



CONTRACT NO. BW283/ARWWTW/22

VOLUME 2: FINANCIAL PROPOSAL

VAAL CENTRAL WATER

**REFURBISHMENT OF THE NYAKALLONG (ALLANRIDGE) WWTW:
CIVIL, MECHANICAL AND ELECTRICAL, CONTROL & INSTRUMENTATION**

PROCUREMENT DOCUMENT

July 2026

TENDER SUBMITTED BY:

Registered Name of Company:

Address:

Telephone Number:

Fax Number:

E-mail:

Issued by:

Vaal Central Water
PO Box 30121
Pellissier
9322



ISSUE DATE: 31 July 2026

BRIEFING SESSION: 13 August 2026 @ 12:00 (COMPULSORY)

CLOSING DATE: 1 September 2026 @ 12:00

VAAL CENTRAL WATER

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REFURBISHMENT OF THE NYAKALLONG (ALLANRIDGE) WWTW: CIVIL, MECHANICAL AND ELECTRICAL, CONTROL & INSTRUMENTATION

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 Contractor

 Witness 1

 Witness 2

 Employer

 Witness 1

 Witness 2

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**REFURBISHMENT OF THE NYAKALLONG (ALLANRIDGE) WWTW:
CIVIL, MECHANICAL AND ELECTRICAL, CONTROL & INSTRUMENTATION**

PART C1:

AGREEMENTS AND CONTRACT DATA

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

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AGREEMENTS AND CONTRACT DATA

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Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

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REFURBISHMENT OF THE NYAKALLONG (ALLANRIDGE) WWTW: CIVIL, MECHANICAL AND ELECTRICAL, CONTROL & INSTRUMENTATION

SECTION C1.1

FORM OF OFFER AND ACCEPTANCE

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

FORM OF OFFER AND ACCEPTANCE

OFFER

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

REFURBISHMENT OF THE NYAKALLONG (ALLANRIDGE) WWTW: CIVIL, MECHANICAL AND ELECTRICAL, CONTROL & INSTRUMENTATION

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 Tenderer 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.

CONTRACT NO: BW283/ARWWTW/22: THE OFFERED TOTAL OF THE PRICES INCLUSIVE OF VALUE ADDED TAX IS:

.....

..... (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 Tenderer before the end of the period of validity stated in the Tender Data, whereupon the Tenderer becomes the party named as the Contractor in the Conditions of Contract identified in the Contract Data.

Signatures

Name(s)

Capacity

for the Tenderer

(Name and address of organisation)

Name & signature of witness :

Date:

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

ACCEPTANCE

By signing this part of this Form of Offer and Acceptance, the Employer identified below accepts the Tenderer'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 Tenderer's Offer shall form an agreement, between the Employer and the Tenderer 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 T1	Tendering Procedures
Part T2	Returnable Documents
Part C1	Agreements and Contract Data, (which includes this Agreement)
Part C2	Pricing Data
Part C3	Scope of Work
Part C4	Drawings

and drawings and documents or parts thereof, which may be incorporated by reference into Parts C1 to C4 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 Tenderer 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 Tenderer shall within two weeks 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 Contract 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 Tenderer receives one fully completed original copy of this document, including the Schedule of Deviations (if any). Unless the Tenderer (now Contractor) within five days of 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.

Signatures
Name(s)
Capacity
for the Tenderer
(Name and address of organisation)

Name & signature of witness : **Date:**

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

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 Tenderer'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;
4. Any change or addition to the tender documents arising from the above agreements 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.....

By the duly authorised representatives signing this Schedule of Deviations, the Employer and the Tenderer agree to and accept the foregoing Schedule of Deviations as the only deviations from the 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 Tenderer and the Employer during this process of offer and acceptance.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

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 Tenderer of a completed signed copy of this Agreement shall have any meaning or effect in the contract between the parties arising from this Agreement.

FOR THE TENDERER:

Signatures
Name(s)
Capacity
for the Tenderer
(Name and address of organisation)

Name & signature of witness : **Date:**

FOR THE EMPLOYER:

Signatures
Name(s)
Capacity
for the Tenderer
(Name and address of organisation)

Name & signature of witness : **Date:**

Contractor

Witness 1

Witness 2

Employer

Witness 1

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VAAL CENTRAL WATER

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SECTION C1.2

CONTRACT DATA

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

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C1.2 CONTRACT DATA

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Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

C1.2 CONTRACT DATA

C1.2.1 CONDITIONS OF CONTRACT

The General Conditions of Contract for Construction Works (2025) as published by the South African Institution of Civil Engineering, is applicable to this contract and forms part of the single volume of the Contract Document. Copies of these conditions of contract may be obtained from the South African Institution of Civil Engineering (Tel. 011 805 5947). Drawings also forms part of the single volume.

The General Conditions of Contract for Construction Works make several references to the Contract Data for specific data, which together with these conditions collectively describe the risks, liabilities and obligations of the contracting parties and the procedures for the administration of the Contract. The Contract Data shall have precedence in the interpretation of any ambiguity or inconsistency between it and the general conditions of contract.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

C1.2.2 VARIATIONS AND ADDITIONS TO THE GENERAL CONDITIONS OF CONTRACT (PARTICULAR CONDITIONS)

In terms of clause 1.1.1.8 of the General Conditions of Contract for Construction Works, Fourth Edition (2025), the following contract specific data, referring to the General Conditions of Contract for Construction Works are applicable to this Contract:

The Contract Data consists of two parts. Part 1 contains information provided by the Employer, while Part 2 contains information to be provided by the Contractor.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

C1.2.3 APPENDIX TO TENDER

(PART 1 - CONTRACT DATA COMPLETED BY EMPLOYER)

Clause	Description
1.1.1.13	The Defects Liability Period is 12 months, measured from the date of the Certificate of Completion.
1.1.1.15	Name of Employer is: Vaal Central Water Board
1.1.1.16	The Employer's Agent is: iX engineers (Pty) Ltd
1.1.1.27	The pricing strategy is: Re-measurement Contract within the constraints of the Vaal Central Water Board Supply Chain policies.
1.2.1.2	The Employer's address for receipt of communications and notices is: Address (Physical): 2 Mzuzu Street Pellissier Bloemfontein 9322 Telephone: (051) 403 0800 The Employer's Agent's address for receipt of communications and notices is: Address (Physical): Hillside Offices 277 The Hillside Street Menlo Park Pretoria 0081 Contact Person: Mr Bernu Steyn Tel: +27 (0)12 745 2526 Mob: +27 (0) 82 441 3586 GPS: -25.773466, 28.269207
1.3.2	The governing law is the law of the Republic of South Africa.
2.6.1	<u>Delete the contents of the clause and insert the following:</u> The documents forming the Contract are to be taken as mutually explanatory of one another. For the purposes of interpretation, the priority of the documents shall be in accordance with the following sequence, listed from highest to lowest priority: (a) Form of Offer and Acceptance (b) Contract Data (c) General Conditions of Contract (d) Drawings

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Clause	Description
	(e) Variations and Additional Clauses to Particular Specifications and Standard Specifications (f) Particular Specifications (g) Standard Specifications (h) Bill of Quantities (i) Service Level Agreement (j) Any other documents forming part of the Contract If an ambiguity or discrepancy between the documents is found, the Employer's Agent shall provide the necessary clarification or instruction.
3.2.3	The Employer's Agent shall obtain specific approval from the Employer before executing any of his functions or duties according to the following Clauses of the General Conditions of Contract: 1. <u>New Clause 3.2.3.2</u> For expenditure on the Contract to exceed the Contract Sum 2. <u>Existing Clauses:</u> 5.12 - Granting of extension of time excluding Clause 5.12.2.2 (Abnormal climatic conditions) 5.13 - Reduction of penalty for delay. 5.14.2 - The issue of a Certificate of Practical Completion. 5.14.6 - The issue of a Certificate of Completion. 5.15.1 - Clearance of Site on Completion 5.16.1 - The issue of a Final Approval Certificate. 6.3 - All Variations 6.6 - Instruction to expend on Provisional and Prime Cost Sums 8.2.2.2 - Order to repair and make good damage arising from any "excepted" risk.
3.2.4	The Employer's Agent has not been appointed as Agent in terms of Occupational Health and Safety on this contract. The Client will perform the duties of the Client, in terms of the Construction Regulations, 2014 as promulgated in terms of Section 43 of the Occupational Health and Safety Act, 1993.
4.3.1	<u>Add the following to the clause:</u> For construction works the Basic Conditions of Employment Act of 1997 (Act No 75 of 1997) shall apply and the minimum employment conditions which will apply shall be guided by the latest Sectorial Determination: Civil Engineering Sector published from time to time. Compliance with the National Environmental Management Act (NEMA), Act 107 of 1998.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Clause	Description
	The Contractor shall comply with the Occupational Health and Safety Specification prepared by the Employer in terms of the Construction Regulations, 2014 promulgated in terms of Section 43 of the Occupational Health and Safety Act (Act No. 85 of 1993). Without limiting the Contractor's obligations in terms of the Contract, the Contractor shall before commencement of the Works or any part thereof, be in the possession of an approved Health and Safety Plan.
4.3.2	<u>Add the following to the clause:</u> Failure to provide such proof shall entitle the Employer to withhold any payment due to the Contractor until such proof is provided.
4.4.2	The Contractor shall submit the names of all subcontractors to the Employer's Agent for approval. Such approval shall not transfer any liabilities from the Contractor to any other party.
4.4.4	<u>Add the following to the clause (refer also to Form 2.1.14 Section C Specifications in Volume 1):</u> The Employer shall require the Contractor to appoint subcontractors and local enterprises as per this clause called "LEP Subcontractors" to a minimum value of 30% of the final Contract Price (excludes VAT & CPA) by the Contractor. It is the Contractor's responsibility to ensure that this target is achieved, irrespective of any sums allowed for LEP work in the BoQ, which are only estimates. Should the Contractor not reach the target percentage, the Contractor shall be penalised 5% of the value of final Contract Price (excludes VAT & CPA). No additional mark-up or costs will be payable to the Contractor for this other than under the relevant items of the BoQ, the tendered rate which shall cover all costs including but not limited to management, administration, overheads, risk and profit for the work done under this clause. Refer to Form 2.1.14 in the Tender Data in Volume 1
4.10.2	<u>Add the following to the clause:</u> The dates for the information to be provided will be communicated to the Contractor during the Site Handover Meeting. Late and/or incomplete information will be penalised at a rate of R1,000.00 per day.
5.2.1	<u>Add the following to the clause:</u> The commencement date shall be the date one week (7 calendar days) after the Confirmation of Receipt referred to in the form of Offer and Acceptance has been signed for by the Contractor.
5.3.1	<u>The documentation required before Commencement of the Works are:</u> Health and Safety Plan Approval (Refer to Clause 4.3) Occupational Health and Safety Agreement (Refer to Clause 4.3) Initial Programme including Cashflow (Refer to Clause 5.6) Security (Refer to Clause 6.2)

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Clause	Description
	Proof of Insurance (Refer to Clause 8.6), copies of receipts of registration, or payment for the premiums Letter of Good Standing (Refer to Clause 4.3) BCCEI membership and good standing (Refer to Clause 4.3) Local Economic Participation Plan as per Form 2.1.14 Copy of the Construction Permit Environmental Management Plan for the site CV and Qualifications of Construction Manager Contract Organisational Organogram
5.3.2	The Contractor is required, within 14 days of the Commencement Date, to submit the documents listed above in Clause 5.3.1 to the Employer's Agent for his approval.
5.4.2	Access to and possession of the site shall not be exclusive to the Contractor insofar as the provisions of Clause 4.8 apply and where ongoing use by the general public is required. The Contractor shall bear all costs and charges for special and temporary rights of way required by him in connection with access to the site.
5.5	Due Completion Date is 18 months after the Commencement Date.
5.6	The Contractor's programme shall allow for a period of three (3) months for rotary core drilling and rock anchor design (Items C2.1.8.1 and C3.3.1 of the Bill of Quantities), which are required prior to the construction of the aerobic basin. These activities shall be scheduled to commence directly after site establishment, in such a manner as not to delay other activities on site.
5.8.1	Delete the words "between sunset and sunrise" in the first line and replace with "outside normal working hours". Normal working hours shall be those as stated in the applicable Sectoral Determination applicable to a 5 (five) day week. Non-working days are Saturdays and Sundays and special non-working days are public holidays and official builder's holidays as per the Sectoral Determination.
5.8.1.1	<u>Add the following to the clause:</u> The cost of supervision by the Employer's Agent or his representatives outside of normal (Monday to Friday) working hours in accordance with this Clause, shall be to the Contractor's account.
5.12.1	<u>Add the following to the clause:</u> A delay in so far as extension of time is concerned, will be regarded as a delay only if, on a claim by the Contractor in accordance with the General Conditions of Contract, the Employer's Agent rules that all progress on an item or items of work on the critical path of the approved programme for the execution of the Works by the Contractor, has been brought to a halt. Delays on normal working days only, based on a working week, of five normal working days, will be taken in account for the extension of time.

Contractor

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Employer

Witness 1

Witness 2

Clause	Description
5.12.2.2	<u>Add the following to the clause:</u> The time period specified as the time for completion excludes allowances for those days on which it is expected that work, on the critical path items of the works, would be prevented due to weather conditions such as wind, rain falling or the subsequent waterlogged condition. • Allowance should be made for 3 days per month for Oct - Apr. • Allowance should be made for 1 days per month for May - Sept. If the Contractor has been prevented by these weather conditions from working on the critical path items of the works, then he must notify the Employer's Agent in writing. The notification shall be made within five calendar days of the resumption of work. The Employer's Agent shall upon considering all the relevant factors determine the extension of time to be granted. The tendered sums of the appropriate time-related items shall be increased to take account of the extensions of time granted.
5.13.1	The penalty for failing to complete the Works in accordance with Clause 5.14.1 is R 15 000.00 per calendar day
5.14.1	<u>Add the following to the clause:</u> The completion and acceptance of all works as follows: The completion of all commissioning activities, including the performance trial period, The completion of Training of all staff for the duration of the commissioning and trial period, including issuing of certificates of competency. The above should not exceed three months.
5.16.3	The latent defect period is 10 years.
6.2.1	Submit a guarantee of an Insurance Company or Bank to be jointly and severally bound with the Contractor for an amount equal to ten per cent (10%) of the Contract Sum. The wording of the Guarantee shall be identical to the pro forma provided in this Section. A Retention Money Guarantee is not permitted.
6.2.3	The expiry date shall be the date, 30 calendar days after the programmed completion date.
6.5.1.1.3	<u>Add the following to the clause:</u> The maximum percentage allowed to cover overhead charges is: Labour – 10% Materials – 10%
6.8.4	<u>Add at the end of Clause 6.8.4:</u> Notwithstanding the above, in the event that a public holiday is proclaimed within 28 days before the closing date for tenderers, no cost other than those that can be claimed under Clause 5.12.3 shall be added to the contract price.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Clause	Description
6.9.1	<u>Add the following to the clause:</u> "The Contractor shall where practicable before delivery, and in any event not later than 24 hours after delivery to the Site, inform the Employer's Agent of any materials which are not his sole property."
6.10.1.5	The percentage advance on materials on site not yet built into the Permanent Works is 80%, and will only be paid once invoices, delivery slips and proof of payments have been submitted with the IPC to the Employer's Agent as per this clause and Clause 6.10.2.
6.10.3	Retention monies held will be 10% (excl VAT) of payments due up to the limit of retention money which will be 5% of the Contract Sum (excl VAT).
6.10.4	Contractor's statement to include ALL relevant information, including calculation sheets and details as required by the Employer's Agent for evaluation. The "7 day period" will commence once ALL information and details have been received. <u>Replace</u> the wording "within 28 days" in Clause 6.10.4 with the wording "within 30 days".
6.10.6.2	<u>Delete this clause and replace with the following new wording:</u> No interest shall be payable to the Contractor upon any moneys retained or overdue in terms of the Contract.
6.10.8	<u>Replace</u> the wording "within 28 days" in Clause 6.10.8 with the wording "within 30 days".
6.10.9	<u>Replace</u> the wording "within 28 days" in Clause 6.10.9 with the wording "within 30 days".
7.2.1	<u>Add at the end of Clause 7.2.1:</u> "Unless otherwise directed in writing by the Employer's Agent, materials for the Permanent Works shall be new and unused."
7.8.1	In Clause 7.8.1, paragraph 2, line 3, after the words "Defects Liability Period", insert "within the period specified by the Employer's Agent",
8.1.2	The Contractor shall comply with The Environmental Management Programme (EMPr) and all conditions of applicable authorisations, licences and permits. All OHS and Environmental non-conformances / non-compliances based on the monthly audit reports shall be corrected within the period stated in the respective audit report and if not corrected the Contractor shall be liable for penalties as described below: • Non-conformances / non-compliances identified for the first time shall be corrected within the period stated in the respective audit report, and evidence provided to the relevant persons that corrective actions were implemented. • Should the same non-conformances / non-compliances be identified in a following audit (not necessarily consecutive), the Project Manager shall issue a notice of non-conformance / non-compliance to the Contractor, stating the nature and magnitude of the contravention with a copy be provided to the ECO / OHS Agent and it shall be corrected within 48 hours and evidence provided to the relevant persons that corrective actions were implemented.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Clause	Description
	- Should the same non-conformances / non-compliances be identified in a subsequent audit (not necessarily consecutive) to the one mentioned above, it shall be considered an recurring non-conformance / non-compliance, and shall be corrected within 24 hours, as well as be penalised at R 2000.00 per finding, per day that it remains uncorrected and evidence shall be provided to the relevant persons that corrective actions were implemented as well as when they were implemented. - In the case of a non-compliance giving rise to physical damage or destruction of the environment, the ER shall be entitled to undertake such remedial works as may be required to make good such damage and to recover from the Contractor the full costs incurred in doing so. - The ER shall at all times have the right to stop work and/or certain activities on site in the case of non-conformances / non-compliances or failure to implement remediation measures. - The Contractor will incur an immediate penalty of R 50,000.00 for the removal of or damage of any endangered plants or trees, if such removal occurs without written approval of the Employer's Agent. Note that if audited by DEA / DWS or other regulatory body, any first offence / non-conformances / non-compliances could attract prosecution immediately. Note that these are fines imposed by the Client, and that DEA / DWS or any other regulatory body may impose other fines as well as prosecutions.
8.6.1	The value of Plant and materials supplied by the Employer to be included in the insurance sum is R0.00. The amount to cover professional fees for repairing damage and loss to be included in the insurance sum is R 200 000.00. A Coupon Policy for Special Risks Insurance issued by the South African Special Risks Insurance Association (SASRIA) is required. The limit of indemnity for liability insurance is R 10 000 000.00 for any single claim, the number of claims to be unlimited during construction and Defects Liability Period. In addition to the insurances required in terms of General Conditions of Contract The following insurances are also required: (a) Insurance of Construction Equipment (including tools, offices and other temporary structures and contents) and other things (except those intended for incorporation into the Works) brought onto the site for a sum sufficient to provide for their replacement. (b) Insurance in terms of the provisions of the Compensation for Occupational injuries and Diseases Act No. 130 of 1993. (c) Motor Vehicle Liability Insurance comprising (as a minimum) "Balance of Third Party" Risks including Passenger Liability Indemnity. (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

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Clause	Description
	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.
8.6.6	The insurance policies and proof of due payment shall be produced to the Employer's Agent within the time stated in Clause 5.3.2.
8.6.7	The Contractor may effect, at his own cost, any insurance additional to that effected by the Employer which he deems necessary in his own interests. The Employer reserves the right to call for full information regarding such insurances.
8.6.8	The insurances to be provided by the Contractor and Sub-Contractor shall be effected with Insurers and on terms approved by the Employer (which approval shall not be unreasonably withheld) and the Contractor shall, if required by the employer, produce to the employer the Policy or Policies of insurance and the receipts for payment of the current premiums. <u>Add Clause 8.6.8:</u> "In the event of any claim arising under the policies held in terms of this Clause, the Contractor shall forthwith take all necessary steps to lodge his claim on the joint behalf of himself and the Employer, and to secure settlement of such claim, and he shall submit to the Employer's Agent copies of all claims and associated documents. The claim submitted by the Contractor shall cover the cost of repairing and making good as required by Clauses 8.2.2.1 and 8.2.2.3."
8.6.9	If the Contractor fails to effect and keep in force the insurances referred to, then the employer may effect and keep in force any such insurance and pay such premium or premiums as may be necessary for that purpose and, from time to time, deduct the amount paid by the Employer from any monies due or which may become due to the Contractor or recover same as a debt from the Contractor.
8.6.10	Where the Contractor is responsible for the appointment of Sub-Contractors, then the Contractor shall: (a) ensure that potential and appointed Sub-Contractors are aware of the whole content of this Special Conditions of Contract Clause; and (b) ensure the compliance of Sub-Contractors with this Special Conditions of Contract clause, where applicable.
8.6.11	The Contractor warrants that he shall give all notices and shall observe all the Terms and Conditions and requirements of all insurances applicable to this Contract.
9.1.4	<u>Replace Clause 9.1.4 with the following:</u> Up to the time of termination of the contract by either party in terms of this Clause, or until the Contractor gives notice in terms of this Clause to terminate the contract and the Contractor is precluded from exercising his right to terminate the contract because the Employer agrees to bear any resultant additional costs provided for in Clause 9.1.2.2 hereof, the Contractor: a) will be entitled to an extension of calendar time for working days lost as may be approved by the Employer's Agent, and

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Clause	Description
	b) will be reimbursed the cost of delays per working day, where the number of working days will be determined pro rata the effect the delays have on the progress of the work as agreed with the Employer's Agent. Payment in full and final settlement will be made at the rates tendered for the payment items specially provided in the Bill of Quantities Where the circumstances described in Clauses 9.1.1 and 9.1.2 are applicable only to a certain portion of the contract, the Employer's Agent will decide after consulting the Contractor, to what extent the contract as a whole is affected and whether or not a claim in terms of this Clause can be submitted. No payment will be made in terms of this Clause after the expiry of the due completion date.
10.3.2	Amicable settlement in terms of Clause 10.4 shall be contemplated for all disputes prior to referring any dispute to adjudication or arbitration.
10.5.1	Dispute resolution shall be by ad-hoc adjudication
10.5.3	The number of Adjudication Board Members to be appointed is one.
10.7.1	The determination of disputes which are unresolved in terms of Clause 10.5.3 shall be by arbitration.
New Clause	CONTRACT PRICE ADJUSTMENT SCHEDULE <u>PRELIMINARIES AND GENERAL ITEMS (P&G's)</u> P&G's shall be divided as per the BoQ if so divided between Civil, Mechanical and Electrical, else it shall be pro rata divided based on the % of Civil/Mechanical/Electrical relevant to the month during which the certificate is submitted. <u>CIVIL CONTRACT PRICE ADJUSTMENT</u> Replace the definitions of "L", "P", "M", "F" with the following: "L" is the "Labour Index" and shall be the "Geographic Index" (CPI per province) for the province in which the site lies, as stated in the Contract Data and as published in the Statistical News Release, P0151.1, Table A of Statistics South Africa. "P" is the "Plant Index" and shall be the index for "Civil Engineering Plant" as published in the Statistical News Release P0151.1, Table 4 of Statistics South Africa. "M" is the "Materials Index" and shall be the index for "Civil engineering material: (excl bitumen)" as published in the Statistical News Release P0142.1, Table 6 of Statistics South Africa. "F" is the "Fuel Index" and shall be the index for "Diesel fuel" as published in the Statistical News Release P0142.1, Table 1 of Statistics South Africa. The base month is one month before the tender enquiry closes. The following values for x, a, b, c and d shall apply: x = 0.15; a = 0.25; b = 0.25; c = 0.45; d = 0.05

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Clause	Description
	<u>MECHANICAL & ELECTRICAL CONTRACT PRICE ADJUSTMENT</u> Adjustments to the Contract Price for the design, manufacture, painting, testing, supply, delivery, offloading and storage of Plant and Materials manufactured in the Republic of South Africa, shall be allowed only for variations in the cost of labour and material based on the indices published by the Steel and Engineering Industries Federation of South Africa (SEIFSA). The following SEIFSA tables shall be regarded as relevant to Mechanical and Electrical Works in this Contract: Table C3 Index of Actual labour cost Table G Statistics SA – production price index, Mechanical and Electrical Engineering Materials, as applicable Table Q (A) Index of stainless steel flats products (excluding imports), Hot rolled steel Table N Ruling price of certain electrical cable manufacturing materials, Copper rod 7,90mm Supply of Mechanical Plant and Materials The amount of Contract Price Adjustment (CPA) will be as follows: $CPA = PT(1-x) \left[a \frac{(L_1 - L_0)}{L_0} + b \frac{(M_1 - M_0)}{M_0} + c \frac{(S_1 - S_0)}{S_0} \right] \text{ where:}$ PT = Contract sum for the supply of plant and equipment subject to escalation which sum shall exclude Value Added Tax x = Portion of the original contract sum to be taken as fixed and therefore not subject to escalation a = Percentage of contract sum to be taken as that portion that consists of Actual Labour cost L₀ = SEIFSA index of Actual Labour cost (all hourly paid employees) (Table C3) for the month during which tender enquiry closes plus the validity period L₁ = SEIFSA index of Actual Labour cost (all hourly paid employees) (Table C3) for the month during which delivery takes place as specified b = Percentage of contract sum to be taken as that portion that consists of Mechanical Engineering materials M₀ = SEIFSA index for Mechanical Engineering materials (Table G) for the month during which tender enquiry closes plus the validity period M₁ = SEIFSA index for Mechanical Engineering materials (Table G) for the months during which delivery as specified takes place c = Percentage of contract sum to be taken as that portion that consists of Stainless-Steel materials S₀ = SEIFSA index for Stainless Steel materials (Table Q–(A)) for the month during which tender enquiry closes plus the validity period

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Clause	Description
	S1 = SEIFSA index for Stainless Steel materials (Table Q–(A)) for the month during which delivery as specified takes place The following values for x, a, b and c shall apply: x = 0.15; a = 0.45; b = 0.35; c = 0.20 Supply of Electrical Plants and Materials The amount of Contract Price Adjustment (CPA) will be as follows: $CPA = PT(1 - X) \times \left[\frac{C \times (C1 - C0)}{C0} + \frac{M \times (M1 - M0)}{M0} + \frac{L \times (L1 - L0)}{L0} \right] \quad \text{where}$ C = Proportion of Contract Price to which the SEIFSA Metal Prices Table F Copper shall apply M = Proportion of Contract Price to which the SEIFSA Index Table G Electrical Engineering Material shall apply L = Proportion of Contract Price to which the SEIFSA Index of Actual Labour cost Metal Prices Table C-3 shall apply C0 = SEIFSA index of Copper Price Table F for the month during which the tender enquiry closes plus the validity period C1 = SEIFSA index of Copper Price Table F for the month the month during which delivery as specified takes place M0 = SEIFSA index of Table G Electrical Engineering Material for the month during which the tender enquiry closes plus the validity period M1 = SEIFSA index of Table G Electrical Engineering Material for the month during which delivery as specified takes place L0 = SEIFSA index of Actual Labour cost (all hourly paid employees) (Table C3) for the month during which the tender enquiry closes plus the validity period L1 = SEIFSA index of Actual Labour cost (all hourly paid employees) (Table C3) for the month during which delivery as specified takes place The following values for X, C, M and L shall apply: X = 0.15 C = 0.20 M = 0.45 L = 0.35

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

C1.2.4 APPENDIX TO TENDER (continued)

(PART 2 - CONTRACT DATA PROVIDED BY THE CONTRACTOR)

Item	Clause	Entry
Contractor's Name	1.1.1.9	
Contractor's Address	1.2.1.2	
Time for Completion (offered)	5.5.1	 Months (subject to acceptance by Employer)

Signature

On behalf of

Date:

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

VAAL CENTRAL WATER

CONTRACT NO. BW283/ARWWTW/22

REFURBISHMENT OF THE NYAKALLONG (ALLANRIDGE) WWTW: CIVIL, MECHANICAL AND ELECTRICAL, CONTROL & INSTRUMENTATION

GUARANTEE FOR EXECUTION OF THE CONTRACT

Employer: Vaal Central Water Office Contractor:
2 Mzuzu Street
Pellissier
Bloemfontein
.....

Amount of Guarantee: To be equal to 10 percent of the Tender Sum

I/WE the undersigned, duly acting on behalf of the Company that is described below, do hereby bind the said Company to the Employer that is described above, as surety or co-principal debtor in solidum for the due performance, fulfilment and completion of the Contract by the Contractor that is described above, and we hereby undertake, on behalf of the Company to pay on demand at the above mentioned address

- any loss or damage which the Employer may sustain
- as well as any penalties or claims and legal costs to which the Employer may become entitled by reason of the non-fulfilment or breach of the terms of the Contract by the Contractor

always provided that the liability of the Company under this guarantee shall not exceed the guaranteed amount that is described above.

On behalf of the Company I/we do hereby renounce all benefits from the legal exceptions *non numeratae pecuniae*, *non causa debiti excussionis et divisionis* and all other exceptions which might or could be pleaded against the validity of this guarantee, the meaning whereof we declare ourselves to be fully acquainted with.

On behalf of the Company, I/we do hereby agree that this guarantee shall be irrevocable and shall remain in full force and effect during the term of the Contract, either until the date of issue of a Certificate of

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Completion for the whole or the final portion of the Works by the Engineer, or until any liability of the Contractor which has arisen before such date in terms of the Conditions of Contract has been satisfied, whichever is the later.

I/we do further agree and declare

- that all admissions and acknowledgements of indebtedness by the Contractor shall be binding on the Company,
- that the indebtedness of the Contractor to the Employer shall at all times be determined and proved by a written certificate of the Chief Executive Officer, or by any other person acting in such capacity,
- that such certificate shall be binding on the Company and shall be conclusive proof of the amount of the Company's indebtedness, and that such certificate annexed to this guarantee will be valid as a liquid document against the Company in a competent court in the Republic of South Africa,
- that the Employer shall, without reference and/or notice to us, have complete liberty of action to act in any manner authorised and/or contemplated by the terms of the Contract, and/or to agree to any modifications, variations or alterations to the Works, or to any extensions of the Due Completion Date for the Works under the Contract, and that the rights of the Employer under this guarantee shall in no way be prejudiced nor the liability of the Company be in any way reduced by reason of any steps or concessions which the Employer may take, make, give, concede or agree to under the Contract.
- that the Employer shall be entitled, without prejudice to any of its rights under this guarantee, to give time to and compound with, release from liability or to make any other arrangement with the Contractor, its assigns, its liquidators or its judicial managers, and that any such actions shall not exonerate the Company from any portion of its liability under this guarantee.
- this guarantee is neither negotiable nor transferable, purports to the payment of money only and should be returned to the Company upon payment, completion or cancellation whichever occurs earlier.

Name of Company: _____

The Company chooses as its *domicilium citandi et executandi*, and for the purpose of the service of any notices and legal processes the following address:

Address to be entered _____

THUS DONE AND SIGNED AT _____ on _____ 20____.

On behalf of the Company _____

In his capacity as _____

On behalf of the Company _____

In his capacity as _____

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

In the presence of the following witnesses:

Witness No 1:

Name

Signature

Witness No 2:

Name

Signature

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

GENERAL CONDITIONS OF CONTRACT

NOTES

Where there is conflict between these general Conditions of Contract and any other part of the document it must be referred to the Engineer.

The purpose of this document is to:

- (i) Draw special attention to certain general conditions applicable to government bids, contracts and orders; and
- (ii) To ensure that clients be familiar with regard to the rights and obligations of all parties involved in doing business with government.

In this document words in the singular also mean in the plural and vice versa and words in the masculine also mean in the feminine and neuter.

- The General Conditions of Contract will form part of all bid documents and may not be amended.
- Special Conditions of Contract (SCC) relevant to a specific bid, should be compiled separately for every bid (if applicable) and will supplement the General Conditions of Contract. Whenever there is a conflict, the provisions in the SCC shall prevail.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

General Conditions of Contract

1. Definitions

1. The following terms shall be interpreted as indicated:
 - 1.1 "Closing time" means the date and hour specified in the bidding documents for the receipt of bids.
 - 1.2 "Contract" means the written agreement entered into between the purchaser and the supplier, as recorded in the contract form signed by the parties, including all attachments and appendices thereto and all documents incorporated by reference therein.
 - 1.3 "Contract price" means the price payable to the supplier under the contract for the full and proper performance of his contractual obligations.
 - 1.4 "Corrupt practice" means the offering, giving, receiving, or soliciting of any thing of value to influence the action of a public official in the procurement process or in contract execution.
 - 1.5 "Countervailing duties" are imposed in cases where an enterprise abroad is subsidized by its government and encouraged to market its products internationally.
 - 1.6 "Country of origin" means the place where the goods were mined, grown or produced or from which the services are supplied. Goods are produced when, through manufacturing, processing or substantial and major assembly of components, a commercially recognized new product results that is substantially different in basic characteristics or in purpose or utility from its components.
 - 1.7 "Day" means calendar day.
 - 1.8 "Delivery" means delivery in compliance of the conditions of the contract or order.
 - 1.9 "Delivery ex stock" means immediate delivery directly from stock actually on hand.
 - 1.10 "Delivery into consignees store or to his site" means delivered and unloaded in the specified store or depot or on the specified site in compliance with the conditions of the contract or order, the supplier bearing all risks and charges involved until the supplies are so delivered and a valid receipt is obtained.
 - 1.11 "Dumping" occurs when a private enterprise abroad market its goods on own initiative in the RSA at lower prices than that of the country of origin and which have the potential to harm the local industries in the RSA.
 - 1.12 "Force majeure" means an event beyond the control of the supplier and not involving the supplier's fault or negligence and not foreseeable. Such events may include, but is not restricted to, acts of the purchaser in its sovereign capacity, wars or revolutions, fires, floods, epidemics, quarantine restrictions and freight embargoes.

Contractor

Witness 1

Witness 2

Employer

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Witness 2

- 1.13 "Fraudulent practice" means a misrepresentation of facts in order to influence a procurement process or the execution of a contract to the detriment of any bidder, and includes collusive practice among bidders (prior to or after bid submission) designed to establish bid prices at artificial non-competitive levels and to deprive the bidder of the benefits of free and open competition.
- 1.14 "GCC" means the General Conditions of Contract.
- 1.15 "Goods" means all of the equipment, machinery, and/or other materials that the supplier is required to supply to the purchaser under the contract.
- 1.16 "Imported content" means that portion of the bidding price represented by the cost of components, parts or materials which have been or are still to be imported (whether by the supplier or his subcontractors) and which costs are inclusive of the costs abroad, plus freight and other direct importation costs such as landing costs, dock dues, import duty, sales duty or other similar tax or duty at the South African place of entry as well as transportation and handling charges to the factory in the Republic where the supplies covered by the bid will be manufactured.
- 1.17 "Local content" means that portion of the bidding price which is not included in the imported content provided that local manufacture does take place.
- 1.18 "Manufacture" means the production of products in a factory using labour, materials, components and machinery and includes other related value-adding activities.
- 1.19 "Order" means an official written order issued for the supply of goods or works or the rendering of a service.
- 1.20 "Project site," where applicable, means the place indicated in bidding documents.
- 1.21 "Purchaser" means the organization purchasing the goods.
- 1.22 "Republic" means the Republic of South Africa.
- 1.23 "SCC" means the Special Conditions of Contract.
- 1.24 "Services" means those functional services ancillary to the supply of the goods, such as transportation and any other incidental services, such as installation, commissioning, provision of technical assistance, training, catering, gardening, security, maintenance and other such obligations of the supplier covered under the contract.
- 1.25 "Written" or "in writing" means handwritten in ink or any form of electronic or mechanical writing.

2. Application

- 2.1 These general conditions are applicable to all bids, contracts and orders including bids for functional and professional services, sales, hiring, letting and the granting or acquiring of rights, but excluding immovable property, unless otherwise indicated in the bidding documents.

Contractor

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Witness 2

Employer

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2.2 Where applicable, special conditions of contract are also laid down to cover specific supplies, services or works.

2.3 Where such special conditions of contract are in conflict with these general conditions, the special conditions shall apply.

3. General

3.1 Unless otherwise indicated in the bidding documents, the purchaser shall not be liable for any expense incurred in the preparation and submission of a bid. Where applicable a non-refundable fee for documents may be charged.

3.2 With certain exceptions, invitations to bid are only published in the Government Tender Bulletin. The Government Tender Bulletin may be obtained directly from the Government Printer, Private Bag X85, Pretoria 0001, or accessed electronically from www.treasury.gov.za

4. Standards

4.1 The goods supplied shall conform to the standards mentioned in the bidding documents and specifications.

5. Use of contract documents and information inspection

5.1 The supplier shall not, without the purchaser's prior written consent, disclose the contract, or any provision thereof, or any specification, plan, drawing, pattern, sample, or information furnished by or on behalf of the purchaser in connection therewith, to any person other than a person employed by the supplier in the performance of the contract. Disclosure to any such employed person shall be made in confidence and shall extend only so far as may be necessary for purposes of such performance.

5.2 The supplier shall not, without the purchaser's prior written consent, make use of any document or information mentioned in GCC clause 5.1 except for purposes of performing the contract.

