	1	SS Gr 316	PIPE 1255mm LONG PUDDLE FLANGE 305mm FROM LEFT WELD, 870 DIA.	
1.1	650	2	SS Gr 316	90DEG. BEND.	
4.1	650	2	SS Gr 316	PIPE 2000mm LONG. SLIP-ON FLANGE ONE END.	
4.2	650	4	SS Gr 316	PIPE 6000mm LONG. SLIP-ON FLANGE BOTH ENDS.	
4.3	650	1	SS Gr 316	PIPE 1260mm LONG SLIP-ON FLANGE ONE END.	
1.2	650	2	SS Gr 316	45DEG. BEND.	
4.4	650	1	SS Gr 316	PIPE 400mm LONG SLIP-ON FLANGE ONE END.	
4.5	650	1	SS Gr 316	PIPE 2075mm LONG SLIP-ON FLANGE ONE END.	
4.6	650	1	SS Gr 316	PIPE 2520mm LONG SLIP-ON FLANGE ONE END.	
6.1	650	1	SS Gr 316	SS 304 EXPANSION JOINT	

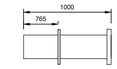
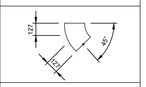
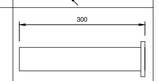
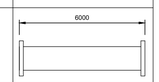
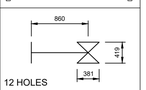
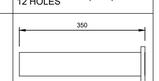
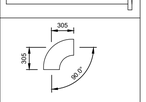
SCHEDULE OF PIPE SPECIALS FOR ROBERTVILLE WATER TOWERS. 550mm OUTLET.

MARK	DIA.	QTY.	MAT.	DESCRIPTION	SKETCH
3.2	550	1	SS Gr 316	PIPE 1085mm LONG SLIP-ON FLANGE ONE END. PUDDLE FLANGE 825mm FROM LEFT WELD, 800 DIA	
1.3	550	1	SS Gr 316	43.5DEG. BEND.	
4.7	550	1	SS Gr 316	PIPE 300mm LONG SLIP-ON FLANGE ONE END.	
4.8	550	3	SS Gr 316	PIPE 6000mm LONG. SLIP-ON FLANGE BOTH ENDS.	
4.9	550	1	SS Gr 316	PIPE 2660mm LONG SLIP-ON FLANGE ONE END.	
1.4	550	1	SS Gr 316	90DEG. BEND.	
4.10	550	1	SS Gr 316	PIPE 1350mm LONG SLIP-ON FLANGE ONE END.	
6.2	550	1	SS Gr 316	SS 304 EXPANSION JOINT	

SCHEDULE OF PIPE SPECIALS FOR ROBERTVILLE WATER TOWERS. 250mm OVERFLOW.

MARK	DIA.	QTY.	MAT.	DESCRIPTION	SKETCH
5.1	1000 x 750	1	SS Gr 316	1000mm X 750mm ECCENTRIC REDUCER	
4.11	750	1	SS Gr 316	PIPE 300mm LONG	
5.2	750 x 500	1	SS Gr 316	750mm X 500mm ECCENTRIC REDUCER	
5.3	500 x 300	1	SS Gr 316	500mm X 300mm ECCENTRIC REDUCER	
5.4	300 x 250	1	SS Gr 316	300mm X 250mm ECCENTRIC REDUCER	
4.12	250	1	SS Gr 316	PIPE 350mm LONG SLIP-ON FLANGE ONE END.	
4.13	250	4	SS Gr 316	PIPE 6000mm LONG. SLIP-ON FLANGE BOTH ENDS.	
4.14	250	1	SS Gr 316	PIPE 2260mm LONG SLIP-ON FLANGE ONE END.	
1.5	250	2	SS Gr 316	45DEG. BEND.	
3.3	250	1	SS Gr 316	PIPE 995mm LONG PUDDLE FLANGE 460mm FROM LEFT WELD, 410 DIA.	
4.15	250	1	SS Gr 316	PIPE 350mm LONG SLIP-ON FLANGE ONE END.	
4.16	250	1	SS Gr 316	PIPE 3900mm LONG SLIP-ON FLANGE ONE END.	
1.6	250	1	SS Gr 316	90DEG. BEND.	
1.7	250 x 200	1	SS Gr 316	250 x 200 REDUCING TEE. 100mm PIPE ON 200DIA END. 90mm PIPE ON 250DIA LEFT END.	
4.17	250	1	SS Gr 316	PIPE 980mm LONG SLIP-ON FLANGE ONE END.	
6.3	250	1	SS Gr 316	SS 304 EXPANSION JOINT	

SCHEDULE OF PIPE SPECIALS FOR ROBERTVILLE WATER TOWERS. 200mm SCOUR(DRAIN)

MARK	DIA.	QTY.	MAT.	DESCRIPTION	SKETCH
3.4	200	1	SS Gr 316	PIPE 1000mm LONG SLIP-ON FLANGE ONE END. PUDDLE FLANGE 765mm FROM BOTTOM WELD, 345 DIA.	
1.8	200	3	SS Gr 316	45DEG. BEND.	
4.18	200	4	SS Gr 316	PIPE 300mm LONG SLIP-ON FLANGE ONE END.	
4.19	200	1	SS Gr 316	PIPE 415mm LONG	
4.20	200	3	SS Gr 316	PIPE 6000mm LONG. SLIP-ON FLANGE BOTH ENDS.	
4.21	200	1	SS Gr 316	PIPE 1875mm LONG SLIP-ON FLANGE BOTH ENDS.	
2.1	200	1	SS Gr 316	TABLE16 GATE VALVE	 12 HOLES
4.22	200	1	SS Gr 316	PIPE 350mm LONG SLIP-ON FLANGE ONE END.	
1.9	200	1	SS Gr 316	90DEG. BEND.	

NOTES:

1.) FINAL DIMENSIONS TO BE VERIFIED, MEASURED AND CHECKED ON SITE PRIOR TO FABRICATION.
2.) HANDWHEEL ORIENTATION TO BE DONE ON SITE TO AVOID CLASH WITH STAIRCASE.
3.) FOR ALL FLANGES & VALVE SIZES REFER TO SANS 1123, TABLE:16.
4.) ALL EXPANSION JOINTS TO BE SS304 AXIAL BELLOWS C/W MILD STEEL PIPE ENDS WITH 300lbs FLANGES.
5.) ALL BENDS TO BE STANDARD LONG RADIUS, MONOLITHIC BENDS.

DEPARTMENT DEPARTEMENT	APPROVED GOEDGEKEUR	DESIGNATION AMPSBENAMING	DATE DATUM

CERTIFIED AS BUILT DRAWING
GESERTIFISEER AS SOOS GEBOU TEKENING

FOR NMS CivEc _____ DATE DATUM _____

FOR NMS JOHANNESBURG WATER (PTY) LTD _____ DATE DATUM _____

CONSULTING ENGINEERS - RAADGEWENDE INGENIEURS

CivEc Civil Engineering Consultants
MODDERFONTEIN PHONE (011) 608-1004 FAX (011) 608-1005
PRETORIA PHONE (012) 998-5463 FAX (112) 998-3619

PRIVATE DRAWING No PRIVAAT TEKENING Nr: 1440aWTPIPE03RR
APPROVED GOEDGEKEUR Pr. Eng. No. Pr. Ing. Nr. 800162 DATE-DATUM

SURVEYED - OPGEMEET		
DESIGNED - ONTWERP	HL	
DRAWN - GETEKEN	JN	
CHECKED - NAGESIEN	HL	
SERVICES CHECKED		
DIENSLEIDINGS NAGESIEN		
GEOTECHNICAL INVESTIGATION		
GEOTEGNIESE ONDERSOEK		
SERVITUDES		
SERWITUTE		
APPROVED		
GOEDGEKEUR		

JOHANNESBURG WATER (PTY) LTD
Johannesburg Water
TRADUNA HOUSE
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CITY OF JOHANNESBURG

CONSTRUCTION OF A 2.25MI WATER TOWER IN ROBERTVILLE WITH ASSOCIATED PIPE AND PUMP WORKS

TOWER PIPEWORK LAYOUT (Sheet 3 of 4 sheets)

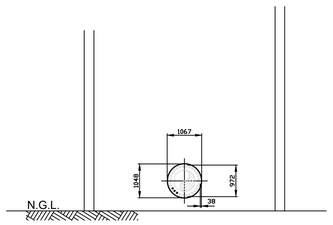
DESIGN MANAGER BESTUURDER ONTWERP DATE DATUM

SCALE SKAAL AS SHOWN

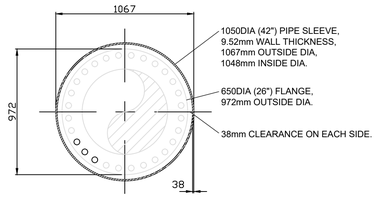
AMENDMENTS - WYSIGINGS	APPROVED GOEDGEKEUR	DATE DATUM

DRAWING No, TEKENING Nr. 1440a/WT/PIPE03RR 0

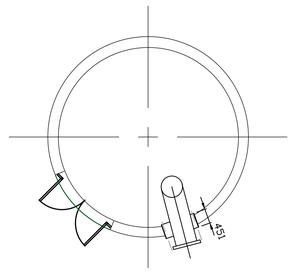
FILE No LEER Nr



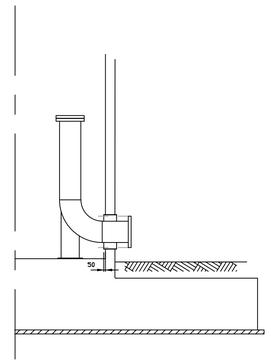
SLEEVE DETAIL FOR
650DIA PIPE
SCALE 1:50



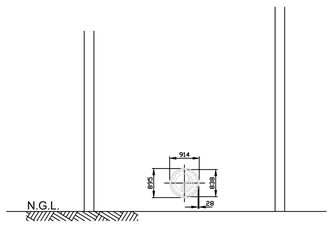
ENLARGED SLEEVE DETAIL
FOR 650DIA PIPE
SCALE 1:25



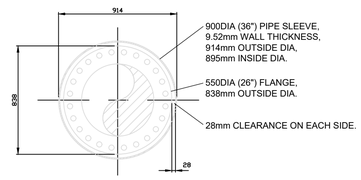
PLAN VIEW OF SLEEVE DETAIL
FOR 650DIA PIPE
SCALE 1:50



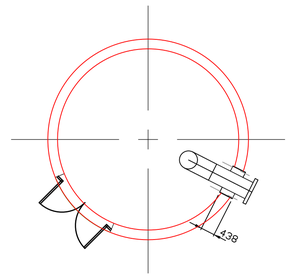
THROUGH WALL DETAIL OF SLEEVE
FOR 650DIA PIPE
SCALE 1:50



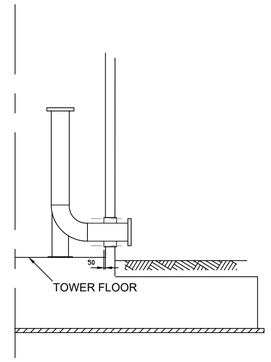
SLEEVE DETAIL FOR
550DIA PIPE
SCALE 1:50



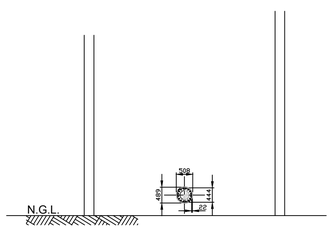
ENLARGED SLEEVE DETAIL
FOR 550DIA PIPE
SCALE 1:25



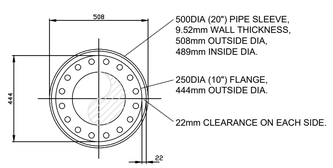
PLAN VIEW OF SLEEVE DETAIL
FOR 550DIA PIPE
SCALE 1:50



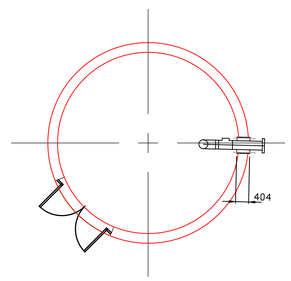
THROUGH WALL DETAIL OF SLEEVE
FOR 550DIA PIPE
SCALE 1:50



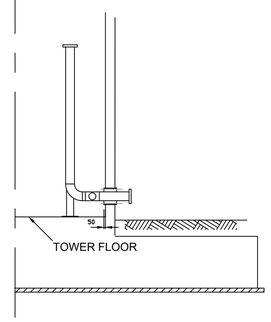
SLEEVE DETAIL FOR
250DIA PIPE
SCALE 1:50



ENLARGED SLEEVE DETAIL
FOR 250DIA PIPE
SCALE 1:25



PLAN VIEW OF SLEEVE DETAIL
FOR 250DIA PIPE
SCALE 1:50



THROUGH WALL DETAIL OF SLEEVE
FOR 250DIA PIPE
SCALE 1:50

DEPARTMENT DEPARTEMENT	APPROVED GOEDGEKEUR	DESIGNATION AMPSBENAMING	DATE DATUM

CERTIFIED AS BUILT DRAWING
GESERTIFISEER AS SOOS GEBOU TEKENING

FOR _____ FOR _____
NMS CivEc NMS JOHANNESBURG WATER (PTY) LTD

DATE _____ DATE _____
DATUM DATUM

CONSULTING ENGINEERS - RAADGEWENDE INGENIEURS

CivEc
Civil Engineering Consultants

MODDERFONTEIN
PHONE (011) 608-1004
FAX (011) 608-1055

PRETORIA
PHONE (012) 998-5463
FAX (112) 998-3619

SURVEYED - OPGEMEET			
DESIGNED - ONTWERP	HL		
DRAWN - GETEKEN	JN		
CHECKED - NAGESIEN	HL		
SERVICES CHECKED			
DIENSLEIDINGS NAGESIEN			
GEOTECHNICAL INVESTIGATION			
GEOTEGNIESE ONDERSOEK			
SERVITUDES			
SERVITUTE			
APPROVED			
GOEDGEKEUR			

PRIVATE DRAWING No
PRIVAAT TEKENING Nr
1440aWTPIPE04RR

0 APPROVED GOEDGEKEUR
Pr. Eng. No.
Pr. Ing. Nr. 800162
DATE -DATUM

JOHANNESBURG WATER (PTY) LTD

Johannesburg Water

TRADUNA HOUSE
58 FREDERICK STREET
MARSHALLTOWN
2107

TEL: (011) 688-1400
FAX: (011) 688-1529

CITY OF JOHANNESBURG

CONSTRUCTION OF A 2.25MI WATER TOWER IN ROBERTVILLE WITH ASSOCIATED PIPE AND PUMP WORKS

TOWER PIPEWORK LAYOUT (Sheet 4 of 4 sheets)

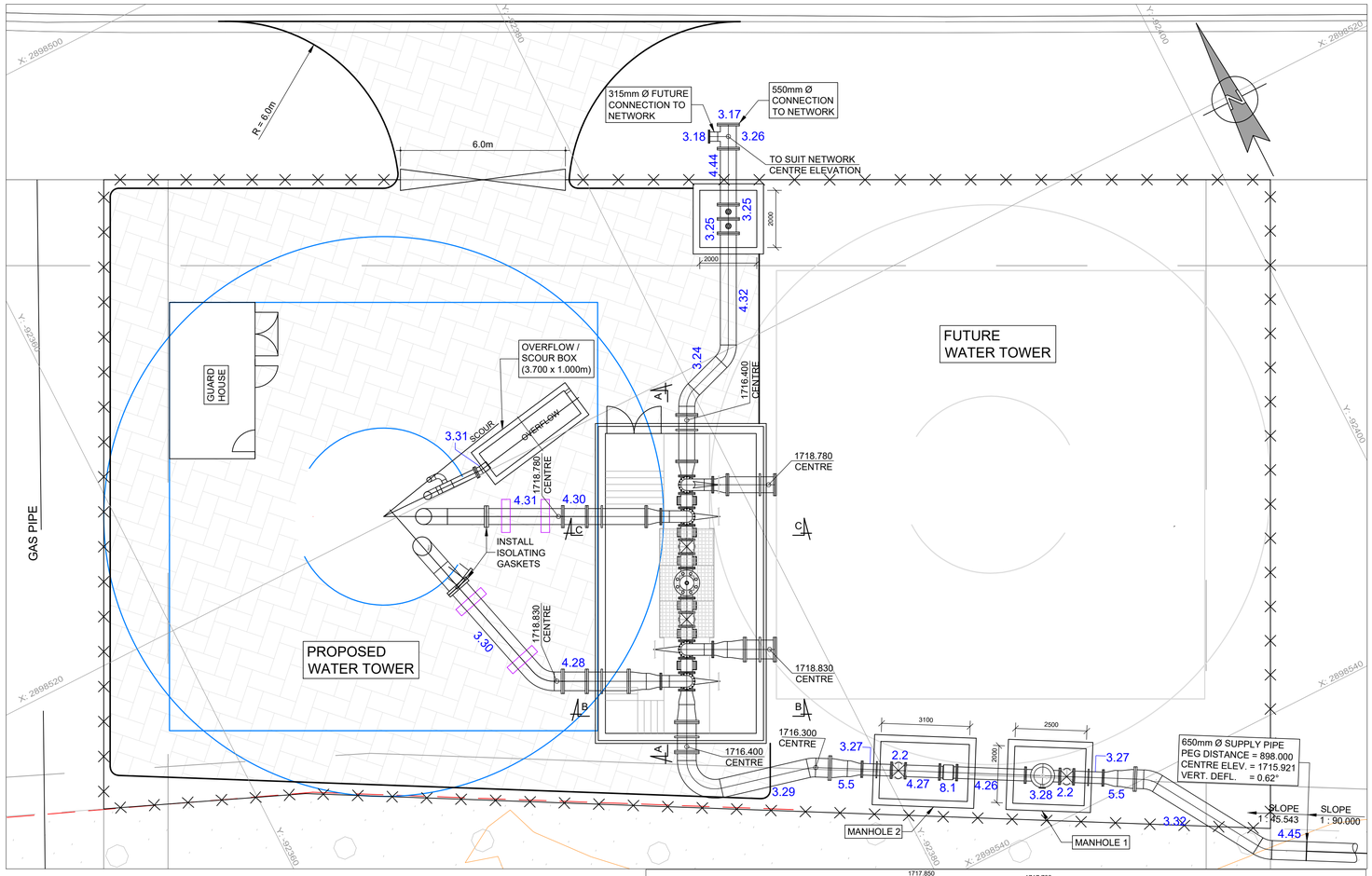
DESIGN MANAGER
BESTUURDER ONTWERP
DATE DATUM

SCALE SKAAL
AS SHOWN

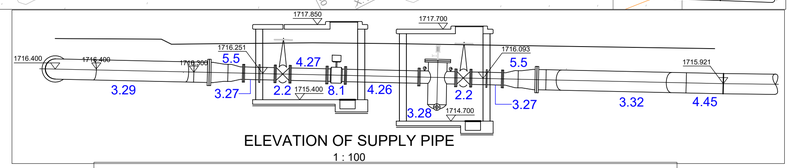
AMENDMENTS - WYSIGINGS	APPROVED GOEDGEKEUR	DATE DATUM

DRAWING No.
TEKENING Nr.
1440a/WT/PIPE04RR
0

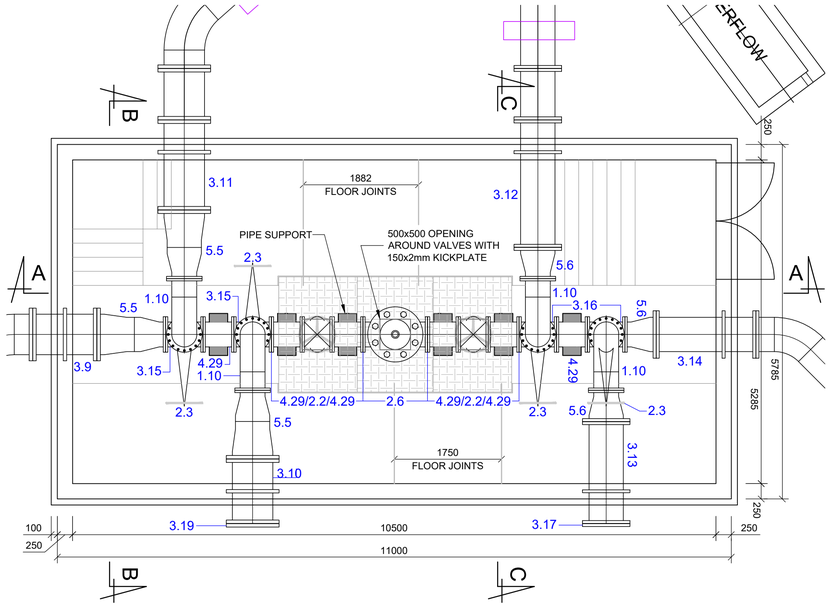
FILE No
LEER Nr



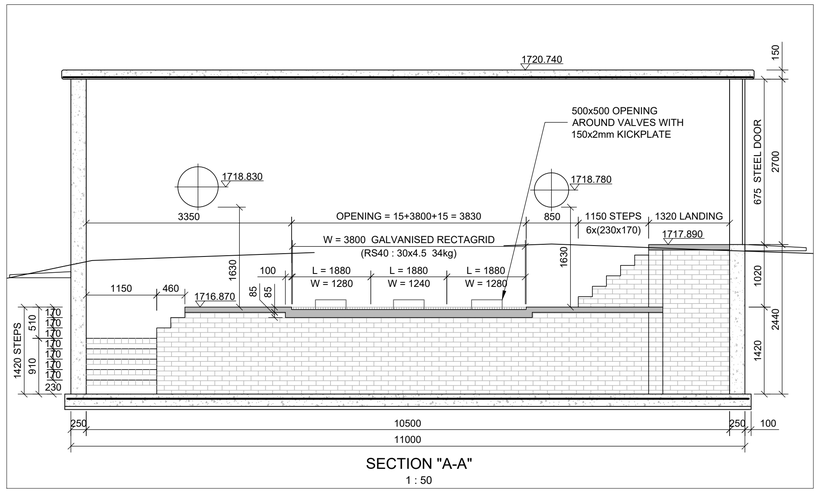
PIPE LAYOUT ON SITE
1 : 100



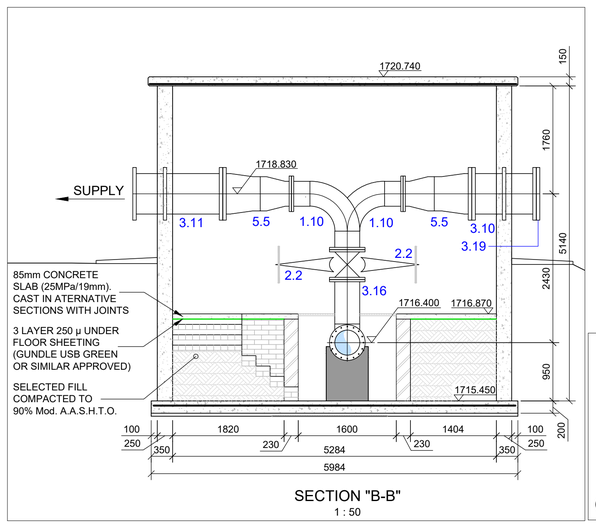
ELEVATION OF SUPPLY PIPE
1 : 100



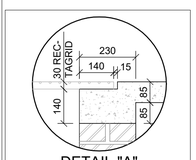
PIPE SPECIALS IN VALVE ROOM
1 : 50



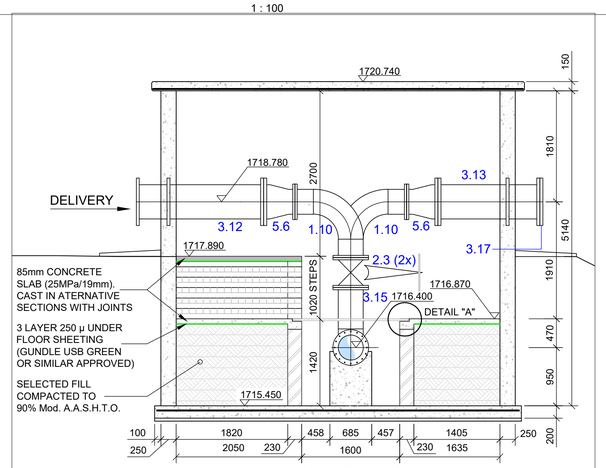
SECTION "A-A"
1 : 50



SECTION "B-B"
1 : 50



DETAIL "A"
(RECTAGRID SUPPORT)



SECTION "C-C"
1 : 50

NOTES:
1. FOR DETAIL ON PIPE SPECIALS SEE DRAWING 1440a/WA/Pipe6
2. FOR VALVE ROOM CHAMBER DETAIL SEE DRAWING 1440a/WA/Det08

NOTES

1. THE EXACT POSITION OF EXISTING PIPES AND OTHER SERVICES TO BE DETERMINED ON SITE WITH SPECIAL ATTENTION WHEN CONNECTING TO EXISTING FACILITIES.
2. ALL PIPE DIMENSIONS TO BE FINALISED ON SITE.
3. ALL FLANGES TO BE ACCORDING TO SANS 1123-1977 TABLE 1600/3 WITH SPECIAL CARE TO DRILLING PATTERNS OF VALVES, ETC.
4. C.A.F. FLANGE GASKETS MUST BE USED.
5. M.S.= MILD STEEL AND S.S.= STAINLESS STEEL.
6. STEEL GRADE, PIPE LINING AND COVER TO BE ACCORDING TO SPECIFICATION.
7. THE POSITION OF THE PIPE SUPPORTS TO BE FINALISED ON SITE.
8. ANCHOR BLOCKS TO BE CAST SYMMETRICALLY AROUND CENTRE LINE OF FITTINGS AND AGAINST UNDISTURBED EXCAVATION. (15MPa/19mm CONCRETE TO BE USED)
9. COUPLINGS AND FLANGES SHALL BE LEFT CLEAR OF CONCRETE
10. ALL CONCRETE SHALL BE CLASS 25MPa/19mm UNLESS SHOWN OTHERWISE.
11. FLANGED JOINTS AND V.J. COUPLINGS, EXPOSED TO SOIL, TO BE WRAPPED WITH DENSO TAPE.