5.3 Any document, other than the contract itself mentioned in GCC clause 5.1 shall remain the property of the purchaser and shall be returned (all copies) to the purchaser on completion of the supplier's performance under the contract if so required by the purchaser.

5.4 The supplier shall permit the purchaser to inspect the supplier's records relating to the performance of the supplier and to have them audited by auditors appointed by the purchaser, if so required by the purchaser.

6. Patent rights

6.1 The supplier shall indemnify the purchaser against all third-party claims of infringement of patent, trademark, or industrial design rights arising from use of the goods or any part thereof by the purchaser.

7. Performance security

7.1 Within thirty (30) days of receipt of the notification of contract award, the successful bidder shall furnish to the purchaser the performance security of the amount specified in SCC.

7.2 The proceeds of the performance security shall be payable to the purchaser as compensation for any loss resulting from the supplier's failure to complete

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his obligations under the contract.

- 7.3 The performance security shall be denominated in the currency of the contract, or in a freely convertible currency acceptable to the purchaser and shall be in one of the following forms:
- (a) a bank guarantee or an irrevocable letter of credit issued by a reputable bank located in the purchaser's country or abroad, acceptable to the purchaser, in the form provided in the bidding documents or another form acceptable to the purchaser; or
 - (b) a cashier's or certified cheque
- 7.4 The performance security will be discharged by the purchaser and returned to the supplier not later than thirty (30) days following the date of completion of the supplier's performance obligations under the contract, including any warranty obligations, unless otherwise specified in SCC.

7. Inspections, tests and analyses (where applicable)

8.

- 8.1 All pre-bidding testing will be for the account of the bidder.
- 8.2 If it is a bid condition that supplies to be produced or services to be rendered should at any stage during production or execution or on completion be subject to inspection, the premises of the bidder or contractor shall be open, at all reasonable hours, for inspection by a representative of the Department or an organization acting on behalf of the Department.
- 8.3 If there are no inspection requirements indicated in the bidding documents and no mention is made in the contract, but during the contract period it is decided that inspections shall be carried out, the purchaser shall itself make the necessary arrangements, including payment arrangements with the testing authority concerned.
- 8.4 If the inspections, tests and analyses referred to in clauses 8.2 and 8.3 show the supplies to be in accordance with the contract requirements, the cost of the inspections, tests and analyses shall be defrayed by the purchaser.
- 8.5 Where the supplies or services referred to in clauses 8.2 and 8.3 do not comply with the contract requirements, irrespective of whether such supplies or services are accepted or not, the cost in connection with these inspections, tests or analyses shall be defrayed by the supplier.
- 8.6 Supplies and services which are referred to in clauses 8.2 and 8.3 and which do not comply with the contract requirements may be rejected.
- 8.7 Any contract supplies may on or after delivery be inspected, tested or analyzed and may be rejected if found not to comply with the requirements of the contract. Such rejected supplies shall be held at the cost and risk of the supplier who shall, when called upon, remove them immediately at his own cost and forthwith substitute them with supplies which do comply with the requirements of the contract. Failing such removal the rejected supplies shall be returned at the suppliers cost and risk. Should the supplier fail to provide the substitute

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supplies forthwith, the purchaser may, without giving the supplier further opportunity to substitute the rejected supplies, purchase such supplies as may be necessary at the expense of the supplier.

- 8.8 The provisions of clauses 8.4 to 8.7 shall not prejudice the right of the purchaser to cancel the contract on account of a breach of the conditions thereof, or to act in terms of Clause 23 of GCC.

9. Packing

- 9.1 The supplier shall provide such packing of the goods as is required to prevent their damage or deterioration during transit to their final destination, as indicated in the contract. The packing shall be sufficient to withstand, without limitation, rough handling during transit and exposure to extreme temperatures, salt and precipitation during transit, and open storage. Packing, case size and weights shall take into consideration, where appropriate, the remoteness of the goods' final destination and the absence of heavy handling facilities at all points in transit.
- 9.2 The packing, marking, and documentation within and outside the packages shall comply strictly with such special requirements as shall be expressly provided for in the contract, including additional requirements, if any, specified in SCC, and in any subsequent instructions ordered by the purchaser.

10. Delivery and documents

- 10.1 Delivery of the goods shall be made by the supplier in accordance with the terms specified in the contract. The details of shipping and/or other documents to be furnished by the supplier are specified in SCC.
- 10.2 Documents to be submitted by the supplier are specified in SCC.

11. Insurance

- 11.1 The goods supplied under the contract shall be fully insured in a freely convertible currency against loss or damage incidental to manufacture or acquisition, transportation, storage and delivery in the manner specified in the SCC.

12. Transportation

- 12.1 Should a price other than an all-inclusive delivered price be required, this shall be specified in the SCC.

13. Incidental services

- 13.1 The supplier may be required to provide any or all of the following services, including additional services, if any, specified in SCC:
- (a) performance or supervision of on-site assembly and/or commissioning of the supplied goods;
 - (b) furnishing of tools required for assembly and/or maintenance of the supplied goods;
 - (c) furnishing of a detailed operations and maintenance manual for each appropriate unit of the supplied goods;
 - (d) performance or supervision or maintenance and/or repair of the supplied goods, for a period of time agreed by the parties, provided that this service shall not relieve the supplier of any warranty obligations under this contract; and
 - (e) training of the purchaser's personnel, at the supplier's plant and/or on site,

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in assembly, start-up, operation, maintenance, and/or repair of the supplied goods.

- 13.2 Prices charged by the supplier for incidental services, if not included in the contract price for the goods, shall be agreed upon in advance by the parties and shall not exceed the prevailing rates charged to other parties by the supplier for similar services.

14. Spare parts 14.1

As specified in SCC, the supplier may be required to provide any or all of the following materials, notifications, and information pertaining to spare parts manufactured or distributed by the supplier:

- (a) such spare parts as the purchaser may elect to purchase from the supplier, provided that this election shall not relieve the supplier of any warranty obligations under the contract; and
- (b) in the event of termination of production of the spare parts:
 - (i) Advance notification to the purchaser of the pending termination, in sufficient time to permit the purchaser to procure needed requirements; and
 - (ii) following such termination, furnishing at no cost to the purchaser, the blueprints, drawings, and specifications of the spare parts, if requested.

15. Warranty 15.1

The supplier warrants that the goods supplied under the contract are new, unused, of the most recent or current models, and that they incorporate all recent improvements in design and materials unless provided otherwise in the contract. The supplier further warrants that all goods supplied under this contract shall have no defect, arising from design, materials, or workmanship (except when the design and/or material is required by the purchaser's specifications) or from any act or omission of the supplier, that may develop under normal use of the supplied goods in the conditions prevailing in the country of final destination.

- 15.2 This warranty shall remain valid for twelve (12) months after the goods, or any portion thereof as the case may be, have been delivered to and accepted at the final destination indicated in the contract, or for eighteen (18) months after the date of shipment from the port or place of loading in the source country, whichever period concludes earlier, unless specified otherwise in SCC.

- 15.3 The purchaser shall promptly notify the supplier in writing of any claims arising under this warranty.

- 15.4 Upon receipt of such notice, the supplier shall, within the period specified in SCC and with all reasonable speed, repair or replace the defective goods or parts thereof, without costs to the purchaser.

- 15.5 If the supplier, having been notified, fails to remedy the defect(s) within the period specified in SCC, the purchaser may proceed to take such remedial action as may be necessary, at the supplier's risk and expense and without prejudice to any other rights which the purchaser may have against the supplier under the contract

16. Payment 16.1

The method and conditions of payment to be made to the supplier under this

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contract shall be specified in SCC.

16.2 The supplier shall furnish the purchaser with an invoice accompanied by a copy of the delivery note and upon fulfilment of other obligations stipulated in the contract.

16.3 Payments shall be made promptly by the purchaser, but in no case later than thirty (30) days after submission of an invoice or claim by the supplier.

16.4 Payment will be made in Rand unless otherwise stipulated in SCC.

17. Prices

17.1 Prices charged by the supplier for goods delivered and services performed under the contract shall not vary from the prices quoted by the supplier in his bid, with the exception of any price adjustments authorized in SCC or in the purchaser's request for bid validity extension, as the case may be.

18. Contract amendments

18.1 No variation in or modification of the terms of the contract shall be made except by written amendment signed by the parties concerned.

19. Assignment

19.1 The supplier shall not assign, in whole or in part, its obligations to perform under the contract, except with the purchaser's prior written consent.

20. Subcontracts

20.1 The supplier shall notify the purchaser in writing of all subcontracts awarded under this contract if not already specified in the bid. Such notification, in the original bid or later, shall not relieve the supplier from any liability or obligation under the contract.

21. Delays in the supplier's performance

21.1 Delivery of the goods and performance of services shall be made by the supplier in accordance with the time schedule prescribed by the purchaser in the contract.

21.2 If at any time during performance of the contract, the supplier or its subcontractor(s) should encounter conditions impeding timely delivery of the goods and performance of services, the supplier shall promptly notify the purchaser in writing of the fact of the delay, its likely duration and its cause(s). As soon as practicable after receipt of the supplier's notice, the purchaser shall evaluate the situation and may at his discretion extend the supplier's time for performance, with or without the imposition of penalties, in which case the extension shall be ratified by the parties by amendment of contract.

21.3 No provision in a contract shall be deemed to prohibit the obtaining of supplies or services from a national department, provincial department, or a local authority.

21.4 The right is reserved to procure outside of the contract small quantities or to have minor essential services executed if an emergency arises, the supplier's point of supply is not situated at or near the place where the supplies are required, or the supplier's services are not readily available.

21.5 Except as provided under GCC Clause 25, a delay by the supplier in the

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performance of its delivery obligations shall render the supplier liable to the imposition of penalties, pursuant to GCC Clause 22, unless an extension of time is agreed upon pursuant to GCC Clause 21.2 without the application of penalties.

- 21.6 Upon any delay beyond the delivery period in the case of a supplies contract, the purchaser shall, without cancelling the contract, be entitled to purchase supplies of a similar quality and up to the same quantity in substitution of the goods not supplied in conformity with the contract and to return any goods delivered later at the supplier's expense and risk, or to cancel the contract and buy such goods as may be required to complete the contract and without prejudice to his other rights, be entitled to claim damages from the supplier.

22. Penalties

- 22.1 Subject to GCC Clause 25, if the supplier fails to deliver any or all of the goods or to perform the services within the period(s) specified in the contract, the purchaser shall, without prejudice to its other remedies under the contract, deduct from the contract price, as a penalty, a sum calculated on the delivered price of the delayed goods or unperformed services using the current prime interest rate calculated for each day of the delay until actual delivery or performance. The purchaser may also consider termination of the contract pursuant to GCC Clause 23.

23. Termination for default

- 23.1 The purchaser, without prejudice to any other remedy for breach of contract, by written notice of default sent to the supplier, may terminate this contract in whole or in part:
- (a) if the supplier fails to deliver any or all of the goods within the period(s) specified in the contract, or within any extension thereof granted by the purchaser pursuant to GCC Clause 21.2;
 - (b) if the Supplier fails to perform any other obligation(s) under the contract; or
 - (c) if the supplier, in the judgment of the purchaser, has engaged in corrupt or fraudulent practices in competing for or in executing the contract.
- 23.2 In the event the purchaser terminates the contract in whole or in part, the purchaser may procure, upon such terms and in such manner as it deems appropriate, goods, works or services similar to those undelivered, and the supplier shall be liable to the purchaser for any excess costs for such similar goods, works or services. However, the supplier shall continue performance of the contract to the extent not terminated.
- 23.3 Where the purchaser terminates the contract in whole or in part, the purchaser may decide to impose a restriction penalty on the supplier by prohibiting such supplier from doing business with the public sector for a period not exceeding 10 years.
- 23.4 If a purchaser intends imposing a restriction on a supplier or any person associated with the supplier, the supplier will be allowed a time period of not more than fourteen (14) days to provide reasons why the envisaged restriction should not be imposed. Should the supplier fail to respond within the stipulated fourteen (14) days the purchaser may regard the intended penalty as not objected against and may impose it on the supplier.

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- 23.5 Any restriction imposed on any person by the Accounting Officer / Authority will, at the discretion of the Accounting Officer / Authority, also be applicable to any other enterprise or any partner, manager, director or other person who wholly or partly exercises or exercised or may exercise control over the enterprise of the first-mentioned person, and with which enterprise or person the first-mentioned person, is or was in the opinion of the Accounting Officer / Authority actively associated.
- 23.6 If a restriction is imposed, the purchaser must, within five (5) working days of such imposition, furnish the National Treasury, with the following information:
- (i) the name and address of the supplier and / or person restricted by the purchaser;
 - (ii) the date of commencement of the restriction
 - (iii) the period of restriction; and
 - (iv) the reasons for the restriction.

These details will be loaded in the National Treasury's central database of suppliers or persons prohibited from doing business with the public sector.

- 23.7 If a court of law convicts a person of an offence as contemplated in sections 12 or 13 of the Prevention and Combating of Corrupt Activities Act, No. 12 of 2004, the court may also rule that such person's name be endorsed on the Register for Tender Defaulters. When a person's name has been endorsed on the Register, the person will be prohibited from doing business with the public sector for a period not less than five years and not more than 10 years. The National Treasury is empowered to determine the period of restriction and each case will be dealt with on its own merits. According to section 32 of the Act the Register must be open to the public. The Register can be perused on the National Treasury website.

24. Anti dumping and countervailing duties and rights

- 24.1 When, after the date of bid, provisional payments are required, or anti-dumping or countervailing duties are imposed, or the amount of a provisional payment or anti-dumping or countervailing right is increased in respect of any dumped or subsidized import, the State is not liable for any amount so required or imposed, or for the amount of any such increase. When, after the said date, such a provisional payment is no longer required or any such anti-dumping or countervailing right is abolished, or where the amount of such provisional payment or any such right is reduced, any such favourable difference shall on demand be paid forthwith by the contractor to the State or the State may deduct such amounts from moneys (if any) which may otherwise be due to the contractor in regard to supplies or services which he delivered or rendered, or is to deliver or render in terms of the contract or any other contract or any other amount which may be due to him

25. Force Majeure

- 25.1 Notwithstanding the provisions of GCC Clauses 22 and 23, the supplier shall not be liable for forfeiture of its performance security, damages, or termination for default if and to the extent that his delay in performance or other failure to perform his obligations under the contract is the result of an event of force majeure.
- 25.2 If a force majeure situation arises, the supplier shall promptly notify the

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purchaser in writing of such condition and the cause thereof. Unless otherwise directed by the purchaser in writing, the supplier shall continue to perform its obligations under the contract as far as is reasonably practical, and shall seek all reasonable alternative means for performance not prevented by the force majeure event.

26. Termination for insolvency

- 26.1 The purchaser may at any time terminate the contract by giving written notice to the supplier if the supplier becomes bankrupt or otherwise insolvent. In this event, termination will be without compensation to the supplier, provided that such termination will not prejudice or affect any right of action or remedy which has accrued or will accrue thereafter to the purchaser.

27. Settlement of Disputes

- 27.1 If any dispute or difference of any kind whatsoever arises between the purchaser and the supplier in connection with or arising out of the contract, the parties shall make every effort to resolve amicably such dispute or difference by mutual consultation.
- 27.2 If, after thirty (30) days, the parties have failed to resolve their dispute or difference by such mutual consultation, then either the purchaser or the supplier may give notice to the other party of his intention to commence with mediation. No mediation in respect of this matter may be commenced unless such notice is given to the other party.
- 27.3 Should it not be possible to settle a dispute by means of mediation, it may be settled in a South African court of law.
- 27.4 Mediation proceedings shall be conducted in accordance with the rules of procedure specified in the SCC.
- 27.5 Notwithstanding any reference to mediation and/or court proceedings herein,
(a) the parties shall continue to perform their respective obligations under the contract unless they otherwise agree; and
(b) the purchaser shall pay the supplier any monies due the supplier.

28. Limitation of liability

- 28.1 Except in cases of criminal negligence or wilful misconduct, and in the case of infringement pursuant to Clause 6;
(a) the supplier shall not be liable to the purchaser, whether in contract, tort, or otherwise, for any indirect or consequential loss or damage, loss of use, loss of production, or loss of profits or interest costs, provided that this exclusion shall not apply to any obligation of the supplier to pay penalties and/or damages to the purchaser; and
(b) the aggregate liability of the supplier to the purchaser, whether under the contract, in tort or otherwise, shall not exceed the total contract price, provided that this limitation shall not apply to the cost of repairing or replacing defective equipment.

29. Governing language

- 29.1 The contract shall be written in English. All correspondence and other

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documents pertaining to the contract that is exchanged by the parties shall also be written in English.

30. Applicable law

- 30.1 The contract shall be interpreted in accordance with South African laws, unless otherwise specified in SCC.

31. Notices

- 31.1 Every written acceptance of a bid shall be posted to the supplier concerned by registered or certified mail and any other notice to him shall be posted by ordinary mail to the address furnished in his bid or to the address notified later by him in writing and such posting shall be deemed to be proper service of such notice
- 31.2 The time mentioned in the contract documents for performing any act after such aforesaid notice has been given, shall be reckoned from the date of posting of such notice.

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32. Taxes and duties

- 32.1 A foreign supplier shall be entirely responsible for all taxes, stamp duties, license fees, and other such levies imposed outside the purchaser's country.
- 32.2 A local supplier shall be entirely responsible for all taxes, duties, license fees, etc., incurred until delivery of the contracted goods to the purchaser.
- 32.3 No contract shall be concluded with any bidder whose tax matters are not in order. Prior to the award of a bid the Department must be in possession of a tax clearance certificate, submitted by the bidder. This certificate must be an original issued by the South African Revenue Services.

33. National Industrial Participation (NIP) Programme

- 33.1 The NIP Programme administered by the Department of Trade and Industry shall be applicable to all contracts that are subject to the NIP obligation.

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Witness 2

Employer

Witness 1

Witness 2

VAAL CENTRAL WATER

CONTRACT NO. BW283/ARWWTW/22

**REFURBISHMENT OF THE NYAKALLONG (ALLANRIDGE) WWTW:
CIVIL, MECHANICAL AND ELECTRICAL, CONTROL & INSTRUMENTATION**

PART C2

PRICING DATA

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

VAAL CENTRAL WATER

CONTRACT NO. BW283/ARWWTW/22

REFURBISHMENT OF THE NYAKALLONG (ALLANRIDGE) WWTW: CIVIL, MECHANICAL AND ELECTRICAL, CONTROL & INSTRUMENTATION

PART C2: PRICING

DATA CONTENTS

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C2.2	Pricing Schedule	C2.2-1
C2.3	Summary of Schedule	C2.3-1
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Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

VAAL CENTRAL WATER

CONTRACT NO. BW283/ARWWTW/22

REFURBISHMENT OF THE NYAKALLONG (ALLANRIDGE) WWTW: CIVIL, MECHANICAL AND ELECTRICAL, CONTROL & INSTRUMENTATION

SECTION C2.1

PRICING INSTRUCTIONS

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Pricing Assumptions mean the criteria as set out below, read together with all Parts of this contract document, which it will be assumed in the contract, that the tenderer has taken into account when developing his prices.

1. This Bill of Quantities has to be read together with the Articles of the Agreement, the Conditions of Contract and Special Conditions of Contract, the Form of Tender, the General Specification, the Project Specification and the Drawings.
2. The method of measurement published by the South African Bureau of Standards in clause 8 of the Standardised Specifications for Civil Engineering Construction is applicable, subject to the variations and amendments contained in the section "Applicable SANS 1200 standardised specifications".
3. General instruction and description of the Work or materials given in the Specification will not be repeated in the Bill of Quantities. It will only be referred to. Doorbell of reference between brackets, to particular Clause in the Conditions of Contract(C-22) or, Special Conditions of Contract (SC-11), General Specification (19.1.3), Project Specification (PS 11) or to a Drawing (Drawing 33650.01-141-01).
4. The clauses in a specification in which further information regarding the schedule item appears under "Reference clause" in the Schedule. The reference clauses indicated are not necessarily the only sources of information in respect of scheduled 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, eg. LB for SANS 1200 LB.
5. The quantities set out in the Bills of Quantities are the estimated quantities of the Contract Works, but the Contractor will be required to undertake whatever quantities may be directed by the Engineer from time to time. The Contract Price for the completed contract shall be computed from the actual quantities of work done, valued at the relevant unit rates and prices.
6. The prices and unit prices given in the Bill of Quantities, is all-embracing prices and it should cover the values of the different items completely and has to include all costs and expenses which may occur and for the building of the Work as described and costs and expenses that are required as well as all general liabilities, obligations and risks which forms a part of this contract. The prices should be given separately in the item(s) if special accountability, responsibilities and risks as in the above occurs.

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7. A price or unit price has to be filled in against every item in the Bill of Quantities even if the amount isn't shown. Items where no price or unit price has been filled in, will be regarded as covered by the other prices and unit prices in the Bill of Quantities. VAT must not be included in the tariffs.
8. Unit rates would be regarded as correct if any difference occurs between unit prices and the total and the total will be corrected according to. The unit prices will be calculated arithmetically in case of omissions.
9. Payments will only be made for items occurring in the Bill of Quantities and if the Contractor thinks that provision hasn't been made for some items, the item should be allowed under another item.
10. Except where rates only are required, insert all amounts to be included in the total tendered price in the "Amount" column and show the corresponding total tendered price.
11. The units of measurement described in the Bills of Quantities are metric units. Abbreviations which may be used in these Bills of Quantities are as follows:

mm	=	millimetre	h	=	hour
m	=	metre	kg	=	kilogram
km	=	kilometre	t	=	ton (1000 kg)
m ²	=	square metre	No.	=	number
m ² .pass	=	square metre-pass	sum	=	lump sum
ha	=	hectare	MN	=	meganewton
m ³	=	cubic metre	MN.m	=	meganewton-metre
m ³ .km	=	cubic metre-kilometre	P C sum	=	Prime Cost sum
l	=	litre	Prov sum	=	Provisional sum
kl	=	kilolitre	kW	=	kilowatt
MI	=	megalitre	%	=	per cent
MPa	=	megapascal			

The Employer has the right whereas any measurements and/or payments were made before the final Payment Certificate to inspect it and if it is incorrect to correct it. The Employer has the right to remove and correct any work not complying with the specification before the submission of the last Payment Certificate.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

VAAL CENTRAL WATER

CONTRACT NO. BW283/ARWWTW/22

**REFURBISHMENT OF THE NYAKALLONG (ALLANRIDGE) WWTW:
CIVIL, MECHANICAL AND ELECTRICAL, CONTROL & INSTRUMENTATION**

SECTION C2.2

SCHEDULE OF QUANTITIES

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

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[illegible]

NYAKALLONG WASTEWATER TREATMENT WORKS REFURBISHMENT
BILL OF QUANTITIES
CIVIL - SCOPE OF WORKS
WORK PACKAGE - SITE CLEARANCE
REV A

ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (ZAR)
C1.1.1	SABS 1200C 8.2	SITE CLEARANCE SCHEDULED ITEMS				
	8.2.1	Clear and Grub				
C1.1.1.1	8.2.1.1	Clear and Grub	m²	3500		
	8.2.2	Remove and grub large trees and tree stumps of girth				
C1.1.1.2.1	8.2.2.1	Over 1m and up to and including 2m	NO	0		RATE ONLY
C1.1.1.2.2	8.2.2.2	Over 2m and up to and including 3m	NO	0		RATE ONLY
C1.1.1.2.3	8.2.2.3	Over 3m, in steps of 1m	NO	0		RATE ONLY
	8.2.3	Remove and grub trees and tree stumps, regardless of girth				
C1.1.1.3	8.2.3.1	Remove and grub trees and tree stumps, regardless of girth	m²	3500		RATE ONLY
	8.2.4	Reclear Surface (Only on the instruction of the Engineer)				
C1.1.1.4	8.2.4.1	Reclear Surface	m²	3500		RATE ONLY
	8.2.5	Take down existing fences and walls				
	8.2.5.1 LIC	Fences Take down, removal, and storage of fencing during construction and reinstall fencing once construction is complete. (Complete)				
C1.1.1.5.1	8.2.5.1.1 LIC	Type 1: Barbed wire fencing up to 1.2m high	m			RATE ONLY
C1.1.1.5.2	8.2.5.1.2 LIC	Type 2: Diamond mesh fencing up to 1.2m high	m			RATE ONLY
C1.1.1.5.3	8.2.5.1.3 LIC	Type 3: Razor mesh wire fencing up to 2.4m high	m			RATE ONLY
C1.1.1.5.4	8.2.5.1.4 LIC	Type 4: ClearVu fencing up to 2.4m high	m			RATE ONLY
C1.1.1.5.5	8.2.5.1.5 LIC	Type 5: Concrete Palisade fencing up to 2.4m high	m			RATE ONLY
C1.1.1.5.6	8.2.5.1.6 LIC	Type 6: Prefabricated concrete walls up to 2.4m high	m			RATE ONLY
C1.1.1.5.7	8.2.5.1.7 LIC	Type 8: Steel Palisade fencing up to 2.4m high	m			RATE ONLY
C1.1.1.5.8	8.2.5.1.8 LIC	Extension of Type 1 to 8: Electrical Fencing	m			RATE ONLY
C1.1.1.5.9	8.2.5.1.9 LIC	Type 9: Electrical fencing up to 2.4m high	m			RATE ONLY
	8.2.5.2	Walls Take down, removal and disposal of walls at a dedicated disposals site within the free haul distance. (Complete)				
C1.1.1.6.1		Type 1: Single brick walls up to 2.4m high	m			RATE ONLY
C1.1.1.6.2		Type 2: Double brick walls up to 2.4m high	m			RATE ONLY
C1.1.1.6.3		Type 3: Tripple brick walls up to 2.4m high	m			RATE ONLY
	8.2.7	Dismantle and remove pipelines, electrical transmission lines, cables, etc.				
C1.1.1.7.1	8.2.7.1	Pipelines	m	60		
C1.1.1.7.2	8.2.7.2	Electrical Transmission lines	m	40		
C1.1.1.7.3	8.2.7.3	Cables	m	100		
Sub-Total Carried Forward						

ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (ZAR)
Sub-Total Carried Forward						
	8.2.8	Demolish and remove infrastructure (structures, buildings, stormwater drain, etc.) and dismantle steelwork, mechanical equipment, electrical equipment, etc. Either store on site as instructed or dispose of within free haul distance.				
	8.2.8.1	Pavements:				
C1.1.1.8.1.1	8.2.8.1.1	Type1: Concrete	m ²	0		RATE ONLY
C1.1.1.8.1.2	8.2.8.1.2	Type2: Brick	m ²	0		RATE ONLY
C1.1.1.8.1.3	8.2.8.1.3	Type3: Tar	m ²	0		RATE ONLY
	8.2.8.2	Stormwater:				
C1.1.1.8.2.1	8.2.8.2.1	Type1: Concrete Drains	NO	0		RATE ONLY
C1.1.1.8.2.2	8.2.8.2.2	Type2: Pipe or box culverts	NO	0		RATE ONLY
C1.1.1.8.2.3	8.2.8.2.3	Type3: Catchpits or Energy Breakers	NO	0		RATE ONLY
	8.2.8.3	Structures and Buildings				
C1.1.1.8.3.1	8.2.8.3.1	Type1: Aeration Basin (Refer to Description of Works)	SUM	1		
C1.1.1.8.3.2	8.2.8.3.2	Type2: Housing Facility (Refer to Description of Works)	SUM	1		
C1.1.1.8.3.3	8.2.8.3.3	Type3: 5 x Sludge Drying Beds	SUM	1		
	8.2.8.4	Steelwork:				
C1.1.1.8.4.1	8.2.8.4.1	Type1: TBC	SUM	0		RATE ONLY
C1.1.1.8.4.2	8.2.8.4.2	Type2: TBC	SUM	0		RATE ONLY
C1.1.1.8.4.3	8.2.8.4.3	Type3: TBC	SUM	0		RATE ONLY
	8.2.8.5	Mechanical Equipment:				
C1.1.1.8.5.1	8.2.8.5.1	Type1: Aeration Basin - Floating Surface Aerators (Complete) (Refer to Description of Works)	SUM	1		
C1.1.1.8.5.2	8.2.8.5.2	Type2: Aeration Basin - A-Recycle Pumps (Complete) (Refer to Description of Works)	SUM	1		
C1.1.1.8.5.3	8.2.8.5.3	Type3: Aeration Basin - Sluice Gates (Complete) (Refer to Description of Works)	SUM	1		
	8.2.10	Remove top soil to a nominal depth of 150mm and stockpile				
C1.1.1.10	8.2.10.1	Remove top soil to a nominal depth of 150mm and stockpile on site at indicate location (To be specified by the Engineer).	m ²	150		
	SANS 1200DA 8.3	EARTHWORKS - SMALL WORKS SCHEDULED ITEMS				
	8.3.6	Topsoiling				
C1.1.2.1.1	8.3.6.1	Top soil to a nominal depth of 150mm from stockpile on site.	m ³	4162.50		
C1.1.2.1.2	8.3.6.2	Top soil obtained from Commercial Source within free haul distance.	m ³	4162.50		RATE ONLY
	8.3.7	Grassing or Other Vegetation Cover				
		Supplying and Applying a chemical fertilizer @ 50g/m ² on horizontal and sloping surfaces				
		Supplying or laying kikuyu on horizontal and sloping surfaces				
C1.1.2.2.1	8.3.7.1	2:3:2 (22) Fertilizer	Kg	1387.50		
C1.1.2.2.2	8.3.7.2	Kikuyu (cuttings) including maintaining for duration of contract	m ²	27750.00		
C1.1.2.2.3	8.3.7.3	Kikuyu (sods) including maintaining for duration of contract	m ²	27750.00		RATE ONLY
C1.1.3.1		Irrigation (Fully Automated)	PROV SUM	1	100 000.00	100 000.00
		Hunter, Rainbird or similar approved Irrigation System.				
		Supply from Water Tower				
C1.1.3.2		Contractors mark-up on material	PERCENTAGE	10%	10 000.00	10 000.00
C1.1.4.1		Lawnmower	SUM	1	120 000.00	120 000.00
		1 x John Deere S140 48" Tractor Mower or similar approved (including				
		Warrantee = 2 Years (120Hours)				
C1.1.4.2		Contractors mark-up on material	PERCENTAGE	10%	12 000.00	12 000.00
Total Carried Forward to Summary						

[illegible]

ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (ZAR)
Sub-Total Carried Forward						
		<u>SLUDGE COLLECTION TANK</u>				
C2.1.5.1		Concrete Repair: Scope of Works	PROV SUM	1	159 750.00	159 750.00
		1. Clear the tank, including disposal at an approved site within free-haul distance.				
		2. Determine, assess and provide access into the tank.				
		3. High pressure wash the entire tank internal surface using a 500Bar pressure washer.				
		4. Perform inspection and mark defects.				
		5. Square cut and break out damaged spalling concrete as required.				
		6. Inspect rebar and replace if required.				
		7. Clean rebar with steel wire brushing or grid washing.				
		8. Apply Sika Armatech 110 Eopocem or similar approved to prepare rebar.				
		9. Reinstate concrete using Sika Monotop 412 NFG and Sika Armatech 110 Epocem or similar approved as bonding agent.				
		10. Cure repair as required.				
		11. Apply Sikagard 720 Epocem up to 2mm thick as required over internal surface.				
		12. For submerged internal surfaces apply Sikafloor 161 primer and two/three coats of Sikagard 63N or similar approved.				
		13. Remove access into the tank,				
		14. Clean the tank.				
C2.1.5.2		Contractors mark-up on material	PERCENTAGE	10%	15 975.00	15 975.00
		<u>OTHER</u>				
C2.1.6.1		Concrete Repair: Scope of Works	PROV SUM	1	213 000.00	213 000.00
		1. Clear the tank, including disposal at an approved site within free-haul distance.				
		2. Determine, assess and provide access into the tank.				
		3. High pressure wash the entire tank internal surface using a 500Bar pressure washer.				
		4. Perform inspection and mark defects.				
		5. Square cut and break out damaged spalling concrete as required.				
		6. Inspect rebar and replace if required.				
		7. Clean rebar with steel wire brushing or grid washing.				
		8. Apply Sika Armatech 110 Eopocem or similar approved to prepare rebar.				
		9. Reinstate concrete using Sika Monotop 412 NFG and Sika Armatech 110 Epocem or similar approved as bonding agent.				
		10. Cure repair as required.				
		11. Apply Sikagard 720 Epocem up to 2mm thick as required over internal surface.				
		12. For submerged internal surfaces apply Sikafloor 161 primer and two/three coats of Sikagard 63N or similar approved.				
		13. Remove access into the tank,				
		14. Clean the tank.				
C2.1.6.2		Contractors mark-up on material	PERCENTAGE	10%	21 300.00	21 300.00
		CONTROL BUILDING				
		SCHEDULED ITEMS				
C2.1.7.1		Repair: Scope of Works	PROV SUM	1	532 500.00	532 500.00
		1. Fix, repair and seal the roof.				
		2. Fix, repair, replace the ceilings, access hatch, cornices,				
		3. Remove the tiles on the inside of the building.				
		4. Paint the inside of the building.				
		5. Tile the inside of the building.				
		6. Any additional SOW deemed necessary by the Engineer.				
C2.1.7.2		Contractors mark-up on material	PERCENTAGE	10%	53 250.00	53 250.00
		ROTARY CORE DRILLING				
		SCHEDULED ITEMS				
C2.1.8.1	SANS 1200 PS A 8,12,6	Nominated Sub-Contractor (ARQ Geotechnical Engineers) to complete rotary core drilling.	PROV SUM	1	191 700.00	191 700.00
C2.1.8.2	SANS 1200 PS A 8,12,7	Contractors mark-up on material	PERCENTAGE	10%	19 170.00	19 170.00
Total Carried Forward to Summary						

ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (ZAR)
Sub-Total Carried Forward						
	SABS 1200 ME	SUBBASE				
	8.3	SCHEDULED ITEMS				
C2.2.8	8.3.1	Construct the subbase course with material excavated in all materials from borrow pits, including all processing of the subbase and discard any excess material within the free haul distance.				
C2.2.8.1	8.3.1.1	Access road as per drawings.	m ³	310		RATE ONLY
		150mm Thickness G5 Sub-Base at 97%MDD, PI ≤ 10, GM=1.75, Min CBR≥45% at 95% MOD AASTHO				
C2.2.8.2	8.3.3.2	Parking area as per drawings.	m ³	10.8		RATE ONLY
		150mm Thickness G5 Sub-Base at 97%MDD, PI ≤ 10, GM=1.75, Min CBR≥45% at 95% MOD AASTHO				
C2.2.9	8.3.2	Construct the subbase course with material excavated in all materials from designated excavation, including all processing of the subbase and discard any excess material within the free haul distance.				
C2.2.9.1	8.3.2.1	Access road as per drawings.	m ³	310		RATE ONLY
		150mm Thickness G5 Sub-Base at 97%MDD, PI ≤ 10, GM=1.75, Min CBR≥45% at 95% MOD AASTHO				
C2.2.9.2	8.3.3.2	Parking area as per drawings.	m ³	10.8		RATE ONLY
		150mm Thickness G5 Sub-Base at 97%MDD, PI ≤ 10, GM=1.75, Min CBR≥45% at 95% MOD AASTHO				
C2.2.10	8.3.3	Construct the subbase course with material excavated in all materials from commercial source or designated borrow areas, including all processing of the subbase and discard any excess material within the free haul distance.				
C2.2.10.1	8.3.3.1	Access road as per drawings.	m ³	310		
		150mm Thickness G5 Sub-Base at 97%MDD, PI ≤ 10, GM=1.75, Min CBR≥45% at 95% MOD AASTHO				
C2.2.10.2	8.3.3.2	Parking area as per drawings.	m ³	10.8		
		150mm Thickness G5 Sub-Base at 97%MDD, PI ≤ 10, GM=1.75, Min CBR≥45% at 95% MOD AASTHO				
	8.3.4	Extra Over:				
C2.2.10.3.1		Extra Over for 8.3.1 for Intermediate Excavation	m ³	46.5		
C2.2.10.3.2		Extra Over for 8.3.1 for Hard Rock Excavation	m ³	31		
	SABS 1200 MF	BASE				
	8.3	SCHEDULED ITEMS				
C2.2.11	8.3.1	Construct the base course with material excavated in all materials from borrow pits, including all processing of the base and discard any excess material within the free haul distance.				
C2.2.11.1	8.3.1.1	Access road as per drawings.	m ³	310		RATE ONLY
		150mm Thickness G5 Base at 97%MDD, PI ≤ 10, GM=1.75, Min CBR≥45% at 95% MOD AASTHO				
C2.2.11.2	8.3.3.2	Parking area as per drawings.	m ³	10.8		RATE ONLY
		150mm Thickness G5 Base at 97%MDD, PI ≤ 10, GM=1.75, Min CBR≥45% at 95% MOD AASTHO				
C2.2.12	8.3.2	Construct the base course with material excavated in all materials from designated excavation, including all processing of the base and discard any excess material within the free haul distance.				
C2.2.12.1	8.3.2.1	Access road as per drawings.	m ³	310		RATE ONLY
		150mm Thickness G5 Base at 97%MDD, PI ≤ 10, GM=1.75, Min CBR≥45% at 95% MOD AASTHO				
C2.2.12.2	8.3.3.2	Parking area as per drawings.	m ³	10.8		RATE ONLY
		150mm Thickness G5 Base at 97%MDD, PI ≤ 10, GM=1.75, Min CBR≥45% at 95% MOD AASTHO				
C2.2.13	8.3.3	Construct the base course with material excavated in all materials from commercial source or designated borrow areas, including all processing of the base and discard any excess material within the free haul distance.				
C2.2.13.1	8.3.3.1	Access road as per drawings.	m ³	310		
		150mm Thickness G5 Base at 97%MDD, PI ≤ 10, GM=1.75, Min CBR≥45% at 95% MOD AASTHO				
C2.2.13.2	8.3.3.2	Parking area as per drawings.	m ³	10.8		
		150mm Thickness G5 Base at 97%MDD, PI ≤ 10, GM=1.75, Min CBR≥45% at 95% MOD AASTHO				
Sub-Total Carried Forward						

ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (ZAR)
Sub-Total Carried Forward						
C2.2.13.3	8.3.4	Extra Over:				
		Extra Over for 8.3.1 and 8.3.2 for Intermediate Excavation	m ³	48.12		
		Extra Over for 8.3.1 and 8.3.2 for Hard Rock Excavation	m ³	32.08		
	SABS 1200 MJ	SEGMENTED PAVING				
	8.3	SCHEDULED ITEMS				
C2.2.14	8.3.1	Construct of paving (Complete)				
C2.2.14.1	LIC	80mm Thickness S-A Interlocking Block Paving (Complete)	m ²	2100		
C2.2.14.2	LIC	20mm Sand Bedding	m ²	2100		
		Any additional requirements.				
		ROAD MARKINGS				
C2.2.15.1		RM1	m	840		
C2.2.15.2		GM7	NO	5		
C2.2.15.3		RTM1	NO	5		
C2.2.15.4		RM7.1	NO	5		
		ROAD SIGNS				
C2.2.16.1		R1	NO	5		
	SABS 1200 MK	KERBING AND CHANNELLING				
	8.2	SCHEDULED ITEMS (As per SANS C Scheduled Items 8.2)				
	8.2.1	Concrete kerbing				
C2.2.17.1	LIC	SANS 927: Figure 4 Half Battered Kerb	m	465		
C2.2.17.2	LIC	SANS 927: Figure 8 Mountable Kerb	m	375		
C2.2.17.3	LIC	Transition Kerbs	m	5		
	8.2.7	Trimming of excavation for concrete-lined open drains in:				
	LIC	500 x 500 V-drain - Slope 1:4				
C2.2.18.1	LIC	Soft excavation	m ²	530		
C2.2.18.2		Intermediate excavation	m ²	265		RATE ONLY
C2.2.18.3		Hard excavation	m ²	79.5		RATE ONLY
	8.2.8	Cast in situ concrete lining to open drains				
C2.2.19.1	LIC	500 x 500 V-drain - Slope 1:4 - 35MPa/20mm	m ³	80		
	8.2.9	Formwork to cast in situ concrete lining to open drains				
	LIC	500 x 500 V-drain - Slope 1:4				
C2.2.20.1	LIC	Smooth - Vertical	m ²	160		
	8.2.10	Sealed joints in concrete lining to open drains.				
	LIC	500 x 500 V-drain - Slope 1:4				
C2.2.21.1	LIC	Joints - Every 2.5m	m	205		
	8.2.12	Steel Reinforcement				
		Steel bars				
C2.2.22.1	LIC	Steel bars (High tensile)	t	1		RATE ONLY
C2.2.22.1	LIC	Steel bars (Mild tensile)	t	1		RATE ONLY
		High tensile welded mesh				
	LIC	High tensile welded mesh (Ref no. 395 - 8mm)	m ²	0		RATE ONLY
	LIC	High tensile welded mesh (Ref no. 617 - 10mm)	m ²	1060		
		Unformed Surface Finish				
	LIC	a) Wood Float Finish	m ²	0		RATE ONLY
	LIC	b) Steel Float Finish	m ²	530		
Total Carried Forward to Summary						

ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (ZAR)
Sub-Total Carried Forward						
	SABS 1200 ME	SUBBASE				
	8.3	SCHEDULED ITEMS				
C2.3.7	8.3.1	Construct the subbase course with material excavated in all materials from borrow pits, including all processing of the subbase and discard any excess material within the free haul distance.				
	8.3.1.1	Access road as per drawings.				
C2.3.7.1		150mm Thickness G5 Sub-Base at 97%MDD, PI ≤ 10, GM=1.75, Min CBR≥45% at 95% MOD AASTHO	m³	330		RATE ONLY
	8.3.3.2	Parking area as per drawings.				
C2.3.7.2		150mm Thickness G5 Sub-Base at 97%MDD, PI ≤ 10, GM=1.75, Min CBR≥45% at 95% MOD AASTHO	m³	15		RATE ONLY
C2.3.8	8.3.2	Construct the subbase course with material excavated in all materials from designated excavation, including all processing of the subbase and discard any excess material within the free haul distance.				
C2.3.8.1	8.3.2.1	Access road as per drawings.				
		150mm Thickness G5 Sub-Base at 97%MDD, PI ≤ 10, GM=1.75, Min CBR≥45% at 95% MOD AASTHO	m³	330		RATE ONLY
C2.3.8.2	8.3.3.2	Parking area as per drawings.				
		150mm Thickness G5 Sub-Base at 97%MDD, PI ≤ 10, GM=1.75, Min CBR≥45% at 95% MOD AASTHO	m³	15		RATE ONLY
C2.3.9	8.3.3	Construct the subbase course with material excavated in all materials from commercial source or designated borrow areas, including all processing of the subbase and discard any excess material within the free haul distance.				
	8.3.3.1	Access road as per drawings.				
C2.3.9.1		150mm Thickness G5 Sub-Base at 97%MDD, PI ≤ 10, GM=1.75, Min CBR≥45% at 95% MOD AASTHO	m³	330		
	8.3.3.2	Parking area as per drawings.				
C2.3.9.2		150mm Thickness G5 Sub-Base at 97%MDD, PI ≤ 10, GM=1.75, Min CBR≥45% at 95% MOD AASTHO	m³	15		
C2.3.9.3	8.3.4	Extra Over:				
C2.3.9.3.1		Extra Over for 8.3.1 for Intermediate Excavation	m³	51.75		
C2.3.9.3.2		Extra Over for 8.3.1 for Hard Rock Excavation	m³	34.5		
	SABS 1200 MF	BASE				
	8.3	SCHEDULED ITEMS				
C2.3.10	8.3.1	Construct the base course with material excavated in all materials from borrow pits, including all processing of the base and discard any excess material within the free haul distance.				
	8.3.1.1	Access road as per drawings.				
C2.3.10.1		150mm Thickness G5 Base at 97%MDD, PI ≤ 10, GM=1.75, Min CBR≥45% at 95% MOD AASTHO	m³	330		RATE ONLY
	8.3.3.2	Parking area as per drawings.				
C2.3.10.2		150mm Thickness G5 Base at 97%MDD, PI ≤ 10, GM=1.75, Min CBR≥45% at 95% MOD AASTHO	m³	15		RATE ONLY
C2.3.11	8.3.2	Construct the base course with material excavated in all materials from designated excavation, including all processing of the base and discard any excess material within the free haul distance.				
C2.3.11.1	8.3.2.1	Access road as per drawings.				
		150mm Thickness G5 Base at 97%MDD, PI ≤ 10, GM=1.75, Min CBR≥45% at 95% MOD AASTHO	m³	330		RATE ONLY
C2.3.11.2	8.3.3.2	Parking area as per drawings.				
		150mm Thickness G5 Base at 97%MDD, PI ≤ 10, GM=1.75, Min CBR≥45% at 95% MOD AASTHO	m³	15		RATE ONLY
C2.3.12	8.3.3	Construct the base course with material excavated in all materials from commercial source or designated borrow areas, including all processing of the base and discard any excess material within the free haul distance.				
	8.3.3.1	Access road as per drawings.				
C2.3.12.1		150mm Thickness G5 Base at 97%MDD, PI ≤ 10, GM=1.75, Min CBR≥45% at 95% MOD AASTHO	m³	330		
	8.3.3.2	Parking area as per drawings.				
C2.3.12.2		150mm Thickness G5 Base at 97%MDD, PI ≤ 10, GM=1.75, Min CBR≥45% at 95% MOD AASTHO	m³	15		
Sub-Total Carried Forward						

ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (ZAR)
Sub-Total Carried Forward						
	SABS 1200 MJ	SEGMENTED PAVING				
	8.3	SCHEDULED ITEMS				
C2.3.13	8.3.1	Construct of paving (Complete)				
C2.3.13.1	LIC	80mm Thickness S-A Interlocking Block Paving (Complete)	m ²	2200		
C2.3.13.2	LIC	20mm Sand Bedding	m ²	2200		
		Any additional requirements.				
C2.3.14		ROAD MARKINGS				
C2.3.14.1		RM1	m	870		
C2.3.14.2		GM7	NO	5		
C2.3.14.3		RTM1	NO	5		
C2.3.14.4		RM7.1	NO	5		
C2.3.15		ROAD SIGNS				
C2.3.15.1		R1	NO	5		
	SABS 1200 MK	KERBING AND CHANNELLING				
	8.2	SCHEDULED ITEMS (As per SANS C Scheduled Items 8.2)				
C2.3.16	8.2.1	Concrete kerbing				
C2.3.16.1	LIC	SANS 927: Figure 4 Half Battered Kerb	m	0		
C2.3.16.2	LIC	SANS 927: Figure 8 Mountable Kerb	m	870		
C2.3.16.3	LIC	Transition Kerbs	m	12		
C2.3.17	8.2.7	Trimming of excavation for concrete-lined open drains in:				
	LIC	<u>500 x 500 V-drain - Slope 1:4</u>				
C2.3.17.1	LIC	Soft excavation	m ²	450		
C2.3.17.2		Intermediate excavation	m ²	225		RATE ONLY
C2.3.17.3		Hard excavation	m ²	67.5		RATE ONLY
C2.3.18	8.2.8	Cast in situ concrete lining to open drains	m ³	70		
C2.3.18.1	LIC	<u>500 x 500 V-drain - Slope 1:4 - 35MPa/20mm</u>				
C2.3.19	8.2.9	Formwork to cast in situ concrete lining to open drains				
	LIC	<u>500 x 500 V-drain - Slope 1:4</u>				
C2.3.19.1	LIC	Smooth - Vertical	m ²	140		
C2.3.20.1	8.2.10	Sealed joints in concrete lining to open drains.				
	LIC	<u>500 x 500 V-drain - Slope 1:4</u>				
C2.3.20.1	LIC	Joints - Every 2.5m	m	175		
C2.3.21	8.2.12	Steel Reinforcement				
		Steel bars				
C2.3.21.1	LIC	<u>Steel bars (High tensile)</u>	t	1		RATE ONLY
C2.3.21.2	LIC	<u>Steel bars (Mild tensile)</u>	t	1		RATE ONLY
		High tensile welded mesh				
C2.3.21.3	LIC	<u>High tensile welded mesh (Ref no. 395 - 8mm)</u>	m ²	0		RATE ONLY
C2.3.21.4	LIC	<u>High tensile welded mesh (Ref no. 617 - 10mm)</u>	m ²	900		
		Unformed Surface Finish				
C2.3.21.5	LIC	a) Wood Float Finish	m ²	0		RATE ONLY
C2.3.21.6	LIC	b) Steel Float Finish	m ²	450		
Total Carried Forward to Summary						

NYAKALLONG WASTEWATER TREATMENT WORKS REFURBISHMENT
BILL OF QUANTITIES
CIVIL - SCOPE OF WORKS
WORK PACKAGE - AERATION BASIN
REV A

ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (ZAR)
C3.1	SANS 1200DA 8.3	EARTHWORKS - SMALL WORKS				
		SCHEDULED ITEMS				
	8.3.1	Excavation				
	8.3.1.1	Remove top soil to a nominal depth of 150mm and stockpile				
C3.1.1	8.3.1.a	Remove top soil to a nominal depth of 150mm and stockpile on site at indicate location (To be specified by the Engineer).	m²	110		
C3.1.2	8.3.1.b	Excavation in all materials and use for embankment or backfill or dispose of material or surplus material within the free haul distance.	m³	3800		
	8.3.1.c	Extra Over:				
C3.1.2.1	8.3.1.c.1	Extra Over for 8.3.1.b for Intermediate Excavation	m³	950		
C3.1.2.2	8.3.1.c.2	Extra Over for 8.3.1.b for Hard Rock Excavation	m³	145		
	8.3.2	Restricted Excavation				
	8.3.2.a	Excavation for restricted foundations, footings, trenches and sub-soil drains in all materials and use for backfilling or embankment or dispose of material or surplus material within the free haul distance.				
C3.1.3.1	8.3.2.a LIC	0m up to 2m	m³	46		
	8.3.2.b	Extra Over:				
C3.1.3.1.1	8.3.2.b.1	Extra Over for Intermediate Excavation	m³	11.5		
C3.1.3.1.2	8.3.2.b.2	Extra Over for Hard Rock Excavation	m³	7		
C3.1.3.2	8.3.2.a LIC	2m up to 4m	m³	0		RATE ONLY
	8.3.2.b	Extra Over:				
C3.1.3.2.1	8.3.2.b.1	Extra Over for Intermediate Excavation	m³	0		RATE ONLY
C3.1.3.2.2	8.3.2.b.2	Extra Over for Hard Rock Excavation	m³	0		RATE ONLY
C3.1.3.3	8.3.2.a	4m up to 6m	m³	0		RATE ONLY
	8.3.2.b	Extra Over:				
C3.1.3.3.1	8.3.2.b.1	Extra Over for Intermediate Excavation	m³	0		RATE ONLY
C3.1.3.3.2	8.3.2.b.2	Extra Over for Hard Rock Excavation	m³	0		RATE ONLY
		Dewatering				
C3.1.3.4		Dewatering of excavation for restricted foundations, footings, trenches and sub-soil drains in 8.3.2 in all materials until construction is complete.	SUM	1		
		Geo-Fabric				
C3.1.3.5	LIC	Supply, lay and install geo-fabric (Kaytech Bidim A2 or similar approved) in sub-soil drains and below floors.	m²	400		
		Sub-Soil Pipes				
C3.1.3.6.1	LIC	Supply, lay and install 110uPVC collection pipes, collecting sub-soil drainage pipes.	m	30		
C3.1.3.6.2	LIC	Supply, lay and install 160uPVC collection pipes, collecting sub-soil drainage pipes.	m	30		
C3.1.3.6.3	LIC	Supply, lay and install 110uPVC slotted or perforated sub-soil drainage pipes.	m	220		
C3.1.3.6.3	LIC	Supply, lay and install 160uPVC slotted or perforated sub-soil drainage pipes.	m	220		
		Crushed Stone				
C3.1.3.7	LIC	Supply and place 19mm crushed stone in sub-soil drains.	m³	50		
Sub-Total Carried Forward						

ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (ZAR)
Sub-Total Carried Forward						
	8.3.4	Importing of material from Commercial Sources or from Borrow Pits				
C3.1.4	8.3.4.1	Importing of material from Commercial Sources or from Borrow Pits within the free haul distance.	m³	720		
	8.3.6	Topsoiling				
C3.1.5.1	8.3.6.1	Top soil to a nominal depth of 150mm from stockpile on site.	m³	0		RATE ONLY
C3.1.5.2	8.3.6.2	Top soil obtained from Commercial Source within free haul distance.	m³	0		RATE ONLY
	8.3.7	Grassing or Other Vegetation Cover				
	LIC	Supplying and Applying a chemical fertilizer @ 50g/m² on horizontal and sloping surfaces.				
	LIC	Supplying or laying kikuyu on horizontal and sloping surfaces.				
C3.1.6.1	8.3.7.1	2:3:2 (22) Fertilizer.	Kg	0		RATE ONLY
C3.1.6.2	8.3.7.2	Kikuyu (cuttings) including maintaining for duration of contract.	m²	0		RATE ONLY
C3.1.6.3	8.3.7.3	Kikuyu (sods) including maintaining for duration of contract.	m²	0		RATE ONLY
Sub-Total Carried Forward						

ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (ZAR)
Sub-Total Carried Forward						
C3.2	SANS 1200GA 8.2	CONCRETE - STRUCTURAL				
		SCHEDULED FORMWORK ITEMS				
	8.2.1	Rough				
		Plane vertical				
C3.2.1.1.1	LIC	Column Base	m ²	0		RATE ONLY
C3.2.1.1.2	LIC	Columns	m ²	0		RATE ONLY
C3.2.1.1.3	LIC	Columns Heads	m ²	0		RATE ONLY
C3.2.1.1.4	LIC	Floor	m ²	0		RATE ONLY
C3.2.1.1.5	LIC	Walls	m ²	0		RATE ONLY
C3.2.1.1.6	LIC	Soffit	m ²	0		RATE ONLY
C3.2.1.1.7	LIC	Beams	m ²	0		RATE ONLY
		Plane horizontal				
C3.2.1.2.1	LIC	Soffit	m ²	0		RATE ONLY
C3.2.1.2.2	LIC	Beams	m ²	0		RATE ONLY
		Plane sloping				
C3.2.1.3.1	LIC	Soffit	m ²	0		RATE ONLY
	8.2.2	Smooth				
		Plane vertical				
C3.2.2.1.1	LIC	Column Base	m ²	0		
C3.2.2.1.2	LIC	Columns	m ²	110		
C3.2.2.1.3	LIC	Columns Heads	m ²	0		RATE ONLY
C3.2.2.1.4	LIC	Floor	m ²	370		
C3.2.2.1.5	LIC	Walls	m ²	2110		
C3.2.2.1.6	LIC	Soffit	m ²	90		
C3.2.2.1.7	LIC	Beams	m ²	105		
		Plane horizontal				
C3.2.2.2.1	LIC	Soffit	m ²	170		
C3.2.2.2.2	LIC	Beams	m ²	35		
		Plane sloping				
C3.2.2.3.1	LIC	Soffit	m ²	0		RATE ONLY
	8.2.4	Box out holes / form voids				
	8.2.4.a	Small, circular of diameter up to and including 0.35m				
C3.2.3.1.1	8.2.4.a.1	Over 0m and up to and including 0.5m deep	NO	3		
C3.2.3.1.2	8.2.4.a.2	Over 0.5m and up to and including 1m deep	NO	0		RATE ONLY
	8.2.4.b	Small, other than circular, of area up to and including 0.1m ²				
C3.2.3.2.1	8.2.4.b.1	Over 0m and up to and including 0.5m deep	NO	0		RATE ONLY
C3.2.3.2.2	8.2.4.b.2	Over 0.5m and up to and including 1m deep	NO	0		RATE ONLY
	8.2.4.c	Large, circular, of diameter over 0.35m and up to and including 0.70m				
C3.2.3.3.1	8.2.4.c.1	Over 0m and up to and including 0.5m deep	NO	2		
C3.2.3.3.2	8.2.4.c.2	Over 0.5m and up to and including 1m deep	NO	0		RATE ONLY
	8.2.4.d	Large, other than circular, of area 0.1m ² and up to and including 0.5m ²				
C3.2.3.4.1	8.2.4.d.1	Over 0m and up to and including 0.5m deep	NO	0		RATE ONLY
C3.2.3.4.2	8.2.4.d.2	Over 0.5m and up to and including 1m deep	NO	0		RATE ONLY
	8.2.4.e	Large, circular, of diameter over 0.70m and up to and including 1.50m				
C3.2.3.5.1	8.2.4.e.1	Over 0m and up to and including 0.5m deep	NO	2		
C3.2.3.5.2	8.2.4.e.2	Over 0.5m and up to and including 1m deep	NO	0		RATE ONLY
	8.2.4.f	Large, other than circular, of area 0.5m ² and up to and including 2.5m ²				
C3.2.3.6.1	8.2.4.f.1	Over 0m and up to and including 0.5m deep	NO	3		
C3.2.3.6.2	8.2.4.f.2	Over 0.5m and up to and including 1m deep	NO	0		RATE ONLY
Sub-Total Carried Forward						

[illegible]

ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (ZAR)
Sub-Total Carried Forward						
	8.4	SCHEDULED CONCRETE ITEMS				
	8.4.1	Prescribed mix concrete				
C3.2.6	8.4.1.1	Prescribed mix concrete (Specified mix design)	m³	0		RATE ONLY
	8.4.2	Blinding layer				
C3.2.7	8.4.2.1 LIC	Blinding layer (20MPa/20mm) - 50mm thickness	m²	1950		
	8.4.3	Strength concrete				
	8.4.3.1	Strength concrete (30MPa/20mm)				
C3.2.8.1.1	8.4.3.1.1	Column Base	m³	0		RATE ONLY
C3.2.8.1.2	8.4.3.1.2	Columns	m³	0		RATE ONLY
C3.2.8.1.3	8.4.3.1.3	Column Head	m³	0		RATE ONLY
C3.2.8.1.4	8.4.3.1.4	Floor	m³	0		RATE ONLY
C3.2.8.1.5	8.4.3.1.5	Walls	m³	0		RATE ONLY
C3.2.8.1.6	8.4.3.1.6	Soffit	m³	0		RATE ONLY
C3.2.8.1.7	8.4.3.1.6	Beams	m³	0		RATE ONLY
	8.4.3.2	Strength concrete (35MPa/20mm)				
C3.2.8.2.1	8.4.3.2.1	Column Base	m³	0		
C3.2.8.2.2	8.4.3.2.2	Columns	m³	0		RATE ONLY
C3.2.8.2.3	8.4.3.2.3	Column Head	m³	12		
C3.2.8.2.4	8.4.3.2.4	Floor	m³	0		RATE ONLY
C3.2.8.2.5	8.4.3.2.5	Walls	m³	600		
C3.2.8.2.6	8.4.3.2.6	Soffit	m³	400		
C3.2.8.2.7	8.4.3.2.6	Beams	m³	42		
				17		
	8.4.3.3	Strength concrete (20MPa/20mm)				
C3.2.8.3.1	8.4.3.3.1 LIC	Mass Concrete	m³	6		
	8.4.3.4	No-fines Concrete (NF20) - 100mm Thickness				
C3.2.8.4.1	8.4.3.4.1 LIC	Vertical surfaces, sloping surfaces, horizontal surfaces and around sub-soils	m³	0		
C3.2.8.4.2	8.4.3.4.2 LIC	Filling of overbreak in rock to form drainage layer	m³	0		RATE ONLY
	8.4.4	Unformed Surface Finish				
C3.2.9.1		a) Wood Float Finish	m²	0		RATE ONLY
C3.2.9.2		b) Steel Float Finish	m²	1500		
	8.5	JOINTS				
C3.2.10.1		Wall Joint-Type A	m	135		
C3.2.10.2.1		Floor Joint-Type A	m	340		
C3.2.10.2.2		Floor Joint-Type B	m	460		
C3.2.10.2.3		Floor Joint-Type C	m	100		
C3.2.10.3		Walkway Joint-Type A	m	6		
C3.2.10.4		Sliding Joint-Type A	m	6		
Sub-Total Carried Forward						

[illegible]

NYAKALLONG WASTEWATER TREATMENT WORKS REFURBISHMENT
BILL OF QUANTITIES
CIVIL - SCOPE OF WORKS
WORK PACKAGE - HOUSING FACILITY (CIVIL)
REV A

ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (ZAR)
C4.1.1	SANS 1200DA 8.3	EARTHWORKS - SMALL WORKS				
		SCHEDULED ITEMS				
	8.3.1	Excavation				
	8.3.1.1	Remove top soil to a nominal depth of 150mm and stockpile				
C4.1.1.1	8.3.1.a	Remove top soil to a nominal depth of 150mm and stockpile on site at indicate location (To be specified by the Engineer).	m²	100		
C4.1.1.2	8.3.1.b	Excavation in all materials and use for embankment or backfill or dispose of material or surplice material within the free haul distance.	m³	25		
	8.3.1.c	Extra Over:				
C4.1.1.2.1	8.3.1.c.1	Extra Over for 8.3.1.b for Intermediate Excavation	m³	6.5		
C4.1.1.2.2	8.3.1.c.2	Extra Over for 8.3.1.b for Hard Rock Excavation	m³	4		
	8.3.2	Restricted Excavation				
	8.3.2.a	Excavation for restricted foundations, footings, trenches and sub-soil drains in all materials and use for backfilling or embankment or dispose of material or surplus material within the free haul distance.				
C4.1.1.3.1	8.3.2.a LIC	0m up to 2m	m³	6		
	8.3.2.b	Extra Over:				
C4.1.1.3.1.1	8.3.2.b.1	Extra Over for Intermediate Excavation	m³	1.5		
C4.1.1.3.1.2	8.3.2.b.2	Extra Over for Hard Rock Excavation	m³	1		
C4.1.1.3.2	8.3.2.a LIC	2m up to 4m	m³	0		RATE ONLY
	8.3.2.b	Extra Over:				
C4.1.1.3.2.1	8.3.2.b.1	Extra Over for Intermediate Excavation	m³	0		RATE ONLY
C4.1.1.3.2.2	8.3.2.b.2	Extra Over for Hard Rock Excavation	m³	0		RATE ONLY
C4.1.1.3.3	8.3.2.a	4m up to 6m	m³	0		RATE ONLY
	8.3.2.b	Extra Over:				
C4.1.1.3.3.1	8.3.2.b.1	Extra Over for Intermediate Excavation	m³	0		RATE ONLY
C4.1.1.3.3.2	8.3.2.b.2	Extra Over for Hard Rock Excavation	m³	0		RATE ONLY
	8.3.4	Importing of material from Commercial Sources or from Borrow Pits				
C4.1.1.4.1	8.3.4.1	Importing of material from Commercial Sources or from Borrow Pits within the free haul distance.	m³	30		
		Damp proofing				
C4.1.1.5.1		Floors				
C4.1.1.5.2		250 micron green medium density polyethylene dampproof sheeting under floors.	m²	100		
		Insect Control				
C4.1.1.6		Ant poison, aldrin emulsifiable concentrates solution to SABS 618 spread at a rate recommended by the Manufacture's Specification under foundation and floors.	m²	100		
Sub-Total Carried Forward						

[illegible]

ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (ZAR)
Sub-Total Carried Forward						
C4.1.2	SANS 1200GA 8.2	CONCRETE - STRUCTURAL				
		SCHEDULED FORMWORK ITEMS				
	8.2.1	Rough				
		Plane vertical				
C4.1.2.1.1.1	LIC	Column Base	m ²	0		RATE ONLY
C4.1.2.1.1.2	LIC	Columns	m ²	0		RATE ONLY
C4.1.2.1.1.3	LIC	Columns Heads	m ²	0		RATE ONLY
C4.1.2.1.1.4	LIC	Floor	m ²	0		RATE ONLY
C4.1.2.1.1.5	LIC	Walls	m ²	0		RATE ONLY
C4.1.2.1.1.6	LIC	Soffit	m ²	0		RATE ONLY
C4.1.2.1.1.7	LIC	Beams	m ²	0		RATE ONLY
		Plane horizontal				
C4.1.2.1.2.1	LIC	Soffit	m ²	0		RATE ONLY
C4.1.2.1.2.2	LIC	Beams	m ²	0		RATE ONLY
		Plane sloping				
C4.1.2.1.3.1	LIC	Soffit	m ²	0		RATE ONLY
	8.2.2	Smooth				
		Plane vertical				
C4.1.2.2.1.1	LIC	Column Base	m ²	0		RATE ONLY
C4.1.2.2.1.2	LIC	Columns	m ²	0		RATE ONLY
C4.1.2.2.1.3	LIC	Columns Heads	m ²	0		RATE ONLY
C4.1.2.2.1.4	LIC	Floor	m ²	25		
C4.1.2.2.1.5	LIC	Walls	m ²	0		RATE ONLY
C4.1.2.2.1.6	LIC	Soffit	m ²	0		RATE ONLY
C4.1.2.2.1.7	LIC	Beams	m ²	55		
		Plane horizontal				
C4.1.2.2.2.1	LIC	Soffit	m ²	0		RATE ONLY
C4.1.2.2.2.2	LIC	Beams	m ²	0		RATE ONLY
		Plane sloping				
C4.1.2.2.3.1	LIC	Soffit	m ²	0		RATE ONLY
	8.2.4	Box out holes / form voids				
	8.2.4.a	Small, circular of diameter up to and including 0.35m				
C4.1.2.3.1.1	8.2.4.a.1	Over 0m and up to and including 0.5m deep	NO	0		RATE ONLY
C4.1.2.3.1.2	8.2.4.a.2	Over 0.5m and up to and including 1m deep	NO	0		RATE ONLY
	8.2.4.b	Small, other than circular, of area up to and including 0.1m ²				
C4.1.2.3.2.1	8.2.4.b.1	Over 0m and up to and including 0.5m deep	NO	0		RATE ONLY
C4.1.2.3.2.2	8.2.4.b.2	Over 0.5m and up to and including 1m deep	NO	0		RATE ONLY
	8.2.4.c	Large, circular, of diameter over 0.35m and up to and including 0.70m				
C4.1.2.3.3.1	8.2.4.c.1	Over 0m and up to and including 0.5m deep	NO	0		RATE ONLY
C4.1.2.3.3.2	8.2.4.c.2	Over 0.5m and up to and including 1m deep	NO	0		RATE ONLY
	8.2.4.d	Large, other than circular, of area 0.1m ² and up to and including 0.5m ²				
C4.1.2.3.4.1	8.2.4.d.1	Over 0m and up to and including 0.5m deep	NO	0		RATE ONLY
C4.1.2.3.4.2	8.2.4.d.2	Over 0.5m and up to and including 1m deep	NO	0		RATE ONLY
	8.2.4.e	Large, circular, of diameter over 0.70m and up to and including 1.50m				
C4.1.2.3.5.1	8.2.4.e.1	Over 0m and up to and including 0.5m deep	NO	0		RATE ONLY
C4.1.2.3.5.2	8.2.4.e.2	Over 0.5m and up to and including 1m deep	NO	0		RATE ONLY
	8.2.4.f	Large, other than circular, of area 0.5m ² and up to and including 2.5m ²				
C4.1.2.3.6.1	8.2.4.f.1	Over 0m and up to and including 0.5m deep	NO	0		RATE ONLY
C4.1.2.3.6.2	8.2.4.f.2	Over 0.5m and up to and including 1m deep	NO	0		RATE ONLY
Sub-Total Carried Forward						

[illegible]

ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (ZAR)
Sub-Total Carried Forward						
	8.4	SCHEDULED CONCRETE ITEMS				
	8.4.1	Prescribed mix concrete				
C4.1.2.6	8.4.1.1	Prescribed mix concrete (Specified mix design)	m³	0		RATE ONLY
	8.4.2	Blinding layer				
C4.1.2.7	8.4.2.1 LIC	Blinding layer (20MPa/20mm) - 50mm thickness	m²	0		RATE ONLY
	8.4.3	Strength concrete				
	8.4.3.1	Strength concrete (30MPa/20mm)				
C4.1.2.8.1.1	8.4.3.1.1	Column Base	m³	0		RATE ONLY
C4.1.2.8.1.2	8.4.3.1.2	Columns	m³	0		RATE ONLY
C4.1.2.8.1.3	8.4.3.1.3	Column Head	m³	0		RATE ONLY
C4.1.2.8.1.4	8.4.3.1.4	Floor	m³	0		RATE ONLY
C4.1.2.8.1.5	8.4.3.1.5	Walls	m³	0		RATE ONLY
C4.1.2.8.1.6	8.4.3.1.6	Soffit	m³	0		RATE ONLY
C4.1.2.8.1.7	8.4.3.1.7	Beams	m³	0		RATE ONLY
	8.4.3.2	Strength concrete (35MPa/20mm)				
C4.1.2.8.2.1	8.4.3.2.1	Column Base	m³	0		RATE ONLY
C4.1.2.8.2.2	8.4.3.2.2	Columns	m³	0		RATE ONLY
C4.1.2.8.2.3	8.4.3.2.3	Column Head	m³	0		RATE ONLY
C4.1.2.8.2.4	8.4.3.2.4	Floor	m³	30		
C4.1.2.8.2.5	8.4.3.2.5	Walls	m³	0		RATE ONLY
C4.1.2.8.2.6	8.4.3.2.6	Soffit	m³	0		RATE ONLY
C4.1.2.8.2.7	8.4.3.2.7	Beams	m³	10		
	8.4.3.3	Strength concrete (20MPa/20mm)				
C4.1.2.8.3.1	8.4.3.3.1 LIC	Mass Concrete	m³	1		
	8.4.3.4	No-fines Concrete (NF20) - 100mm Thickness				
C4.1.2.8.4.1	8.4.3.4.1 LIC	Vertical surfaces, sloping surfaces, horizontal surfaces and around sub-soils	m³	0		RATE ONLY
C4.1.2.8.4.2	8.4.3.4.2 LIC	Filling of overbreak in rock to form drainage layer	m³	0		RATE ONLY
	8.4.4	Unformed Surface Finish				
C4.1.2.9.1		a) Wood Float Finish	m²	120		
C4.1.2.9.2		b) Steel Float Finish	m²	0		RATE ONLY
	8.5	Joints				
C4.1.2.10.1		Wall Joint-Type A	m	0		RATE ONLY
C4.1.2.10.2.1		Floor Joint-Type A	m	0		RATE ONLY
C4.1.2.10.2.2		Floor Joint-Type B	m	0		RATE ONLY
	8.7	Grouting				
		Grouting in of Equipment supplied and installed by Mechanical or Electrical Equipment Supplier, Contractor and/or Sub-Contractor.				
		SCHEDULED ROOF STRUCTURE				
C4.1.3		Roof design to be submitted for structural approval. Timber roof trusses, with IBR Sheeting.	SUM	1		
Total Carried Forward to Summary						

NYAKALLONG WASTEWATER TREATMENT WORKS REFURBISHMENT
BILL OF QUANTITIES
CIVIL - SCOPE OF WORKS
WORK PACKAGE - HOUSING FACILITY (ARCHITECTUAL)
REV A

ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (ZAR)
C4.2.1		FLOOR CONSTRUCTION				
C4.2.1.1		FC1: Concrete slab (Measured in Civil Quantities)	m²	0		
		250mm reinforced concrete slab with steel trowel finish as per Structural Engineer's specification. All construction and expansion joints as per Structural Engineer's specification.				
C4.2.1.2		FC2: Paving (Measured in Civil Quantities)	m²	0		
		200 x 100 x 80mm SABS approved concrete paving blocks with bevelled edges laid in herring bone pattern on 30mm thick river sand on well compacted earth, trimmed with 150 x 75 x 400mm matching concrete mini kerbs, grouted with plaster and/cement mix. Paving blocks colour: Grey. Treat soil with approved weed killer prior to laying of blocks.				
C4.2.1.3		FC3: False Floor (Not Applicable)	m²	0		
		Multi lock raised access floor system consisting of 600mm x 600mm x 35mm modular and interchangeable steel panels, all supported by steel under structure. Fixed and installed according to Manufacturers specification.				
C4.2.2		FLOOR FINISH				
C4.2.2.1		FF1: Screed	m²	46		
		30mm thick steel trowelled screed on concrete floor.				
C4.2.2.2		FF2: Tile - Type 1	m²	44		
		350 x 350 x 7mm kilimanjaro african slate, anti-slip floor tile as supplied by CTM, laid with approved tile adhesive, with 5mm gaps between the tiles. Fill gaps and movement joints with pro grip waterproof tile grout. Fill movement joints @ 9m² with polysulphide. Position of expansion joints to match expansion joints in concrete.Tile grout colour: To Client Architect approval.				
C4.2.2.3		FF3: Tile - Type 2	m²	3		
		200 x 200mm blanco white slip-resins porcelain mosaic tiles laid & fixed with approved mosaic tile adhesive and grout. Tile grout colour: To Client Architect approval.				
C4.2.2.5		FF4: Epoxy Resin	m²	0		
		3mm thick Flowcrete Peran STB epoxy resin floor coating application. Colour: To Client Architect approval, applied strictly according to Manufacturer's specifications.				
C4.2.2.6		FF5: Carpet Tiles	m²	0		
		Berber point "nexus" or equal approved carpet tiles laid by specialist on an even, true, clean & dry steel floated floor surface, including all edge and fixing strips. Finish: Nile blue.promax aluminium round edge trim 10mm x 2.5m for a smooth, rounded finish on the edge of the tile.				
C4.2.3		SKITINGS				
C4.2.3.1		S1: Tile skirtings	m	30		
		350 x 120mm high tile skirting from cut kilimanjaro african slate floor tiles as supplied by CTM. Fixed with approved tile adhesive and grout as for floor tiles. Floor joints to continue through skirting tiles. Aluminium edge trims to be applied at the top of skiting,				
C4.2.3.2		S2: Epoxy Resin Skirtings	m	0		
		85mm high epoxy resin coved skirting (including columns): Prepare surface and finish with 1 coat cement plaster smooth wood float finish. Apply approved primer. Apply two coats slip proof epoxy resin paint in accordance with Manufacturers' specifications. Colour: To Client Architect approval.				
C4.2.3.3		S3: Power skirtings	m	0		
		To Electrical Engineers design and specification.				
Sub-Total Carried Forward						

ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (ZAR)
Sub-Total Carried Forward						
C4.2.4		WALL				
C4.2.4.1		W1: 110mm stock brick	m	35		
C4.2.4.2		W2: 220mm stock brick	m	10		
C4.2.4.3		W3: 110mm Corobrik Protea Travertine face bricks bedded in mortar in stretcher bond with 10mm square recessed & polished horizontal & vertical joints. Wire brushed down twice with a solution of spirits of salts. To Client Architects approval.	m	30		
C4.2.4.4		W4: 220mm Corobrik Protea Travertine face bricks bedded in mortar in stretcher bond with 10mm square recessed & polished horizontal & vertical joints. Wire brushed down twice with a solution of spirits of salts. To Client Architects approval.	m	0		
C4.2.4.5		W5: 330mm Corobrik Protea Travertine face bricks bedded in mortar in stretcher bond with 10mm square recessed & polished horizontal & vertical joints. Wire brushed down twice with a solution of spirits of salts. To Client Architects approval.	m	0		
C4.2.5		BRICK FORCE (EVERY 3RD LAYER - 3/3), 15mm HT WIRE				
C4.2.5.1		110mm walls	m	15		
C4.2.5.2		220mm walls	m	490		
C4.2.5.3		330mm walls	m	0		
C4.2.6		DAMPPROOFING				
C4.2.6.1		Walls 375 micron embossed black polyethylene dampproof course in walls and sills	m²	30		
C4.2.7		WALL FINISH				
C4.2.7.1		WF1: Plaster 10mm 1:4 cement/sand mix plaster with smooth wood trowel finish. According to Manufacturer's specifications.	m²	140		
C4.2.7.2		WF2: Paint Prepare surface. Prime entire area with plascon plaster primer (UC 56). Paint 2 coats of plascon Wall & All (Colour: Cement wash Y1-E2-2),	m²	105		
C4.2.7.3		WF3: Tiled walls SANS approved clay stock bricks finished with 10mm 1:4 cement/sand mix plaster with smooth wood trowel finish. Prepare surface to take approved 200 x 200mm wall tile super white gloss ceramic wall tiles (grade A) up to ceiling height glued to the wall with tile adhesive applied as per Manufacturer's specifications. All exposed edges to have aluminium edge trims. Fixed with approved tile adhesive and grout as for floor tiles. Fill joints where tiles meet sanitary fittings with white silicone sealer.	m²	40		
Sub-Total Carried Forward						

ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (ZAR)
Sub-Total Carried Forward						
C4.2.8		CEILINGS				
C4.2.8.1		C1: Suspended ceilings	m²	0		
		Isover soundlite 1200 x 600 x 40mm thick ceiling tiles in coral vinyl, into the donn ceiling grid complete with donn main tees and down cross tees suspended with donn pre-stretched galvanized hanger wire 2.5mm thick, including perimeter trims against walls. Installation strictly according to Manufacturers specifications.				
C4.2.8.2		C2: Conventional ceilings	m²	50		
		6.4mm Gypsum ceiling boards with chromaprep h-profile metal jointing strips, clout nailed at max 150mm centres to 38 x 50mm s.a.pine (m4) branderung on max. 400mm spacings. Including Isotherm,				
C4.2.9		CORNICES				
C4.2.9.1		CC1: Suspended ceilings	m	0		
		Wall perimeter trim ISM 25 by donncell.				
C4.2.9.2		CC2: Conventional ceilings	m	50		
		76mm Rhino coved cornice.				
C4.2.10		GUTTERS AND DOWN PIPES				
C4.2.10.1		Gutters				
		Supply and fix all alluminium gutters, including all brackets, connections, bots and sealants.	m	0		
C4.2.10.2		Downpipes				
		Supply and fix all aluminium downpipes, including all brackets, connections, bots and sealants.	NO	0		
Sub-Total Carried Forward						

ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (ZAR)
Sub-Total Carried Forward						
C4.2.12		ROOM LOADING				
C4.2.12.1		RL11: Mirror 4mm plain mirror CTS (Size: 750 x 750mm) with anodized aluminum frame at the rear. Four key holes in mirror for fixing, plugged and screwed to wall with CP. Cap mirror screws and rubber washer spacers at the back as distance pieces.	NO	1		
C4.2.12.2		RL2: Shelves Citlwood melamine faced chipboard – Vancouver maple 300 x 400 x 32mm thick post formed melamine clad chipboard shelf with all edges concealed, each 2 x screwed (brass) to 150x250mm stainless steel gallow brackets each twice rawl bolted to wall.	NO	2		
C4.2.12.3		RL3: Kitchen Kitchen design to be submitted for approval to the Client (L-shaped kitchen proposed). Kitchen units to be plugged and screwed to wall (fisher plugs). Kitchen units to be formed of 16mm thick melamine(chip board) doors, backs, sides, bottom, shelves with white melamine finish on all internal surface and Client selected melamine finish on the exposed surfaces and edges. Kitchen units to be installed on legs (100-150mm high - Depending on the kitchen design) with aluminium kick plates at the bottom. Doors to be hung on steel spring loaded self closing hinges and fitted with 'union' dove cupboard pull handles (Colour: Anodized silver or equal & approved). Tops to be 15mm quarts with 100mm backsplash against wall. Seal junction with wall with silicone. Drawers on bottom mounted runners 550mm long & fitted with 'union' dove pull handles (Colour: Anodized silver or equal & approved). All cupboard doors to be fitted with "union" 2 lever cupboard lock keyed alike Ref: 423-76 KA & "union" lever lock escutcheon Ref: NY584-24N67. Kitchen design to include a single fridge, free standing stove and microwave included in the kitchen design price.	NO	1		
C4.2.12.4		RL4: Kitchen - Hand towel Towel Ring – Brushed Stainless Steel (Sa08840S)	NO	1		
C4.2.12.5		RL5: Bench 2000mm long freestanding bench,	NO	0		
C4.2.12.6		RL6: Shower bench Brushed stainless steel & timber 450 x 300mm,	NO	0		
C4.2.12.7		RL7: Commercial lockers Grey & white steel locker 899mm(l) x 450mm(w) x 1001mm(h)	NO	0		
C4.2.12.8		RL8: Burglar bars Solid square steel bars, 12mm x 12 mm in a horizontal or vertical layout with solid steel crossbars for support. Hot dip galvanised & polyester powder coating.	NO	6		
C4.2.12.9		RL9: Cabin hook Blue Tide - Single Robe Hook – Brushed Stainless Steel	NO	2		
C4.2.12.10		RL10: Coat hook Blue Tide - Single Robe Hook – Brushed Stainless Steel	NO	2		
C4.2.12.11		RL10: Bedroom Cupboards Cupboard design to be submitted for approval to the Client (1 x 600 cupboard with shelves, 1 x 1200 cupboard with top shelf and top an dbottom hangers proposed).Cupboard units to be plugged and screwed to wall (fisher plugs). Cupboard units to be formed of 16mm thick melamine(chip board) doors, sides, bottom, shelves with white melamine finish on all internal surface and Client selected melamine finish on the exposed surfaces and edges. Cupboards suports to be 16mm thick melamine(chip board) boxed usints with supports. Doors to be hung on steel spring loaded self closing hinges and fitted with 'union' dove cupboard pull handles (Colour: Anodized silver or equal & approved). Seal junction with wall with silicone. All cupboard doors to be fitted with "union" 2 lever cupboard lock keyed alike Ref: 423-76 KA & "union" lever lock escutcheon Ref: NY584-24N67.	NO	1		
Sub-Total Carried Forward						

ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (ZAR)
Sub-Total Carried Forward						
C4.2.13		LOUVERS (NOT APPLICABLE)				
C4.2.14		WINDOWS				
C4.2.14.1		W1: Window	NO	2		
		Type: PT69 (600 x 900mm) - Top Hung				
		Frame: Standard approved aluminium window frame.				
		Finish: Powdercoated: Dove grey				
		Glazing: 6mm clear "LOW E" toughned safety glass as per NBR, SANS 10400-XA, SAGGA & AAAMSA. For bathrooms use opaque instead of clear. Intruderprufe per smartglass. Clip on glazing beads on the inside.				
		Accessories: None				
C4.2.14.2		W2: Window	NO	1		
		Type: PT249 (2400 x 900mm) - Top Hung				
		Frame: Standard approved aluminium window frame.				
		Finish: Powdercoated: Dove grey				
		Glazing: 6mm clear "LOW E" toughned safety glass as per NBR, SANS 10400-XA, SAGGA & AAAMSA. For bathrooms use opaque instead of clear. Intruderprufe per smartglass. Clip on glazing beads on the inside.				
		Accessories: None				
C4.2.14.3		W2: Window	NO	3		
		Type: PTTTT1812 (1800 x 1200mm) - Top Hung				
		Frame: Standard approved aluminium window frame.				
		Finish: Powdercoated: Dove grey				
		Glazing: 6mm clear "LOW E" toughned safety glass as per NBR, SANS 10400-XA, SAGGA & AAAMSA. For bathrooms use opaque instead of clear. Intruderprufe per smartglass. Clip on glazing beads on the inside.				
		Accessories: None				
Sub-Total Carried Forward						

ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (ZAR)
Sub-Total Carried Forward						
C4.2.15		DOORS				
C4.2.15.1		D1: Door - LHC	NO	1		
		Door - Single - Fire Door				
		Panel: Standard masonite semi-solid core flush panel door with concealed hardwood edges.				
		Frame: Standard single rebate hot dipped galvanised mild steel door frame to suit wall thickness with lock box and s.s. striker plate. 1 pair of hinges. Fill frame with dagha.				
		Ironmongery: Union cedar AL6C63-05AS. I-22315-76SS mortice upright lockset with 2x18SC euro profile cylinder.				
		Accessories: Buchel B2391 anodised aluminium floor mounted door stop. Modern screw mounted aluminium front fixin. Natural anadised hook SKU:H060				
		Glazing: None				
		Finish: Prepare surface according to paint Manufacturer's specifications. Apply 2 coats plascon velvagio. Colour: Dove grey.				
C4.2.15.2		D2: Door - RHC	NO	1		
		Door - Single - Fire Door				
		Panel: Standard Class B fire door as part of a fire door set. Masonite finish for painting.				
		Frame: Standard single rebate hot dipped galvanised mild steel door frame for Class B fire door, to suit wall thickness with lock box and stainless steel striker plate. 1.5 pairs of hinges. Fill frame with dagha.				
		Ironmongery: Union cedar AL6C63-05AS. I-22315-76SS mortice upright lockset with 2x18SC euro profile cylinder.				
		Accessories: None				
		Glazing: None				
		Finish: Prepare surface according to paint Manufacturer's specifications. Apply 2 coats plascon velvagio. Colour: Dove grey.				
C4.2.15.3		D3: Door - LHC	NO	1		
		Door - Single - Fire Door				
		Panel: Standard Class B fire door as part of a fire door set. Masonite finish for painting.				
		Frame: Standard single rebate hot dipped galvanised mild steel door frame for Class B fire door, to suit wall thickness with lock box and stainless steel striker plate. 1.5 pairs of hinges. Fill frame with dagha.				
		Ironmongery: Union cedar AL6C63-05AS. I-22315-76SS mortice upright lockset with 2x18SC euro profile cylinder.				
		Accessories: None				
		Glazing: None				
		Finish: Prepare surface according to paint Manufacturer's specifications. Apply 2 coats plascon velvagio. Colour: Dove grey.				
C4.2.15.4		D4: Door - RHC	NO	0		
		Door - Single - Fire Door				
		Panel: Standard Class B fire door as part of a fire door set. Masonite finish for painting.				
		Frame: Standard single rebate hot dipped galvanised mild steel door frame for Class B fire door, to suit wall thickness with lock box and stainless steel striker plate. 1.5 pairs of hinges. Fill frame with dagha.				
		Ironmongery: Union cedar AL6C63-05AS. I-22315-76SS mortice upright lockset with 2x18SC euro profile cylinder.				
		Accessories: None				
		Glazing: None				
		Finish: Prepare surface according to paint Manufacturer's specifications. Apply 2 coats plascon velvagio. Colour: Dove grey.				
Sub-Total Carried Forward						

ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (ZAR)
Sub-Total Carried Forward						
C4.2.16		WATER SUPPLY SYSTEM				
C4.2.16.1		Water Closet: 15mm Coper Class 1 cold water supply. Drop in wall to supply water closet below with angle valve.	NO	1		
C4.2.16.2		Wash Hand Basin: 15mm Coper Class 1 cold water supply. Drop in wall to supply wash hand basin below with angle valve. 15mm Coper Class 1 hot water supply. Drop in wall to supply wash hand basin below with angle valve.	NO	1		
C4.2.16.3		Shower: 15mm Coper Class 1 cold water supply. Drop in wall to supply shower below with angle valve. 15mm Coper Class 1 hot water supply. Drop in wall to supply shower below with angle valve.	NO	1		
C4.2.16.4		Sink: 15mm Coper Class 1 cold water supply. Drop in wall to supply wash hand basin below with angle valve. 15mm Coper Class 1 hot water supply. Drop in wall to supply wash hand basin below with angle valve.	NO	1		
C4.2.16.5		Geyser Supply/Feed: 22mm Coper Class 1 supply to 100L Solar Geyser, including non return valve and pressure reducing valve as per geyser Standard Detail from Manufacturer.	NO	1		
C4.2.16.6		Water Tap: 22mm Coper Class 1 cold water supply, Drop wall mounted to supply locable BIB tap below with splash block.	NO	1		
C4.2.16.7		Geyser: 100L Solar Geyser-220V-230V-2kW-100L Kwikot Direct System or similar, complete with standard valves and drain cock as per Supplier Specification.	NO	1		
C4.2.16.8		Water Meter: Digital water meter, metering the supply to the building.	NO	1		
Sub-Total Carried Forward						

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NYAKALLONG WASTEWATER TREATMENT WORKS REFURBISHMENT
BILL OF QUANTITIES
CIVIL - SCOPE OF WORKS
WORK PACKAGE - CHLORINE DOSING FACILITY (CIVIL)
REV A

ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (ZAR)
C5.1.1	SANS 1200DA 8.3	EARTHWORKS - SMALL WORKS				
		SCHEDULED ITEMS				
	8.3.1	Excavation				
	8.3.1.1	Remove top soil to a nominal depth of 150mm and stockpile.				
C5.1.1.1	8.3.1.a	Remove top soil to a nominal depth of 150mm and stockpile on site at indicate location (To be specified by the Engineer).	m²	100		
C5.1.1.2	8.3.1.b	Excavation in all materials and use for embankment or backfill or dispose of material or surplus material within the free haul distance.	m³	25		
	8.3.1.c	Extra Over:				
C5.1.1.2.1	8.3.1.c.1	Extra Over for 8.3.1.b for Intermediate Excavation	m³	6.5		
C5.1.1.2.2	8.3.1.c.2	Extra Over for 8.3.1.b for Hard Rock Excavation	m³	4		
	8.3.2	Restricted Excavation				
	8.3.2.a	Excavation for restricted foundations, footings, trenches and sub-soil drains in all materials and use for backfilling or embankment or dispose of material or surplus material within the free haul distance.				
C5.1.1.3.1	8.3.2.a LIC	0m up to 2m	m³	7		
	8.3.2.b	Extra Over:				
C5.1.1.3.1.1	8.3.2.b.1	Extra Over for Intermediate Excavation	m³	2		
C5.1.1.3.1.2	8.3.2.b.2	Extra Over for Hard Rock Excavation	m³	1.5		
C5.1.1.3.2	8.3.2.a LIC	2m up to 4m	m³	0		
	8.3.2.b	Extra Over:				
C5.1.1.3.2.1	8.3.2.b.1	Extra Over for Intermediate Excavation	m³	0		
C5.1.1.3.2.2	8.3.2.b.2	Extra Over for Hard Rock Excavation	m³	0		
C5.1.1.3.3	8.3.2.a	4m up to 6m	m³	0		
	8.3.2.b	Extra Over:				
C5.1.1.3.3.1	8.3.2.b.1	Extra Over for Intermediate Excavation	m³	0		
C5.1.1.3.3.2	8.3.2.b.2	Extra Over for Hard Rock Excavation	m³	0		
	8.3.4	Importing of material from Commercial Sources or from Borrow Pits				
C5.1.1.4.1	8.3.4.1	Importing of material from Commercial Sources or from Borrow Pits within the free haul distance	m³	15		
		Damp proofing				
		Floors				
C5.1.1.5.1		250 micron green medium density polyethylene dampproof sheeting under floors.	m²	100		
		Insect Control				
C5.1.1.6		Ant poison, aldrin emulsifiable concentrates solution to SABS 618 spread at a rate recommended by the Manufacture's Specification under foundation and floors.	m²	100		
Sub-Total Carried Forward						

ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (ZAR)
Sub-Total Carried Forward						
C5.1.2	SANS 1200GA 8.2	CONCRETE - STRUCTURAL				
		SCHEDULED FORMWORK ITEMS				
	8.2.1	Rough				
		Plane vertical				
C5.1.2.1.1.1		Column Base	m ²	0		
C5.1.2.1.1.2		Columns	m ²	0		
C5.1.2.1.1.3		Columns Heads	m ²	0		
C5.1.2.1.1.4		Floor	m ²	0		
C5.1.2.1.1.5		Walls	m ²	0		
C5.1.2.1.1.6		Soffit	m ²	0		
C5.1.2.1.1.7		Beams	m ²	0		
		Plane horizontal				
C5.1.2.1.2.1		Soffit	m ²	0		
C5.1.2.1.2.2		Beams	m ²	0		
		Plane sloping				
C5.1.2.1.3.1		Soffit	m ²	0		
	8.2.2	Smooth				
		Plane vertical				
C5.1.2.2.1.1		Column Base	m ²	0		
C5.1.2.2.1.2		Columns	m ²	0		
C5.1.2.2.1.3		Columns Heads	m ²	0		
C5.1.2.2.1.4		Floor	m ²	16		
C5.1.2.2.1.5		Walls	m ²	10		
C5.1.2.2.1.6		Soffit	m ²	0		
C5.1.2.2.1.7		Beams	m ²	70		
		Plane horizontal				
C5.1.2.2.2.1		Soffit	m ²	0		
C5.1.2.2.2.2		Beams	m ²	0		
		Plane sloping				
C5.1.2.2.3.1		Soffit	m ²	0		
	8.2.4	Box out holes / form voids				
	8.2.4.a	Small, circular of diameter up to and including 0.35m				
C5.1.2.3.1.1	8.2.4.a.1	Over 0m and up to and including 0.5m deep	NO	0		
C5.1.2.3.1.2	8.2.4.a.2	Over 0.5m and up to and including 1m deep	NO	0		
	8.2.4.b	Small, other than circular, of area up to and including 0.1m ²				
C5.1.2.3.2.1	8.2.4.b.1	Over 0m and up to and including 0.5m deep	NO	0		
C5.1.2.3.2.2	8.2.4.b.2	Over 0.5m and up to and including 1m deep	NO	0		
	8.2.4.c	Large, circular, of diameter over 0.35m and up to and including 0.70m				
C5.1.2.3.3.1	8.2.4.c.1	Over 0m and up to and including 0.5m deep	NO	0		
C5.1.2.3.3.2	8.2.4.c.2	Over 0.5m and up to and including 1m deep	NO	0		
	8.2.4.d	Large, other than circular, of area 0.1m ² and up to and including 0.5m ²				
C5.1.2.3.4.1	8.2.4.d.1	Over 0m and up to and including 0.5m deep	NO	0		
C5.1.2.3.4.2	8.2.4.d.2	Over 0.5m and up to and including 1m deep	NO	0		
	8.2.4.e	Large, circular, of diameter over 0.70m and up to and including 1.50m				
C5.1.2.3.5.1	8.2.4.e.1	Over 0m and up to and including 0.5m deep	NO	0		
C5.1.2.3.5.2	8.2.4.e.2	Over 0.5m and up to and including 1m deep	NO	0		
	8.2.4.f	Large, other than circular, of area 0.5m ² and up to and including 2.5m ²				
C5.1.2.3.6.1	8.2.4.f.1	Over 0m and up to and including 0.5m deep	NO	0		
C5.1.2.3.6.2	8.2.4.f.2	Over 0.5m and up to and including 1m deep	NO	0		
Sub-Total Carried Forward						

[illegible]

ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (ZAR)
Sub-Total Carried Forward						
	8.4	SCHEDULED CONCRETE ITEMS				
	8.4.1	Prescribed mix concrete				
C5.1.2.6	8.4.1.1	Prescribed mix concrete (Specified mix design)	m³	0		
	8.4.2	Blinding layer				
C5.1.2.7	8.4.2.1 LIC	Blinding layer (20MPa/20mm) - 50mm thickness	m²	0		
	8.4.3	Strength concrete				
	8.4.3.1	Strength concrete (30MPa/20mm)				
C5.1.2.8.1.1	8.4.3.1.1	Column Base	m³	0		
C5.1.2.8.1.2	8.4.3.1.2	Columns	m³	0		
C5.1.2.8.1.3	8.4.3.1.3	Column Head	m³	0		
C5.1.2.8.1.4	8.4.3.1.4	Floor	m³	0		
C5.1.2.8.1.5	8.4.3.1.5	Walls	m³	0		
C5.1.2.8.1.6	8.4.3.1.6	Soffit	m³	0		
C5.1.2.8.1.7	8.4.3.1.7	Beams	m³	0		
	8.4.3.2	Strength concrete (35MPa/20mm)				
C5.1.2.8.2.1	8.4.3.2.1	Column Base	m³	0		
C5.1.2.8.2.2	8.4.3.2.2	Columns	m³	0		
C5.1.2.8.2.3	8.4.3.2.3	Column Head	m³	0		
C5.1.2.8.2.4	8.4.3.2.4	Floor	m³	25		
C5.1.2.8.2.5	8.4.3.2.5	Walls	m³	1		
C5.1.2.8.2.6	8.4.3.2.6	Soffit	m³	0		
C5.1.2.8.2.7	8.4.3.2.7	Beams	m³	9		
	8.4.3.3	Strength concrete (20MPa/20mm)				
C5.1.2.8.3.1	8.4.3.3.1 LIC	Mass Concrete	m³	1		
	8.4.3.4	No-fines Concrete (NF20) - 100mm Thickness				
C5.1.2.8.4.1	8.4.3.4.1 LIC	Vertical surfaces, sloping surfaces, horizontal surfaces and around sub-soils	m³	0		
C5.1.2.8.4.2	8.4.3.4.2 LIC	Filling of overbreak in rock to form drainage layer	m³	0		
	8.4.4	Unformed Surface Finish				
C5.1.2.9.1		a) Wood Float Finish	m²	110		
C5.1.2.9.2		b) Steel Float Finish	m²	0		
	8.5	Joints				
C5.1.2.10.1		Wall Joint-Type A	m	0		
C5.1.2.10.2.1		Floor Joint-Type A	m	0		
C5.1.2.10.2.2		Floor Joint-Type B	m	0		
	8.7	Grouting				
		Grouting in of Equipment supplied and installed by Mechanical or Electrical Equipment Supplier, Contractor and/or Sub-Contractor.				
		SCHEDULED ROOF STRUCTURE				
C5.1.3		Roof design to be submitted for structural approval. Timber roof trusses, with IRB Sheeting.	SUM	1		
Total Carried Forward to Summary						

NYAKALLONG WASTEWATER TREATMENT WORKS REFURBISHMENT
BILL OF QUANTITIES
CIVIL - SCOPE OF WORKS
WORK PACKAGE - CHLORINE DOSING FACILITY (ARCHITECTUAL)
REV A

ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (ZAR)
C5.2.1		FLOOR CONSTRUCTION				
C5.2.1.1		FC1: Concrete slab (Measured in Civil Quantities)	m²	0		
		250mm reinforced concrete slab with steel trowel finish as per Structural Engineer's specification. All construction and expansion joints as per Structural Engineer's specification.				
C5.2.1.2		FC2: Paving (Measured in Civil Quantities)	m²	0		
		200 x 100 x 80mm SABS approved concrete paving blocks with bevelled edges laid in herring bone pattern on 30mm thick river sand on well compacted earth, trimmed with 150 x 75 x 400mm matching concrete mini kerbs, grouted with plaster and/cement mix. Paving blocks colour: Grey. Treat soil with approved weed killer prior to laying of blocks.				
C5.2.1.3		FC3: False Floor (Not Applicable)	m²	0		
		Multi lock raised access floor system consisting of 600mm x 600mm x 35mm modular and interchangeable steel panels, all supported by steel under structure. Fixed and installed according to Manufacturers specification.				
C5.2.2		FLOOR FINISH				
C5.2.2.1		FF1: Screed	m²	30		
		30mm thick steel trowelled screed on concrete floor.				
C5.2.2.2		FF2: Tile - Type 1	m²	0		
		350 x 350 x 7mm kilimanjaro african slate, anti-slip floor tile as supplied by CTM, laid with approved tile adhesive, with 5mm gaps between the tiles. Fill gaps and movement joints with pro grip waterproof tile grout. Fill movement joints @ 9m² with polysulphide. Position of expansion joints to match expansion joints in concrete.Tile grout colour: To Client Architect approval.				
C5.2.2.3		FF3: Tile - Type 2	m²	0		
		200 x 200mm blanco white slip-resins porcelain mosaic tiles laid & fixed with approved mosaic tile adhesive and grout. Tile grout colour: To Client Architect approval.				
C5.2.2.5		FF4: Epoxy Resin	m²	30		
		3mm thick Flowcrete Peran STB epoxy resin floor coating application. Colour: To Client Architect approval, applied strictly according to Manufacturer's specifications.				
C5.2.2.6		FF5: Carpet Tiles	m²	0		
		Berber point "nexus" or equal approved carpet tiles laid by specialist on an even, true, clean & dry steel floated floor surface, including all edge and fixing strips. Finish: Nile blue.promax aluminium round edge trim 10mm x 2.5m for a smooth, rounded finish on the edge of the tile.				
C5.2.3		SKITINGS				
C5.2.3.1		S1: Tile skirtings	m	0		
		350 x 120mm high tile skirting from cut kilimanjaro african slate floor tiles as supplied by CTM. Fixed with approved tile adhesive and grout as for floor tiles. Floor joints to continue through skirting tiles. Aluminium edge trims to be applied at the top of skiting,				
C5.2.3.2		S2: Epoxy Resin Skirtings	m	40		
		85mm high epoxy resin coved skirting (including columns): Prepare surface and finish with 1 coat cement plaster smooth wood float finish. Apply approved primer. Apply two coats slip proof epoxy resin paint in accordance with Manufacturers' specifications. Colour: To Client Architect approval.				
C5.2.3.3		S3: Power skirtings	m	0		
		To Electrical Engineers design and specification.				
Sub-Total Carried Forward						

ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (ZAR)
Sub-Total Carried Forward						
C5.2.4		WALL				
C5.2.4.1		W1: 110mm stock brick	m	30		
C5.2.4.2		W2: 220mm stock brick	m	7		
C5.2.4.3		W3: 110mm Corobrik Protea Travertine face bricks bedded in mortar in stretcher bond with 10mm square recessed & polished horizontal & vertical joints. Wire brushed down twice with a solution of spirits of salts. To Client Architects approval.	m	30		
C5.2.4.4		W4: 220mm Corobrik Protea Travertine face bricks bedded in mortar in stretcher bond with 10mm square recessed & polished horizontal & vertical joints. Wire brushed down twice with a solution of spirits of salts. To Client Architects approval.	m	0		
C5.2.4.5		W5: 330mm Corobrik Protea Travertine face bricks bedded in mortar in stretcher bond with 10mm square recessed & polished horizontal & vertical joints. Wire brushed down twice with a solution of spirits of salts. To Client Architects approval.	m	0		
C5.2.5		BRICK FORCE (EVERY 3RD LAYER - 3/3), 15mm HT WIRE				
C5.2.5.1		110mm walls	m	0		
C5.2.5.2		220mm walls	m	415		
C5.2.5.3		330mm walls	m	0		
C5.2.6		DAMPPROOFING				
C5.2.6.1		Walls 375 micron embossed black polyethylene dampproof course in walls and sills	m²	30		
C5.2.7		WALL FINISH				
C5.2.7.1		WF1: Plaster 10mm 1:4 cement/sand mix plaster with smooth wood trowel finish. According to Manufacturer's specifications.	m²	115		
C5.2.7.2		WF2: Paint Prepare surface. Prime entire area with plascon plaster primer (UC 56). Paint 2 coats of plascon Wall & All (Colour: Cement wash Y1-E2-2),	m²	115		
C5.2.7.3		WF3: Tiled walls SANS approved clay stock bricks finished with 10mm 1:4 cement/sand mix plaster with smooth wood trowel finish. Prepare surface to take approved 200 x 200mm wall tile super white gloss ceramic wall tiles (grade A) up to ceiling height glued to the wall with tile adhesive applied as per Manufacturer's specifications. All exposed edges to have aluminium edge trims. Fixed with approved tile adhesive and grout as for floor tiles. Fill joints where tiles meet sanitary	m²	0		
Sub-Total Carried Forward						

ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (ZAR)
Sub-Total Carried Forward						
C5.2.8		CEILINGS				
C5.2.8.1		C1: Suspended ceilings	m²	30		
		Isover soundlite 1200 x 600 x 40mm thick ceiling tiles in coral vinyl, into the donn ceiling grid complete with donn main tees and down cross tees suspended with donn pre-stretched galvanized hanger wire 2.5mm thick, including perimeter trims against walls. Installation strictly according to Manufacturers specifications.				
C5.2.8.2		C2: Conventional ceilings	m²	0		
		6.4mm Gypsum ceiling boards with chromaprep h-profile metal jointing strips, clout nailed at max.150mm centres to 38 x 50mm s.a.pine (m4) branderung on max. 400mm spacings.				
C5.2.9		CORNICES				
C5.2.9.1		CC1: Suspended ceilings	m	40		
		Wall perimeter trim ISM 25 by donnceil.				
C5.2.9.2		CC2: Conventional ceilings	m	0		
		76mm Rhino coved cornice.				
C5.2.10		GUTTERS AND DOWN PIPES				
C5.2.10.1		Gutters				
		Supply and fix all aluminium gutters, including all brackets, connections, bots and sealants.	m	0		
C5.2.10.2		Downpipes				
		Supply and fix all aluminium downpipes, including all brackets, connections, bots and sealants.	NO	0		
C5.2.11		SANITARY (NOT APPLICABLE)				
C5.2.12		ROOM LOADING (NOT APPLICABLE)				
C5.2.13		LOUVERS (NOT APPLICABLE)				
C5.2.14		WINDOWS				
C5.2.14.1		W1: Window	NO	2		
		Type: PT69 (600 x 900mm) - Top Hung				
		Frame: Standard approved aluminium window frame.				
		Finish: Powder coated: Dove grey				
		Glazing: 6mm clear "LOW E" toughened safety glass as per NBR, SANS 10400-XA, SAGGA & AAAMSA. For bathrooms use opaque instead of clear. Intruderprufe per smartglass. Clip on glazing beads on the inside.				
		Accessories: None				
C5.2.14.2		W2: Window	NO	1		
		Type: PTT912 (900 x 1200mm) - Top Hung				
		Frame: Standard approved aluminium window frame.				
		Finish: Powder coated: Dove grey				
		Glazing: 6mm clear "LOW E" toughened safety glass as per NBR, SANS 10400-XA, SAGGA & AAAMSA. For bathrooms use opaque instead of clear. Intruderprufe per smartglass. Clip on glazing beads on the inside.				
		Accessories: None				
C5.2.14.3		W3: Window	NO	1		
		Type: Sound proof window (2000 x 900mm)				
		Frame: Standard approved aluminium window frame.				
		Finish: Powder coated: Dove grey				
		Glazing: 6mm clear "LOW E" toughened safety glass as per NBR, SANS 10400-XA, SAGGA & AAAMSA. For bathrooms use opaque instead of clear. Intruderprufe per smartglass. Clip on glazing beads on the inside.				
		Accessories: None				
Sub-Total Carried Forward						

ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (ZAR)
Sub-Total Carried Forward						
C5.2.15		DOORS				
C5.2.15.1		D1: Door - LHC	NO	1		
		Door - Single - Fire Door				
		Panel: Standard Class B fire door as part of a fire door set. Masonite finish for painting.				
		Frame: Standard single rebate hot dipped galvanised mild steel door frame for Class B fire door, to suit wall thickness with lock box and stainless steel striker plate. 1.5 pairs of hinges. Fill frame with dacha.				
		Ironmongery: Union cedar AL6C63-05AS. I-22315-76SS mortice upright lockset with 2x18SC euro profile cylinder.				
		Accessories: None				
		Glazing: None				
		Finish: Prepare surface according to paint Manufacturer's specifications. Apply 2 coats plascon velvagio. Colour: Dove grey.				
C5.2.15.2		D2: Door - RHC	NO	2		
		Door - Single - Fire Door				
		Panel: Standard Class B fire door as part of a fire door set. Masonite finish for painting.				
		Frame: Standard single rebate hot dipped galvanised mild steel door frame for Class B fire door, to suit wall thickness with lock box and stainless steel striker plate. 1.5 pairs of hinges. Fill frame with dacha.				
		Ironmongery: Union cedar AL6C63-05AS. I-22315-76SS mortice upright lockset with 2x18SC euro profile cylinder.				
		Accessories: None				
		Glazing: None				
		Finish: Prepare surface according to paint Manufacturer's specifications. Apply 2 coats plascon velvagio. Colour: Dove grey.				
C5.2.15.3		D3: Door - Transformer Door	NO	3		
		Door-Double-Transformer				
		Panel: Transformer room door with louvre panels with vermin proof mesh screen on the inside as per Bitcon Industries or similar approved.				
		Frame: Standard double rebate hot dipped galvanised mild steel door frame to suit wall thickness. 1 pair of 100mm heavy duty 4mm thick flanged brass hinges per leaf. Fill frame with dacha.				
		Ironmongery: Pull and push handle, pad latch and barrel bolts as supplied by manufacturer.				
		Accessories: Door closer (handle sink grey cisa door closer sku: d16100397 and horizontal middle rail)				
		Glazing: None				
		Finish: Prepare surface according to paint Manufacturer's specifications. Apply 2 coats plascon velvagio. Colour: Dove grey				
C5.2.16		WATER SUPPLY SYSTEM (NOT APPLICABLE)				
C5.2.17		SANITARY SYSTEM (NOT APPLICABLE)				
Total Carried Forward to Summary						

NYAKALLONG WASTEWATER TREATMENT WORKS REFURBISHMENT
BILL OF QUANTITIES
CIVIL - SCOPE OF WORKS
WORK PACKAGE - CHLORINE CONTACT TANK
REV A

ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (ZAR)
C6.1	SANS 1200DA 8.3	EARTHWORKS - SMALL WORKS				
		SCHEDULED ITEMS				
	8.3.1	Excavation				
	8.3.1.1	Remove top soil to a nominal depth of 150mm and stockpile				
C6.1.1	8.3.1.a	Remove top soil to a nominal depth of 150mm and stockpile on site at indicate location (To be specified by the Engineer).	m²	300		
C6.1.2	8.3.1.b	Excavation in all materials and use for embankment or backfill or dispose of material or surplus material within the free haul distance.	m³	550		
	8.3.1.c	Extra Over:				
C6.1.2.1	8.3.1.c.1	Extra Over for 8.3.1.b for Intermediate Excavation	m³	140		
C6.1.2.2	8.3.1.c.2	Extra Over for 8.3.1.b for Hard Rock Excavation	m³	85		
	8.3.2	Restricted Excavation				
	8.3.2.a	Excavation for restricted foundations, footings, trenches and sub-soil drains in all materials and use for backfilling or embankment or dispose of material or surplus material within the free haul distance.				
C6.1.3.1	8.3.2.a LIC	0m up to 2m	m³	8		
	8.3.2.b	Extra Over:				
C6.1.3.1.1	8.3.2.b.1	Extra Over for Intermediate Excavation	m³	2		
C6.1.3.1.2	8.3.2.b.2	Extra Over for Hard Rock Excavation	m³	1.5		
C6.1.3.2	8.3.2.a LIC	2m up to 4m	m³	0		
	8.3.2.b	Extra Over:				
C6.1.3.2.1	8.3.2.b.1	Extra Over for Intermediate Excavation	m³	0		
C6.1.3.2.2	8.3.2.b.2	Extra Over for Hard Rock Excavation	m³	0		
C6.1.3.3	8.3.2.a	4m up to 6m	m³	0		
	8.3.2.b	Extra Over:				
C6.1.3.3.1	8.3.2.b.1	Extra Over for Intermediate Excavation	m³	0		
C6.1.3.3.2	8.3.2.b.2	Extra Over for Hard Rock Excavation	m³	0		
		Dewatering				
C6.1.3.4		Dewatering of excavation for restricted foundations, footings, trenches and sub-soil drains in 8.3.2 in all materials until construction is complete.	SUM	1		
		Geo-Fabric				
C6.1.3.5		Supply, lay and install geo-fabric (Kaytech Bidim A2 or similar approved) in sub-soil drains and below floors.	m²	70		
		Sub-Soil Pipes				
C6.1.3.6.1		Supply, lay and install 110uPVC collection pipes, collecting sub-soil drainage pipes.	m	22		
C6.1.3.6.2		Supply, lay and install 160uPVC collection pipes, collecting sub-soil drainage pipes.	m	22		
C6.1.3.6.3		Supply, lay and install 110uPVC slotted or perforated sub-soil drainage pipes.	m	10		
C6.1.3.6.3		Supply, lay and install 160uPVC slotted or perforated sub-soil drainage pipes.	m	10		
		Crushed Stone				
C6.1.3.7		Supply and place 19mm crushed stone in sub-soil drains.	m³	8		
Sub-Total Carried Forward						