DEPARTMENT DEPARTEMENT	APPROVED GOEDGEKEUR	DESIGNATION AMPSBENAMING	DATE DATUM

CERTIFIED AS BUILT DRAWING
GESERTIFISEER AS SOOS GEBOU TEKENING

FOR NMS CivEc ____ FOR NMS JOHANNESBURG WATER (PTY) LTD ____

DATE DATUM ____ DATE DATUM ____

CONSULTING ENGINEERS - RAADGEWENDE INGENIEURS
CivEc Civil Engineering Consultants
MODDERFONTEIN
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PRIVATE DRAWING No PRIVAAT TEKENING Nr: 1440a/WT/PIPE05RR

SURVEYED - OPGEMEET			
DESIGNED - ONTWERP	HL		
DRAWN - GETEKEN	JN		
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SERVICES CHECKED			
DIENSLEIDINGS NAGESIEN			
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SERWITUTE			
APPROVED GOEDGEKEUR Pr. Eng. No. Pr. Ing. Nr.: 800162 DATE - DATUM			
APPROVED GOEDGEKEUR			

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CITY OF JOHANNESBURG

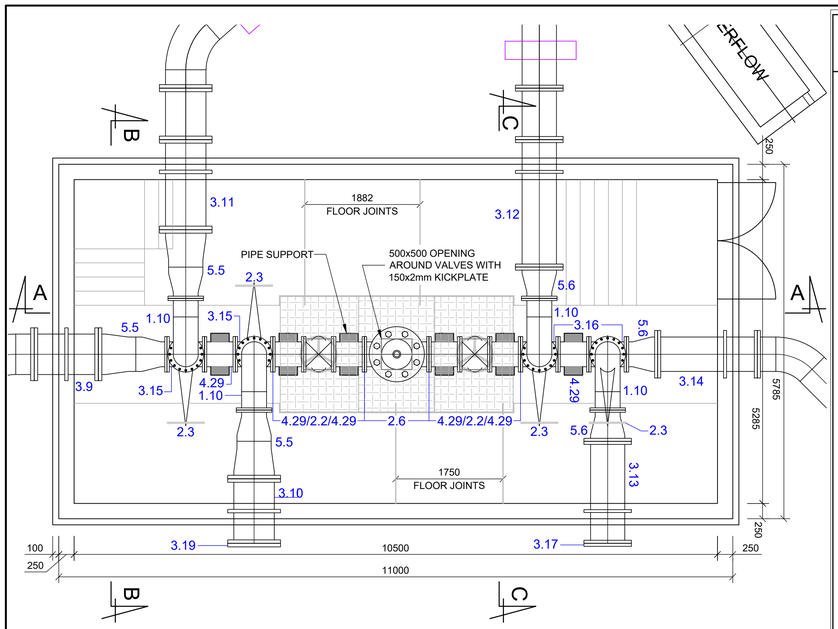
CONSTRUCTION OF A 2.25MI WATER TOWER IN ROBERTVILLE WITH ASSOCIATED PIPE AND PUMP WORKS

PIPES ON TOWER SITE (Sheet 1 of 2 Sheets)

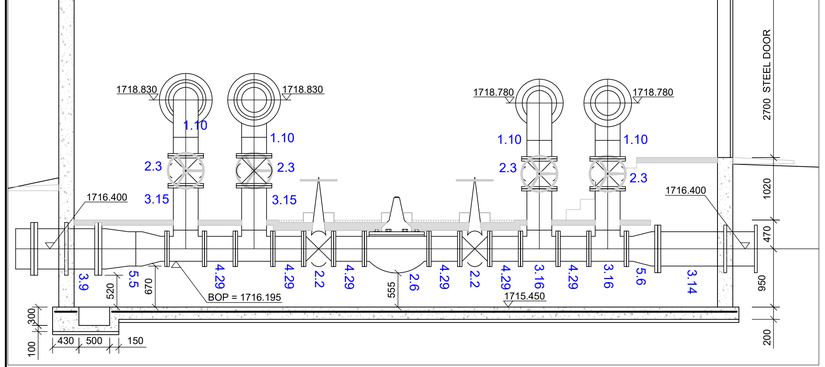
DESIGN MANAGER	SCALE SKAAL	AMENDMENTS - WYSIGINGS	APPROVED GOEDGEKEUR	DATE DATUM
BESTUURDER ONTWERP	AS SHOWN			
DATE DATUM				

DRAWING No. TEKENING Nr. 1440a/WT/PIPE05RR Revision 0

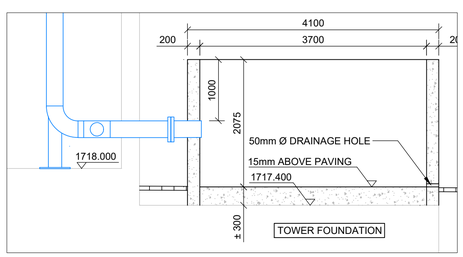
FILE No LEER Nr



PIPE SPECIALS IN VALVE ROOM
1 : 50



VALVE ROOM SECTION ALONG MAIN PIPE CENTRELINE
1 : 50



OVERFLOW BOX DETAIL
1 : 50

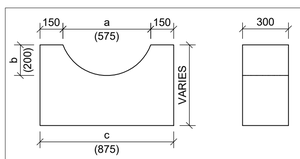
ITEM	NUMBER	DESCRIPTION OF ITEMS	DETAIL SKETCH
1		**BENDS**	
1.10	4	400mm Ø, 90° M.S. LONG RADIUS BEND WITH 300 FLANGED CUT LENGTHS ON BOTH ENDS. (C-E=910 WITH R=610)	
2		**VALVES**	
2.2	4	400mm Ø PN16, DUCTILE IRON TO SANS 936 SG 42, ANTI CLOCKWISE CLOSING, GEARBOX OPERATED (6:1 RATIO), VERTICALLY INSTALLED WEDGE TYPE GATE VALVE. VALVE ACCORDING TO SANS 664 AND TO COMPLY WITH JOHANNESBURG WATER SPECIFICATION. FLANGES TO BE FLAT FACED TO SANS 1123 TABLE 1600 (F-F=470). (VOSA "D" SERIES OR SIMILAR APPROVED)	
2.3	4	400mm Ø PN16, DUCTILE IRON TO SANS 936 SG 42, ANTI CLOCKWISE CLOSING, GEARBOX OPERATED (6:1 RATIO), HORIZONTALLY INSTALLED WEDGE TYPE GATE VALVE. VALVE ACCORDING TO SANS 664 AND TO COMPLY WITH JOHANNESBURG WATER SPECIFICATION. FLANGES TO BE FLAT FACED TO SANS 1123 TABLE 1600 (F-F=470). (VOSA "D" SERIES OR SIMILAR APPROVED)	
2.6	1	400mm Ø, EPOXY COATED, DUCTILE IRON, FLANGED PN16, COMBINATION CONTROL VALVE. THE VALVE SHOULD BE ABLE TO CONTROL THE FLOW TO 500 l/s AT 30m PRESSURE. ("CLA-VAL 100-01 SERIES" OR SIMILAR APPROVED)	
3		**GENERAL**	
3.9	1	650mm Ø M.S. FULLY FLANGED CUT LENGTH WITH PUDDLE FLANGE. (E-E=1045)	
3.10	1	650mm Ø M.S. FULLY FLANGED CUT LENGTH WITH PUDDLE FLANGE. (E-E=1050)	
3.11	1	650mm Ø M.S. FULLY FLANGED CUT LENGTH WITH PUDDLE FLANGE. (E-E=1465)	
3.12	1	550mm Ø M.S. FULLY FLANGED CUT LENGTH WITH PUDDLE FLANGE. (E-E=2075)	
3.13	1	550mm Ø M.S. FULLY FLANGED CUT LENGTH WITH PUDDLE FLANGE. (E-E=1660)	
3.14	1	550mm Ø M.S. FULLY FLANGED CUT LENGTH WITH PUDDLE FLANGE. (E-E=1625)	
3.15	2	400mm Ø M.S. FULLY FLANGED EQUAL TEE WITH A 725 LONG SPOOL PIECE ADDED TO THE BRANCH END. (F-F=610 AND C-F=1030)	
3.16	2	400mm Ø M.S. FULLY FLANGED EQUAL TEE WITH A 675 LONG SPOOL PIECE ADDED TO THE BRANCH END. (F-F=610 AND C-F=980)	
3.17	2	BLANK FLANGE TO SEAL 550mm Ø END.	
3.18	1	BLANK FLANGE TO SEAL 300mm Ø END.	
3.19	1	BLANK FLANGE TO SEAL 650mm Ø END.	
3.24	1	550mm Ø M.S. 45° LONG RADIUS S-BEND WITH A 300 FLANGED CUT LENGTH ON ONE END, THE OTHER BEVEL EDGED. THE LENGTH OF THE CENTRE SPOOL PIECE IS DEPENDANT ON THE ELEVATION DIFFERENCE BETWEEN THE TWO PIPES AND IS TO BE FINALISED ON SITE. (BEND C-E=347 AND R=838)	
3.25	2	550mm Ø M.S. FULLY FLANGED CUT LENGTH. (E-E=500) A FLANGED CUT LENGTH AND BLANK FLANGE ADDED TO ACCOMODATE THE ELECTROMACNETIC INSERTION FLOWMETER. ALL DIMENSIONS TO BE VARIFIED WITH THE SUPPLIER	
3.26	1	550x300mm Ø M.S. TEE WITH A 300x300mm Ø CUT LENGTH ADDED. ALL ENDS FLANGED	
3.27	2	400mm Ø M.S. FULLY FLANGED CUT LENGTH WITH PUDDLE FLANGE. (E-E=1030)	
3.28	1	400mm Ø M.S. FULLY FLANGED POT OR BASKET STRAINER WITH 500mm Ø BODY AND A 100mm Ø TANGENTIAL FLANGED SCOUR OUTLET. THE BODY SHOULD HAVE A FULL SIZED (500mm Ø) FLANGED INSPECTION OPENING COVERED WITH A BLANK FLANGE, IT MUST INCLUDE A HEAVY DUTY GRADE 304 STAINLESS STEEL REMOVABLE CARTRIDGE WITH A COMBINED OPEN AREA OF 0.377m². THE STRAINER SHOULD BE EQUIPED WITH A DN50 PN25 AIR RELEASE AND VACUUM BREAK VALVE, INSTALLED ON TOP OF THE COVER (VENT-O-MAT RBX2511 OR SIMILAR APPROVED). IT SHOULD ALSO HAVE INLET AND OUTLET GLYCERINE FILLED PRESSURE GAUGES AND GAUGE COCKS. (F-F = ±1200)	

PLAN / SIDE VIEW - TO BE UPDATED DURING CONSTRUCTION

PLAN SIDE VIEW

PLAN SIDE VIEW

ITEM	NUMBER	DESCRIPTION OF ITEMS	DETAIL SKETCH
3.29	1	650mm Ø M.S. LONG RADIUS S-BEND WITH FLANGED CUT LENGTHS OF 300 AND 500 ADDED TO ENDS AND A CENTRE SPOOL PIECE OF 3120. THE TWO BENDS ARE 15° AND 102.94° (R = 991) (PIPE SLOPE = 1 : 45.543)	
3.30	1	650mm Ø, 37.65° M.S. LONG RADIUS BEND WITH FLANGED CUT LENGTHS ON BOTH ENDS. (C-E=300 AND 3966 WITH R=991)	
3.31	1	250mm Ø, 11.25° S.S. KINK WITH ONE END FLANGED, OTHER END BUTT ENDED	
3.32	1	650mm Ø M.S. LONG RADIUS S-BEND WITH A FLANGED CUT LENGTH OF 300 ADDED TO ONE END, THE OTHER END BEVEL EDGED. A CENTRE SPOOL PIECE OF 4140 IS ADDED. BOTH BENDS ARE 29.68° (R = 991)	
4		**CUT LENGTHS**	
4.26	1	400mm Ø M.S. FULLY FLANGED CUT LENGTH. (E-E=2400)	
4.27	1	400mm Ø M.S. FULLY FLANGED CUT LENGTH. (E-E=1200)	
4.28	1	650mm Ø M.S. FULLY FLANGED CUT LENGTH. (E-E=835)	
4.29	6	400mm Ø M.S. FULLY FLANGED CUT LENGTH. (E-E=500)	
4.30	1	550mm Ø M.S. FULLY FLANGED CUT LENGTH. (E-E=835)	
4.31	1	550mm Ø M.S. FULLY FLANGED CUT LENGTH. (E-E=2675)	
4.32	1	550mm Ø M.S. ONE FLANGED OTHER END BEVEL EDGED CUT LENGTH. (E-E=3910)	
4.44	1	550mm Ø M.S. FULLY FLANGED CUT LENGTH. (E-E=1955)	
4.45	1	650mm Ø M.S. BEVEL EDGED CUT LENGTH, ONE END MITRED FOR VERTICAL DEFLECTION ANGLE 0.62°. (E-E=1210)	
5		**REDUCERS**	
5.5	5	650x400mm Ø M.S. FULLY FLANGED CONCENTRIC REDUCER. TWO STANDARD REDUCERS 660x559 AND 559x406 JOINED. (E-E=1118)	
5.6	3	550x400mm Ø M.S. FULLY FLANGED CONCENTRIC REDUCER. (E-E=508)	
8		**WATER METERS**	
8.1	1	400mm Ø PN16, FULL BORE ELECTROMAGNETIC FLOW METER AND TRANSMITTER, COMPLETE WITH TERMINAL BOX,CONDUTES, CABLES, ETC. ALL TO JOHANNESBURG WATER SPECIFICATION. [SITRANS FM MAGFLO MAG 5100 W FLOW SENSOR AND SITRANS FM MAG 5000 TRANSMITTER BY SIEMENS, USED FOR DIMENSIONS] (F-F=600) Johannesburg Water Specification 1. Meter must be ISO7145, ISO4064|OIML R49 approved and must be delivered with a certificate of calibration. 2. Meter flanges must comply with SABS1123 Table 1600/3. 3. Meter must have a dual pulse (forward and reverse), 4-20mA and must have a Modbus output standard (HART optional add-on). 4. Meter must be able to be installed horizontally and vertically. 5. Meter must be PN16. 6. Meter must be able to work up to 70°C. 7. The meter needs to have an error of less than 2%. 8. The enclosure sensor must be IP68 or higher. 9. Meters must comply with Johannesburg Water's metering policy. 10. The meter must be able to measure forward and reverse flow.	
8.2	1	INSERTION ELECTROMAGNETIC FLOW METER AND TRANSMITTER, COMPLETE WITH TERMINAL BOX,CONDUTES, CABLES, ETC. ALL TO JOHANNESBURG WATER SPECIFICATION. 1 . Meter must be ISO7145, ISO4064|OIML R49 approved and must be delivered with a certificate of calibration. 2. Meter must have a dual pulse (forward and reverse), 4-20mA and a MODBUS output standard (HART optional add-on). 3. Meter must be inserted perpendicular to the pipe, with the ability to remove the meter in relation to the chamber dimensions. 4. Meter must be able to work up to 50°C. 5. The meter needs to have an error of less than 5%. 6. The probe needs to be able to handle 20bar of pressure. 7. Meters must comply with Johannesburg Water's metering policy. 8. Meter Housing needs to be IP68. 9. Meter needs to have a digital display showing totals. 10. Meter needs to be able to run off 24V DC. Where meter is installed at a remote site, the meter must be battery operated. 11. Meter needs to be able to record forward and reverse flow.	



NOMINAL Ø	OUTSIDE Ø	a	b	c
700	711	670	240	970
650	660	620	220	920
600	610	575	200	875
550	559	525	185	825
500	508	480	170	880
400	406	385	140	685
300	324	280	80	580
250	273	255	90	555

DETAIL OF PIPE SUPPORTS (600 NOMINAL Ø SHOWN)
1:20

NOTE:
FOR VALVE ROOM CHAMBER DETAIL
SEE DRAWING 1440a/WA/Det08

NOTES

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DEPARTMENT DEPARTEMENT	APPROVED GOEDGEKEUR	DESIGNATION AMPSBENAMING	DATE DATUM

CERTIFIED AS BUILT DRAWING
GESERTIFISEER AS SOOS GEBOU TEKENING

FOR _____ _____ _____ FOR _____ _____ _____
NMS CivEc NMS JOHANNESBURG WATER (PTY) LTD

DATE _____ _____ DATE _____ _____
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CONSULTING ENGINEERS - RAADGEWENDE INGENIEURS

CivEc
Civil Engineering Consultants

MODDERFONTEIN
PHONE (011) 608-1004
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PRETORIA
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PRIVATE DRAWING No
PRIVAAT TEKENING Nr
1440a/WT/PIPE06RR

0 APPROVED GOEDGEKEUR Pr. Eng. No.
Pr. Ing. Nr. 800162
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CITY OF JOHANNESBURG

CONSTRUCTION OF A 2.25MI WATER TOWER IN ROBERTVILLE WITH ASSOCIATED PIPE AND PUMP WORKS

PIPES ON TOWER SITE (Sheet 2 of 2 Sheets)

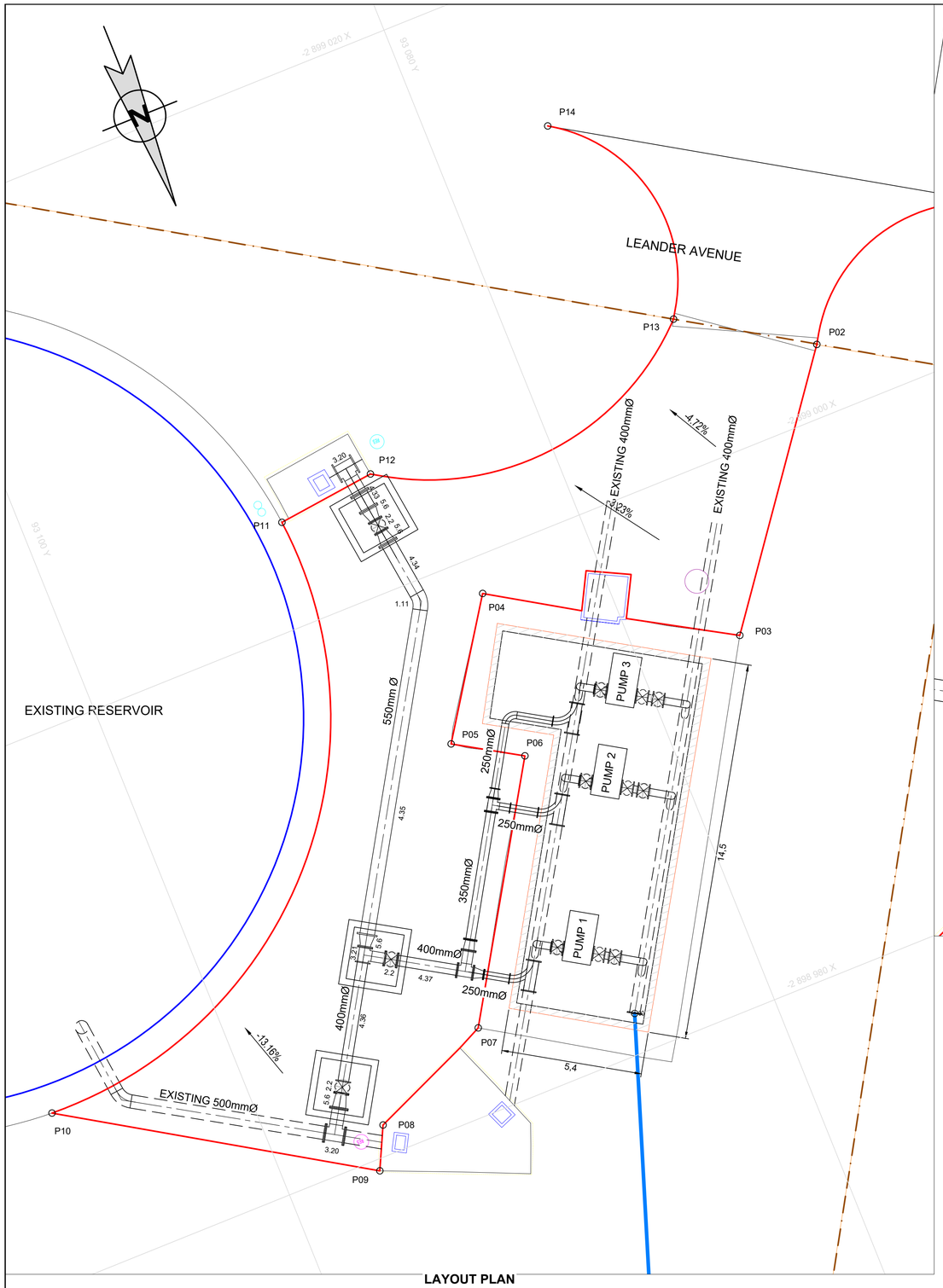
DESIGN MANAGER
BESTUURDER ONTWERP
DATE DATUM

SCALE SKAAL
AS SHOWN

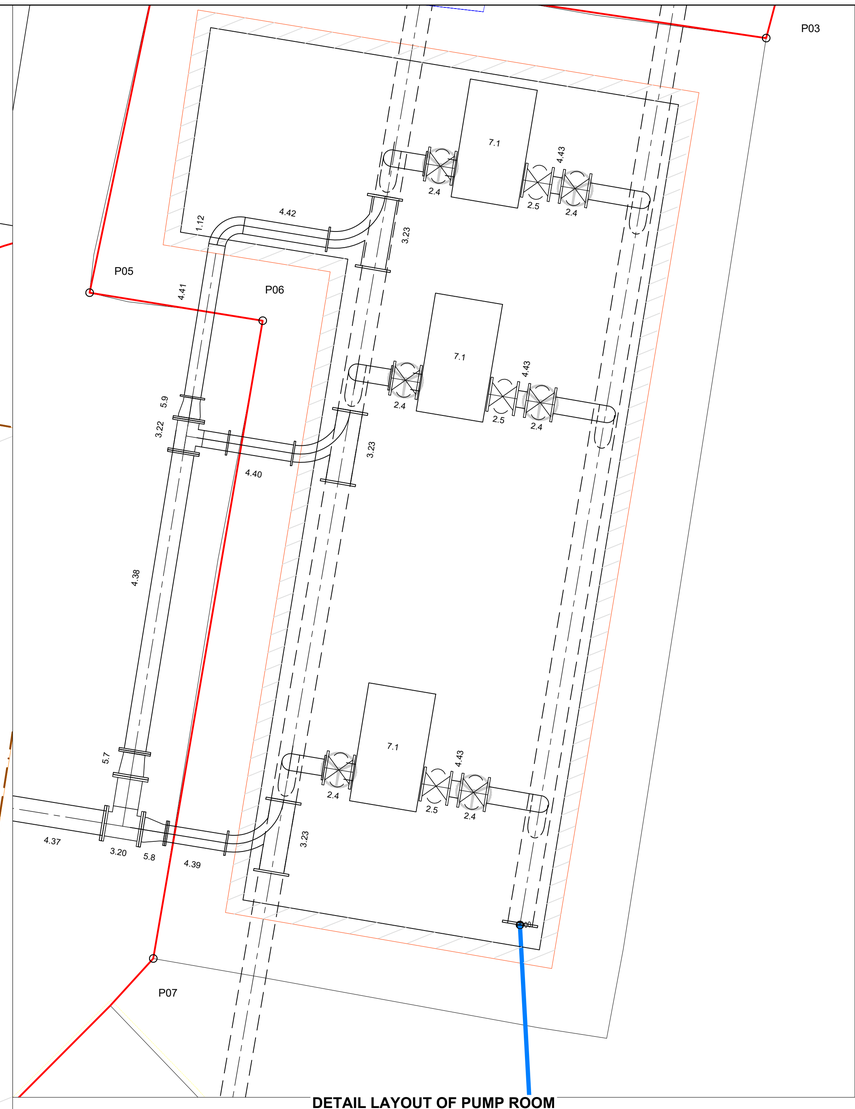
	AMENDMENTS - WYSIGINGS	APPROVED GOEDGEKEUR	DATE DATUM
0	NEW DRAWING	JN	2018-11-16

DRAWING No, TEKENING Nr. 0 Revision
1440a/WT/PIPE06RR

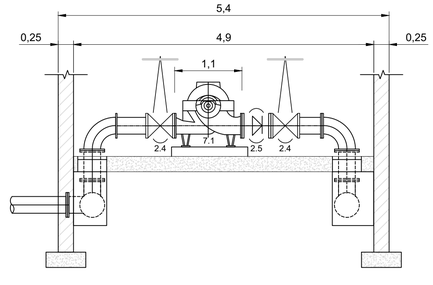
FILE No
LEER Nr



LAYOUT PLAN
1:100



DETAIL LAYOUT OF PUMP ROOM
1:50



PUMP SECTION AND CONFIGURATION
1:50

ITEM	NUMBER	DESCRIPTION OF ITEMS
1		**BENDS**
1.11	1	550mm Ø, 55.00° M.S. BEVEL EDGED BEND.
1.12	1	250mm Ø, 90.00° M.S. BEVEL EDGED BEND.
2		**VALVES**
2.2	3	400mm Ø PN16, CAST IRON, HAND WHEEL OPERATED, ANTI CLOCKWISE CLOSING WITH NON-RISING SPINDLE, WEDGE TYPE GATE VALVE. VALVE ACCORDING TO SANS 664 AND FLANGES TO BE FLAT FACED TO SANS 1123 TABLE 1600 (F-F=470). (VOSA "D" SERIES OR SIMILAR APPROVED)
2.4	6	250mm Ø PN16, CAST IRON, HAND WHEEL OPERATED, ANTI CLOCKWISE CLOSING WITH NON-RISING SPINDLE, WEDGE TYPE GATE VALVE. VALVE ACCORDING TO SANS 664 AND FLANGES TO BE FLAT FACED TO SANS 1123 TABLE 1600. (VOSA "D" SERIES OR SIMILAR APPROVED)
2.5	3	250mm Ø, EPOXY COATED, DUCTILE IRON, FLANGED PN16, SINGLE DOOR SWING NON-RETURN VALVE. (VOSA OR SIMILAR APPROVED)
3		**GENERAL**
3.20	2	500mm Ø M.S. FULLY FLANGED EQUAL TEE WITH A 505 LONG SPOOL PIECE ADDED TO THE BRANCH END. (F-F=610 AND C-F=810)
3.21	2	400mm Ø M.S. FULLY FLANGED EQUAL TEE WITH A 505 LONG SPOOL PIECE ADDED TO THE BRANCH END. (F-F=610 AND C-F=810)
3.22	1	350mm Ø x 250mm Ø M.S. FULLY FLANGED REDUCING TEE.
3.23	3	400mm Ø x 250mm Ø M.S. FULLY FLANGED SWEEP TEE.
4		**CUT LENGTHS**
4.33	1	550mm Ø B.E.F (l = 586)
4.34	1	550mm Ø O.E.F (l = 2187)
4.35	1	550mm Ø O.E.F - BEVELLED EDGE (l = 12 631)
4.36	1	400mm Ø B.E.F (l = 3955)
4.37	1	400mm Ø B.E.F (l = 2293)
4.38	1	350mm Ø B.E.F (l = 4895)
4.39	1	250mm Ø B.E.F (l = 958)
4.40	1	250mm Ø B.E.F (l = 1053)
4.41	1	250mm Ø O.E.F (l = 2508)
4.42	1	250mm Ø O.E.F (l = 1377)
4.43	1	250mm Ø B.E.F (l = 150)
5		**REDUCERS**
5.6	4	550x400mm Ø M.S. FULLY FLANGED CONCENTRIC REDUCER.
5.7	1	400x350mm Ø M.S. FULLY FLANGED CONCENTRIC REDUCER.
5.8	1	400x250mm Ø M.S. FULLY FLANGED CONCENTRIC REDUCER.
5.9	1	350x250mm Ø M.S. FULLY FLANGED CONCENTRIC REDUCER.
7		**PUMPS**
7.1	3	KSB SA OMEGA 250-480A (423 IMPELLER) WITH A WEG 250kW 380v 355 M/L 4p MOTOR. (OR SIMILAR APPROVED)

NOTES

1. THE EXACT POSITION OF EXISTING PIPES AND OTHER SERVICES TO BE DETERMINED ON SITE WITH SPECIAL ATTENTION WHEN CONNECTING TO EXISTING FACILITIES.
2. ALL PIPE DIMENSIONS TO BE FINALISED ON SITE.
3. ALL FLANGES TO BE ACCORDING TO SANS 1123-1977 TABLE 1600/3 WITH SPECIAL CARE TO DRILLING PATTERNS OF VALVES, ETC.
4. C.A.F. FLANGE GASKETS MUST BE USED.
5. M.S.= MILD STEEL AND S.S.= STAINLESS STEEL.
6. STEEL GRADE, PIPE LINING AND COVER TO BE ACCORDING TO SPECIFICATION.
7. THE POSITION OF THE PIPE SUPPORTS TO BE FINALISED ON SITE.
8. ANCHOR BLOCKS TO BE CAST SYMMETRICALLY AROUND CENTRE LINE OF FITTINGS AND AGAINST UNDISTURBED EXCAVATION.
9. COUPLINGS AND FLANGES SHALL BE LEFT CLEAR OF CONCRETE
10. ALL THRUST BLOCKS SHALL BE OF 15MPa CONCRETE
11. FLANGED JOINTS AND V.J. COUPLINGS TO BE WRAPPED WITH DENSO TAPE.