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ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (ZAR)
Sub-Total Carried Forward						
C6.2	SANS 1200GA 8.2	CONCRETE - STRUCTURAL				
		SCHEDULED FORMWORK ITEMS				
	8.2.1	Rough				
		Plane vertical				
C6.2.1.1.1		Column Base	m ²	0		
C6.2.1.1.2		Columns	m ²	0		
C6.2.1.1.3		Columns Heads	m ²	0		
C6.2.1.1.4		Floor	m ²	0		
C6.2.1.1.5		Walls	m ²	0		
C6.2.1.1.6		Soffit	m ²	0		
C6.2.1.1.7		Beams	m ²	0		
		Plane horizontal				
C6.2.1.2.1		Soffit	m ²	0		
C6.2.1.2.2		Beams	m ²	0		
		Plane sloping				
C6.2.1.3.1		Soffit	m ²	0		
	8.2.2	Smooth				
		Plane vertical				
C6.2.2.1.1		Column Base	m ²	0		
C6.2.2.1.2		Columns	m ²	0		
C6.2.2.1.3		Columns Heads	m ²	0		
C6.2.2.1.4		Floor	m ²	18		
C6.2.2.1.5		Walls	m ²	540		
C6.2.2.1.6		Soffit	m ²	0		
C6.2.2.1.7		Beams	m ²	0		
		Plane horizontal				
C6.2.2.2.1		Soffit	m ²	0		
C6.2.2.2.2		Beams	m ²	0		
		Plane sloping				
C6.2.2.3.1		Soffit	m ²	0		
	8.2.4	Box out holes / form voids				
	8.2.4.a	Small, circular of diameter up to and including 0.35m				
C6.2.3.1.1	8.2.4.a.1	Over 0m and up to and including 0.5m deep	NO	2		
C6.2.3.1.2	8.2.4.a.2	Over 0.5m and up to and including 1m deep	NO	0		
	8.2.4.b	Small, other than circular, of area up to and including 0.1m ²				
C6.2.3.2.1	8.2.4.b.1	Over 0m and up to and including 0.5m deep	NO	0		
C6.2.3.2.2	8.2.4.b.2	Over 0.5m and up to and including 1m deep	NO	0		
	8.2.4.c	Large, circular, of diameter over 0.35m and up to and including 0.70m				
C6.2.3.3.1	8.2.4.c.1	Over 0m and up to and including 0.5m deep	NO	0		
C6.2.3.3.2	8.2.4.c.2	Over 0.5m and up to and including 1m deep	NO	0		
	8.2.4.d	Large, other than circular, of area 0.1m ² and up to and including 0.5m ²				
C6.2.3.4.1	8.2.4.d.1	Over 0m and up to and including 0.5m deep	NO	0		
C6.2.3.4.2	8.2.4.d.2	Over 0.5m and up to and including 1m deep	NO	0		
	8.2.4.e	Large, circular, of diameter over 0.70m and up to and including 1.50m				
C6.2.3.5.1	8.2.4.e.1	Over 0m and up to and including 0.5m deep	NO	0		
C6.2.3.5.2	8.2.4.e.2	Over 0.5m and up to and including 1m deep	NO	0		
	8.2.4.f	Large, other than circular, of area 0.5m ² and up to and including 2.5m ²				
C6.2.3.6.1	8.2.4.f.1	Over 0m and up to and including 0.5m deep	NO	2		
C6.2.3.6.2	8.2.4.f.2	Over 0.5m and up to and including 1m deep	NO	0		
Sub-Total Carried Forward						

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NYAKALLONG WASTEWATER TREATMENT WORKS REFURBISHMENT
BILL OF QUANTITIES
CIVIL - SCOPE OF WORKS
WORK PACKAGE - TIE IN - CLEARANCE
REV A

ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (ZAR)
C7.0.1	SABS 1200C 8.2	SITE CLEARANCE				
		SCHEDULED ITEMS				
	8.2.1	Clear and Grub				
	8.2.1.1	Clear and Grub				
C7.0.1.1.1		Tie In 1	m²	86.0		
C7.0.1.1.2		Tie In 2	m²	44.0		
C7.0.1.1.3		Tie In 3	m²	50.0		
C7.0.1.1.4		Tie In 4	m²	10.0		
C7.0.1.1.5		Tie In 5	m²	50.0		
C7.0.1.1.6		Tie In 6	m²	0.0		
	8.2.2	Remove and grub large trees and tree stumps of girth				
C7.0.1.2.1	8.2.2.1	Over 1m and up to and including 2m	NO	0		RATE ONLY
C7.0.1.2.2	8.2.2.2	Over 2m and up to and including 3m	NO	0		RATE ONLY
C7.0.1.2.3	8.2.2.3	Over 3m, in steps of 1m	NO	0		RATE ONLY
	8.2.3	Remove and grub trees and tree stumps, regardless of girth				
C7.0.1.3	8.2.3.1	Remove and grub trees and tree stumps, regardless of girth	m²	0.0		RATE ONLY
	8.2.4	Reclear Surface (Only on the instruction of the Engineer)				
C7.0.1.4	8.2.4.1	Reclear Surface	m²	0.0		RATE ONLY
	8.2.5	Take down existing fences and walls				
	8.2.5.1	Fences				
		Take down, removal, and storage of fencing during construction and instal fencing once construction is complete. (Complete)				
C7.0.1.5.1	8.2.5.1.1	Type 1: Barbed wire fencing up to 1.2m high	m	0.0		RATE ONLY
C7.0.1.5.2	8.2.5.1.2	Type 2: Diamond mesh fencing up to 1.2m high	m	0.0		RATE ONLY
C7.0.1.5.3	8.2.5.1.3	Type 3: Razor mesh wire fencing up to 2.4m high	m	0.0		RATE ONLY
C7.0.1.5.4	8.2.5.1.4	Type 4: ClearVu fencing up to 2.4m high	m	0.0		RATE ONLY
C7.0.1.5.5	8.2.5.1.5	Type 5: Concrete Palisade fencing up to 2.4m high	m	0.0		RATE ONLY
C7.0.1.5.6	8.2.5.1.6	Type 6: Prefabricated concrete walls up to 2.4m high	m	0.0		RATE ONLY
C7.0.1.5.7	8.2.5.1.7	Type 8: Steel Palisade fencing up to 2.4m high	m	0.0		RATE ONLY
C7.0.1.5.8	8.2.5.1.8	Extension of Type 1 to 8: Electrical Fencing	m	0.0		RATE ONLY
C7.0.1.5.9	8.2.5.1.9	Type 9: Electrical fencing up to 2.4m high	m	0.0		RATE ONLY
	8.2.5.2	Walls				
		Take down, removal and disposal of walls at a dedicated diposal site within the free haul distance. (Complete)				
C7.0.1.6.1		Type 1: Single brick walls up to 2.4m high	m	0.0		RATE ONLY
C7.0.1.6.2		Type 2: Double brick walls up to 2.4m high	m	0.0		RATE ONLY
C7.0.1.6.3		Type 3: Tripple brick walls up to 2.4m high	m	0.0		RATE ONLY
Sub-Total Carried Forward						

ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (ZAR)
Sub-Total Carried Forward						
	8.2.7	Dismantle and remove pipelines, electrical transmission lines, cables, etc.				
C7.0.1.7.1	8.2.7.1	Pipelines	m	30.0		
C7.0.1.7.2	8.2.7.2	Electrical Transmission Lines	m	0.0		
C7.0.1.7.3	8.2.7.3	Cables	m	0.0		
	8.2.8	Demolish and remove infrastructure (structures, buildings, stormwater drain, etc.) and dismantle steelwork,mechanical equipment, electrical equipment, etc. Either store on site as instructed or dispose of within free haul distance.				
	8.2.8.1	Pavements:				
C7.0.1.8.1.1	8.2.8.1.1	Type1: Concrete	m ²	0.0		RATE ONLY
C7.0.1.8.1.2	8.2.8.1.2	Type2: Brick	m ²	0.0		RATE ONLY
C7.0.1.8.1.3	8.2.8.1.3	Type3: Tar	m ²	0.0		RATE ONLY
	8.2.8.2	Stormwater:				
C7.0.1.8.2.1	8.2.8.2.1	Type1: Concrete Drains	NO	0		RATE ONLY
C7.0.1.8.2.2	8.2.8.2.2	Type2: Pipe or box culverts	NO	0		RATE ONLY
C7.0.1.8.2.3	8.2.8.2.3	Type3: Catchpits or Energy Breakers	NO	0		RATE ONLY
	8.2.8.3	Structures and Buildings:				
C7.0.1.8.3.1	8.2.8.3.1	Type1: TBC	SUM	0		RATE ONLY
C7.0.1.8.3.2	8.2.8.3.2	Type2: TBC	SUM	0		RATE ONLY
C7.0.1.8.3.3	8.2.8.3.3	Type3: TBC	SUM	0		RATE ONLY
	8.2.8.4	Steelwork:				
C7.0.1.8.4.1	8.2.8.4.1	Type1: TBC	SUM	0		RATE ONLY
C7.0.1.8.4.2	8.2.8.4.2	Type2: TBC	SUM	0		RATE ONLY
C7.0.1.8.4.3	8.2.8.4.3	Type3: TBC	SUM	0		RATE ONLY
	8.2.8.5	Mechanical Equipment:				
C7.0.1.8.5.1	8.2.8.5.1	Type1: TBC	SUM	0		RATE ONLY
C7.0.1.8.5.2	8.2.8.5.2	Type2: TBC	SUM	0		RATE ONLY
C7.0.1.8.5.3	8.2.8.5.3	Type3: TBC	SUM	0		RATE ONLY
	8.2.10	Remove top soil to a nominal depth of 150mm and stockpile				
	8.2.10.1	Remove top soil to a nominal depth of 150mm and stockpile on site at indicate location (To be specified by the Engineer).				
C7.0.1.10.1		Tie In 1	m ²	86.0		
C7.0.1.10.2		Tie In 2	m ²	44.0		
C7.0.1.10.3		Tie In 3	m ²	50.0		
C7.0.1.10.4		Tie In 4	m ²	10.0		
C7.0.1.10.5		Tie In 5	m ²	50.0		
C7.0.1.10.6		Tie In 6	m ²	0.0		
Total Carried Forward to Summary						

[illegible]

ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (ZAR)
Sub-Total Carried Forward						
C7.1.2	SANS 1200LB 8.2	BEDDING (PIPES)				
		SCHEDULED ITEMS				
	8.2.1	Provision of bedding material from trench excavation, compacted to 90% MOD AASHTO density				
		a) Selected granular material (Bedding cradle)				
C7.1.2.1.1		Bedding - Granular	m ³	35.0		RATE ONLY
		b) Selected fill material (Selected fill blanket)				
C7.1.2.1.2		Bedding - Selected Fill	m ³	45.0		RATE ONLY
	8.2.2	Supply only of bedding by importation				
	8.2.2.1	Provision of bedding material from other necessary excavation, compacted to 90% MOD AASHTO density, including all costs for additional handling and transport (provisional):				
		a) Selected granular material (Bedding cradle)				
C7.1.2.2.1		Bedding - Granular	m ³	35.0		RATE ONLY
		b) Selected fill material (Selected fill blanket)				
C7.1.2.2.2		Bedding - Selected Fill	m ³	45.0		RATE ONLY
	8.2.2.3	Provision of bedding material from commercial sources (provisional), compacted to 90% MOD AASHTO density				
		a) Selected granular material (Bedding cradle)				
C7.1.2.3.1		Bedding - Granular	m ³	35.0		
		b) Selected fill material (Selected fill blanket)				
C7.1.2.3.2		Bedding - Selected Fill	m ³	45.0		
	8.2.4	Encasing of Pipes in Concrete				
	LIC	Concrete encasement to pipes in Class 20MPa/19mm concrete including reinforcement (Rate to include for any temporary formwork required).				
C7.1.2.4		Soilcrete encasement to pipes (Rate to include for any temporary formwork required).	m ³	0.0		RATE ONLY
C7.1.3	SABS 1200L 8.2	MEDIUM PRESSURE PIPELINES				
		SCHEDULED ITEMS				
		Concrete - Spigot & Socket Ends (Including rubber ring joints)				
	8.2.1	Supply, Lay and Bed Pipes Complete with Couplings				
C7.1.3.1.1		300ND-50D-Spigot and socket	m	68.3		RATE ONLY
C7.1.3.1.2		300ND-75D-Spigot and socket	m	68.3		RATE ONLY
C7.1.3.1.3		375ND-50D-Spigot and socket	m	68.3		RATE ONLY
C7.1.3.1.4		375ND-75D-Spigot and socket	m	68.3		RATE ONLY
C7.1.3.1.5		450ND-50D-Spigot and socket	m	68.3		RATE ONLY
C7.1.3.1.6		450ND-75D-Spigot and socket	m	68.3		RATE ONLY
C7.1.3.1.7		525ND-50D-Spigot and socket	m	68.3		RATE ONLY
C7.1.3.1.8		525ND-75D-Spigot and socket	m	68.3		RATE ONLY
C7.1.3.1.9		600ND-50D-Spigot and socket	m	68.3		RATE ONLY
C7.1.3.1.10		600ND-75D-Spigot and socket	m	68.3		RATE ONLY
C7.1.3.1.9		675ND-50D-Spigot and socket	m	68.3		RATE ONLY
C7.1.3.1.10		675ND-75D-Spigot and socket	m	68.3		RATE ONLY
C7.1.3.1.11		750ND-50D-Spigot and socket	m	68.3		
C7.1.3.1.12		750ND-75D-Spigot and socket	m	68.3		
		Anchor / Thrust Blocks and pedestals				
C7.1.3.2.1	LIC	Concrete	m ³	2.0		
C7.1.3.2.2		Formwork	m ²	5.0		
C7.1.3.2.3		Reinforcement	t	0.3		
Total Carried Forward to Summary						

NYAKALLONG WASTEWATER TREATMENT WORKS REFURBISHMENT
BILL OF QUANTITIES
CIVIL - SCOPE OF WORKS
WORK PACKAGE - TIE IN 1 - MANHOLES
REV A

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ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (ZAR)
Sub-Total Carried Forward						
	8.3	SCHEDULED REINFORCEMENT ITEMS				
	8.3.1	Steel bars				
	8.3.1.1	Steel bars (High tensile)				
C7.2.2.4.1.1	8.3.1.1.4	Floor	t	1.00		RATE ONLY
C7.2.2.4.1.2	8.3.1.1.5	Walls	t	2.50		RATE ONLY
	8.3.1.2	Steel bars (Mild tensile)				
C7.2.2.4.2.1	8.3.1.2.4	Floors	t	0.00		RATE ONLY
C7.2.2.4.2.2	8.3.1.2.5	Walls	t	0.00		RATE ONLY
	8.3.2	High tensile welded mesh				
C7.2.2.5.1	8.3.2.1	High tensile welded mesh (Ref no. 395 - 8mm)	m ²	0.00		RATE ONLY
C7.2.2.5.2	8.3.2.2	High tensile welded mesh (Ref no. 617 - 10mm)	m ²	0.00		RATE ONLY
	8.4	SCHEDULED CONCRETE ITEMS				
	8.4.1	Prescribed mix concrete				
C7.2.2.6	8.4.1.1	Prescribed mix concrete (Specified mix design)	m ³	0.00		RATE ONLY
	8.4.2	Blinding layer				
C7.2.2.7	8.4.2.1 LIC	Blinding layer (20MPa/20mm) - 50mm thickness	m ²	36.00		
	8.4.3	Strength concrete				
	8.4.3.1	Strength concrete (30MPa/20mm)				
C7.2.2.8.1.1	8.4.3.1.1	Floor	m ³	0.00		RATE ONLY
C7.2.2.8.1.2	8.4.3.1.2	Walls	m ³	0.00		RATE ONLY
	8.4.3.2	Strength concrete (35MPa/20mm)				
C7.2.2.8.2.1	8.4.3.2.1	Floor	m ³	5.00		
C7.2.2.8.2.2	8.4.3.2.2	Walls	m ³	17.00		
	8.4.3.3	Strength concrete (20MPa/20mm)				
C7.2.2.8.3.1	8.4.3.3.1 LIC	Mass Concrete	m ³	0.50		
	8.4.3.4	No-fines Concrete (NF20) - 100mm Thickness				
C7.2.2.8.4.1	8.4.3.4.1 LIC	Vertical surfaces, sloping surfaces, horizontal surfaces and around sub-soils	m ³	0.00		RATE ONLY
C7.2.2.8.4.2	8.4.3.4.2 LIC	Filling of overbreak in rock to form drainage layer	m ³	0.00		RATE ONLY
	8.4.4	Unformed Surface Finish				
C7.2.2.9.1		a) Wood Float Finish	m ²	6.00		
C7.2.2.9.2		b) Steel Float Finish	m ²	0.00		RATE ONLY
Sub-Total Carried Forward						

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NYAKALLONG WASTEWATER TREATMENT WORKS REFURBISHMENT
BILL OF QUANTITIES
CIVIL - SCOPE OF WORKS
WORK PACKAGE - TIE IN 2 - INTERCONNECTING PIPEWORK
REV A

[illegible]

[illegible]

ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (ZAR)
Sub-Total Carried Forward						
C8.1.2	SANS 1200LB 8.2	BEDDING (PIPES)				
		SCHEDULED ITEMS				
	8.2.1	Provision of bedding material from trench excavation, compacted to 90% MOD AASHTO density				
		a) Selected granular material (Bedding cradle)				
C8.1.2.1.1		Bedding - Granular	m ³	20.0		RATE ONLY
		b) Selected fill material (Selected fill blanket)				
C8.1.2.1.2		Bedding - Selected Fill	m ³	25.0		RATE ONLY
	8.2.2	Supply only of bedding by importation				
	8.2.2.1	Provision of bedding material from other necessary excavation, compacted to 90% MOD AASHTO density, including all costs for additional handling and transport (provisional):				
		a) Selected granular material (Bedding cradle)				
C8.1.2.2.1		Bedding - Granular	m ³	20.0		RATE ONLY
		b) Selected fill material (Selected fill blanket)				
C8.1.2.2.2		Bedding - Selected Fill	m ³	25.0		RATE ONLY
	8.2.2.3	Provision of bedding material from commercial sources (provisional), compacted to 90% MOD AASHTO density				
		a) Selected granular material (Bedding cradle)				
C8.1.2.3.1		Bedding - Granular	m ³	20.0		
		b) Selected fill material (Selected fill blanket)				
C8.1.2.3.2		Bedding - Selected Fill	m ³	25.0		
	8.2.4	Encasing of Pipes in Concrete				
	LIC	Concrete encasement to pipes in Class 20MPa/19mm concrete including reinforcement (Rate to include for any temporary formwork required).				
C8.1.2.4		Soilcrete encasement to pipes (Rate to include for any temporary formwork required).	m ³	0.0		RATE ONLY
C8.1.3	SABS 1200L 8.2	MEDIUM PRESSURE PIPELINES				
		SCHEDULED ITEMS				
		Concrete - Spigot & Socket Ends (Including rubber ring joints)				
	8.2.1	Supply, Lay and Bed Pipes Complete with Couplings				
C8.1.3.1.1		300ND-50D-Spigot and socket	m	34.2		RATE ONLY
C8.1.3.1.2		300ND-75D-Spigot and socket	m	34.2		RATE ONLY
C8.1.3.1.3		375ND-50D-Spigot and socket	m	34.2		RATE ONLY
C8.1.3.1.4		375ND-75D-Spigot and socket	m	34.2		RATE ONLY
C8.1.3.1.5		450ND-50D-Spigot and socket	m	34.2		RATE ONLY
C8.1.3.1.6		450ND-75D-Spigot and socket	m	34.2		RATE ONLY
C8.1.3.1.7		525ND-50D-Spigot and socket	m	34.2		RATE ONLY
C8.1.3.1.8		525ND-75D-Spigot and socket	m	34.2		RATE ONLY
C8.1.3.1.9		600ND-50D-Spigot and socket	m	34.2		RATE ONLY
C8.1.3.1.10		600ND-75D-Spigot and socket	m	34.2		RATE ONLY
C8.1.3.1.11		675ND-50D-Spigot and socket	m	34.2		RATE ONLY
C8.1.3.1.12		675ND-75D-Spigot and socket	m	34.2		RATE ONLY
C8.1.3.1.13		750ND-50D-Spigot and socket	m	34.2		
C8.1.3.1.14		750ND-75D-Spigot and socket	m	34.2		
		Anchor / Thrust Blocks and pedestals				
C8.1.3.2.1	LIC	Concrete	m ³	2.0		
C8.1.3.2.2		Formwork	m ²	5.0		
C8.1.3.2.3		Reinforcement	t	0.3		
Total Carried Forward to Summary						

[illegible]

ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (ZAR)
Sub-Total Carried Forward						
	8.3	SCHEDULED REINFORCEMENT ITEMS				
	8.3.1	Steel bars				
	8.3.1.1	Steel bars (High tensile)				
C8.2.2.4.1.1	8.3.1.1.4	Floor	t	0.75		
C8.2.2.4.1.2	8.3.1.1.5	Walls	t	4.00		
	8.3.1.2	Steel bars (Mild tensile)				
C8.2.2.4.2.1	8.3.1.2.4	Floors	t	0.75		RATE ONLY
C8.2.2.4.2.2	8.3.1.2.5	Walls	t	4.00		RATE ONLY
	8.3.2	High tensile welded mesh				
C8.2.2.5.1	8.3.2.1	High tensile welded mesh (Ref no. 395 - 8mm)	m²	0.00		
C8.2.2.5.2	8.3.2.2	High tensile welded mesh (Ref no. 617 - 10mm)	m²	0.00		
	8.4	SCHEDULED CONCRETE ITEMS				
	8.4.1	Prescribed mix concrete				
C8.2.2.6	8.4.1.1	Prescribed mix concrete (Specified mix design)	m³	0.00		
	8.4.2	Blinding layer				
C8.2.2.7	8.4.2.1 LIC	Blinding layer (20MPa/20mm) - 50mm thickness	m²	26.00		
	8.4.3	Strength concrete				
	8.4.3.1	Strength concrete (30MPa/20mm)				
C8.2.2.8.1.1	8.4.3.1.1	Floor	m³	0.00		RATE ONLY
C8.2.2.8.1.2	8.4.3.1.2	Walls	m³	0.00		RATE ONLY
	8.4.3.2	Strength concrete (35MPa/20mm)				
C8.2.2.8.2.1	8.4.3.2.1	Floor	m³	4.00		
C8.2.2.8.2.2	8.4.3.2.2	Walls	m³	27.00		
	8.4.3.3	Strength concrete (20MPa/20mm)				
C8.2.2.8.3.1	8.4.3.3.1 LIC	Mass Concrete	m³	0.50		
	8.4.3.4	No-fines Concrete (NF20) - 100mm Thickness				
C8.2.2.8.4.1	8.4.3.4.1	Vertical surfaces, sloping surfaces, horizontal surfaces and around sub-soils	m³	0.00		RATE ONLY
C8.2.2.8.4.2	8.4.3.4.2	Filling of overbreak in rock to form drainage layer	m³	0.00		RATE ONLY
	8.4.4	Unformed Surface Finish				
C8.2.2.9.1	a) Wood Float Finish		m²	7.00		
C8.2.2.9.2	b) Steel Float Finish		m²	0.00		RATE ONLY
Sub-Total Carried Forward						

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ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (ZAR)
Sub-Total Carried Forward						
C9.1.2	SANS 1200LB 8.2	BEDDING (PIPES)				
		SCHEDULED ITEMS				
	8.2.1	Provision of bedding material from trench excavation, compacted to 90% MOD AASHTO density				
		a) Selected granular material (Bedding cradle)				
C9.1.2.1.1		Bedding - Granular	m ³	20.0		RATE ONLY
		b) Selected fill material (Selected fill blanket)				
C9.1.2.1.2		Bedding - Selected Fill	m ³	25.0		RATE ONLY
	8.2.2	Supply only of bedding by importation				
	8.2.2.1	Provision of bedding material from other necessary excavation, compacted to 90% MOD AASHTO density, including all costs for additional handling and transport (provisional):				
		a) Selected granular material (Bedding cradle)				
C9.1.2.2.1		Bedding - Granular	m ³	20.0		RATE ONLY
		b) Selected fill material (Selected fill blanket)				
C9.1.2.2.2		Bedding - Selected Fill	m ³	25.0		RATE ONLY
	8.2.2.3	Provision of bedding material from commercial sources (provisional), compacted to 90% MOD AASHTO density				
		a) Selected granular material (Bedding cradle)				
C9.1.2.3.1		Bedding - Granular	m ³	20.0		
		b) Selected fill material (Selected fill blanket)				
C9.1.2.3.2		Bedding - Selected Fill	m ³	25.0		
	8.2.4	Encasing of Pipes in Concrete				
	LIC	Concrete encasement to pipes in Class 20MPa/19mm concrete including reinforcement (Rate to include for any temporary formwork required).				
C9.1.2.4		Soilcrete encasement to pipes (Rate to include for any temporary formwork required).	m ³	0.0		RATE ONLY
C9.1.3	SABS 1200L 8.2	MEDIUM PRESSURE PIPELINES				
		SCHEDULED ITEMS				
		Concrete - Spigot & Socket Ends (Including rubber ring joints)				
	8.2.1	Supply, Lay and Bed Pipes Complete with Couplings				
C9.1.3.1.1		300ND-50D-Spigot and socket	m	51.2		RATE ONLY
C9.1.3.1.2		300ND-75D-Spigot and socket	m	51.2		RATE ONLY
C9.1.3.1.3		375ND-50D-Spigot and socket	m	51.2		RATE ONLY
C9.1.3.1.4		375ND-75D-Spigot and socket	m	51.2		RATE ONLY
C9.1.3.1.5		450ND-50D-Spigot and socket	m	51.2		
C9.1.3.1.6		450ND-75D-Spigot and socket	m	51.2		
C9.1.3.1.7		525ND-50D-Spigot and socket	m	51.2		RATE ONLY
C9.1.3.1.8		525ND-75D-Spigot and socket	m	51.2		RATE ONLY
C9.1.3.1.9		600ND-50D-Spigot and socket	m	51.2		RATE ONLY
C9.1.3.1.10		600ND-75D-Spigot and socket	m	51.2		RATE ONLY
C9.1.3.1.11		675ND-50D-Spigot and socket	m	51.2		RATE ONLY
C9.1.3.1.12		675ND-75D-Spigot and socket	m	51.2		RATE ONLY
C9.1.3.1.13		750ND-50D-Spigot and socket	m	51.2		RATE ONLY
C9.1.3.1.14		750ND-75D-Spigot and socket	m	51.2		RATE ONLY
		Anchor / Thrust Blocks and pedestals				
C9.1.3.2.1	LIC	Concrete	m ³	2.0		
C9.1.3.2.2		Formwork	m ²	5.0		
C9.1.3.2.3		Reinforcement	t	0.3		
Total Carried Forward to Summary						

NYAKALLONG WASTEWATER TREATMENT WORKS REFURBISHMENT
BILL OF QUANTITIES
CIVIL - SCOPE OF WORKS
WORK PACKAGE - TIE IN 3 - MANHOLES
REV A

[illegible]

[illegible]

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ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (ZAR)
Sub-Total Carried Forward						
	8.3	SCHEDULED REINFORCEMENT ITEMS				
	8.3.1	Steel bars				
	8.3.1.1	Steel bars (High tensile)				
C9.2.2.4.1.1	8.3.1.1.4	Floor	t	0.75		
C9.2.2.4.1.2	8.3.1.1.5	Walls	t	2.00		
	8.3.1.2	Steel bars (Mild tensile)				
C9.2.2.4.2.1	8.3.1.2.4	Floors	t	0.00		RATE ONLY
C9.2.2.4.2.2	8.3.1.2.5	Walls	t	0.00		RATE ONLY
	8.3.2	High tensile welded mesh				
C9.2.2.5.1	8.3.2.1	High tensile welded mesh (Ref no. 395 - 8mm)	m²	0.00		RATE ONLY
C9.2.2.5.2	8.3.2.2	High tensile welded mesh (Ref no. 617 - 10mm)	m²	0.00		RATE ONLY
	8.4	SCHEDULED CONCRETE ITEMS				
	8.4.1	Prescribed mix concrete				
C9.2.2.6	8.4.1.1	Prescribed mix concrete (Specified mix design)	m³	0.00		RATE ONLY
	8.4.2	Blinding layer				
C9.2.2.7	8.4.2.1 LIC	Blinding layer (20MPa/20mm) - 50mm thickness	m²	27.00		
	8.4.3	Strength concrete				
	8.4.3.1	Strength concrete (30MPa/20mm)				
C9.2.2.8.1.1	8.4.3.1.1	Floor	m³	0.00		RATE ONLY
C9.2.2.8.1.2	8.4.3.1.2	Walls	m³	0.00		RATE ONLY
	8.4.3.2	Strength concrete (35MPa/20mm)				
C9.2.2.8.2.1	8.4.3.2.1	Floor	m³	4.00		
C9.2.2.8.2.2	8.4.3.2.2	Walls	m³	13.00		
	8.4.3.3	Strength concrete (20MPa/20mm)				
C9.2.2.8.3.1	8.4.3.3.1 LIC	Mass Concrete	m³	0.50		
	8.4.3.4	No-fines Concrete (NF20) - 100mm Thickness				
C9.2.2.8.4.1	8.4.3.4.1 LIC	Vertical surfaces, sloping surfaces, horizontal surfaces and around sub-soils	m³	0.00		RATE ONLY
C9.2.2.8.4.2	8.4.3.4.2 LIC	Filling of overbreak in rock to form drainage layer	m³	0.00		RATE ONLY
	8.4.4	Unformed Surface Finish				
C9.2.2.9.1		a) Wood Float Finish	m²	5.00		
C9.2.2.9.2		b) Steel Float Finish	m²	0.00		RATE ONLY
Sub-Total Carried Forward						

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NYAKALLONG WASTEWATER TREATMENT WORKS REFURBISHMENT
BILL OF QUANTITIES
CIVIL - SCOPE OF WORKS
WORK PACKAGE - TIE IN 4 - INTERCONNECTING PIPEWORK
REV A

[illegible]

[illegible]

ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (ZAR)
Sub-Total Carried Forward						
C10.1.2	SANS 1200LB 8.2	BEDDING (PIPES)				
		SCHEDULED ITEMS				
	8.2.1	Provision of bedding material from trench excavation, compacted to 90% MOD AASHTO density				
		a) Selected granular material (Bedding cradle)				
C10.1.2.1.1		Bedding - Granular	m ³	3.0		RATE ONLY
		b) Selected fill material (Selected fill blanket)				
C10.1.2.1.2		Bedding - Selected Fill	m ³	4.0		RATE ONLY
	8.2.2	Supply only of bedding by importation				
	8.2.2.1	Provision of bedding material from other necessary excavation, compacted to 90% MOD AASHTO density, including all costs for additional handling and transport (provisional):				
		a) Selected granular material (Bedding cradle)				
C10.1.2.2.1		Bedding - Granular	m ³	3.0		RATE ONLY
		b) Selected fill material (Selected fill blanket)				
C10.1.2.2.2		Bedding - Selected Fill	m ³	4.0		RATE ONLY
	8.2.2.3	Provision of bedding material from commercial sources (provisional), compacted to 90% MOD AASHTO density				
		a) Selected granular material (Bedding cradle)				
C10.1.2.3.1		Bedding - Granular	m ³	3.0		
		b) Selected fill material (Selected fill blanket)				
C10.1.2.3.2		Bedding - Selected Fill	m ³	4.0		
	8.2.4	Encasing of Pipes in Concrete				
	LIC	Concrete encasement to pipes in Class 20MPa/19mm concrete including reinforcement (Rate to include for any temporary formwork required).				
C10.1.2.4		Soilcrete encasement to pipes (Rate to include for any temporary formwork required).	m ³	0.0		RATE ONLY
C10.1.3	SABS 1200L 8.2	MEDIUM PRESSURE PIPELINES				
		SCHEDULED ITEMS				
		Concrete - Spigot & Socket Ends (Including rubber ring joints)				
	8.2.1	Supply, Lay and Bed Pipes Complete with Couplings				
C10.1.3.1.1		300ND-50D-Spigot and socket	m	9.8		RATE ONLY
C10.1.3.1.2		300ND-75D-Spigot and socket	m	9.8		RATE ONLY
C10.1.3.1.3		375ND-50D-Spigot and socket	m	9.8		
C10.1.3.1.4		375ND-75D-Spigot and socket	m	9.8		
C10.1.3.1.5		450ND-50D-Spigot and socket	m	9.8		RATE ONLY
C10.1.3.1.6		450ND-75D-Spigot and socket	m	9.8		RATE ONLY
C10.1.3.1.7		525ND-50D-Spigot and socket	m	9.8		RATE ONLY
C10.1.3.1.8		525ND-75D-Spigot and socket	m	9.8		RATE ONLY
C10.1.3.1.9		600ND-50D-Spigot and socket	m	9.8		RATE ONLY
C10.1.3.1.10		600ND-75D-Spigot and socket	m	9.8		RATE ONLY
C10.1.3.1.11		675ND-50D-Spigot and socket	m	9.8		RATE ONLY
C10.1.3.1.12		675ND-75D-Spigot and socket	m	9.8		RATE ONLY
C10.1.3.1.13		750ND-50D-Spigot and socket	m	9.8		RATE ONLY
C10.1.3.1.14		750ND-75D-Spigot and socket	m	9.8		RATE ONLY
		Anchor / Thrust Blocks and pedestals				
C10.1.3.2.1	LIC	Concrete	m ³	2.0		
C10.1.3.2.2		Formwork	m ²	5.0		
C10.1.3.2.3		Reinforcement	t	0.3		
Total Carried Forward to Summary						

NYAKALLONG WASTEWATER TREATMENT WORKS REFURBISHMENT
BILL OF QUANTITIES
CIVIL - SCOPE OF WORKS
WORK PACKAGE - TIE IN 5 - INTERCONNECTING PIPEWORK
REV A

[illegible]

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ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (ZAR)
Sub-Total Carried Forward						
C11.1.2	SANS 1200LB 8.2	BEDDING (PIPES)				
		SCHEDULED ITEMS				
	8.2.1	Provision of bedding material from trench excavation, compacted to 90% MOD AASHTO density				
		a) Selected granular material (Bedding cradle)				
C11.1.2.1.1		Bedding - Granular	m ³	20.0		RATE ONLY
		b) Selected fill material (Selected fill blanket)				
C11.1.2.1.2		Bedding - Selected Fill	m ³	25.0		RATE ONLY
	8.2.2	Supply only of bedding by importation				
	8.2.2.1	Provision of bedding material from other necessary excavation, compacted to 90% MOD AASHTO density, including all costs for additional handling and transport (provisional):				
		a) Selected granular material (Bedding cradle)				
C11.1.2.2.1		Bedding - Granular	m ³	20.0		RATE ONLY
		b) Selected fill material (Selected fill blanket)				
C11.1.2.2.2		Bedding - Selected Fill	m ³	25.0		RATE ONLY
	8.2.2.3	Provision of bedding material from commercial sources (provisional), compacted to 90% MOD AASHTO density				
		a) Selected granular material (Bedding cradle)				
C11.1.2.3.1		Bedding - Granular	m ³	20.0		
		b) Selected fill material (Selected fill blanket)				
C11.1.2.3.2		Bedding - Selected Fill	m ³	25.0		
	8.2.4	Encasing of Pipes in Concrete				
	LIC	Concrete encasement to pipes in Class 20MPa/19mm concrete including reinforcement (Rate to include for any temporary formwork required).				
C11.1.2.4		Soilcrete encasement to pipes (Rate to include for any temporary formwork required).	m ³	45.0		
C11.1.3	SABS 1200L 8.2	MEDIUM PRESSURE PIPELINES				
		SCHEDULED ITEMS				
		Concrete - Spigot & Socket Ends (Including rubber ring joints)				
	8.2.1	Supply, Lay and Bed Pipes Complete with Couplings				
C11.1.3.1.1		300ND-50D-Spigot and socket	m	11.6		
C11.1.3.1.2		300ND-75D-Spigot and socket	m	11.6		
C11.1.3.1.3		375ND-50D-Spigot and socket	m	52.0		RATE ONLY
C11.1.3.1.4		375ND-75D-Spigot and socket	m	52.0		RATE ONLY
C11.1.3.1.5		450ND-50D-Spigot and socket	m	52.0		RATE ONLY
C11.1.3.1.6		450ND-75D-Spigot and socket	m	52.0		RATE ONLY
C11.1.3.1.7		525ND-50D-Spigot and socket	m	52.0		RATE ONLY
C11.1.3.1.8		525ND-75D-Spigot and socket	m	52.0		RATE ONLY
C11.1.3.1.9		600ND-50D-Spigot and socket	m	52.0		RATE ONLY
C11.1.3.1.10		600ND-75D-Spigot and socket	m	52.0		RATE ONLY
C11.1.3.1.11		675ND-50D-Spigot and socket	m	52.0		RATE ONLY
C11.1.3.1.12		675ND-75D-Spigot and socket	m	52.0		RATE ONLY
C11.1.3.1.13		750ND-50D-Spigot and socket	m	39.0		
C11.1.3.1.14		750ND-75D-Spigot and socket	m	39.0		
		Anchor / Thrust Blocks and pedestals				
C11.1.3.2.1	LIC	Concrete	m ³	2.0		
C11.1.3.2.2		Formwork	m ²	5.0		
C11.1.3.2.3		Reinforcement	t	0.3		
Total Carried Forward to Summary						