DEPARTMENT DEPARTEMENT	APPROVED GOEDGEKEUR	DESIGNATION AMPSBENAMING	DATE DATUM

CERTIFIED AS BUILT DRAWING
GESERTIFISEER AS SOOS GEBOU TEKENING

FOR NMS CivEc ____ DATE DATUM ____

FOR NMS JOHANNESBURG WATER (PTY) LTD ____ DATE DATUM ____

CONSULTING ENGINEERS - RAADGEWENDE INGENIEURS

CivEc
Civil Engineering Consultants

MODDERFONTEIN
PHONE (011) 608-1004
FAX (011) 608-1005

PRETORIA
PHONE (012) 998-5463
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PRIVATE DRAWING No
PRIVAAT TEKENING Nr
1440b/RE/PIPE01RR

APPROVED
GOEDGEKEUR
Pr. Eng. No.
Pr. Ing. Nr. 800162
DATE-DATUM

SURVEYED - OPGEMEET		
DESIGNED - ONTWERP	FT	
DRAWN - GETEKEN	FT	
CHECKED - NAGESIEN	HL	
SERVICES CHECKED		
DIENSLEIDINGS NAGESIEN		
GEOTECHNICAL INVESTIGATION		
GEOTEGNIESE ONDERSOEK		
SERVITUDES		
SERWITUTE		
APPROVED		
GOEDGEKEUR		

JOHANNESBURG WATER (SOC) LTD

Johannesburg Water

17 HARRISON STREET
MARSHALLTOWN
2107

TEL: (011) 688-1400
FAX: (011) 688-1529

CITY OF JOHANNESBURG

CONSTRUCTION OF A 2.25MI WATER TOWER IN ROBERTVILLE WITH ASSOCIATED PIPE AND PUMP WORKS

RESERVOIR SITE PIPE LAYOUT AND DETAILS

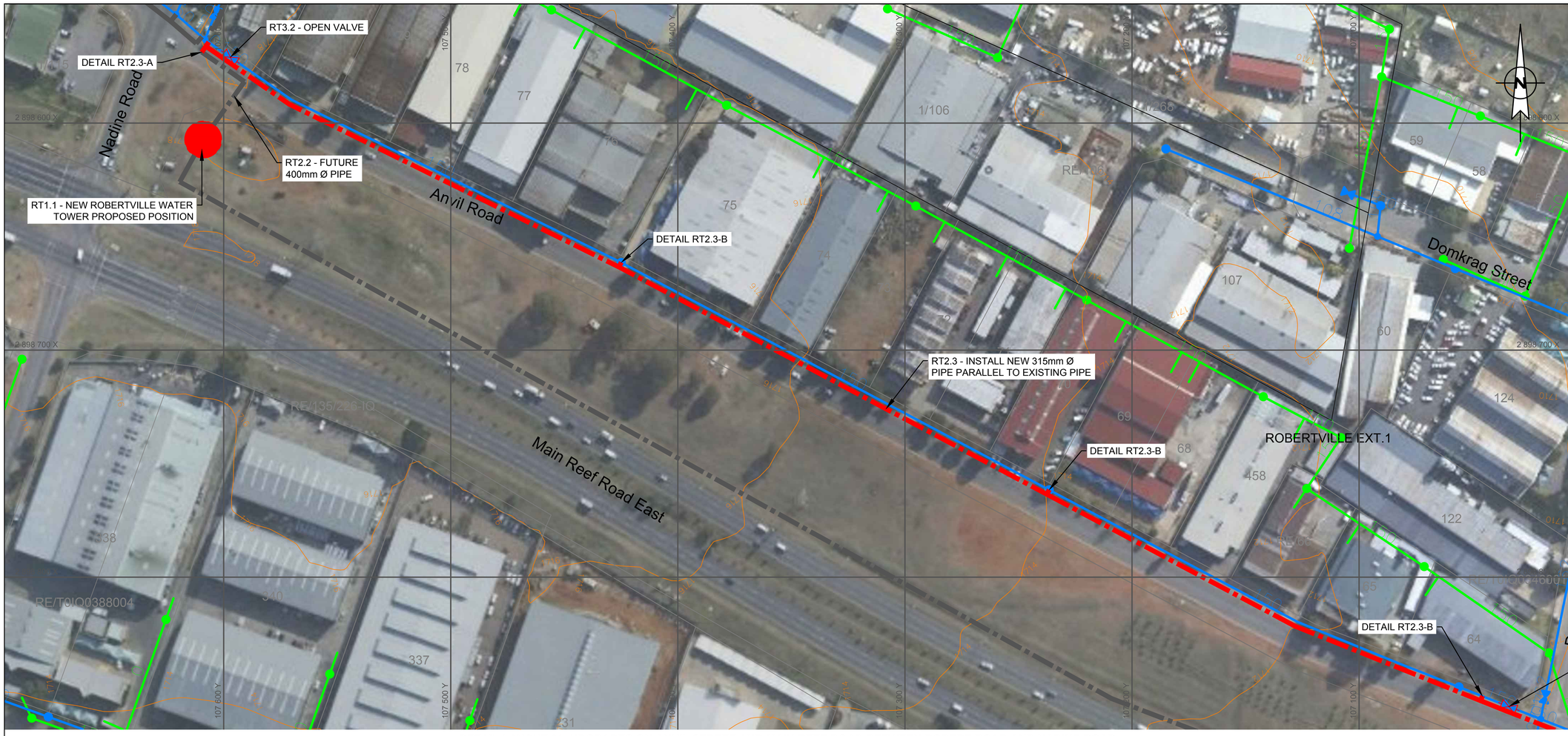
DESIGN MANAGER
BESTUURDER ONTWERP
DATE DATUM

SCALE
SKAAL
AS SHOWN

AMENDMENTS - WYSIGINGS	APPROVED GOEDGEKEUR	DATE DATUM

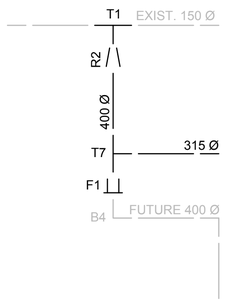
DRAWING No.
TEKENING Nr.
Revision
1440b/RE/PIPE01RR

FILE No
LEER Nr

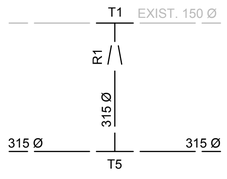


DETAIL LAYOUT 01: UPGRADES ON ANVIL STREET AND MAIN REEF ROAD BETWEEN ROBERT ROAD AND NADINE ROAD

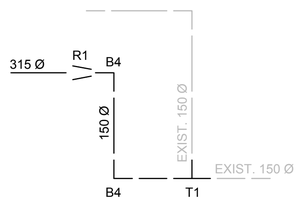
1:1 000



DETAIL RT2.3-A



DETAIL RT2.3-B



DETAIL RT2.3-C

SKAAL OP VERKLEINDE TEKENING
SCALE ON REDUCED DRAWING

100mm OP OORSPRONKLIKE TEKENING
100mm SCALE ON ORIGINAL DRAWING

GENERAL NOTES :

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2. ALL DIMENSIONS SHOULD BE CHECKED BEFORE ANY WORK ON THE SITE COMMENCES
3. ANY DISCREPANCIES THAT MAY OCCUR DURING THE CONSTRUCTION PHASE OF THIS
4. DRAWING MUST BE BROUGHT IMMEDIATELY UNDER THE ATTENTION OF THE ENGINEER

NOTES :

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2. ALL M.S. FITTINGS TO BE COPON COATED.
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8. ALL PREFABRICATED FITTINGS TO BE COPON EP 2300 COATED AND LINED.
9. FLANGED JOINTS AND V.J. COUPLINGS TO BE WRAPPED WITH DENSO TAPE.
10. ALL PIPE SIZES TO BE CONFIRMED ON SITE PRIOR TO THE ORDERING OF FITTINGS.

LEGEND

- EXISTING WATER
- EXISTING SEWER
- NEW WATER PIPES
- CLOSED VALVE
- OPEN VALVE

PIPE DETAILS

200mm Ø: High Impact PVC-u Class 16, with shouldered-end Coupling.
250mm Ø: High Impact PVC-u Class 16, with shouldered-end Coupling.
315mm Ø: High Impact PVC-u Class 16, with shouldered-end Coupling.
400mm Ø: HDPE Class 16 PE 100 SDR 11, jointed by electro fusion or butt welding.

LEGEND FOR PIPE COMPONENTS

TEES

T1 = 150mm Ø CAST IRON EQUAL TEE
T2 = 160mm Ø CAST IRON EQUAL TEE
T3 = 200mm Ø CAST IRON EQUAL TEE
T4 = 250mm Ø CAST IRON EQUAL TEE
T5 = 315mm Ø STEEL EQUAL TEE
T6 = 400mm Ø STEEL EQUAL TEE
T7 = 315mm Ø x 400mmØ STEEL REDUCING TEE

FLANGE ADAPTOR

F1 = 400mm Ø STEEL FLANGE ADAPTOR

REDUCERS

R1 = 150mm Ø x 315mm Ø STEEL REDUCERS
R2 = 150mm Ø x 400mm Ø STEEL REDUCERS

BEND

B1 = 11¼° STEEL BEND
B2 = 22½° STEEL BEND
B3 = 45° STEEL BEND
B4 = 90° STEEL BEND

DEPARTMENT DEPARTEMENT	APPROVED GOEDGEKEUR	DESIGNATION AMPSBENAMING	DATE DATUM

CERTIFIED AS BUILT DRAWING
GESERTIFISEER AS SOOS GEBOU TEKENING

FOR NMS CivEc ____ DATE DATUM ____

FOR NMS JOHANNESBURG WATER (PTY) LTD ____ DATE DATUM ____

CONSULTING ENGINEERS - RAADGEWENDE INGENIEURS
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PRIVATE DRAWING No / PRIVAAT TEKENING Nr: 1440b/WA/DET01
APPROVED GOEDGEKEUR Pr. Eng. No. Pr. Ing. Nr. 800162 DATE -DATUM

SURVEYED - OPGEMEET		
DESIGNED - ONTWERP	FT	
DRAWN - GETEKEN	FT	
CHECKED - NAGESIEN	FJH	
SERVICES CHECKED DIENSLEIDINGS NAGESIEN		
GEOTECHNICAL INVESTIGATION GEOTECHNIESE ONDERSOEK		
SERVITUDES SERWITUTE		
APPROVED GOEDGEKEUR		

JOHANNESBURG WATER (PTY) LTD
Johannesburg Water
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2107
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CITY OF JOHANNESBURG

UPGRADING OF ROBERTVILLE WATER NETWORK

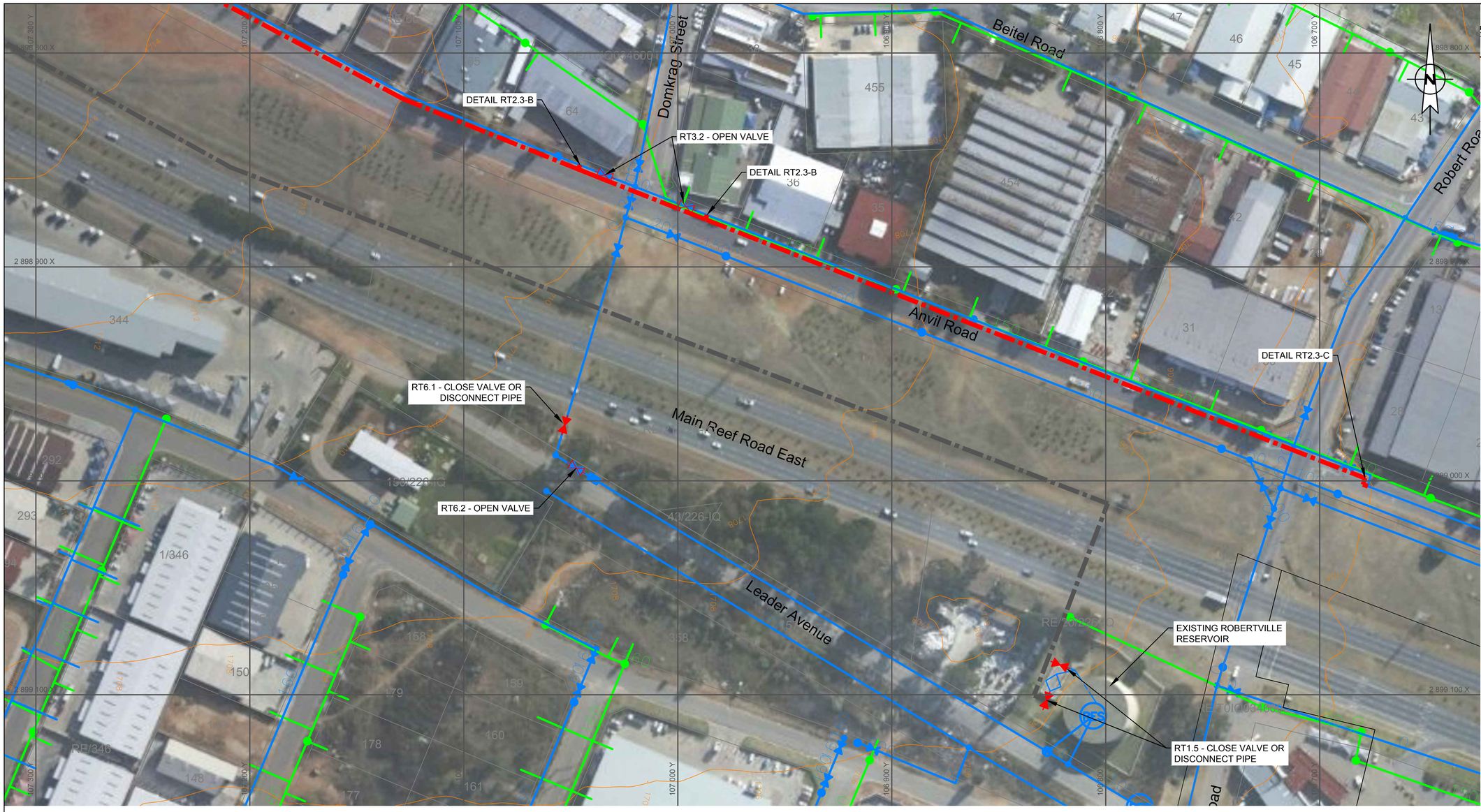
DETAIL LAYOUT 01: UPGRADES ON ANVIL STREET AND MAIN REEF ROAD BETWEEN ROBERT ROAD AND NADINE ROAD

DESIGN MANAGER BESTUURDER ONTWERP
DATE DATUM

SCALE SKAAL: AS SHOWN

AMENDMENTS - WYSIGINGS	APPROVED GOEDGEKEUR	DATE DATUM

DRAWING No. TEKENING Nr. Revision: 1440b/WA/DET01
FILE No LEER Nr



SKAAL OP VERKLEINDE TEKENING
SCALE ON REDUCED DRAWING

100mm OP OORSPRONKLIKE TEKENING
100mm SCALE ON ORIGINAL DRAWING

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NOTES :

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2. ALL M.S. FITTINGS TO BE COPON COATED.
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LEGEND

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- EXISTING SEWER
- NEW WATER PIPES
- CLOSED VALVE
- OPEN VALVE

PIPE DETAILS

200mm Ø: High Impact PVC-u Class 16, with shouldered-end Coupling.
250mm Ø: High Impact PVC-u Class 16, with shouldered-end Coupling.
315mm Ø: High Impact PVC-u Class 16, with shouldered-end Coupling.
400mm Ø: HDPE Class 16 PE 100 SDR 11, jointed by electro fusion or butt welding.

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FLANGE ADAPTOR

F1 = 400mm Ø STEEL FLANGE ADAPTOR

REDUCERS

R1 = 150mm Ø x 315mm Ø STEEL REDUCERS
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BEND

B1 = 11¼° STEEL BEND
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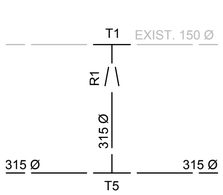
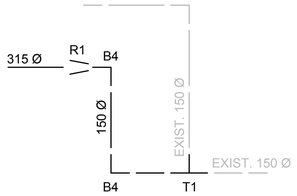
DETAIL LAYOUT 01: UPGRADES ON ANVIL STREET AND MAIN REEF ROAD BETWEEN ROBERT ROAD AND NADINE ROAD
1:1 000



DETAIL RT2.3-B



DETAIL RT2.3-C

DEPARTMENT DEPARTEMENT	APPROVED GOEDGEKEUR	DESIGNATION AMPSBENAMING	DATE DATUM

CERTIFIED AS BUILT DRAWING
GESERTIFISEER AS SOOS GEBOU TEKENING

FOR NMS CivEc _____ DATE DATUM _____

FOR NMS JOHANNESBURG WATER (PTY) LTD _____ DATE DATUM _____

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PRIVATE DRAWING No
PRIVAAT TEKENING Nr
1440b/WA/DET02

APPROVED GOEDGEKEUR
Pr. Eng. No.
Pr. Ing. Nr. 800162
DATE -DATUM

SURVEYED - OPGEMEET			
DESIGNED - ONTWERP	FT		
DRAWN - GETEKEN	FT		
CHECKED - NAGESIEN	FJH		
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DIENSLEIDINGS NAGESIEN			
GEOTECHNICAL INVESTIGATION			
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SERVITUDES			
SERWITUTE			
APPROVED			
GOEDGEKEUR			

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CITY OF JOHANNESBURG

UPGRADING OF ROBERTVILLE WATER NETWORK

DETAIL LAYOUT 02: UPGRADES ON ANVIL STREET AND MAIN REEF ROAD BETWEEN ROBERT ROAD AND NADINE ROAD (CONTINUED)

DESIGN MANAGER
BESTUURDER ONTWERP
DATE DATUM

SCALE SKAAL
AS SHOWN

AMENDMENTS - WYSIGINGS	APPROVED GOEDGEKEUR	DATE DATUM

DRAWING No. TEKENING Nr. 1440b/WA/DET02
Revision 0
FILE No LEER Nr

RT3.2 - OPEN VALVE

RT2.5 - INSTALL NEW 250mm Ø PIPE PARALLEL TO EXISTING PIPE

RT4.2 - INSTALL NEW 200mm Ø PIPE

RT4.1 - INSTALL NEW 200mm Ø PIPE PARALLEL TO EXISTING PIPE

RT2.4 - INSTALL NEW 400mm Ø PIPE PARALLEL TO EXISTING PIPE

RT3.2 - OPEN VALVE

RT2.2 - INSTALL NEW 400mm Ø PIPE

RT1.1 - NEW ROBERTVILLE WATER TOWER PROPOSED POSITION

RT2.3 - INSTALL NEW 315mm Ø PIPE PARALLEL TO EXISTING PIPE

RT1.2 - INSTALL NEW 650mm Ø BULK SUPPLY PIPE TO ROBERTVILLE TOWER

RT3.2 - OPEN VALVE

RT6.1 - CLOSE VALVE OR DISCONNECT PIPE

RT6.2 - OPEN VALVE

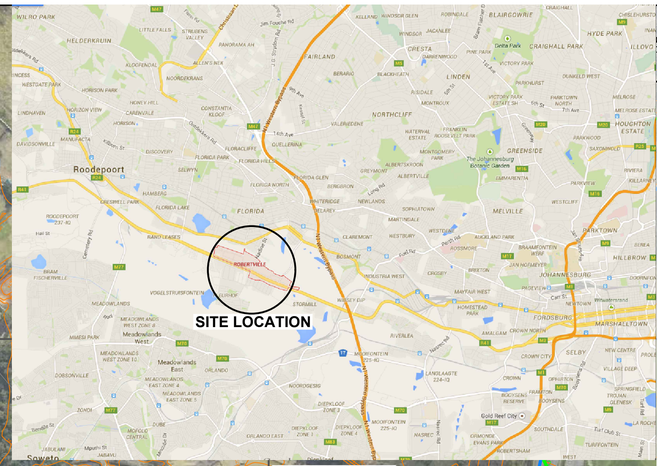
RT1.5 - CLOSE VALVE OR DISCONNECT PIPE

MAIN REEF ROAD — EXISTING ROBERTVILLE RESERVOIR

RT3.1 - CLOSE VALVE OR DISCONNECT PIPE

Uys Kruge Avenue
Kathleen Street
Elemal Avenue
Nadine Road
Minnie Postma Avenue
Ellemal Avenue
Frans Venter Str
Vatrol Avenue
Saag Street
Nadine Road
ROBERTVILLE EXT.4
ROBERTVILLE EXT.5
Anvil Road
Main Reef Road East
Yaron Avenue
Nadine Road
Damkrag Street
ROBERTVILLE EXT.1
Main Reef Road East
Damkrag Street
Bethel Road
Robert Road
ROBERTVILLE EXT.3
ROBERTVILLE EXT.5
Anvil Road
Main Reef Road East
Minerva Avenue
Leador Avenue
Condenser Road

2 898 500 mN
2 898 000 mN
2 899 500 mE
2 900 000 mE



LOCALITY PLAN
NTS

LIST OF DRAWINGS

1440b/WA/KEY01	-	KEY PLAN AND LIST OF DRAWINGS
1440b/WA/LAY01	-	LONGITUDINAL SECTION CH0.0 TO CH600.0
1440b/WA/LAY02	-	LONGITUDINAL SECTION CH600.0 TO CH940.0
1440b/WA/DET01	-	DETAIL LAYOUT 01: ANVIL STREET (BETWEEN ROBERT ROAD AND NADINE ROAD)
1440b/WA/DET02	-	DETAIL LAYOUT 02: ANVIL STREET (BETWEEN ROBERT ROAD AND NADINE ROAD)
1440b/WA/DET03	-	DETAIL LAYOUT 03: ANVIL STREET (BETWEEN NADINE ROAD AND SAAG STREET)
1440b/WA/DET04	-	DETAIL LAYOUT 04: SAAG STREET
1440b/WA/DET05	-	DETAIL LAYOUT 05: NADINE ROAD
1440b/WA/DET06	-	FENCE DETAILS

SKAAL OP VERKLEINDE TEKENING
SCALE ON REDUCED DRAWING

100mm OP OORSPRONKLIKE TEKENING
100mm SCALE ON ORIGINAL DRAWING

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NOTES :

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LEGEND

- EXISTING WATER
- EXISTING SEWER
- NEW WATER PIPES
- CLOSED VALVE
- OPEN VALVE

DEPARTMENT DEPARTEMENT	APPROVED GOEDGEKEUR	DESIGNATION AMPSBENAMING	DATE DATUM

CERTIFIED AS BUILT DRAWING
GESERTIFISEER AS SOOS GEBOU TEKENING

FOR NMS CivEc ____ FOR NMS JOHANNESBURG WATER (PTY) LTD ____

DATE DATUM ____ DATE DATUM ____

CONSULTING ENGINEERS - RAADGEWENDE INGENIEURS

CivEc
Civil Engineering Consultants

MODDERFONTEIN
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PRETORIA
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SURVEYED - OPGEMEET		
DESIGNED - ONTWERP	FT	
DRAWN - GETEKEN	FT	
CHECKED - NAGESIEN	FJH	
SERVICES CHECKED DIENSLEIDINGS NAGESIEN		
GEOTECHNICAL INVESTIGATION GEOTEGNIESE ONDERSOEK		
SERVITUDES SERWITUTE		
APPROVED GOEDGEKEUR		

PRIVATE DRAWING No PRIVAAT TEKENING Nr: 1440b/WA/SITE01
APPROVED GOEDGEKEUR
Pr. Eng. No.
Pr. Ing. Nr. 800162
DATE-DATUM

JOHANNESBURG WATER (PTY) LTD

Johannesburg Water

TRADUNA HOUSE
58 FREDERICK STREET
MARSHALLTOWN
2107

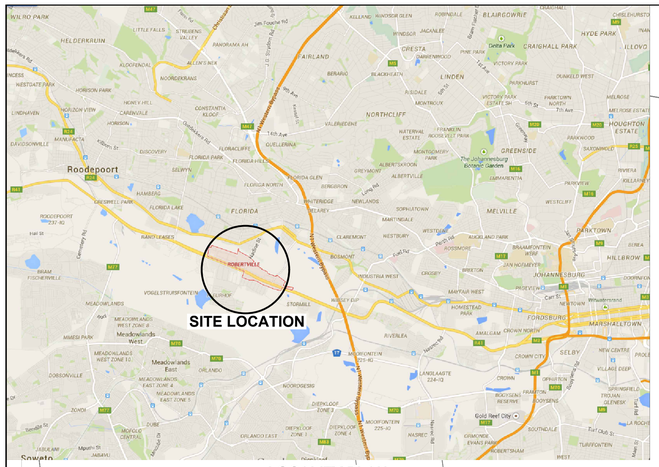
TEL: (011) 688-1400
FAX: (011) 688-1529

CITY OF JOHANNESBURG

UPGRADING OF ROBERTVILLE WATER NETWORK

KEY PLAN

DESIGN MANAGER	SCALE SKAAL	AMENDMENTS - WYSIGINGS	APPROVED GOEDGEKEUR	DATE DATUM	DRAWING No. TEKENING Nr.	Revision
BESTUURDER ONTWERP	AS SHOWN				1440b/WA/SITE01	0
DATE DATUM					FILE No LEER Nr	



LOCALITY PLAN
NTS

RESERVOIR FENCE SETTING OUT COORDINATES - Hartebeesthoek94 (WGS84) Lo27		
Name	Y Lo27	X Lo27
F1	-93 117.966	2 899 032.936
F2	-93 063.922	2 898 999.533
F3	-93 085.743	2 898 962.838
F4	-93 109.576	2 898 972.235
F5	-93 113.193	2 898 973.918
F6	-93 134.051	2 898 992.627

BENCHMARK COORDINATES - Hartebeesthoek94 (WGS84) Lo27			
Name	Y Lo27	X Lo27	Z
P1	-92 561.640	2 898 621.785	1 715.635
P2	-92 624.024	2 898 643.474	1 714.627
RRBM1	-93 220.879	2 898 889.793	1 704.051
RRBM2	-92 878.442	2 898 762.427	1 709.766
RRBM3	-92 367.490	2 898 488.336	1 717.254