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ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (ZAR)
Sub-Total Carried Forward						
	8.3	SCHEDULED REINFORCEMENT ITEMS				
	8.3.1	Steel bars				
	8.3.1.1	Steel bars (High tensile)				
C11.2.2.4.1.1	8.3.1.1.4	Floor	t	0.50		
C11.2.2.4.1.2	8.3.1.1.5	Walls	t	0.75		
	8.3.1.2	Steel bars (Mild tensile)				
C11.2.2.4.2.1	8.3.1.2.4	Floors	t	0.00		RATE ONLY
C11.2.2.4.2.2	8.3.1.2.5	Walls	t	0.00		RATE ONLY
	8.3.2	High tensile welded mesh				
C11.2.2.5.1	8.3.2.1	High tensile welded mesh (Ref no. 395 - 8mm)	m ²	0.00		RATE ONLY
C11.2.2.5.2	8.3.2.2	High tensile welded mesh (Ref no. 617 - 10mm)	m ²	0.00		RATE ONLY
	8.4	SCHEDULED CONCRETE ITEMS				
	8.4.1	Prescribed mix concrete				
C11.2.2.6	8.4.1.1	Prescribed mix concrete (Specified mix design)	m ³	0.00		RATE ONLY
	8.4.2	Blinding layer				
C11.2.2.7	8.4.2.1 LIC	Blinding layer (20MPa/20mm) - 50mm thickness	m ²	9.00		
	8.4.3	Strength concrete				
	8.4.3.1	Strength concrete (30MPa/20mm)				
C11.2.2.8.1.1	8.4.3.1.1	Floor	m ³	0.00		RATE ONLY
C11.2.2.8.1.2	8.4.3.1.2	Walls	m ³	0.00		RATE ONLY
	8.4.3.2	Strength concrete (35MPa/20mm)				
C11.2.2.8.2.1	8.4.3.2.1	Floor	m ³	1.50		
C11.2.2.8.2.2	8.4.3.2.2	Walls	m ³	4.50		
	8.4.3.3	Strength concrete (20MPa/20mm)				
C11.2.2.8.3.1	8.4.3.3.1 LIC	Mass Concrete	m ³	0.50		
	8.4.3.4	No-fines Concrete (NF20) - 100mm Thickness				
C11.2.2.8.4.1	8.4.3.4.1 LIC	Vertical surfaces, sloping surfaces, horizontal surfaces and around sub-soils	m ³	0.00		RATE ONLY
C11.2.2.8.4.2	8.4.3.4.2 LIC	Filling of overbreak in rock to form drainage layer	m ³	0.00		RATE ONLY
	8.4.4	Unformed Surface Finish				
C11.2.2.9.1		a) Wood Float Finish	m ²	2.00		
C11.2.2.9.2		b) Steel Float Finish	m ²	0.00		RATE ONLY
Sub-Total Carried Forward						

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ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (ZAR)
Sub-Total Carried Forward						
C12.1.2	SANS 1200LB 8.2	BEDDING (PIPES)				
		SCHEDULED ITEMS				
	8.2.1	Provision of bedding material from trench excavation, compacted to 90% MOD AASHTO density				
		a) Selected granular material (Bedding cradle)				
C12.1.2.1.1		Bedding - Granular	m ³	22.0		RATE ONLY
		b) Selected fill material (Selected fill blanket)				
C12.1.2.1.2		Bedding - Selected Fill	m ³	30.0		RATE ONLY
	8.2.2	Supply only of bedding by importation				
	8.2.2.1	Provision of bedding material from other necessary excavation, compacted to 90% MOD AASHTO density, including all costs for additional handling and transport (provisional):				
		a) Selected granular material (Bedding cradle)				
C12.1.2.2.1		Bedding - Granular	m ³	22.0		RATE ONLY
		b) Selected fill material (Selected fill blanket)				
C12.1.2.2.2		Bedding - Selected Fill	m ³	30.0		RATE ONLY
	8.2.2.3	Provision of bedding material from commercial sources (provisional), compacted to 90% MOD AASHTO density				
		a) Selected granular material (Bedding cradle)				
C12.1.2.3.1		Bedding - Granular	m ³	22.0		
		b) Selected fill material (Selected fill blanket)				
C12.1.2.3.2		Bedding - Selected Fill	m ³	30.0		
	8.2.4	Encasing of Pipes in Concrete				
	LIC	Concrete encasement to pipes in Class 20MPa/19mm concrete including reinforcement (Rate to include for any temporary formwork required).				
C12.1.2.4		Soilcrete encasement to pipes (Rate to include for any temporary formwork required).	m ³	0.0		RATE ONLY
C12.1.3	SABS 1200L 8.2	MEDIUM PRESSURE PIPELINES				
		SCHEDULED ITEMS				
		Concrete - Spigot & Socket Ends (Including rubber ring joints)				
	8.2.1	Supply, Lay and Bed Pipes Complete with Couplings				
C12.1.3.1.1		300ND-50D-Spigot and socket	m	41.5		
C12.1.3.1.2		300ND-75D-Spigot and socket	m	41.5		
C12.1.3.1.3		375ND-50D-Spigot and socket	m	41.5		RATE ONLY
C12.1.3.1.4		375ND-75D-Spigot and socket	m	41.5		RATE ONLY
C12.1.3.1.5		450ND-50D-Spigot and socket	m	41.5		RATE ONLY
C12.1.3.1.6		450ND-75D-Spigot and socket	m	41.5		RATE ONLY
C12.1.3.1.7		525ND-50D-Spigot and socket	m	41.5		RATE ONLY
C12.1.3.1.8		525ND-75D-Spigot and socket	m	41.5		RATE ONLY
C12.1.3.1.9		600ND-50D-Spigot and socket	m	41.5		RATE ONLY
C12.1.3.1.10		600ND-75D-Spigot and socket	m	41.5		RATE ONLY
C12.1.3.1.11		675ND-50D-Spigot and socket	m	41.5		RATE ONLY
C12.1.3.1.12		675ND-75D-Spigot and socket	m	41.5		RATE ONLY
C12.1.3.1.13		750ND-50D-Spigot and socket	m	41.5		
C12.1.3.1.14		750ND-75D-Spigot and socket	m	41.5		
		Anchor / Thrust Blocks and pedestals				
C12.1.3.2.1	LIC	Concrete	m ³	2.0		
C12.1.3.2.2		Formwork	m ²	5.0		
C12.1.3.2.3		Reinforcement	t	0.3		
Total Carried Forward to Summary						

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ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (ZAR)
Sub-Total Carried Forward						
C12.2.2	SANS 1200GA 8.2	CONCRETE - STRUCTURAL				
		SCHEDULED FORMWORK ITEMS				
	8.2.1	Rough				
		Plane vertical				
C12.2.2.1.1.1		Floor	m²	0.00		RATE ONLY
C12.2.2.1.1.2		Walls	m²	0.00		RATE ONLY
	8.2.2	Smooth				
		Plane vertical				
C12.2.2.2.1.1		Floor	m²	5.00		
C12.2.2.2.1.2		Walls	m²	23.00		
	8.2.4	Box out holes / form voids				
	8.2.4.a	Small, circular of diameter up to and including 0.35m				
C12.2.2.3.1.1	8.2.4.a.1	Over 0m and up to and including 0.5m deep	NO	0		RATE ONLY
C12.2.2.3.1.2	8.2.4.a.2	Over 0.5m and up to and including 1m deep	NO	0		RATE ONLY
	8.2.4.b	Small, other than circular, of area up to and including 0.1m²				
C12.2.2.3.3.1	8.2.4.b.1	Over 0m and up to and including 0.5m deep	NO	0		RATE ONLY
C12.2.2.3.3.2	8.2.4.b.2	Over 0.5m and up to and including 1m deep	NO	0		RATE ONLY
	8.2.4.c	Large, circular, of diameter over 0.35m and up to and including 0.70m				
C12.2.2.3.3.1	8.2.4.c.1	Over 0m and up to and including 0.5m deep	NO	0		RATE ONLY
C12.2.2.3.3.2	8.2.4.c.2	Over 0.5m and up to and including 1m deep	NO	0		RATE ONLY
	8.2.4.d	Large, other than circular, of area 0.1m² and up to and including 0.5m²				
C12.2.2.3.4.1	8.2.4.d.1	Over 0m and up to and including 0.5m deep	NO	0		RATE ONLY
C12.2.2.3.4.2	8.2.4.d.2	Over 0.5m and up to and including 1m deep	NO	0		RATE ONLY
	8.2.4.e	Large, circular, of diameter over 0.70m and up to and including 1.50m				
C12.2.2.3.5.1	8.2.4.e.1	Over 0m and up to and including 0.5m deep	NO	4		
C12.2.2.3.5.2	8.2.4.e.2	Over 0.5m and up to and including 1m deep	NO	0		RATE ONLY
	8.2.4.f	Large, other than circular, of area 0.5m² and up to and including 2.5m²				
C12.2.2.3.6.1	8.2.4.f.1	Over 0m and up to and including 0.5m deep	NO	0		RATE ONLY
C12.2.2.3.6.2	8.2.4.f.2	Over 0.5m and up to and including 1m deep	NO	0		RATE ONLY
Sub-Total Carried Forward						

ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (ZAR)
Sub-Total Carried Forward						
	8.3	SCHEDULED REINFORCEMENT ITEMS				
	8.3.1	Steel bars				
	8.3.1.1	Steel bars (High tensile)				
C12.2.2.4.1.1	8.3.1.1.4	Floor	t	0.50		
C12.2.2.4.1.2	8.3.1.1.5	Walls	t	0.75		
	8.3.1.2	Steel bars (Mild tensile)				
C12.2.2.4.2.1	8.3.1.2.4	Floors	t	0.00		RATE ONLY
C12.2.2.4.2.2	8.3.1.2.5	Walls	t	0.00		RATE ONLY
	8.3.2	High tensile welded mesh				
C12.2.2.5.1	8.3.2.1	High tensile welded mesh (Ref no. 395 - 8mm)	m²	0.00		RATE ONLY
C12.2.2.5.2	8.3.2.2	High tensile welded mesh (Ref no. 617 - 10mm)	m²	0.00		RATE ONLY
	8.4	SCHEDULED CONCRETE ITEMS				
	8.4.1	Prescribed mix concrete				
C12.2.2.6	8.4.1.1	Prescribed mix concrete (Specified mix design)	m³	0.00		RATE ONLY
	8.4.2	Blinding layer				
C12.2.2.7	8.4.2.1 LIC	Blinding layer (20MPa/20mm) - 50mm thickness	m²	9.00		
	8.4.3	Strength concrete				
	8.4.3.1	Strength concrete (30MPa/20mm)				
C12.2.2.8.1.1	8.4.3.1.1	Floor	m³	0.00		RATE ONLY
C12.2.2.8.1.2	8.4.3.1.2	Walls	m³	0.00		RATE ONLY
	8.4.3.2	Strength concrete (35MPa/20mm)				
C12.2.2.8.2.1	8.4.3.2.1	Floor	m³	1.50		
C12.2.2.8.2.2	8.4.3.2.2	Walls	m³	4.50		
	8.4.3.3	Strength concrete (20MPa/20mm)				
C12.2.2.8.3.1	8.4.3.3.1 LIC	Mass Concrete	m³	0.50		
	8.4.3.4	No-fines Concrete (NF20) - 100mm Thickness				
C12.2.2.8.4.1	8.4.3.4.1 LIC	Vertical surfaces, sloping surfaces, horizontal surfaces and around sub-soils	m³	0.00		RATE ONLY
C12.2.2.8.4.2	8.4.3.4.2 LIC	Filling of overbreak in rock to form drainage layer	m³	0.00		RATE ONLY
	8.4.4	Unformed Surface Finish				
C12.2.2.9.1	a) Wood Float Finish		m²	1.50		
C12.2.2.9.2	b) Steel Float Finish		m²	0.00		RATE ONLY
Sub-Total Carried Forward						

[illegible]

NYAKALLONG WASTEWATER TREATMENT WORKS REFURBISHMENT
BILL OF QUANTITIES
CIVIL - SCOPE OF WORKS
WORK PACKAGE - SLUDGE DRYING BEDS
REV A

ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (ZAR)
C13.1	SANS 1200DA 8.3	EARTHWORKS - SMALL WORKS				
		SCHEDULED ITEMS				
	8.3.1	Excavation				
	8.3.1.1	Remove top soil to a nominal depth of 150mm and stockpile				
C3.1.1	8.3.1.a	Remove top soil to a nominal depth of 150mm and stockpile on site at indicate location (To be specified by the Engineer).	m²	200		RATE ONLY
C3.1.2	8.3.1.b	Excavation in all materials and use for embankment or backfill or dispose of material or surpice material within the free haul distance.	m³	540		
	8.3.1.c	Extra Over:				
C3.1.2.1	8.3.1.c.1	Extra Over for 8.3.1.b for Intermediate Excavation	m³	81		RATE ONLY
C3.1.2.2	8.3.1.c.2	Extra Over for 8.3.1.b for Hard Rock Excavation	m³	54		RATE ONLY
	8.3.2	Restricted Excavation				
	8.3.2.a	Excavation for restricted foundations, footings, trenches and sub-soil drains in all materials and use for backfilling or embankment or dispose of material or surpice material within the free haul distance.				
C3.1.3.1	8.3.2.a	0m up to 2m	m³	75		RATE ONLY
	8.3.2.b	Extra Over:				
C3.1.3.1.1	8.3.2.b.1	Extra Over for Intermediate Excavation	m³	11.25		RATE ONLY
C3.1.3.1.2	8.3.2.b.2	Extra Over for Hard Rock Excavation	m³	7.5		RATE ONLY
C3.1.3.2	8.3.2.a	2m up to 4m	m³	0		RATE ONLY
	8.3.2.b	Extra Over:				
C3.1.3.2.1	8.3.2.b.1	Extra Over for Intermediate Excavation	m³	0		RATE ONLY
C3.1.3.2.2	8.3.2.b.2	Extra Over for Hard Rock Excavation	m³	0		RATE ONLY
C3.1.3.3	8.3.2.a	4m up to 6m	m³	0		RATE ONLY
	8.3.2.b	Extra Over:				
C3.1.3.3.1	8.3.2.b.1	Extra Over for Intermediate Excavation	m³	0		RATE ONLY
C3.1.3.3.2	8.3.2.b.2	Extra Over for Hard Rock Excavation	m³	0		RATE ONLY
		Dewatering				
C3.1.3.4		Dewatering of excavation for restricted foundations, footings, trenches and sub-soil drains in 8.3.2 in all materials until construction is complete.	SUM	1		RATE ONLY
		Geo-Fabric				
C3.1.3.5		Supply, lay and install geo-fabric (Kaytech Bidim A2 or similar approved) in sub-soil drains and below floors.	m²	500		RATE ONLY
		Sub-Soil Pipes				
C3.1.3.6.1		Supply, lay and install 110uPVC collection pipes, collecting sub-soil drainage pipes.	m	80		RATE ONLY
C3.1.3.6.2		Supply, lay and install 160uPVC collection pipes, collecting sub-soil drainage pipes.	m	0		RATE ONLY
C3.1.3.6.3		Supply, lay and install 110uPVC slotted or perforated sub-soil drainage pipes.	m	200		RATE ONLY
C3.1.3.6.3		Supply, lay and install 160uPVC slotted or perforated sub-soil drainage pipes.	m	0		RATE ONLY
		Crushed Stone				
C3.1.3.7		Supply and place 19mm crushed stone in sub-soil drains.	m³	72		RATE ONLY
Sub-Total Carried Forward						

ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (ZAR)
Sub-Total Carried Forward						
C3.2	SANS 1200GA 8.2	CONCRETE - STRUCTURAL				
		SCHEDULED FORMWORK ITEMS				
	8.2.1	Rough				
		Plane vertical				
C3.2.1.1.1		Column Base	m ²	0		RATE ONLY
C3.2.1.1.2		Columns	m ²	0		RATE ONLY
C3.2.1.1.3		Columns Heads	m ²	0		RATE ONLY
C3.2.1.1.4		Floor	m ²	0		RATE ONLY
C3.2.1.1.5		Walls	m ²	0		RATE ONLY
C3.2.1.1.6		Soffit	m ²	0		RATE ONLY
C3.2.1.1.7		Beams	m ²	0		RATE ONLY
		Plane horizontal				
C3.2.1.2.1		Soffit	m ²	0		RATE ONLY
C3.2.1.2.2		Beams	m ²	0		RATE ONLY
		Plane sloping				
C3.2.1.3.1		Soffit	m ²	0		RATE ONLY
	8.2.2	Smooth				
		Plane vertical				
C3.2.2.1.1		Column Base	m ²	0		RATE ONLY
C3.2.2.1.2		Columns	m ²	0		RATE ONLY
C3.2.2.1.3		Columns Heads	m ²	0		RATE ONLY
C3.2.2.1.4		Floor	m ²	90		
C3.2.2.1.5		Walls	m ²	450		
C3.2.2.1.6		Soffit	m ²	0		RATE ONLY
C3.2.2.1.7		Beams	m ²	0		RATE ONLY
		Plane horizontal				
C3.2.2.2.1		Soffit	m ²	0		RATE ONLY
C3.2.2.2.2		Beams	m ²	0		RATE ONLY
		Plane sloping				
C3.2.2.3.1		Soffit	m ²	0		RATE ONLY
	8.2.4	Box out holes / form voids				
	8.2.4.a	Small, circular of diameter up to and including 0.35m				
C3.2.3.1.1	8.2.4.a.1	Over 0m and up to and including 0.5m deep	NO	10		
C3.2.3.1.2	8.2.4.a.2	Over 0.5m and up to and including 1m deep	NO	0		RATE ONLY
	8.2.4.b	Small, other than circular, of area up to and including 0.1m ²				
C3.2.3.2.1	8.2.4.b.1	Over 0m and up to and including 0.5m deep	NO	0		RATE ONLY
C3.2.3.2.2	8.2.4.b.2	Over 0.5m and up to and including 1m deep	NO	0		RATE ONLY
	8.2.4.c	Large, circular, of diameter over 0.35m and up to and including 0.70m				
C3.2.3.3.1	8.2.4.c.1	Over 0m and up to and including 0.5m deep	NO	0		RATE ONLY
C3.2.3.3.2	8.2.4.c.2	Over 0.5m and up to and including 1m deep	NO	0		RATE ONLY
	8.2.4.d	Large, other than circular, of area 0.1m ² and up to and including 0.5m ²				
C3.2.3.4.1	8.2.4.d.1	Over 0m and up to and including 0.5m deep	NO	0		RATE ONLY
C3.2.3.4.2	8.2.4.d.2	Over 0.5m and up to and including 1m deep	NO	0		RATE ONLY
	8.2.4.e	Large, circular, of diameter over 0.70m and up to and including 1.50m				
C3.2.3.5.1	8.2.4.e.1	Over 0m and up to and including 0.5m deep	NO	0		RATE ONLY
C3.2.3.5.2	8.2.4.e.2	Over 0.5m and up to and including 1m deep	NO	0		RATE ONLY
	8.2.4.f	Large, other than circular, of area 0.5m ² and up to and including 2.5m ²				
C3.2.3.6.1	8.2.4.f.1	Over 0m and up to and including 0.5m deep	NO	0		RATE ONLY
C3.2.3.6.2	8.2.4.f.2	Over 0.5m and up to and including 1m deep	NO	0		RATE ONLY
Sub-Total Carried Forward						

[illegible]

ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT (ZAR)
Sub-Total Carried Forward						
	8.4	SCHEDULED CONCRETE ITEMS				
	8.4.1	Prescribed mix concrete				
C3.2.6	8.4.1.1	Prescribed mix concrete (Specified mix design)	m³	0		RATE ONLY
	8.4.2	Blinding layer				
C3.2.7	8.4.2.1 LIC	Blinding layer (20MPa/20mm) - 50mm thickness	m²	2000		
	8.4.3	Strength concrete				
	8.4.3.1	Strength concrete (30MPa/20mm)				
C3.2.8.1.1	8.4.3.1.1	Column Base	m³	0		RATE ONLY
C3.2.8.1.2	8.4.3.1.2	Columns	m³	0		RATE ONLY
C3.2.8.1.3	8.4.3.1.3	Column Head	m³	0		RATE ONLY
C3.2.8.1.4	8.4.3.1.4	Floor	m³	0		RATE ONLY
C3.2.8.1.5	8.4.3.1.5	Walls	m³	0		RATE ONLY
C3.2.8.1.6	8.4.3.1.6	Soffit	m³	0		RATE ONLY
C3.2.8.1.7	8.4.3.1.6	Beams	m³	0		RATE ONLY
	8.4.3.2	Strength concrete (35MPa/20mm)				
C3.2.8.2.1	8.4.3.2.1	Column Base	m³	0		RATE ONLY
C3.2.8.2.2	8.4.3.2.2	Columns	m³	0		RATE ONLY
C3.2.8.2.3	8.4.3.2.3	Column Head	m³	0		RATE ONLY
C3.2.8.2.4	8.4.3.2.4	Floor	m³	288		
C3.2.8.2.5	8.4.3.2.5	Walls	m³	201.6		
C3.2.8.2.6	8.4.3.2.6	Soffit	m³	0		RATE ONLY
C3.2.8.2.7	8.4.3.2.6	Beams	m³	0		RATE ONLY
	8.4.3.3	Strength concrete (20MPa/20mm)				
C3.2.8.3.1	8.4.3.3.1 LIC	Mass Concrete	m³	6		
	8.4.3.4	No-fines Concrete (NF20) - 100mm Thickness				
C3.2.8.4.1	8.4.3.4.1 LIC	Vertical surfaces, sloping surfaces, horizontal surfaces and around sub-soils	m³	10		RATE ONLY
C3.2.8.4.2	8.4.3.4.2 LIC	Filling of overbreak in rock to form drainage layer	m³	10		RATE ONLY
	8.4.4	Unformed Surface Finish				
C3.2.9.1		a) Wood Float Finish	m²	0		RATE ONLY
C3.2.9.2		b) Steel Float Finish	m²	2310		
	8.5	JOINTS				
C3.2.10.1		Wall Joint-Type A	m	124.2		
C3.2.10.2.1		Floor Joint-Type A	m	396		
Sub-Total Carried Forward						

[illegible]

NYAKALLONG WASTEWATER TREATMENT WORKS REFURBISHMENT
BILL OF QUANTITIES
MECHANICAL - SCOPE OF WORKS
SUMMARY
REV A

[illegible]

NYAKALLONG WASTEWATER TREATMENT WORKS REFURBISHMENT
BILL OF QUANTITIES
MECHANICAL - SCOPE OF WORKS
PACKAGE - GENERAL RATES
REV A

ITEM	PAYMENT REF.	DESCRIPTION	UNIT	QTY	DESIGN, SUPPLY AND DELIVERY	INSTALLATION	COMMISSIONING	TOTAL	AMOUNT (ZAR)
M0.0.0		ELECTROMAGNETIC FLOW METER							
M0.0.1		ENDRESS & HAUSER - 50ND PROMAG 400-PN10 OR SIMILAR APPROVED	NO	0					RATE ONLY
M0.0.2		ENDRESS & HAUSER - 80ND PROMAG 400-PN10 OR SIMILAR APPROVED	NO	0					RATE ONLY
M0.0.3		ENDRESS & HAUSER - 100ND PROMAG 400-PN10 OR SIMILAR APPROVED	NO	0					RATE ONLY
M0.0.4		ENDRESS & HAUSER - 150ND PROMAG 400-PN10 OR SIMILAR APPROVED	NO	0					RATE ONLY
M0.0.5		ENDRESS & HAUSER - 200ND PROMAG 400-PN10 OR SIMILAR APPROVED	NO	0					RATE ONLY
M0.0.6		ENDRESS & HAUSER - 250ND PROMAG 400-PN10 OR SIMILAR APPROVED	NO	0					RATE ONLY
M0.0.7		ENDRESS & HAUSER - 300ND PROMAG 400-PN10 OR SIMILAR APPROVED	NO	0					RATE ONLY
M0.0.8		ENDRESS & HAUSER - 350ND PROMAG 400-PN10 OR SIMILAR APPROVED	NO	0					RATE ONLY
M0.0.9		ENDRESS & HAUSER - 400ND PROMAG 400-PN10 OR SIMILAR APPROVED	NO	0					RATE ONLY
M0.0.10		ENDRESS & HAUSER - 450ND PROMAG 400-PN10 OR SIMILAR APPROVED	NO	0					RATE ONLY
M0.0.1		PUDDLE PIPES							
M0.0.1.1		PUDDLE PIPE FLANGED ON BOTH SIDES (150ND) (ASME B36.19 SCH 10S)	NO	0					RATE ONLY
M0.0.1.2		PUDDLE PIPE FLANGED ON ONE SIDES (150ND) (ASME B36.19 SCH 10S)	NO	0					RATE ONLY
M0.0.1.3		PUDDLE PIPE FLANGED ON BOTH SIDES (200ND) (ASME B36.19 SCH 10S)	NO	0					RATE ONLY
M0.0.1.4		PUDDLE PIPE FLANGED ON ONE SIDES (200ND) (ASME B36.19 SCH 10S)	NO	0					RATE ONLY
M0.0.1.5		PUDDLE PIPE FLANGED ON BOTH SIDES (250ND) (ASME B36.19 SCH 10S)	NO	0					RATE ONLY
M0.0.1.6		PUDDLE PIPE FLANGED ON ONE SIDES (250ND) (ASME B36.19 SCH 10S)	NO	0					RATE ONLY
M0.0.1.7		PUDDLE PIPE FLANGED ON BOTH SIDES (300ND) (ASME B36.19 SCH 10S)	NO	0					RATE ONLY
M0.0.1.8		PUDDLE PIPE FLANGED ON ONE SIDES (300ND) (ASME B36.19 SCH 10S)	NO	0					RATE ONLY
M0.0.1.9		PUDDLE PIPE FLANGED ON BOTH SIDES (350ND) (ASME B36.19 SCH 10S)	NO	0					RATE ONLY
M0.0.1.10		PUDDLE PIPE FLANGED ON ONE SIDES (350ND) (ASME B36.19 SCH 10S)	NO	0					RATE ONLY
M0.0.1.11		PUDDLE PIPE FLANGED ON BOTH SIDES (400ND) (ASME B36.19 SCH 10S)	NO	0					RATE ONLY
M0.0.1.12		PUDDLE PIPE FLANGED ON ONE SIDES (400ND) (ASME B36.19 SCH 10S)	NO	0					RATE ONLY
M0.0.1.13		PUDDLE PIPE FLANGED ON BOTH SIDES (450ND) (ASME B36.19 SCH 10S)	NO	0					RATE ONLY
M0.0.1.14		PUDDLE PIPE FLANGED ON ONE SIDES (450ND) (ASME B36.19 SCH 10S)	NO	0					RATE ONLY
M0.0.2		PUDDLE PIPES (FINISH: EPOXY COATED AND LINED TO MECHANICAL SPECIFICATION)							
M0.0.2.1		PUDDLE PIPE FLANGED ON BOTH SIDES (150ND) (SANS 62 CARBON STEEL)	NO	0					RATE ONLY
M0.0.2.2		PUDDLE PIPE FLANGED ON ONE SIDES (150ND) (SANS 62 CARBON STEEL)	NO	0					RATE ONLY
M0.0.2.3		PUDDLE PIPE FLANGED ON BOTH SIDES (200ND) (SANS 719 CARBON STEEL)	NO	0					RATE ONLY
M0.0.2.4		PUDDLE PIPE FLANGED ON ONE SIDES (200ND) (SANS 719 CARBON STEEL)	NO	0					RATE ONLY
M0.0.2.5		PUDDLE PIPE FLANGED ON BOTH SIDES (250ND) (SANS 719 CARBON STEEL)	NO	0					RATE ONLY
M0.0.2.6		PUDDLE PIPE FLANGED ON ONE SIDES (250ND) (SANS 719 CARBON STEEL)	NO	0					RATE ONLY
M0.0.2.7		PUDDLE PIPE FLANGED ON BOTH SIDES (300ND) (SANS 719 CARBON STEEL)	NO	0					RATE ONLY
M0.0.2.8		PUDDLE PIPE FLANGED ON ONE SIDES (300ND) (SANS 719 CARBON STEEL)	NO	0					RATE ONLY
M0.0.2.9		PUDDLE PIPE FLANGED ON BOTH SIDES (350ND) (SANS 719 CARBON STEEL)	NO	0					RATE ONLY
M0.0.2.10		PUDDLE PIPE FLANGED ON ONE SIDES (350ND) (SANS 719 CARBON STEEL)	NO	0					RATE ONLY
M0.0.2.11		PUDDLE PIPE FLANGED ON BOTH SIDES (400ND) (SANS 719 CARBON STEEL)	NO	0					RATE ONLY
M0.0.2.12		PUDDLE PIPE FLANGED ON ONE SIDES (400ND) (SANS 719 CARBON STEEL)	NO	0					RATE ONLY
M0.0.2.13		PUDDLE PIPE FLANGED ON BOTH SIDES (450ND) (SANS 719 CARBON STEEL)	NO	0					RATE ONLY
M0.0.2.14		PUDDLE PIPE FLANGED ON ONE SIDES (450ND) (SANS 719 CARBON STEEL)	NO	0					RATE ONLY
M0.0.3		RISING SPINDLE GATE VALVES							
M0.0.3.1		AVK 21-34-50ND-PN10 OR SIMILAR APPROVED	NO	0					RATE ONLY
M0.0.3.2		AVK 21-34-80ND-PN10 OR SIMILAR APPROVED	NO	0					RATE ONLY
M0.0.3.3		AVK 21-34-100ND-PN10 OR SIMILAR APPROVED	NO	0					RATE ONLY
M0.0.3.4		AVK 21-34-150ND-PN10 OR SIMILAR APPROVED	NO	0					RATE ONLY
M0.0.3.5		AVK 21-34-200ND-PN10 OR SIMILAR APPROVED	NO	0					RATE ONLY
M0.0.3.6		AVK 21-34-250ND-PN10 OR SIMILAR APPROVED	NO	0					RATE ONLY
M0.0.3.7		AVK 21-34-300ND-PN10 OR SIMILAR APPROVED	NO	0					RATE ONLY
M0.0.3.8		AVK 21-34-350ND-PN10 OR SIMILAR APPROVED	NO	0					RATE ONLY
M0.0.3.9		AVK 21-34-400ND-PN10 OR SIMILAR APPROVED	NO	0					RATE ONLY
M0.0.3.10		AVK 21-34-450ND-PN10 OR SIMILAR APPROVED	NO	0					RATE ONLY
M0.0.4		NON-RETURN VALVES - BALL CHECK							
M0.0.4.1		AVK 53-35-50ND-PN10 OR SIMILAR APPROVED	NO	0					RATE ONLY
M0.0.4.2		AVK 53-35-80ND-PN10 OR SIMILAR APPROVED	NO	0					RATE ONLY
M0.0.4.3		AVK 53-35-100ND-PN10 OR SIMILAR APPROVED	NO	0					RATE ONLY
M0.0.4.4		AVK 53-35-150ND-PN10 OR SIMILAR APPROVED	NO	0					RATE ONLY
M0.0.4.5		AVK 53-35-200ND-PN10 OR SIMILAR APPROVED	NO	0					RATE ONLY
M0.0.4.6		AVK 53-35-250ND-PN10 OR SIMILAR APPROVED	NO	0					RATE ONLY
M0.0.4.7		AVK 53-35-300ND-PN10 OR SIMILAR APPROVED	NO	0					RATE ONLY
M0.0.4.8		AVK 53-35-350ND-PN10 OR SIMILAR APPROVED	NO	0					RATE ONLY
M0.0.4.9		AVK 53-35-400ND-PN10 OR SIMILAR APPROVED	NO	0					RATE ONLY
M0.0.4.10		AVK 53-35-450ND-PN10 OR SIMILAR APPROVED	NO	0					RATE ONLY
Sub-Total Carried Forward									

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ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	DESIGN, SUPPLY AND DELIVERY RATE	INSTALLATION RATE	COMMISSIONING RATE	TOTAL RATE	AMOUNT (ZAR)
Sub-Total Carried Forward									
M2.1.4.1		Other general expenses incurred in complying with the requirements of the Scope of Work, not included above.	SUM	1					
M2.1.5		Flow Indicating Transmitter (AER-001-FIT-005) - New	NO	1					
		Ultrasonic Level Sensor - Prosonic S FMU90 & Prosonic S FDU90							
		Ultrasonic Level Transmitter with Flow Measurement Option							
		Supplier: Endress and Hauser or similar approved							
		Ultrasonic Level Sensor linked to the Ultrasonic Transmitter, linked to PLC							
		Purpose: Measuring the Waste Activated Sludge (WAS) wasted from the Aeration Basin to the Sludge Collection Tank. Linking to main PLC via hardwiring 4-20mA							
		Electrical supply from MCC2							
		Scope of Work:							
		Design, supply, deliver, install and commission the Flow Indicating Transmitter (Complete)							
M2.1.5.1		Other general expenses incurred in complying with the requirements of the Scope of Work, not included above.	SUM	1					
M2.1.6		Analytical Indicating Transmitter (AER-001-AIT-001) - New	NO	1					
		Dissolved Oxygen Sensor - Oxymax COS61D							
		Transmitter - CM44x 4- 20mA signal to PLC for each channel.							
		Supplier: Endress and Hauser or similar approved							
		Dissolved Oxygen Sensor linked to the Transmitter, linked to PLC							
		Purpose: Measuring the Dissolved Oxygen in basin 1 of the Aeration Basin. Linked to controllers.							
		Electrical supply from MCC2							
		Scope of Work:							
		Design, supply, deliver, install and commission the Analytical Indicating Transmitter (Complete)							
M2.1.6.1		Other general expenses incurred in complying with the requirements of the Scope of Work, not included above.	SUM	1					
M2.1.7		Analytical Indicating Transmitter (AER-001-AIT-002) - New	NO	1					
		Dissolved Oxygen Sensor - Oxymax COS61D							
		Transmitter - CM44x 4- 20mA signal to PLC for each channel.							
		Supplier: Endress and Hauser or similar approved							
		Dissolved Oxygen Sensor linked to the Transmitter, linked to PLC.							
		Purpose: Measuring the Dissolved Oxygen in basin 4 of the Aeration Basin. Linked to controllers.							
		Electrical supply from MCC2.							
		Scope of Work:							
		Design, supply, deliver, install and commission the Analytical Indicating Transmitter (Complete)							
M2.1.7.1		Other general expenses incurred in complying with the requirements of the Scope of Work, not included above.	SUM	1					
M2.1.8		Analytical Indicating Transmitter (AER-001-AIT-003) - New	NO	1					
		Suspended Solids Sensor - Turbimax CUS51D							
		Transmitter - CM44x 4- 20mA signal to PLC for each channel.							
		Supplier: Endress and Hauser or similar approved							
		Suspended Solids Sensor linked to the Transmitter, linked to PLC.							
		Purpose: Measuring the MLSS in basin 4 of the Aeration Basin.							
		Electrical supply from MCC2.							
		Scope of Work:							
		Design, supply, deliver, install and commission the Analytical Indicating Transmitter (Complete)							
M2.1.8.1		Other general expenses incurred in complying with the requirements of the Scope of Work, not included above.	SUM	1					
Sub-Total Carried Forward									

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ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	DESIGN, SUPPLY AND DELIVERY RATE	INSTALLATION RATE	COMMISSIONING RATE	TOTAL RATE	AMOUNT (ZAR)
Sub-Total Carried Forward									
M2.3.2.1		Vertical Surface Aerators (AER-001-VSA-001/4) - New Vertical Surface Aerator: SAME Supplier: S.A.M.E. Water (Pty) Ltd Power: 45kW / Unit Purpose: Oxygen supply to the Aeration Basin. Electrical supply from MCC2. <u>Scope of Work:</u> Design, procure, fabricate, supply, install, commission new vertical fixed surface mount aerators. FAT Testing prior to delivery on site. Site Testing. Commissioning. Etc.	NO	4					
M2.3.2.2		Other general expenses incurred in complying with the requirements of the Scope of Work, not included above. (Specify additional SOW required for complete SOW. If not then rate should be zero)	SUM	1					
M2.3.2.3		CFD Analysis (One week deliverable - Commercial and Certified CFD Software) SIEMENS STAR CCM+ or similar approved. Free Surface Volume of Fluid, Multi Phase (Air & Water) to be able to capture dynamic behaviours of the impellers at unsteady rotating motions will be used (Aerotherm or similar approved). 2 Simulations (1- Baseline & 2 - Geometric Modification) Deliverable: 3D Flow Field, Settling velocity Analysis, Air Entrainment Assessment - Report (Complete)	PROV SUM	1	100 000.00	N/A	N/A	100 000.00	100 000.00
M2.3.2.4		Contractors mark-up on material	PERCENTAGE	10%	10 000.00	N/A	N/A	10 000.00	10 000.00
M2.4		AXIAL FLOW PUMPS SCHEDULED ITEMS							
M2.4.1.1		Axial Flow Pumps (AER-001-PUMP-001A/1B) - Existing Axial Flow Pumps - Dry Installation Duty + Standby Model: 400NB Supplier: Brenhor Pumps (Pty) Ltd Duty (Flow Rate) = 437,5m ³ /Hr Duty (Head) = 0,5m Power = 3kW/Unit Poles = 6 Phase = 3 Purpose: Recycle (a-recycle) from the Aeration Basin to the Anaerobic / Anoxic Basin. Electrical supply from MCC2. <u>Scope of Work:</u> Dismantle and remove the existing recycle pumps to indicate position on site. Remove from site the recycle pumps for refurbishment. Refurbish existing recycle pumps. Transport, install and commission the Axial Flow Pumps.	No	2					
M2.4.1.2		Other general expenses incurred in complying with the requirements of the Scope of Work, not included above. (Specify additional SOW required for complete SOW. If not then rate should be zero)	SUM	1					
M2.4.2.1		Axial Flow Pumps (AER-001-PUMP-002A/2B) - NOT USED							
Sub-Total Carried Forward									

ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	DESIGN, SUPPLY AND DELIVERY RATE	INSTALLATION RATE	COMMISSIONING RATE	TOTAL RATE	AMOUNT (ZAR)
Sub-Total Carried Forward									
M2.4.2.2		Other general expenses incurred in complying with the requirements of the Scope of Work, not included above.	SUM	1					
		(Specify additional SOW required for complete SOW. If not then rate should be zero)							
M2.5		ISOLATION							
		SCHEDULED ITEMS							
M2.5.1		Penstocks (AAN-001-PS-001) New - Penstocks (Complete) Wall mount gate 800 x 800mm - SS304 - with all fixing brackets and seal components (Allow for 200mm variation in both direction) SAME or similar approved.	NO	1					
M2.5.2		Penstocks (AAN-001-PS-002) Service - Penstocks (Complete) Wall mount gate 600 x 600mm - SS304 - with all fixing brackets and seal components (Allow for 200mm variation in both direction) SAME or similar approved.	NO	1					
M2.5.3		Penstocks (AER-001-PS-001/005) New - Penstocks (Complete) Wall mount gate 800 x 800mm - SS304 - with all fixing brackets and seal components (Allow for 200mm variation in both direction) SAME or similar approved.	NO	2					
M2.5.4		Penstocks (AER-001-PS-002-004) New - Penstocks (Complete) Wall mount gate 200 x 200mm - SS304 - with all fixing brackets and seal components (Allow for 200mm variation in both direction) SAME or similar approved.	NO	3					
M2.6		STEELWORK							
		SCHEDULED ITEMS							
M2.6.1		Platforms and grating (Complete) All structural elements and fixing requirements. Structural sections material = SANS1431 Grade 300WA. Bots and nuts = SANS 1700-5 304 Stainless steel or 4.8 equivalent quality. Bolt projection after fastening more than two threads, Washers same material as bolts. Welding in accordance with SANS 455. Hot dipped galvanized	m²	30.00					
M2.6.2		Handrails, knee rails and stations (Complete)	m	170.00					
M2.6.3.1		Steel Roof Structure (Complete) Design, fabricate and install. Design to be submitted to the Engineer for Approval.	PROV SUM	1	65 000.00	15 000.00	10 000.00	90 000.00	90 000.00
M2.6.3.2		Contractors mark-up on material	PERCENTAGE	10%	6 500.00	1 500.00	1 000.00	9 000.00	9 000.00
M2.7		WEIRS							
		SCHEDULED ITEMS							
M2.7.1		Tilting Weir (Actuated) (Complete) W=2000mm and H = 700mm, SS304 SAME or similar approved. Actuated. Open and Close Operation. AUMA or similar approved. Design to be submitted for approval by Engineer.	NO	1					
M2.7.2		Weir Plate, including all fixtures (Complete) W=6000mm H = 7500mm T= 4mm, SS304	NO	1					
Total Carried Forward to Summary									

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ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	DESIGN, SUPPLY AND DELIVERY RATE	INSTALLATION RATE	COMMISSIONING RATE	TOTAL RATE	AMOUNT (ZAR)
Sub-Total Carried Forward									
M3.3		RAS PUMP STATION SCHEDULED ITEMS							
M3.3.1.1		Self Priming Pumps (SST-001-PUMP-001A/001B) - Existing	NO	2					
		Self Priming Pumps - Dry Installation							
		Duty + Standby							
		Model: 6STX							
		Supplier: Cornell Pump Company							
		Duty (Flow Rate) = TBC							
		Duty (Head) = TBC							
		Power = 7,5kW/Unit							
		Poles = 4							
		Phase = 3							
		Purpose: Underflow from the Secondary Settling Tanks recycled (s-recycle) back to the Anaerobic / Anoxic Basin or waste to the Sludge Collection Tank.							
		Electrical supply from MCC3.							
		Scope of Work:							
		Dismantle and remove the existing recycle pumps to indicate position on site.							
		Remove from site the recycle pumps for complete refurbishment of pump, motors, baseplate, etc.							
		Transport, install and commission the pumps.							
M3.3.1.2		Other general expenses incurred in complying with the requirements of the Scope of Work, not included above.	SUM	1					
		(Specify additional SOW required for complete SOW. If not then rate should be zero)							
Sub-Total Carried Forward									

ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	DESIGN, SUPPLY AND DELIVERY RATE	INSTALLATION RATE	COMMISSIONING RATE	TOTAL RATE	AMOUNT (ZAR)
Sub-Total Carried Forward									
M3.3.2		Pipework Specification: SANS 62 (≤150ND) and SANS 719 (>150ND) Coating System: Refer to Mechanical Specification Lining System: Refer to Mechanical Specification Flanges: SANS 1123 (Table 1000/3) <u>Scope of Work:</u> Dismantle and remove the existing pipework to indicate position on site. Remove from site the pipework to workshop for refurbishment. Refurbish pipework (Sand blast, clean, coating and lining, etc.) (Complete) Fabricate required spool pieces to install new Electromagnetic Flow Meter and Valves. Fabricate required spool piece to fix Pressure Sensor position. Transport, install and comission the pipework.	SUM	1					
M3.3.3		Valves							
M3.3.3.1.1		Ball Check Non-Return Valves (VAL-005/7) Model: AVK 53-35 Supplier: AVK or similar approved Pressure Rating: PN10 Size: 150ND <u>Scope of Work:</u> Design, supply, deliver, install and comission the valves (Complete),	NO	2					
M3.3.3.1.2		Other general expenses incurred in complying with the requirements of the Scope of Work, not included above. (Specify additional SOW required for complete SOW. If not then rate should be zero)	SUM	1					
M3.3.3.2.1		Rising Spindle Gate Valves (VAL-002/4/6/8/9/10) Model: AVK 21-89 Supplier: AVK or similar approved Pressure Rating: PN10 Size: 150ND <u>Scope of Work:</u> Design, supply, deliver, install and comission the valves (Complete),	NO	6					
M3.3.3.2.2		Other general expenses incurred in complying with the requirements of the Scope of Work, not included above. (Specify additional SOW required for complete SOW. If not then rate should be zero)	SUM	1					
M3.3.4.1		Pipe Supports - Existing <u>Scope of Work:</u> Dismantle and remove the existing pipe supports to indicate position on site. Remove from site the pipesupports to workshop for refurbishment. Refurbish pipesupports (Sand blast, clean, coating, etc.) (Complete) Replace nuts, bolts, etc. where required to ensure all equipment is completely refurbished. Transport, install and comission the pipe supports.	SUM	1					
M3.3.4.2		Other general expenses incurred in complying with the requirements of the Scope of Work, not included above. (Specify additional SOW required for complete SOW. If not then rate should be zero)	SUM	1					
M4.1		ISOLATION SCHEDULED ITEMS Penstocks - Isolation of Screen-Course-Mechanical (PS-001-9)							
M4.1.1		Service - Penstocks (Complete) Wall mount gate 400 x 400mm - SS304 - with all fixing brackets and seal components (Allow for 200mm variation in both direction) SAME or similar approved.	NO	3					
Total Carried Forward to Summary									

ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	DESIGN, SUPPLY AND DELIVERY RATE	INSTALLATION RATE	COMMISSIONING RATE	TOTAL RATE	AMOUNT (ZAR)
Sub-Total Carried Forward									
M4.1.5		Instrumentation cable							
M4.1.5.1		SWA PVC 1.5mm2 2 pair individually screened and overall screened cable including termination	m	100					
M4.1.5.2		Galvanize bosal tubing 25mm	m	100					
		<u>Scope of Work:</u>							
		Supply and install							
M4.1.6		Other general expenses incurred in complying with the requirements of the Scope of Work, not included above.	SUM	1					
		(Specify additional SOW required for complete SOW. If not then rate should be zero)							
M4.2		DOSING							
		SCHEDULED ITEMS							
M4.2.1.1		Calcium Hypochlorite Dosing System - Automated Dosing System	SUM	1					
		Clarity Installations (Pty) Ltd or similar approved							
		Installation: New Calcium Hypochlorite Dosing Facility							
		Allowance: Full Flow							
		<u>Proposed:</u>							
		Clarity Open bunded 10mm thick Polypropylene dosing skid for TWO (Duty/Standby) Grundfos DDC 15-4 AR-PVC/V/C-F-311002FG - 97721508 dosing pumps, strainer on each inlet line, multifunction valve on each dosing pump (Pressure relief, backpressure). Calibration tube, pressure gauge with chemical seal with mild steel pow							
		MCC for dosing pumps and electric mixer.							
		Bosal conduit, hospital saddles, cabling, sundries.							
		Grundfos 1000L tank - Calcium Hypochlorite solution							
		Rigid suction lance							
		Electric mixer							
		Installation piping, fittings, valves to dosing skid and to dosing point.							
		8 x Calcium hypochlorite tablets/chips in drum - 25kg (First fill) 200kg							
		CHLORINE MD 100 DUO USING TABS - Residual chlorine sample tester for operators to test manual samples.							
		All P&G's Covered under this Item.							
M4.2.1.2		Other general expenses incurred in complying with the requirements of the Scope of Work, not included above.	SUM	1					
		(Specify additional SOW required for complete SOW. If not then rate should be zero)							
M4.2.2.1		Chlorine Dosing System - Automated Dosing System	SUM	1					
		Clarity Installations (Pty) Ltd							
		Installation: New Chlorine Dosing Facility							
		Allowance: Full Flow							
		<u>Proposed:</u>							
		2 x Manifold, wall mount liquid trap & trace heater for THREE x 70 kg chlorine cylinders.							
		4 x Pigtail / Flex lines 1.5m.							
		2 x Pigtail / Flex lines 1.5m - Spare.							
		Ammonia - Ammonia leak tester 100ml.							
		2 x Frame and platform for THREE chlorine cylinders with chain restraints..							
		2 x Digital platform scale with indicator - 400x500 - 150kg capacity.							
		2 x Grundfos Vacuum Regulator VGA 111.							
		Grundfos Vacuum Change Over 189.							
		Manual Dosing Regulator 2kg/h - VGA-113-2000.							
		Grundfos Injector 0-4 kg/h.							
		Polypropylene Sheet 10mm x 1000mm x 2000mm with pipe, valves & fittings for skid.							
		Gas Leak detector 1 sensor.							
		Siren Flasher Unit.							
		20m Signal cable							
		3 x Vacuum hose 8/11 10m.							
		2 x JP 5-48 Booster pump.							
		Pressure transmitter (to prevent dry running of pump).							
		Pump stand for two pumps.							
		Motive water piping, valves, fittings.							
		Dosing line PVC piping, valves fittings, diffuser.							
		Electrical MCC panel - pump control.							
		Electrical cabling, bosal conduit, hospital saddles.							
		Anchor bolts, fischer plugs.							
		Extraction fan, isolator and cabling.							
		All P&G's Covered under this Item.							
Sub-Total Carried Forward									

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ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	DESIGN, SUPPLY AND DELIVERY RATE	INSTALLATION RATE	COMMISSIONING RATE	TOTAL RATE	AMOUNT (ZAR)
Sub-Total Carried Forward									
M5.2		FINAL EFFLUENT PUMP STATION - SUBMERSIBLE PUMPS							
		SCHEDULED ITEMS							
M5.2.1.1		Submersible Pumps (CCT-001-PUMP-001A/1B) - New	PROV SUM	1	250 000.00	25 000.00	25 000.00	300 000.00	300 000.00
		Submersible Pumps - Wet Installation							
		Duty + Standby							
		Model: TBC							
		Supplier: Grundfos South Africa (PTY) Ltd							
		Duty (Flow Rate) = TBC							
		Duty (Head) = TBC							
		Power = 0.37kW/Unit							
		Poles = 4							
		Phase = 3							
		Purpose: Final effluent is discharged to the elevated tank, which supplies water to the Heda of Works.							
		Electrical supply from MCC6							
		<u>Scope of Work:</u>							
		Design, supply, deliver, install and comission the pumps, guiderails, duct foot, etc. (Complete).							
M5.2.1.2		Contractors mark-up on material	PERCENTAGE	10%	25 000.00	2 500.00	2 500.00	30 000.00	30 000.00
M5.2.1.3		Other general expenses incurred in complying with the requirements of the Scope of Work, not included above.	SUM	1					
		(Specify additional SOW required for complete SOW. If not then rate should be zero)							
M5.2.2		Pipework	SUM	1					
		Specification: SANS 62 (≤150ND) and SANS 719 (>150ND)							
		Coating System: Refer to Mechanical Specification.							
		Lining System: Refer to Mechanical Specification.							
		Flanges: SANS 1123 (Table 1000/3)							
		<u>Scope of Work:</u>							
		Fabricate new pipework,							
		Allow for a drain line back into the sump , therby emptying the pipeline. (Not required for this pump station)							
		Coat and line new pipework,							
		Transport, install and comission the pipework.							
		Allow for connection to existing 50ND HDPE delivery pipeline, as well as 50m of new 50ND HDPE PE100/PN10/SDR17.							
M5.2.3		Valves							
M5.2.3.1.1		Ball Check Non-Return Valves (CCT-001-VAL-001/3)	NO	2					
		Model: AVK 53-35							
		Supplier: AVK or similar approved							
		Pressure Rating: PN10							
		Size: 50ND							
		<u>Scope of Work:</u>							
		Design, supply, deliver, install and comission the valves (Complete),							
M5.2.3.1.2		Other general expenses incurred in complying with the requirements of the Scope of Work, not included above.	SUM	1					
		(Specify additional SOW required for complete SOW. If not then rate should be zero)							
M5.2.3.2.1		Rising Spindle Gate Valves (CCT-001-VAL-002/4)	NO	2					
		Model: AVK 21-89							
		Supplier: AVK or similar approved							
		Pressure Rating: PN10							
		Size: 50ND							
		<u>Scope of Work:</u>							
		Design, supply, deliver, install and comission the valves (Complete),							
M5.2.3.2.2		Other general expenses incurred in complying with the requirements of the Scope of Work, not included above.	SUM	1					
		(Specify additional SOW required for complete SOW. If not then rate should be zero)							
Sub-Total Carried Forward									

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ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	DESIGN, SUPPLY AND DELIVERY RATE	INSTALLATION RATE	COMMISSIONING RATE	TOTAL RATE	AMOUNT (ZAR)
Sub-Total Carried Forward									
M6.2.4.1		Pipe Supports - New <u>Scope of Work:</u> Design new pipe support. (Structural analysis to be done using Prokon or similar approved.) Submit drawings to Mechanical Engineer for approval. Fabricate the pipe supports, Coat the pipe supports, Transport, install and commission the pipe supports.	SUM	5					
M6.2.4.2		Other general expenses incurred in complying with the requirements of the Scope of Work, not included above. (Specify additional SOW required for complete SOW. If not then rate should be zero)	SUM	1					
M6.3		STEELWORK SCHEDULED ITEMS							
M6.3.1		Platforms and grating (Complete) All structural elements and fixing requirements. Structural sections material = SANS1431 Grade 300WA. Bots and nuts = SANS 1700-5 304 Stainless steel or 4.8 equivalent quality. Bolt projection after fastening more than two threads, Washers same material as bolts. Welding in accordance with SANS 455. Hot dipped galvanized	m²	5					
M6.3.2		Handrails, knee rails and stations (Complete)	m	10.00					
M6.3.3		Cat ladder (Complete) All structural elements and fixing requirements. Height = 6.0m Structural sections material = SANS1431 Grade 300WA. Bots and nuts = SANS 1700-5 304 Stainless steel or 8.8 equivalent quality. Bolt projection after fastening more than two threads. Washers same material as bolts. Welding in accordance with SANS 455. Hot dipped galvanized.	NO	1					
Total Carried Forward to Summary									

ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	DESIGN, SUPPLY AND DELIVERY RATE	INSTALLATION RATE	COMMISSIONING RATE	TOTAL RATE	AMOUNT (ZAR)
Sub-Total Carried Forward									
M7.2		FINAL EFFLUENT PUMP STATION - SUBMERSIBLE PUMPS SCHEDULED ITEMS							
M7.2.1.1		Submersible Pumps (SLD-001-PUMP-002A/2B) - New Submersible Pumps - Wet Installation Duty + Standby Model: SLV.80.80.22.4.50D.C (TBC on site) Supplier: Grundfos South Africa (PTY) Ltd Duty (Flow Rate) = 30m³/hr Duty (Head) = 10,9m Power = 1,4kW/Unit Poles = 4 Phase = 3 Purpose: Discharge sludge from the Sludge Collection Tank to the Sludge Drying Beds. Electrical supply from MCC4. <u>Scope of Work:</u> Design, supply, deliver, install and commission the pumps (Complete).	NO	2					
M7.2.1.2		Other general expenses incurred in complying with the requirements of the Scope of Work, not included above. (Specify additional SOW required for complete SOW. If not then rate should be zero)	SUM	1					
M7.2.2		Pipework Specification: SANS 62 (<150ND) and SANS 719 (>150ND) Coating System: TBC Lining System: TBC Flanges: SANS 1123 (Table 1000/3) <u>Scope of Work:</u> Fabricate new pipework, Allow for a drain line back into the sump , thereby emptying the pipeline. Coat and line new pipework, Transport, install and commission the pipework. Allow for connection to existing delivery pipeline.	SUM	1					
Sub-Total Carried Forward									

ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	DESIGN, SUPPLY AND DELIVERY RATE	INSTALLATION RATE	COMMISSIONING RATE	TOTAL RATE	AMOUNT (ZAR)
Sub-Total Carried Forward									
M7.2.3		Valves							
M7.2.3.1.1		Ball Check Non-Return Valves (SLD-001-VAL-015/17) Model: AVK 53-35 Supplier: AVK or similar approved Pressure Rating: PN10 Size: 150ND <u>Scope of Work:</u> Design, supply, deliver, install and commission the valves (Complete),	NO	2					
M7.2.3.1.2		Other general expenses incurred in complying with the requirements of the Scope of Work, not included above. (Specify additional SOW required for complete SOW. If not then rate should be zero)	SUM	1					
M7.2.3.2.1		Rising Spindle Gate Valves (SLD-001-VAL-016/18) Model: AVK 21-89 Supplier: AVK or similar approved Pressure Rating: PN10 Size: 150ND <u>Scope of Work:</u> Design, supply, deliver, install and commission the valves (Complete),	NO	3					
M7.2.3.2.2		Other general expenses incurred in complying with the requirements of the Scope of Work, not included above. (Specify additional SOW required for complete SOW. If not then rate should be zero)	SUM	1					
M7.2.4.1		Pipe Supports - New <u>Scope of Work:</u> Design new pipe support. (Structural analysis to be done using Prokon or similar approved.) Submit drawings to Mechanical Engineer for approval. Fabricate the pipe supports, Coat the pipe supports, Transport, install and commission the pipe supports.	SUM	1					
M7.2.4.2		Other general expenses incurred in complying with the requirements of the Scope of Work, not included above.	SUM	1					
Total Carried Forward to Summary									

NYAKALLONG WASTEWATER TREATMENT WORKS REFURBISHMENT
BILL OF QUANTITIES
MECHANICAL - SCOPE OF WORKS
PACKAGE - SLUDGE DRYING BEDS
REV A

NYAKALLONG WASTEWATER TREATMENT WORKS REFURBISHMENT
BILL OF QUANTITIES
ELECTRICAL - SCOPE OF WORKS
WORK PACKAGE - MCC-1
REV A

[illegible]

[illegible]

NYAKALLONG WASTEWATER TREATMENT WORKS REFURBISHMENT
BILL OF QUANTITIES
ELECTRICAL - SCOPE OF WORKS
WORK PACKAGE - MCC-3
REV A

[illegible]

NYAKALLONG WASTEWATER TREATMENT WORKS REFURBISHMENT
BILL OF QUANTITIES
CONTROL & INSTRUMENTATION- SCOPE OF WORKS
SUMMARY
REV A

[illegible]

NYAKALLONG WASTEWATER TREATMENT WORKS REFURBISHMENT
BILL OF QUANTITIES
CONTROL & INSTRUMENTATION- SCOPE OF WORKS
WORK PACKAGE - SCADA
REV A

ITEM NO	PAY REF	DESCRIPTION	UNIT	QTY	DESIGN, SUPPLY AND DELIVERY RATE	INSTALLATION RATE	COMMISSIONING RATE	TOTAL RATE	AMOUNT (ZAR)
C&I8		SCADA EQUIPMENT AND ENGINEERING							
		SCHEDULED ITEMS							
C&I8.1		New SCADA Computer	SUM	1					
		As minimum the hardware must comply to the following specifications:							
		i7 CPU							
		1 GB HDD							
		64 GB RAM							
		Rack mount							
		Scope of Work:							
		Supply setup communication, testing and commissioning of hardware							
		Install into 19 inch rack							
C&I8.2		KVM Switch	SUM	1					
		KVM switch to allow extension from MCC room to control app. 15 meter							
		Extension for mouse, screen and keyboard							
		Scope of Work:							
		Supply setup communication, testing and commissioning of hardware							
		Install into 19 inch rack and in control room							
C&I8.3		Inverter based UPS	SUM	1					
		3kW inverter, 48V							
		5kWh battery							
		Wall panel							
		Auxiliaries e.g. CB, fuses etc.							
		Scope of Work:							
		Supply setup communication, testing and commissioning of hardware							
		Install in MCC room							
C&I8.4		SCADA Software							
		Upgrade existing Citect SCADA to latest version a to allow for all extension in this project	SUM	1					
		Allow for support license agreement for 24 months	SUM	1					
		Scope of Work:							
		Supply setup and install software license onto new SCADA computer							
C&I8.5		SCADA Programming							
C&I8.5.1		Transfer current SCADA application to new SCADA computer and new Citect license	SUM	1					
C&I8.5.2		Update SCADA application to include for all new additions and changes	SUM	1					
		Scope of Work:							
		Program and commission the following:							
		Mimics with parameters and per specification							
		Trending of all analogue values							
		Events							
		Alarms							
		Security setup							
		Communication to LC network							
C&I8.6		SCADA FAT	SUM	1					
		Scope of Work:							
		Allow for 2 sessions of SCADA mimic and functioning FAT							
C&I8.7		SCADA Functional Description	SUM	1					
		Scope of Work:							
		Compile complete SCADA functional specification to include:							
		Mimics							
		Interlocks							
		Trips							
		Alarms							
		Control functions							
Sub-Total Carried Forward									

[illegible]

VAAL CENTRAL WATER

CONTRACT NO. BW283/ARWWTW/22

REFURBISHMENT OF THE NYAKALLONG (ALLANRIDGE) WWTW: CIVIL, MECHANICAL AND ELECTRICAL, CONTROL & INSTRUMENTATION

SECTION C2.3

SUMMARY OF SCHEDULES

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

<u>SUMMARY</u>		Amount	
		R	c
1	PRELIMINARY AND GENERAL		
2	CIVIL WORKS		
3	MECHANICAL WORKS		
4	ELECTRICAL WORKS		
5	CONTROL & INSTRUMENTATION		
	SUB-TOTAL		
<u>PROVISIONAL CPA (for tender evaluation only)</u>			
ADD: CPA at the rate of 7%			
<u>CONTINGENCIES</u>			
ADD: Contingencies at the rate of 10%			
SUB-TOTAL			
<u>VALUE ADDED TAX</u>			
ADD: VAT at the rate of 15%			
TOTAL			
CONFIRM TOTAL IN WORDS			

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

VAAL CENTRAL WATER

CONTRACT NO. BW283/ARWWTW/22

REFURBISHMENT OF THE NYAKALLONG (ALLANRIDGE) WWTW: CIVIL, MECHANICAL AND ELECTRICAL, CONTROL & INSTRUMENTATION

SECTION C2.4

BANKING DETAILS

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

VAAL CENTRAL WATER

CONTRACT NO. BW283/ARWWTW/22

REFURBISHMENT OF THE NYAKALLONG (ALLANRIDGE) WWTW: CIVIL, MECHANICAL AND ELECTRICAL, CONTROL & INSTRUMENTATION

FINANCIAL REFERENCES

(a). **BANK RATING**

1. It is requisite that a bank rating be obtained, bearing an original stamp by the relevant bank.
2. Failure to complete the bank rating Form overleaf may invalidate the tender rating should be based on highest contract value tendered for and the corresponding timeframe.

(b) **FINANCIAL STATEMENTS**

I/We agree, if required, to furnish an audited copy of the latest set of financial statements together with my/our Directors' and Auditors' report for consideration by the Employer.

(c) **DETAILS OF COMPANY'S BANK**

I/We hereby authorize the Employer/Engineer to approach all or any of the following banks for a reference:

DESCRIPTION OF BANK DETAIL	BANK DETAIL APPLICABLE TO COMPANY HEAD OFFICE	BANK DETAIL APPLICABLE TO THE SITE OF THE WORKS
Name of bank		
Branch name		
Branch code		
Street Address		
Name of manager		
Telephone number	()	()
Account number		
Bank Rating		

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

.....
SIGNATURE OF TENDERER:

.....
DATE:

DECLARATION BY BANK MANAGER

This is to certify that the Tenderer has sufficient good standing with this bank that he will, in my opinion, be financially able to complete a contract to the value as entered, by the Tenderer, in Form C1.1 over the specified duration, or such other duration as the Tenderer may offer. In addition we confirm that, for the amount of the enquiry, the Tenderer is rated Code

.....
SIGNATURE OF BANK MANAGER:

.....
DATE:

Place bank stamp here

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

VAAL CENTRAL WATER

CONTRACT NO. BW283/ARWWTW/22

**REFURBISHMENT OF THE NYAKALLONG (ALLANRIDGE) WWTW:
CIVIL, MECHANICAL AND ELECTRICAL, CONTROL & INSTRUMENTATION**

PORTION 2: CONTRACT

PART C3: SCOPE OF WORKS

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

VAAL CENTRAL WATER

CONTRACT NO. BW283/ARWWTW/22

REFURBISHMENT OF THE NYAKALLONG (ALLANRIDGE) WWTW: CIVIL, MECHANICAL AND ELECTRICAL, CONTROL & INSTRUMENTATION

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Witness 2

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Witness 1

Witness 2

C3.1 DESCRIPTION OF WORKS

C3.1.1 Employer's Objectives

It is the objective of the Employer to solicit tenders from suitably qualified and experienced Contractors for the refurbishment of the Nyakallong (Allanridge) Wastewater Treatment Works (WWTW).

The Nyakallong (Allanridge) WWTW has an estimated capacity of 3.5MLD (Average Dry Weather Flow (ADWF)) and receives raw sewage via gravity and pump feed from Nyakallong and Allanridge. The refurbishment of the Nyakallong (Allanridge) WWTW will ensure that all gravity and pump feed of raw sewage from the Nyakallong and Allanridge surrounding area is treated to General Standards prior to being discharged to the Voëlpan.

The project will provide opportunity for CIDB-registered contractors to participate in a large infrastructure project.

The Tender Programme requirements are included in Clause C3.1.4 and the Contractor shall be deemed to have based his Tender Price on this Tender Programme and the time for achieving Practical Completion as specified in the Contract Data. Any material deviations from this Tender Programme shall be clearly noted in the Contractor's tender submission.

It is furthermore the Employer's objective to stimulate local economic development through this Contract and the Contractor will be expected to participate in the process by employing local labour and acquiring plant and materials from local enterprises as far as practically possible. The Contractor's attention is drawn to section T2.2.18 (Form R) – Local Economic Participation (LEP) Claim Form for more details on this important aspect of the Contract.

C3.1.2 Scope of the Works

The description of the work contained in this section is merely an outline of the Scope of Works, but does not limit the work to be carried out under this Contract. Approximate quantities for each type of activity to be carried out under the Contract are listed in the Bill of Quantities (Volume 2, Section C2.1).

The existing treatment process prior to refurbishment of the Nyakallong (Allanridge) WWTW is as follows:

Raw sewage is screened and de-gritted at the Head of Works through a single coarse front rake screen and three grit removal channels. Overflow at the Head of Works is by passed through a manual coarse screen and discharged into the three grit removal channels allowing coarse screening of the overflow.

Screened and de-gritted raw sewage is discharged to the Biological Nutrient Reactor (BNR) consisting of an Anaerobic, Anoxic Basin and an Aerobic Basin, with two Secondary Settling Tanks downstream of the BNR allowing clarification and thickening. The BNR has an internal return (recycle) from the Aerobic Basin to the Anaerobic Basin. The internal return (recycle) is two axial flow pumps lifting the liquid from the Aeration Basin and discharging the liquid into a gravity feed pipeline discharging into the Anaerobic Basin. WAS (Waste

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Activated Sludge) from the Aerobic Basin is done through opening and closing manual sluice gates located at the end of the Aerobic Basin, discharging sludge to the Sludge Collection Sump.

Settled and thickened solids at the bottom of the Secondary Sedimentation Tank (SST's) is returned (recycled) to the downstream end of the Head of Works, through two RAS (Return Activated Sludge) self-priming pumps. Clarified supernatant from the top of the SST's are discharged to the Voëlpan.

WAS, sludge settled and thickened (not returned to downstream end of Head of Works) and scum from the Secondary Sedimentation Tank are collected in the Sludge Collection Sump and discharged to the Sludge Drying Beds by a submersible pump. Sludge is discharged to 10 x Sludge Drying Beds. Isolation to each allows for flexibility in operation of dewatering the sludge for removal. Filtrate from the Sludge Drying Beds is discharged under gravity to a collection sump, from where the filtrate is pumped through two submersible pumps to the downstream end of the Head of Works.

The new or refurbished treatment process after refurbishment of the Nyakallong (Allanridge) WWTW will be as follows:

Raw sewage will be screened and de-gritted at the Head of Works through a single coarse front rake screen and three grit removal channels. Overflow at the Head of Works will be bypassed through a manual coarse screen and discharged into the three grit removal channels allowing coarse screening of the overflow.

Screened and de-gritted raw sewage will be discharged to the Biological Nutrient Reactor (BNR) consisting of an Anaerobic, Anoxic Basin and an Aerobic Basin, with two Secondary Settling Tanks downstream of the BNR allowing clarification and thickening. The BNR will have an internal return (recycle) from the Aerobic Basin to the Anaerobic Basin. The internal return (recycle) will be two axial flow pumps lifting the liquid from the Aeration Basin and discharging the liquid into a gravity feed pipeline discharging into the Anaerobic Basin. WAS (Waste Activated Sludge) from the Aerobic Basin will be done through opening a tilting weir at the downstream end of the Aeration Basin and discharging the liquid into a gravity feed pipeline discharging into the Sludge Collection Sump.

Settled and thickened solids at the bottom of the Secondary Sedimentation Tank (SST's) will be returned (recycled) to the downstream end of the Head of Works, through two RAS (Return Activated Sludge) self-priming pumps. Clarified supernatant from the top of the SST's will be discharged to a Chlorine Contact Tank for disinfection prior to discharge to the Voëlpan.

WAS, sludge settled and thickened (not returned to downstream end of Head of Works) and scum from the Secondary Sedimentation Tank will be collected in the Sludge Collection Sump and discharged to the Sludge Drying Beds through a submersible pump. Sludge will be discharged to 10 x Sludge Drying Beds. Isolation to each will allow for flexibility in operation of dewatering the sludge for removal. Filtrate from the Sludge Drying Beds will be discharged under gravity to a collection sump, from where the filtrate will be pumped through two submersible pumps to the downstream end of the Head of Works.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Therefor the only change to the existing treatment process will be allowing disinfection of the clarified supernatant from the SST's prior to discharge to the effluent storage dams, overflowing to the Voëlpan.

The Scope of Work (SOW) includes, but is not limited to, the following:

General:

- Establishment of the Contractor on Site.
- Clearing of the site.
- Installing new security as per the Security Specification Provided.
- Executing the New or Refurbished Treatment Process SOW (Listed below).
- Executing the Building Works SOW (Listed below)..
- Executing the Electrical, Control and Instrumentation SOW (Listed below)..
- Executing the Roads and Stormwater SOW (Listed below).
- Test on Completion.
- Commissioning.
- Training.
- Submission of O&M Manual for the WWTW.

New or Refurbished Treatment Process SOW:

- Head of Works:
 - Isolate structure.
 - Execute MCC-2 SOW as per BOQ related to the Head of Works (refer to Project Specification – Electrical, Control and Instrumentation).
 - Service 1x existing coarse front rake screen.
 - Service 1x existing sluice gates.
 - Remove and refurbish the existing coarse manual screen.
 - Service the level sensor and flow meter.
 - Clean the structure.
 - Concrete refurbishment of the structure (To be determined and evaluated by the Engineer).
 - Refurbishment of the building (To be determined and evaluated by the Engineer).
 - Test the mechanical and electrical equipment.
 - Test the structure for water tightness.
 - Commission the Head of Works.
- Anaerobic/Anoxic Basin:
 - Isolate structure.
 - Execute MCC-5 SOW as per BOQ related to the Anaerobic/Anoxic Basin (refer to Project Specification – Electrical, Control and Instrumentation).
 - Service al 4x existing mixers.
 - Install a new weir plate at the downstream weir of the outlet box to the required level (To be confirmed with the Engineer).