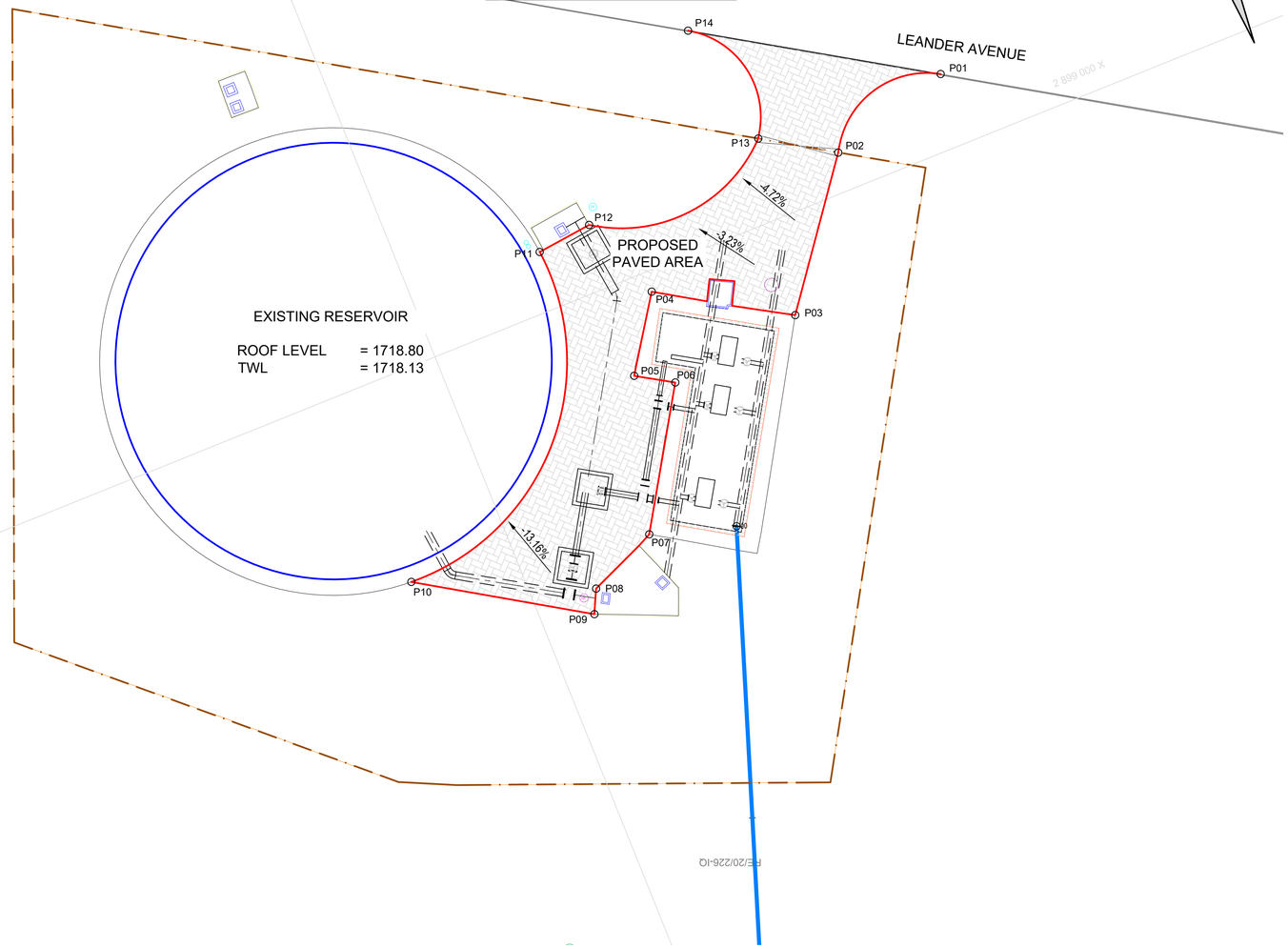
SKAAL OP VERKLEINDE TEKENING
SCALE ON REDUCED DRAWING

100mm OP OORSPRONKLIKE TEKENING
100mm SCALE ON ORIGINAL DRAWING

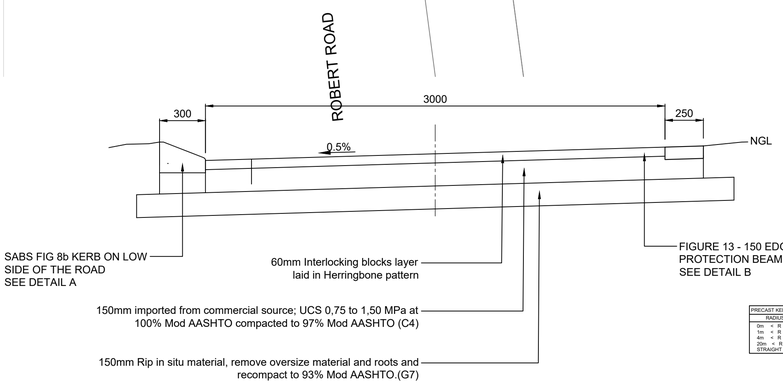
LEGEND

- BENCHMARKS
- NEW 650mm BULK WATER SUPPLY PIPE
- TOWNSHIP RESERVATION
- POWER LINES
- EXISTING GAS LINE
- NEW WATER PIPES
- ELECTRICAL PYLON
- PROPOSED FENCE
- PROPOSED SEWER CONNECTION
- EXISTING SEWER
- EXISTING ESKOM SERVITUDE

RESERVOIR PAVING SETTING OUT COORDINATES - Hartebeesthoek94 (WGS84) Lo27				
Name	Y Lo27	X Lo27	LEVEL	DESCRIPTION
P01	-93 060.615	2 899 005.029	0.000	Tie-in to Existing Road Level
P02	-93 069.134	2 899 002.660	1705.723	
P03	-93 076.025	2 898 993.432	1705.698	
P04	-93 084.551	2 898 998.595	1705.722	
P05	-93 087.821	2 898 993.704	1705.672	
P06	-93 085.370	2 898 992.223	1705.703	
P07	-93 090.915	2 898 983.237	1705.674	
P08	-93 095.681	2 898 981.148	1706.348	
P09	-93 096.448	2 898 979.568	1706.350	
P10	-93 107.260	2 898 986.302	1705.236	
P11	-93 090.657	2 899 003.986	1705.229	
P12	-93 086.823	2 899 004.437	1706.155	
P13	-93 073.854	2 899 005.603	1705.482	
P14	-93 075.562	2 899 014.258	0.000	Tie-in to Existing Road Level

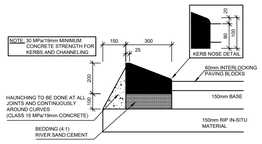


LAYOUT PLAN
1:200

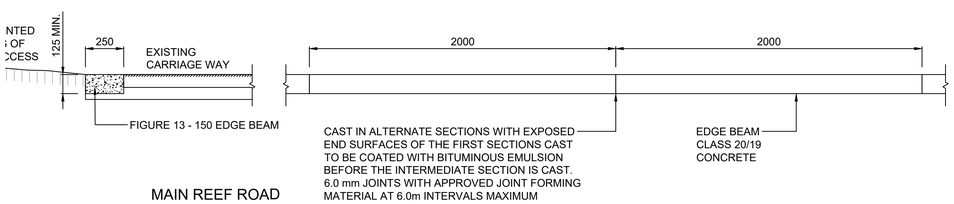


TYPICAL LAYER WORKS CROSS-SECTION
1:50

PRECAST KERBING NOMINAL UNIT LENGTH	
RADIUS (R)	LENGTH (m)
0m < R <= 5m	IN SITU
5m < R <= 4m	0.3m
4m < R <= 20m	0.6m
20m < R STRAIGHT SECTIONS	1.0m 1.0m



DETAIL A: SABS FIG 8c KERB FOR NEW CONSTRUCTION
1:10



DETAIL B: EDGE BEAM DETAIL AND CONFIGURATION
1:50

DEPARTMENT DEPARTEMENT	APPROVED GOEDGEKEUR	DESIGNATION AMPSBENAMING	DATE DATUM

CERTIFIED AS BUILT DRAWING
GESERTIFISEER AS SOOS GEBOU TEKENING

FOR NMS CivEc

FOR NMS JOHANNESBURG WATER (PTY) LTD

DATE DATUM

DATE DATUM

CONSULTING ENGINEERS - RAADGEWENDE INGENIEURS

CivEc
Civil Engineering Consultants

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PRETORIA
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PRIVATE DRAWING No
PRIVAAT TEKENING Nr
1440b/WA/SITE01RR

SURVEYED - OPGEMEET			
DESIGNED - ONTWERP	FT		
DRAWN - GETEKEN	FT		
CHECKED - NAGESIEN	HL		
SERVICES CHECKED DIENSLEIDINGS NAGESIEN			
GEOTECHNICAL INVESTIGATION GEOTEGNIESE ONDERSOEK			
SERVITUDES SERWITUTE			
APPROVED GOEDGEKEUR			

1 APPROVED GOEDGEKEUR
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CITY OF JOHANNESBURG

CONSTRUCTION OF A 2.25MI WATER TOWER IN ROBERTVILLE WITH ASSOCIATED PIPE AND PUMP WORKS

RESERVOIR SITE AND PIPE LAYOUT PLAN

DESIGN MANAGER
BESTUURDER ONTWERP

DATE DATUM

SCALE SKAAL
AS SHOWN

AMENDMENTS - WYSIGINGS	APPROVED GOEDGEKEUR	DATE DATUM

DRAWING No. TEKENING Nr.
1440b/RE/LAY01RR

Revision 1

FILE No
LEER Nr

BENCHMARK COORDINATES - Hartebeesthoek94 (WGS84) Lo27			
Name	Y Lo27	X Lo27	Z
P1	-92 561.640	2 898 621.785	1 715.635
P2	-92 624.024	2 898 643.474	1 714.627
RRBM1	-93 220.879	2 898 889.793	1 704.051
RRBM2	-92 878.442	2 898 762.427	1 709.766
RRBM3	-92 367.490	2 898 488.336	1 717.254

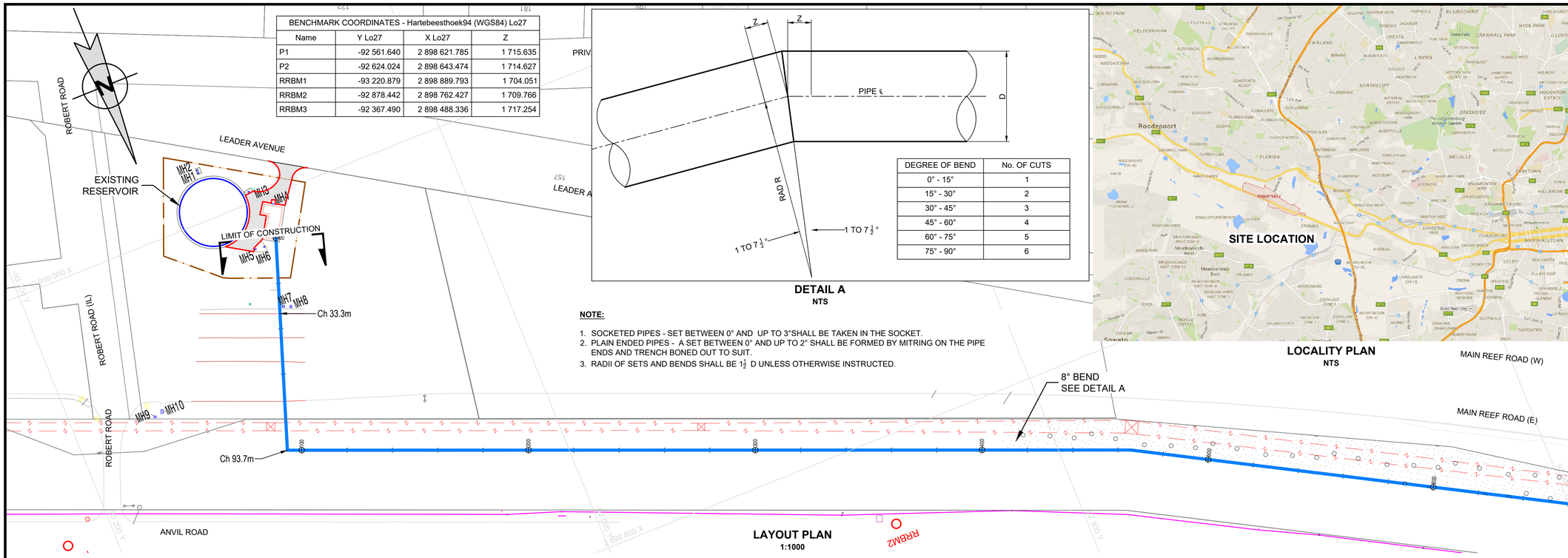
DEGREE OF BEND	No. OF CUTS
0° - 15°	1
15° - 30°	2
30° - 45°	3
45° - 60°	4
60° - 75°	5
75° - 90°	6

DETAIL A
NTS

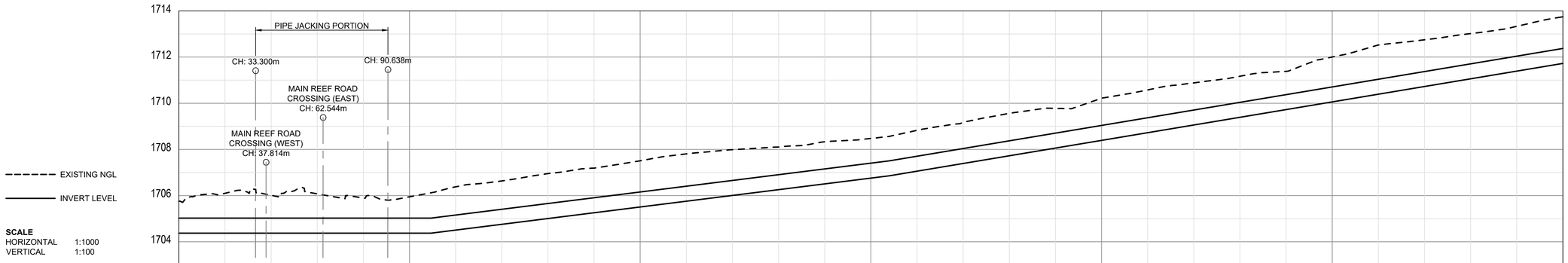
NOTE:

1. SOCKETED PIPES - SET BETWEEN 0° AND UP TO 3°SHALL BE TAKEN IN THE SOCKET.
2. PLAIN ENDED PIPES - A SET BETWEEN 0° AND UP TO 2° SHALL BE FORMED BY MITRING ON THE PIPE ENDS AND TRENCH BONED OUT TO SUIT.
3. RADII OF SETS AND BENDS SHALL BE 1½ D UNLESS OTHERWISE INSTRUCTED.

LOCALITY PLAN
NTS



LAYOUT PLAN
1:1000



CHAINAGE (m)	0	20	40	60	80	100		120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	420	440	460	480	500	520	540	560	580	600
GROUND LEVEL (m)		1706.098	1706.014	1706.076	1705.896	1705.948	1706.103	1706.381	1706.636	1706.956	1707.193	1707.509	1707.686	1707.806	1707.989	1708.106	1708.330	1708.476	1708.822 / 1708.822	1709.163	1709.561	1709.778	1710.217	1710.577 / 1710.849	1710.882	1711.169	1711.381	1712.002	1712.522 / 1712.580	1712.747	1713.018	1713.333	
PIPE INVERT LEVEL (m)	1704.373	1704.373	1704.373	1704.373	1704.373	1704.373	1704.373	1704.507	1704.757	1705.007	1705.257	1705.507	1705.757	1706.007	1706.257	1706.507	1706.757	1706.857	1707.057	1707.390	1707.724	1708.057	1708.390	1708.724	1709.057	1709.390	1709.724	1710.057	1710.391	1710.724	1711.057	1711.391	1711.724
INVERT DEPTH (m)	1.38	1.72	1.64	1.70	1.52	1.57		1.87	1.88	1.95	1.94	2.00	2.05	1.98	1.85	1.82	1.72	1.77	1.77	1.84	1.72	1.83	1.85	1.83	1.78	1.66	1.95	2.13	2.02	1.96	1.94	2.02
GRADE		Horizontal						1:80										1:60														
ENERGY GRADE LINE LEVEL (m)	1704.373	1704.373	1704.373	1704.373	1704.373	1704.373	1704.373	1704.507	1704.757	1705.007	1705.257	1705.507	1705.757	1706.007	1706.257	1706.507	1706.757	1706.857	1707.057	1707.390	1707.724	1708.057	1708.390	1708.724	1709.057	1709.390	1709.724	1710.057	1710.391	1710.724	1711.057	1711.391	1711.724
VELOCITY (m/s)		1.66																														
DESIGN FLOW (l/s)		550																														
PIPE DETAILS		660mm OD SAW to API 5L Grade X42, 6mm thick , butt welded with 6mm CML and Rigid Polyurethane coating																														
PEG DISTANCE (m)	0	94																													466	

SKAAL OP VERKLEINDE TEKENING
SCALE ON REDUCED DRAWING

100mm OP OORSPRONKLIKE TEKENING
100mm SCALE ON ORIGINAL DRAWING

LEGEND

- BENCHMARKS
- NEW 650mm BULK WATER SUPPLY PIPE
- TOWNSHIP RESERVATION
- POWER LINES
- EXISTING GAS LINE
- NEW WATER PIPES
- ELECTRICAL PYLON
- PROPOSED FENCE
- PROPOSED SEWER CONNECTION
- EXISTING SEWER
- EXISTING ESKOM SERVITUDE

NOTES

1. THE EXACT POSITION OF EXISTING PIPES AND OTHER SERVICES TO BE DETERMINED ON SITE WITH SPECIAL ATTENTION WHEN CONNECTING TO EXISTING FACILITIES
2. ALL PIPE DIMENSIONS TO BE FINALISED ON SITE.
3. ALL FLANGES TO BE ACCORDING TO SANS 1123-1977 TABLE 1000/3 WITH SPECIAL CARE TO DRILLING PATTERNS OF VALVES, ETC.
4. C.A.F. FLANGE GASKETS MUST BE USED.
5. M.S.= MILD STEEL AND S.S.= STAINLESS STEEL.
6. STEEL GRADE, PIPE LINING AND COVER TO BE ACCORDING TO SPECIFICATION.
7. ALL M.S. FITTINGS TO BE COPON COATED.
8. M.S. PIPE COATING AND LINING TO BE RED-BROWN: SIGMALINE 855 EXTERIOR COATING, AND SIGMALINE 523 INTERIOR LINING.
9. THE POSITION OF THE PIPE SUPPORTS TO BE FINALISED ON SITE.
10. ANCHOR BLOCKS TO BE CAST SYMMETRICALLY AROUND CENTRE LINE OF FITTINGS AND AGAINST UNDISTURBED EXCAVATION.
11. COUPLINGS AND FLANGES SHALL BE LEFT CLEAR OF CONCRETE.
12. ALL THRUST BLOCKS SHALL BE OF 15MPa CONCRETE.
13. FLANGED JOINTS AND V.J. COUPLINGS TO BE WRAPPED WITH DENSO TAPE.
14. ALL CONCRETE TO BE 40MPa AND A MINIMUM COVER = 40mm, OR AS INDICATED.
15. HIGH YIELD REINFORCEMENT TO BE 450MPa.
16. ALL CONCRETE FOR APPURTENANT WORK TO CONFORM TO SANS 101001:2000
17. STRUCTURAL STEELWORK TO CONFORM WITH SANS 10162-1:2005.

DEPARTMENT DEPARTEMENT	APPROVED GOEDGEKEUR	DESIGNATION AMPSBENAMING	DATE DATUM

CERTIFIED AS BUILT DRAWING
GESERTIFISEER AS SOOS GEBOU TEKENING

FOR NMS CivEc ____ DATE DATUM ____

FOR NMS JOHANNESBURG WATER (PTY) LTD ____ DATE DATUM ____

CONSULTING ENGINEERS - RAADGEWENDE INGENIEURS
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SURVEYED - OPGEMEET		
DESIGNED - ONTWERP		FT
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PRIVATE DRAWING No PRIVAAT TEKENING Nr: 1440b/WA/LAY01RR
APPROVED GOEDGEKEUR Pr. Eng. No. Pr. Ing. Nr. 800162 DATE-DATUM

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TRADUNA HOUSE
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CITY OF JOHANNESBURG

CONSTRUCTION OF A 2.25MI WATER TOWER IN ROBERTVILLE WITH ASSOCIATED PIPE AND PUMP WORKS

SUPPLY PIPE LONGITUDINAL SECTION: 0 to 600m

DESIGN MANAGER
BESTUURDER ONTWERP
DATE DATUM

SCALE SKAAL: AS SHOWN

AMENDMENTS - WYSIGINGS	APPROVED GOEDGEKEUR	DATE DATUM

DRAWING No. TEKENING Nr. 1440b/WA/LAY01RR
Revision 0
FILE No LEER Nr

BENCHMARK COORDINATES - Hartebeesthoek94 (WGS84) Lo27			
Name	Y Lo27	X Lo27	Z
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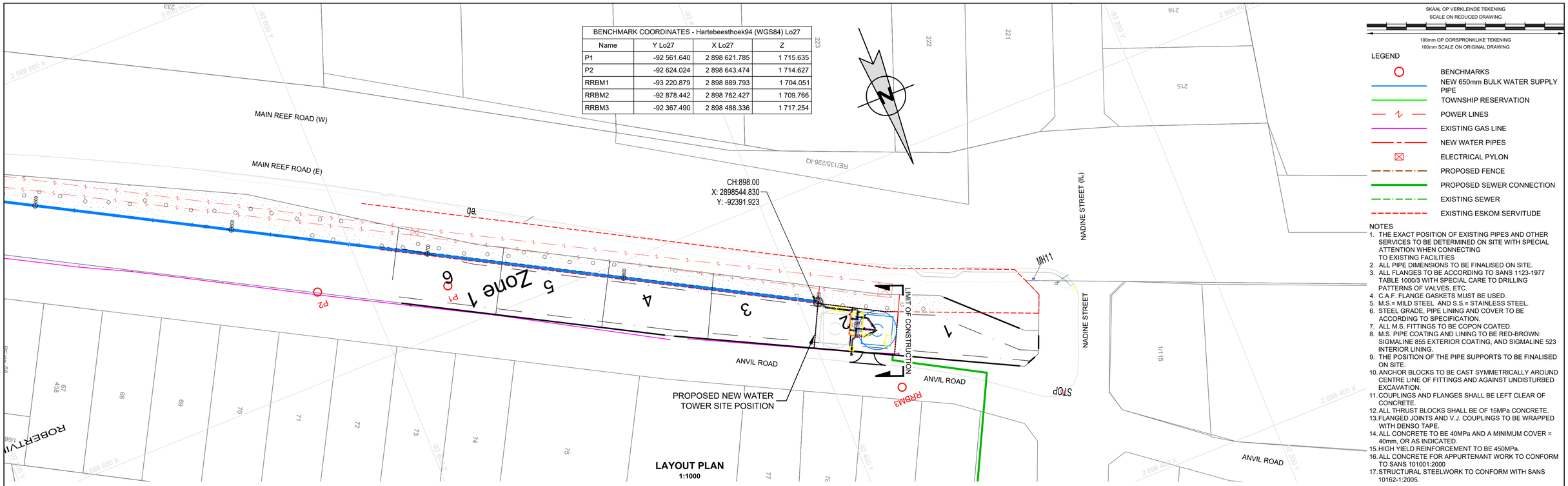
P2	-92 624.024	2 898 643.474	1 714.627
RRBM1	-93 220.879	2 898 889.793	1 704.051
RRBM2	-92 878.442	2 898 762.427	1 709.766
RRBM3	-92 367.490	2 898 488.336	1 717.254



LAYOUT PLAN
1:1000

SKAAL OP VERKLEINDE TEKENING
SCALE ON REDUCED DRAWING

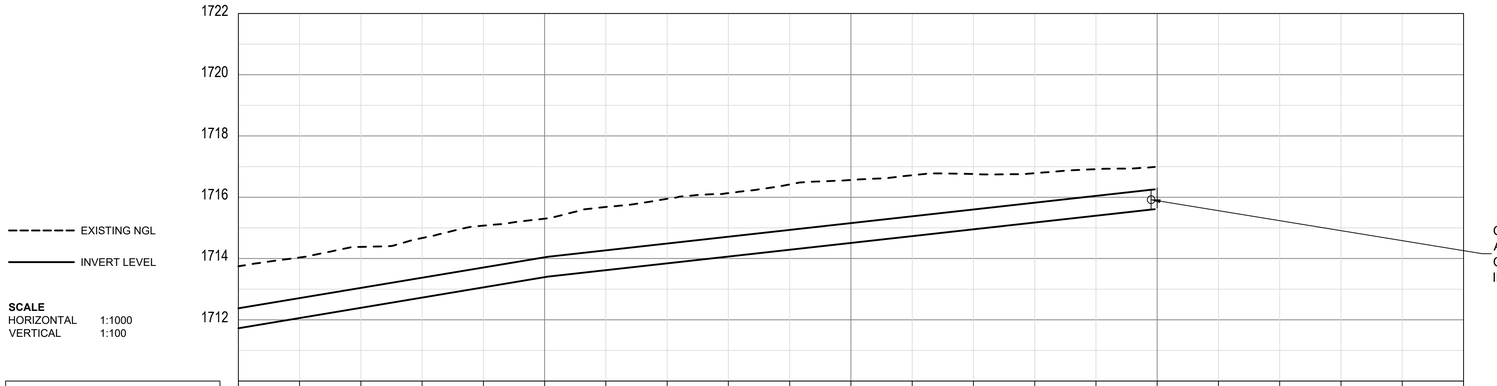
100mm OP OORSPRONKLIKE TEKENING
100mm SCALE ON ORIGINAL DRAWING

LEGEND

- BENCHMARKS
- NEW 650mm BULK WATER SUPPLY PIPE
- TOWNSHIP RESERVATION
- POWER LINES
- EXISTING GAS LINE
- NEW WATER PIPES
- ELECTRICAL PYLON
- PROPOSED FENCE
- PROPOSED SEWER CONNECTION
- EXISTING SEWER
- EXISTING ESKOM SERVITUDE

NOTES

1. THE EXACT POSITION OF EXISTING PIPES AND OTHER SERVICES TO BE DETERMINED ON SITE WITH SPECIAL ATTENTION WHEN CONNECTING TO EXISTING FACILITIES
2. ALL PIPE DIMENSIONS TO BE FINALISED ON SITE.
3. ALL FLANGES TO BE ACCORDING TO SANS 1123-1977 TABLE 1000/3 WITH SPECIAL CARE TO DRILLING PATTERNS OF VALVES, ETC.
4. C.A.F. FLANGE GASKETS MUST BE USED.
5. M.S.= MILD STEEL AND S.S.= STAINLESS STEEL.
6. STEEL GRADE, PIPE LINING AND COVER TO BE ACCORDING TO SPECIFICATION.
7. ALL M.S. FITTINGS TO BE COPON COATED.
8. M.S. PIPE COATING AND LINING TO BE RED-BROWN: SIGMALINE 855 EXTERIOR COATING, AND SIGMALINE 523 INTERIOR LINING.
9. THE POSITION OF THE PIPE SUPPORTS TO BE FINALISED ON SITE.
10. ANCHOR BLOCKS TO BE CAST SYMMETRICALLY AROUND CENTRE LINE OF FITTINGS AND AGAINST UNDISTURBED EXCAVATION.
11. COUPLINGS AND FLANGES SHALL BE LEFT CLEAR OF CONCRETE.
12. ALL THRUST BLOCKS SHALL BE OF 15MPa CONCRETE.
13. FLANGED JOINTS AND V.J. COUPLINGS TO BE WRAPPED WITH DENSO TAPE.
14. ALL CONCRETE TO BE 40MPa AND A MINIMUM COVER = 40mm, OR AS INDICATED.
15. HIGH YIELD REINFORCEMENT TO BE 450MPa.
16. ALL CONCRETE FOR APPURTENANT WORK TO CONFORM TO SANS 101001:2000
17. STRUCTURAL STEELWORK TO CONFORM WITH SANS 10162-1:2005.



SCALE
HORIZONTAL 1:1000
VERTICAL 1:100

CHAINAGE (m)	600	620	640	660	680	700	720	740	760	780	800	820	840	860	880	900	920	940	960	980	1000
GROUND LEVEL (m)	1713.745	1714.033	1714.379	1714.671	1715.074	1715.302	1715.683	1715.949	1716.137	1716.420	1716.565	1716.721	1716.758	1716.786	1716.916	1716.988					
PIPE INVERT LEVEL (m)	1711.724	1712.057	1712.391	1712.724	1713.057	1713.391	1713.618	1713.841	1714.063	1714.285	1714.507	1714.729	1714.952	1715.174	1715.396	1715.609					
INVERT DEPTH (m)	2.02	1.98	1.99	1.95	2.02	1.91	2.06	2.11	2.07	2.14	2.06	1.99	1.81	1.61	1.52	-1.38					
GRADE		1:60					1:90									1:90					
ENERGY GRADE LINE LEVEL (m)	1713.745	1714.033	1714.379	1714.671	1715.074	1715.302	1715.683	1715.949	1716.137	1716.420	1716.565	1716.721	1716.758	1716.786	1716.916	1716.988					
VELOCITY (m/s)		1.66																			
DESIGN FLOW (l/s)		550																			
PIPE DETAILS		660mm OD SAW to API 5L Grade X42, 6mm thick , butt welded with 6mm CML and Rigid Polyurethane coating																			
PEG DISTANCE (m)	600					701										898	899				

DEPARTMENT DEPARTEMENT	APPROVED GOEDGEKEUR	DESIGNATION AMPSBENAMING	DATE DATUM

CERTIFIED AS BUILT DRAWING
GESERTIFISEER AS SOOS GEBOU TEKENING

FOR NMS CivEc
DATE DATUM

FOR NMS JOHANNESBURG WATER (PTY) LTD
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CITY OF JOHANNESBURG

CONSTRUCTION OF A 2.25MI WATER TOWER IN ROBERTVILLE WITH ASSOCIATED PIPE AND PUMP WORKS

SUPPLY PIPE LONGITUDINAL SECTION: 600 to 980m

DESIGN MANAGER
BESTUURDER ONTWERP
DATE DATUM

SCALE SKAAL
AS SHOWN

AMENDMENTS - WYSIGINGS	APPROVED GOEDGEKEUR	DATE DATUM

DRAWING No. TEKENING Nr. 1440b/WA/LAY02RR
Revision 1

FILE No LEER Nr