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

- Install 1x new sluice gate for isolation to the Aerobic Basin from the Anaerobic/Anoxic Basin Outlet Box.
 - Clean the structure.
 - Concrete refurbishment of the structure (To be determined and evaluated by the Engineer).
 - Test the mechanical and electrical equipment.
 - Test the structure for water tightness.
 - Commission the Anaerobic/Anoxic Basin.
- Aerobic Basin:
 - Isolate structure.
 - Dismantle, move and store the existing MCC-2 panel during construction stage in secure place on site. Execute the SOW as per the BOQ sections (refer to Project Specification – Electrical, Control and Instrumentation).
 - Dismantle and remove existing 4x floating surface aerators. Remove from site the components of the existing floating surface aerators required in repurposing the components with additional components required is supplying 4x surface mount surface aerators. Refurbish the existing components as new. Provide a warrantee for the performance and materials of the 4x new surface mount surface aerators (Complete).
 - Procure new sluice gates.
 - Dismantle and remove existing 2 x axial flow pumps used for internal return (recycle) from the Aerobic Basin to the Anaerobic Basin. Refurbish the existing axial flow pumps (Complete) as new. Provide a warrantee for the performance and materials of the 2 x refurbished axial flow pumps (Complete).
 - Procure 1x new tilting weir for scum & WAS removal.
 - Procure 2 x new DO (Dissolved Oxygen) Sensors (Complete) for DO measurement.
 - Procure 1 x new MLSS (Mixed Liquid Suspended Solids) Sensor (Complete) for MLSS measurement.
 - Breakdown and remove the existing civil infrastructure at the existing Aeration Basin.
 - Excavate the footprint of the new Aeration Basin.
 - Construct a new Aeration Basin (Earthworks, sub-soil drains, rock anchor installation, reinforced concrete, puddle pipes, cable access, steelwork, etc.)
 - Clean the structure.
 - Install MCC-2 panel at new location (Complete). Execute the SOW as per the BOQ sections, prior to installation of mechanical equipment (refer to Project Specification – Electrical, Control and Instrumentation).
 - Install new PLC equipment as per specification (refer to Project Specification – Electrical, Control and Instrumentation).
 - Install new sluice gates.
 - Install 4x new fixed surface mount surface aerators (Complete).
 - Install 2x refurbished axial flow pumps (Complete) (Internal return (recycle)).
 - Install 1x new tilting weir (Complete).
 - Install 2x new DO Sensors (Complete).
 - Install 1x new MLSS Sensor (Complete).
 - Test the mechanical and electrical equipment.
 - Test the structure for water tightness.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

- Commission the Aerobic Basin.
- Secondary Sedimentation Tanks (SSTs) and RAS Pump Station:
 - Isolate each structure (SSTs, RAS Pump Station and Division and Collection Boxes (If and where required)).
 - Fabricate, deliver, install and commission new 2 x SST bridges (Complete).
 - Remove and refurbish the RAS Pumps (Self Priming Pumps) (Complete).
 - Execute MCC-3 SOW as per BOQ related to the SSTs and RAS Pump Station (refer to Project Specification – Electrical, Control and Instrumentation).
 - Design, procure and fabricate new pipework for the RAS Pump Station.
 - Procure 2 x new non-return valves.
 - Procure 2 x new isolation valves.
 - Design and fabricate new pipe supports (To be advised by the Engineer)
 - Service 3 x existing sluice gates.
 - Service the existing Level Sensor (Complete).
 - Procure 2 x new Pressure Transmitters and 2x Pressure Gauges (Complete).
 - Procure 1 x new Electromagnetic Flow Meter (ODN) (Complete).
 - Concrete refurbishment of the structures (To be determined and evaluated by the Engineer).
 - Clean the structure.
 - Install 2 x refurbished SST bridges (Complete).
 - Install 2 x refurbished RAS Pumps (Complete).
 - Install new pipework and valves (Complete).
 - Install new pipe supports (Complete).
 - Install 2 x new Pressure Transmitters and 2x new Pressure Gauges (Complete).
 - Install 1 x new Electromagnetic Flow Meter (ODN) (Complete).
 - Test the mechanical and electrical equipment.
 - Install new PLC equipment as per the specification
 - Commission the SSTs, RAS Pump Station and Division and Collection Boxes.
- Chlorine Contact Tank and Final Effluent Pump Station:
 - Excavate the footprint of the new Chlorine Contact Tank.
 - Construct a new Chlorine Contact Tank (Earthworks, sub-soil drains, rock anchor installation, reinforced concrete, puddle pipes, cable access, steelwork, etc.)
 - Procure 2x new Final Effluent Pumps (Complete).
 - Design, procure and fabricate new pipework for the Final Effluent Pump Station.
 - Procure 2x new non-return valves.
 - Procure 2x new isolation valves.
 - Procure 1x new Level Sensor (Complete) for Final Effluent Pump Station Sump.
 - Procure 2x new Pressure Transmitters and 2x Pressure Gauges (Complete).
 - Procure 1x new Electromagnetic Flow Meter (ODN) (Complete).
 - Procure new sluice gates (Complete).
 - Procure 1x new Level Sensor (Complete) for Chlorine Contact Tank outlet weir.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

- Procure 1x new Free Chlorine Meter (Complete).
 - Clean the structure.
 - Execute MCC-6 SOW as per BOQ related to the Chlorine Contact Tank (refer to Project Specification – Electrical, Control and Instrumentation).
 - Install 2x new Final Effluent Pumps (Complete).
 - Install new pipework and valves (Complete).
 - Install 1 x new Level Sensor (Complete) for Final Effluent Pump Station Sump.
 - Install 2 x new Pressure Transmitters and 2x Pressure Gauges (Complete).
 - Install 1 x new Electromagnetic Flow Meter (ODN) (Complete).
 - Install new sluice gates (Complete).
 - Install 1 x new Level Sensor (Complete) for Chlorine Contact Tank outlet weir.
 - Install 1 x new Free Chlorine Meter (Complete).
 - Test the mechanical and electrical equipment.
 - Test the structure for water tightness.
 - Commission the Chlorine Contact Tank and Final Effluent Pump Station.
- Chlorine Dosing Facility:
 - Excavate the footprint of the new Chlorine Dosing Facility.
 - Construct a new Chlorine Dosing Facility (Earthworks, foundation, backfill, floors, walls, roof structure, windows and doors, apron, architectural finishes, etc.)
 - Procure new Chlorine Dosing System (Complete).
 - Procure new Calcium Hypochlorite Dosing System (Complete).
 - Procure all Health and Safety equipment, labelling, signage, etc.
 - Install new small power (refer to Project Specification – Electrical, Control and Instrumentation).
 - Install new MCC-6. Execute MCC-6 SOW as per BOQ related to the Chlorine Dosing Facility (refer to Project Specification – Electrical, Control and Instrumentation).
 - Install a Chlorine Dosing System (Complete).
 - Install a Calcium Hypochlorite Dosing System (Complete).
 - Install all Health and Safety equipment, labelling, signage, etc.
 - Clean the structure.
 - Commission the Chlorine Dosing Facility.
- Sludge Collection Pump Station:
 - Isolate the sump of the pump station.
 - Dismantle and remove the existing pumps, pipework, steelwork, etc.
 - Execute MCC-4 SOW as per BOQ related to the Sludge Collection Pump Station (refer to Project Specification – Electrical, Control and Instrumentation).
 - Procure 2 x new submersible pumps (Complete)
 - Design, procure and fabricate new pipework for the Sludge Collection Pump Station.
 - Procure 2 x new non-return valves.
 - Procure 2 x new isolation valves.
 - Design and fabricate new duct foot and guiderails (To be advised by the Engineer)

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

- Design and fabricate new steel platforms, grating, access hatches, and handrailing (To be advised by the Engineer)
 - Design and fabricate new lifting gantry (To be advised by the Engineer)
 - Design and fabricate new pipe supports (To be advised by the Engineer)
 - Procure new Level Sensor (Complete).
 - Procure 2x new Pressure Transmitters and 2x Pressure Gauges (Complete).
 - Procure 1x new Electromagnetic Flow Meter (ODN) (Complete).
 - Concrete refurbishment of the structures (To be determined and evaluated by the Engineer).
 - Clean the structure.
 - Install new duct foot, guiderails, steelwork, lifting gantry, etc. (Complete).
 - Install new pipework and valves (Complete).
 - Install new pipe supports (Complete).
 - Install new Level Sensor (Complete).
 - Install 2 x new Pressure Transmitters and 2x new Pressure Gauges (Complete).
 - Install 1 x new Electromagnetic Flow Meter (ODN) (Complete).
 - Install new PLC equipment as per the specification
 - Test the mechanical and electrical equipment.
 - Commission the Sludge Collection Pump Station.
- Sludge Drying Beds:
 - Isolate the Sludge Drying Beds.
 - Remove and discard the existing filter media (To be advised by the Engineer).
 - Dismantle and remove the existing pipework and valves (To be advised by the Engineer).
 - Fabricate new pipework (To be advised by the Engineer).
 - Procure new valves (Complete)
 - Procure new filter media (Graded according to the Civil Specification).
 - Construct 10 x Sludge Drying Beds (Earthworks, sub-soil drains, reinforced concrete, puddle pipes, etc.). This will require breakdown, removal and disposal of existing Sludge Drying Bed/s existing infrastructure.
 - Install new pipework and valves (Complete).
 - Install graded filter media (Complete).
 - Commission the Sludge Drying Beds.
- Filtrate Return Pump Station:
 - Isolate the sump of the pump station.
 - Dismantle and remove the existing pumps, pipework, steelwork, etc.
 - Execute MCC-4 SOW as per BOQ related to the Filtrate Return Pump Station (refer to Project Specification – Electrical, Control and Instrumentation).
 - Procure 2 x new submersible pumps (Complete)
 - Design, procure and fabricate new pipework for the Filtrate Return Pump Station.
 - Procure 2 x new non-return valves.
 - Procure 2 x new isolation valves.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

- Design and fabricate new duct foot and guiderails (To be advised by the Engineer)
- Design and fabricate new lifting gantry (To be advised by the Engineer)
- Design and fabricate new pipe supports (To be advised by the Engineer)
- Procure new Level Sensor (Complete).
- Procure 2 x new Pressure Transmitters and 2x Pressure Gauges (Complete).
- Procure 1 x new Electromagnetic Flow Meter (ODN) (Complete).
- Concrete refurbishment of the structures (To be determined and evaluated by the Engineer).
- Clean the structure.
- Install new duct foot, guiderails, lifting gantry, etc. (Complete).
- Install new pipework and valves (Complete).
- Install new pipe supports (Complete).
- Install new Level Sensor (Complete).
- Install 2 x new Pressure Transmitters and 2x new Pressure Gauges (Complete).
- Install 1 x new Electromagnetic Flow Meter (ODN) (Complete).
- Test the mechanical and electrical equipment.
- Commission the Filtrate Return Pump Station.

Building SOW:

- Housing Facility:
 - Excavate the footprint of the new Housing Facility.
 - Construct a new Housing Facility (Earthworks, foundation, backfill, floors, walls, roof structure, windows and doors, plumbing, apron, architectural finishes, etc.)
 - Procure new sanitary ware (Complete).
 - Procure new room loading (To be advised by the Engineer).
 - Install new DB-H and small power and Lighting, complete with CoC (refer to Project Specification – Electrical, Control and Instrumentation).
 - Install new sanitary ware (Complete).
 - Install new room loading (To be advised by the Engineer).
 - Clean.
 - Hand over the Housing Facility.
- Control Building:
 - Refurbish the Control Building (SOW to be defined by the Engineer).
 - Clean.
 - Hand over the Control Building.

Electrical, Control and Instrumentation SOW:

- Execute the SOW as per the BOQ for each of the new or refurbished processes.
- Design, fabricate and install new MCC for Filtrate Return Pump Station.
- Service and replace where needed the Transformer and associated cabling.
- Service, programme and commission the PLC and SCADA.
- Service or reinstate the lightning protection.
- Service the existing generator (Complete), replace the battery and fill with diesel.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

- Service the existing high mast lights at the WWTW.
- Procure and install two new high mast lights at the Sludge Drying Beds.

Roads and Stormwater SOW:

- Construct a new access and ring road for the WWTW (Complete).
- Construct a new access road to the Sludge Drying Beds (Complete).
- Construct new stormwater infrastructure (Complete).

Security:

- Construct a new security fence and install new security system based on VCWB Specification (Complete) for the Sludge Drying Beds and WWTW.

C3.1.3 Location of the Works and Description of the Site

The Nyakallong (Allanridge) WWTW is situated on the northern border of Nyakallong, with the exact coordinates of 27°46'7.82"S and 26°39'46.88"E. The works receives raw sewage from Allanridge and Nyakallong via gravity feed and several raw wastewater pump stations and discharge the treated wastewater or effluent to effluent storage dam overflowing to the Voëlpan.

The following climatic and general conditions are prevalent on Site and the specified capacities of all equipment provided under this Tender shall be applicable under these conditions.

Maximum ambient temperature:	31°C
Minimum ambient temperature:	-5°C
Altitude (meters above mean sea level):	±1 300 m
Humidity:	TBC
Atmosphere:	TBC
Lightning:	TBC

C3.1.4 Construction Programme & Cash Flow

It is estimated that the total Construction Period of the infrastructure will be **18 months** from the Commencement Date, excluding the builder's holiday. It is expected that the Contract will be awarded in March 2025 with final commissioning by September 2026.

The Contractor shall complete the whole of the works within the specified Construction Period. In this regard the Contractor shall note that a minimum trial and operation period of 6 weeks will be required after successful commissioning of the works as specified as part of the Tests on Completion.

Each Tenderer shall submit with his Tender a suitable and realistic Tender Programme for consideration by the Engineer. This Tender Programme shall commence from the Commencement Date and shall be prepared in accordance with the Construction Period estimated for the refurbishment of the works.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

The Tenderer shall allow in his Tender Programme for all SOW as previously listed, as well as any other SOW listed in the Tender Documentation. The Tender Programme should be programmed to reflect the various work packages as well as the associated civil, mechanical and electrical, control and instrumentation SOW. The Tender Programme should indicate the sequence of how the Contractor aims to execute the Contract, and this will be considered and reviewed by the Engineer.

After award of a Contract, the Contractor shall submit a detailed Construction Programme to the Engineer in accordance with the requirements of Sub-Clause 5.6 [Programme] of the Conditions of Contract. Except as provided above, the approval by the Engineer of the Contractor's Construction Programme, or of any amendment or adjustment thereto, shall not in any way alter the Contract, act as an estoppel or limit the right of the Employer to demand due performance under the Contract. The approval of a Construction Programme by the Engineer indicates only that the Engineer will be satisfied if the work is carried out according to such Construction Programme and that the Contractor undertakes to carry out the work in accordance with the Construction Programme. However, the approval of a Construction Programme by the Engineer shall not limit his right to give notice to the Contractor to submit a revised Construction Programme if the existing Construction Programme fails to comply with the Contract.

Delay damages for late completion of the Works are indicated in the Appendix to Tender.

The Employer shall not pay an early completion reward to the Contractor for the early completion of Works.

In addition to the requirements of Sub-Clause 5.6 of the General Conditions of Contract, the programme shall be compiled by means of MS Project in Gantt chart form.

C3.1.5 Exceptionally Adverse Climatic Conditions

Extension of time resulting from abnormal rainfall or other forms of exceptionally adverse weather conditions in terms of Sub-Clause 5.12 of the General Conditions of Contract - Fourth Edition (GCC 2025) shall be determined in terms of the *Critical-path method*.

Critical path method – A delay caused by exceptionally adverse climatic conditions will be regarded as a delay only if, in the opinion of the Engineer, all progress on an item or items of work on the critical path of the latest approved Construction Programme of the Contractor has been brought to a halt. Delays on working days only will be taken into account for the extension of time, but the Contractor shall make provision in his programme of work for an expected “n” working days caused by normal rainy weather, for which he will not receive any extension of time. The value of “n” shall be according to **Table 1** below.

Table 1: Average delays due to adverse climatic conditions

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Tot
“n” delays (rain)	2.9	3.7	2.0	1.0	1.0	0.1	0.5	0.5	0.4	1.5	4.0	3.6	21.2
“n” delays (other)	0	0	0	0	0	0	0	0	0	0	0	0	0
Avg rainfall (mm)	94	89	60	39	29	12	7	19	13	55	107	100	624

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

The number of rain-related delays is the average number of days on which 10 mm of rain or more has been measured. Other exceptionally adverse climatic conditions, for which the Contractor must make allowance in his Construction Programme, have been derived from previous experience of wind and temperature influence on similar construction in the area of the site(s). Actual extensions of time due to exceptionally adverse climatic conditions shall be agreed between the Engineer's and Contractor's representatives on the site. The agreed whole days or parts thereof shall be recorded in the site diary and monthly site meetings. Adjustment of the contract period shall only be made at the end of the Contract when the Contractor may submit his claim for the agreed extension of time due, as well as any additional payment resulting from the delay.

If approved extensions of time extend the completion date beyond the start of the Contractor's holiday in December, the holiday period shall not be considered as working days. Any remaining extension of time at this date shall be calculated from the first statutory working day in January the following year, provided that the Contractor has shown in his programme that he intends to close during the traditional Christmas/New Year break.

END OF SECTION

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

C3.2 ENGINEERING

C3.2.1 Employer's Design

The Engineer has designed the refurbishment of the Works on behalf of the Employer for the intended use and has selected materials that he deems are suitable and fit for purpose.

The Contractor shall be expected to construct the Works in terms of the construction drawings compiled and issued by the Engineer or special directives issued by the Engineer in writing.

In cases where there is a discrepancy between the civil drawings and structural (rebar) drawings, the Contractor shall request clarification from the Engineer in the form of a RFI (Request for Information) prior to proceeding with the affected work.

The Engineer has provided the proposed layout of the structures, interconnecting pipework, collection and division boxes, roads, housing facilities, etc. on the drawings for tendering purposes. However, the Contractor shall be responsible for all final confirmation of levels, measurements on site, final design, correct manufacturing and installation of all structures, pipes and chambers, etc. covered under the SOW. The Contractor shall also maintain suitable records of all such items in order for the Engineer to complete the as-built drawings at the completion of the works.

C3.2.2 Alternative Offers at Tender Stage

No alternative offers will be accepted.

C3.2.4 Drawings

Refer to **Volume 3** for the drawings issued for tender purposes.

END OF SECTION

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

C3.3 PROCUREMENT

C3.3.1 General Clauses and Requirements

C3.3.1.1 Tenders received shall be evaluated in terms of the tender evaluation criteria described in the Tender Data, taking cognisance of the Employer's preferential procurement requirements as provided.

C3.3.1.2 The works shall be carried out by a suitably qualified, experienced and capable with a CIBD grading corresponding to the value of the civil works, inclusive of VAT. Based on the Engineer's pre-tender estimate, the required rating shall be at least **8CE AND 7ME** in accordance with Regulation 25(1B) or 25(7A) of the Construction Industry Development Regulations, 2004.

Failure to meet the minimum CIBD requirements for civil contracting entities may result in the tenders being disqualified and tenders shall submit all information necessary in order for the Engineer to assess the proposed (sub) contractors in terms of the capability and experience (refer to functionality criteria).

C3.3.2 Local Economic Participation

The Contractor shall procure local goods, services and labour in order to stimulate local economic development in terms of the requirement of the Local Economic Participation Specifications included under section T2.2.14.

C3.3.3 Sub-Contractors

The Contractor shall appoint such authorities and/or specialist sub-contractors and suppliers as may be designated or nominated by the Employer or the Engineer for those portions of the Works specified in the Scope of Works.

In accordance with the Preferential Procurement Regulations, 2017, the Contractor shall subcontract 30% of the Contract Sum (excluding Preliminary and General Items) to a local sub-contractor(s).

As required by the Conditions of Contract, the Contractor shall be responsible for all work carried out by sub-contractors (whether nominated by the Employer or selected by the Contractor) on his behalf. The Engineer will not liaise directly with any such sub-contractor, nor will he become involved in any problems and/or disputes related to payments, programming, workmanship, etc., unless provided for in the Conditions of Contract. Such problems and/or disputes shall remain the sole concern of the Contractor and his sub-contractors.

No additional management fee will be payable to the Contractor for works executed by the sub-contractor(s).

Notwithstanding other requirements of the Contract, the Contractor shall not sub-contract any part of the Contract without prior consent of the Engineer, which consent shall not be unreasonable withheld.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Any consent granted by the Engineer for the appointment of any sub-contractor shall not imply a Contract between the Employer and the sub-contractor, or a responsibility or liability on the part of the Employer to the sub-contractor and shall not imply a Contract between the Engineer and the sub-contractor, or a responsibility or liability on the part of the Engineer to the sub-contractor and shall not relieve the Contractor from any liability under the Contract and the Contractor shall be liable for the acts, defaults and neglects of any sub-contractor, his agents or employees as fully as if they were the acts, defaults or neglects of the Contractor, his agents or employees.

Before the Engineer, in terms of Clause 6.10 of the General Conditions of Contract - Fourth Edition (GCC 2025), issues any certificate that includes any payment in respect of work done or goods supplied by any sub-contractor in terms of Sub-Clause 4.4 of the General Conditions of Contract - Fourth Edition (GCC 2025), he shall be entitled to call upon the Contractor to furnish reasonable proof that all payments (less retention moneys) included in previous Payment Certificates in respect of the work or goods of such sub-contractors have been made or discharged by the Contractor, in default of which, unless the Contractor:-

- Informs the Engineer in writing that he has reasonable cause for withholding or refusing such payment, and
- Submits to the Engineer reasonable proof that he has informed such sub-contractor accordingly in writing.

The Employer shall be entitled to pay directly such sub-contractor on the Engineer's certificate all payments (less retention moneys) the Contractor has failed to make to such subcontractor and to deduct, by way of settlement, the amount so paid by the Employer from any moneys owing to or that may become owing to the Contractor.

Provided always that where the Engineer has certified and the Employer has paid directly as aforesaid, the Engineer shall, in issuing any further certificate in favour of the Contractor, deduct from the amount thereof the amount paid direct as aforesaid, but shall not withhold or delay the issue of the Payment Certificate when due to be issued in terms of the Contract.

C3.3.4 Contractor's Personnel

The Contractor shall limit the utilisation of his permanently employed personnel to that of key personnel only on the Works, as defined below, and shall execute and complete the Works utilising a temporary workforce employed directly by the Contractor and/or by his sub-contractors, using the assistance of the Labour Desk(s), from the various communities that are established in proximity to the Works or which will be consumers from the Scheme.

Without derogating from the Contractor's obligations to complete the Works within the specified time for completion in terms of the General Conditions of Contract, the numbers in each category of the Contractor's key personnel, as stated by the Contractor in the Returnable Schedules, will be strictly controlled during the contract period and any increase in numbers will be subject to the prior approval of the Employer.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Key personnel mean all contracts managers, designers, site agents, site clerks, materials and survey technicians, quantity surveyors, trainers, supervisors, foremen, skilled plant operators, brick layers, welders, shutter hands and the like, and all other personnel in the permanent employ of the Contractor or his sub-contractors who possess special skills, and/or who play key roles within the Contractor's or his sub-contractor's operations.

The Engineer may at his discretion, upon receipt of a written and fully motivated application from the Contractor, and where he deems the circumstances so warrant, authorise in writing that the Contractor may utilise in the execution of the Works, workers not being his key personnel but who are in his permanent employment. Without limiting the generality of application of this Sub-Clause, circumstances which may be considered by the Engineer to warrant authorization of the use of the Contractor's permanent employees other than key personnel, include:

- a) The unavailability from local sources of sufficient numbers of temporary workers and/or sub-contractors to execute the Works, provided always that the Contractor has satisfied the Engineer that he has exercised his best endeavours and taken all reasonable actions to recruit sufficient temporary workers and sub-contractors from local sources.
- b) The unavailability within the temporary worker pool and/or from subcontractor sources available to the Contractor in terms of the Contract, of sufficient skills necessary to execute the Works or specific portions thereof, in situations where the completion period allowed in the Contract is insufficient to facilitate the creation of the necessary skills through the provision of suitable training as contemplated in the Contract.
- c) Any other circumstances which the Engineer may deem as constituting a warrant.

C3.3.5 Temporary Workforce

The Contractor shall employ labour from the local communities through the Labour Desk(s). Accordingly, the workforce that is employed on Site shall consist of local residents, except for approved key staff in the permanent employ of the Contractor, to the maximum extent that is compatible with the requirements of Clause C3.3.2.

With the assistance of the Infrastructure Portfolio Committee of the Vaal Central Water Board and local ward committees, and a Project Steering Committee (PSC) will be established. The PSC will appointment a Community Liaison Officer (CLO) that will be employed by the Contractor for the duration of the Contract.

The CLO will assist the Contractor with local labour issues, including employment conditions, remuneration, performance monitoring, etc.

The PSC shall assist in identifying available local labour and, where available, semi-skilled labour as well as local sub-contractors. The PSC shall also assist and advise regarding conditions of employment, minimum wages, disputes and disciplinary procedures. The function of the PSC shall however in no way diminish the responsibilities of the Contractor in terms of the Conditions of Contract.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Although the Contractor shall adhere to the statutory minimum wage rates, he is however at liberty to negotiate additional incentive payments based on performance.

A contract of employment or subcontract shall be signed between the Contractor and each of his employees and sub-contractors. Likewise, contracts of employment must be entered into between each such sub-contractor and each of the specific sub-contractor's employees. Although the Contractor shall adhere to the minimum wage rates described below, he is at liberty to negotiate additional incentive payments based on performance.

Contracts of employment or sub-contracts should provide for the following basic conditions:

- a) The minimum wage payable will be determined in terms of latest applicable (at the time of tendering) legislation and shall, as a minimum, adhere to section 56(1) of the Basic Conditions of Employment Act (Act 75 of 1997), Sectorial Determination 2: Civil Engineering Sector as published by the Department of Labour.
- b) The Contractor shall adhere to the provisions for payment method and intervals, overtime and pay for work on Sundays and public holidays (if required) in the Basic Conditions of Employment Act (Act 75 of 1997).
- c) The Contractor shall register all labourers employed on the Contract with the Workmen's Compensation Commissioner and the Unemployment Insurance Fund, as applicable. The Contractor shall obtain the Unemployment Insurance Fund and Workmen's Compensation registration cards.
- d) Workers shall be entitled to one (1) day sick leave with full pay per month worked. This will accumulate if the leave is not used.
- e) Annual leave shall be calculated as published in terms of (the latest edition of) section 56(1) of the Basic Conditions of Employment Act (Act 75 of 1997), Sectorial Determination 2: Civil Engineering Sector as published by the Department of Labour.
- f) Upon termination of the Contract, each locally employed labourer shall be entitled to receive his/her Unemployment Insurance Fund and the Workmen's Compensation registration cards as well as a Certificate of Employment from the Contractor clearly stating the following:
 - i) The type of work done.
 - ii) The duration of employment.
 - iii) The number of days absent from work.
 - iv) The Contractor's general impression of the quality of work done.
- g) The Occupational Health and Safety Act must be adhered to with reference to the safety of all employees employed by the Contractor. Suitable safety equipment and clothing shall be issued and maintain by the Contractor for the duration of construction.
- h) Contractor's company policy regarding:
 - i) Inclement weather
 - ii) Sickness and absence
 - iii) Disciplinary matters

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

iv) Grievances

Should any of the above conditions be less favourable than any bargaining council agreement or Act applicable to the Contractor, the more favourable condition shall apply.

C3.3.6 Labour Intensive Construction

Labour Intensive Construction shall mean the economically efficient employment of as great a portion of labour as is technically feasible to produce a standard of construction as demanded by the Specifications with completion by the Due Completion Date, thus the effective substitution of labour for equipment.

Appropriate portions of the Works included in the Contract shall be executed using labour intensive construction methods. These portions of the Works shall be constructed utilising only locally employed labour and/or the labour of local sub-contractors, supplemented to the extent necessary and unavoidable by the Contractors key personnel as provided for in clause C3.3.2, unless otherwise instructed by the Engineer. The portions of the Works to be executed using labour intensive construction methods are:

- bedding, selected fill and compaction of all pipe trenches irrespective of depth, but assisted by mechanical compaction equipment in order to achieve the specified densities;
- reinstatement of all fill, shoulder and pavement layers at road crossings, but using mechanical compaction equipment in order to achieve the specified densities;
- jointing, testing and disinfection of all pipelines, including all fittings, valves and house/erf connections; but excluding all stormwater pipe- and rectangular culverts;
- construction of all manholes, cleaning eyes, kerb inlets, junction boxes, culvert floors, end structures and balustrades, valve chambers, thrust blocks, pipeline markers and the like (earth-, concrete-, brick- and metal works), but excluding the mixing of concrete and transporting of same to the point of pouring;
- kerbing;
- dismantling and re-erection of fences; and
- cleaning and tidying of the Site.

In respect of those portions of works which are not listed above, the construction methods adopted and plant utilised shall be at the discretion of the Contractor, provided always that the construction methods adopted and plant utilised by the Contractor are appropriate in respect of the nature of the Works to be executed and the standards to be achieved in terms of the Contract.

END OF SECTION

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

C3.4 CONSTRUCTION

C3.4.1 General Clauses and Requirements

These general clauses cover the general, administrative, legal and organizational requirements relating to quality of materials, installation, testing, commissioning and maintenance of the installation applicable to this Contract.

These clauses should be read together with all other sections and Project Specifications included in the Contract documentation. The Contract documentation should be read and interpreted jointly in order to determine the full requirements of the Contract.

Any/all deviations from these General Clauses or Project Specifications shall be listed in writing as Deviations at tender stage. Where the Engineer does not approve of these deviations, the Contractor shall be responsible to conform to the requirements of these General Clauses and Project Specifications.

C3.4.1.1 Relevant Acts, Regulations and Standards

The whole of the installation shall comply and the work shall be executed in accordance with the latest edition of the following:

- a) The Occupational Health and Safety Act, 1993 (Act no 85 of 1993) and the latest applicable Regulations promulgated in terms of the Act or the Factories Machinery and Building Works Act of 1941, whichever is applicable and their respective Regulations;
- b) The regulations and by-laws of the local supply authorities;
- c) The applicable regulations of the relevant telecommunications authority;
- d) The local Fire Department Regulations; and
- e) The latest revisions of the relevant supporting specifications referred to in the Particular Specifications.

C3.4.1.2 Responsible Persons and Representation

The Contractor shall, before establishing on site, appoint and submit to the Engineer in writing a project organisational chart, listing the name(s) of the responsible person(s) in terms of the Occupational Health and Safety Act, 1993 (Act no 85 of 1993) and the Regulations promulgated in terms of the Act within 14 days from being appointed.

The Contractor shall submit to the Employer and Engineer within 14 days of the Commencement Date a list of addresses and telephone numbers of his Representative and key personnel who may be contacted both during and outside normal working hours in connection with the Works. The Contractor shall also refer to Clause 8 of the General Conditions of Contract.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

The Contractor shall be responsible for supplying and installing the required safety signs as determined by the Occupational Health and Safety Act, 1993 (Act no 85 of 1993) and the regulations promulgated in terms of the Act, both during the construction phase and the completed works. All safety signs shall comply with the requirements of the latest edition of SANS 1186-1 as applicable.

C3.4.1.3 Health and Safety

The Contractor shall allow in his Tender for compliance with the requirements of the Occupational Health and Safety Act, 1993 (Act no 85 of 1993) and the latest applicable Regulations promulgated in terms of the Act, especially the latest Construction Regulation promulgated in 2014.

From the date of site handover until the Taking-Over Certificates are issued, the Contractor shall be responsible for maintaining safe working conditions on Site as prescribed by the Occupational Health and Safety Act and the regulations promulgated in terms thereof. In the event that the Site of the Works is managed by another contractor, the Contractor shall be expected to also adhere to the health and safety regulations prescribed by such contractor.

The Contractor shall be responsible for supplying and installing the required safety signs as determined by the Occupational Health and Safety Act, 1993 (Act no 85 of 1993) and the regulations promulgated in terms of the Act, both during the construction phase and the completed works. All safety signs shall comply with the requirements of the latest edition of SANS 1186-1 as applicable.

The Contractor shall comply with the Occupational Health and Safety Specification prepared by the Employer in terms of the Construction Regulations 2014 promulgated in terms of Section 43 of the Occupational Health and Safety Act (Act No. 85 of 1993).

The Contractor shall submit an approved Health and Safety Plan to the Engineer within 14 days from the date that the Agreement made in terms of the Form of Offer and Acceptance comes into effect.

The Contractor shall, before establishing on site, appoint and submit to the Engineer in writing a project organisational chart, listing the name(s) of the responsible person(s) in terms of the Occupational Health and Safety Act, 1993 (Act no 85 of 1993) and the regulations promulgated in terms of the Act within 14 days from being appointed.

Notwithstanding any actions which the Employer may take, the Contractor accepts sole liability for due compliance with the relevant duties, obligations, prohibitions, arrangements and procedures imposed by the Occupational Health and Safety Act, 1993 (Act 85 of 1993), and all its regulations, including the Construction Regulations, 2014, for which he is liable as mandatory. By entering into this Contract it shall be deemed that the parties have agreed in writing to the above provisions in terms of Section 37 (2) of the Act.

The Contractor and his designer shall accept full responsibility and liability to comply with the Occupational Health and Safety Act, 1993 (Act 85 of 1993) and the Construction Regulations, 2014 for the design of the

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Temporary Works and those part of the Permanent Works which the Contractor is responsible to design in terms of the Contract.

C3.4.1.4 Quality Assurance and Control

All materials and workmanship shall be of a suitable type and quality to ensure that the Works will operate satisfactorily in accordance with the Specifications.

The Contractor shall submit a Quality Assurance Plan outlining quality assurance policies and procedures to be used for the project relating to the areas such as materials, manufacturing, and installation and testing. A documented quality control and quality assurance system shall be maintained, which shall be in accordance with ISO 9000 or equivalent approved by the Engineer. The Contractor shall ensure that the same requirements is applied to products, systems, and services supplied by his sub-contractors and suppliers. The Contractor shall file all quality certification documents relating to the products and systems supplied for the Works. The Engineer shall have full access to such files.

Registration to ISO 9001:2000 is preferable and evidence of current registration to this or another acceptable quality management system shall be provided upon request.

C3.4.1.5 Drawings and Documentation

C3.4.1.5.1 Tender Drawings and Engineer's Drawings

The Tender Drawings prepared by the Engineer and issued with the tender show the general layout, position and detail of the Works to be constructed under this Contract. These details may in some instances constitute schematic arrangements. These drawings, together with the Specification, are deemed to provide sufficient detail to enable the Contractor to determine the requirements of the Works and to price and schedule the Works to be completed on time.

Only figured dimensions on the Drawings may be used in the interpretation thereof, and the Drawings shall not be scaled unless the Contractor is so instructed by the Engineer in writing. The Engineer will upon written request provide any dimensions that may have been omitted from the Drawings.

C3.4.1.5.2. Contractor's Drawings and Documentation

a) General

All drawings and documentation submitted by the Contractor shall be in English and shall comply with the requirements prescribed below.

All the symbols used in the electrical drawings shall be in accordance with IEC Publication 60617 unless otherwise specified in the Project Specifications and the SI system of units shall be used throughout.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

All designs shall be complete, accurate and geographically correct. The designs and drawings shall be sufficiently detailed to enable construction and installation to proceed without further need for additional drawings or documentation.

All drawings and documentation submitted shall be suitably identified and labelled by means of title blocks, page numbers and revision status.

All designs and drawings shall be submitted for the Engineer's approval prior to the commencement of plant ordering, manufacturing or construction on site. Approval by the Engineer of any design or drawing does not relieve the Contractor of his responsibility of any part of the works manufactured or constructed in accordance with the design or drawing. Designs approved by the Engineer shall not be altered without his written agreement.

b) Preparation and Submission of Drawings

All drawings shall be accurately scaled in terms of generally accepted scaling factors and submitted on A3 size sheets.

Electronic submissions of drawings shall in all instances comprise of *.DXF (Drawing Exchange Format) or *.DWG (AutoCad) formats accompanied by the *.PDF (Adobe Reader) format.

The Contractor may request a set of the Engineer's drawings in digital or paper format for modification and updating if necessary. These drawings shall be re-titled in accordance with the Contractor's system and shall thereafter be submitted as a Contractor's drawing.

The Contractor shall submit all drawings with reasonable promptness and in an orderly sequence as to cause no delay in the execution of any work directly or indirectly linked to the finalisation of the details contained in the drawings. The Engineer shall be given reasonable opportunity of at least 14 days to evaluate, comment on or approve the drawings. In the event that the Engineer does not respond within the said period, the Contractor shall notify the Engineer in writing of his assumption that the drawings have been approved and that manufacturing and/or construction will commence in accordance with the drawings.

The Contractor shall make the corrections or provide additional information if requested by the Engineer and shall re-submit the corrected or updated drawings until approved. When re-submitting drawings, the Contractor shall specifically direct the Engineer's attention (in writing) on revisions other than the corrections required by the Engineer on previous submissions.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

c) "As-Built" Drawings

"As-Built" drawings shall be furnished on completion and the relevant completion or taking over certificate shall not be issued until such drawings have been received and approved by the Engineer.

Final and approved as-built drawings shall be submitted to the Engineer in five-fold hard copy in A3 size accurately scaled. In addition, the Contractor shall also prepare one complete set of all drawings in digital format as specified above for submission to the Engineer.

For large plant such as high voltage switchgear, transformers, standby generators, pumps, compressors and lifts, catalogues and brochures shall be submitted for approval.

Plant and material shall only be approved in writing by the Engineer and the Contractor is responsible for obtaining such approval prior to commencing with the installation.

C3.4.1.6 Care and Supply of Documents

In addition to the documents prepared and issued by the Employer and Engineer for purposes of the Contract, the Contractor shall procure and keep on site, at the most suitable location, one or more copies of the applicable legislation, regulations, project specifications and codes of practice upon which the Contract rely, and which are incorporated into the Contract by reference.

C3.4.1.7 Operation and Maintenance Manuals and As-Built Drawings

The submission of draft Operation and Maintenance (O&M) manual is a prerequisite to commencing with the Tests on Completion. Two (2) copies of the draft O&M manuals shall be submitted in terms of the format described below for the Engineer's approval at least two weeks prior to the commencing of the Tests on Completion.

Once the Operating and Maintenance manuals have been approved by the Engineer, four (4) complete sets of the manuals shall be provided by the Contractor to the Engineer. The submission of these final O&M manuals shall not be later than four weeks after the works have been taken over by the Employer.

The O&M manuals shall be printed on durable paper and be neatly and securely bound in A4 size hard-backed plastic/waterproof ring binders with clear pockets on the spine and front cover for insertion of title slips giving the contract number, scheme description and plant supplied.

As-Built drawings in A3 size, index and other title pages shall be contained in separate pockets.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

Layout and Content

The O&M manual shall contain the following:

- (1) Title page
- (2) Contents list
- (3) List of drawings and appendices
- (4) Maintenance and Lubrication Schedule (summary)

The maintenance schedule shall be in table format and shall include a summary of all the maintenance actions required of all the different systems and functional units covered by the manual to give an overall summary of maintenance actions required for the complete works.

The schedule shall indicate daily, weekly, fortnightly, monthly and annual maintenance actions. A lubrication schedule shall also be included under this section.

A schedule indicating daily, weekly, fortnightly, monthly and yearly maintenance actions shall also be provided.

- (5) Detailed Plant Description

The main body of the manual shall be divided into sensible sections, each covering a system or functional units. Each section shall contain the following sub-sections:

- >> Plant description (brief but detailed);
- >> Maintenance and Lubrication Schedule (in table format);
- >> Process and Instrumentation Diagrams (P&ID's);
- >> Operating instructions (including start-up and stopping procedures as well as manual and/or automatic operation)
- >> Fault Finding
- >> Plant Data Sheets containing as a minimum:
 - (a) Plant Tag Number (for asset register purposes)
 - (b) Plant Description
 - (c) Supplier Details
 - (d) Model and Make
 - (e) Cost of supply (at date of tendering)
- >> Plant Technical Manuals

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

For each piece of plant and/or machine supplied, the following shall be provided under this sub-section:

- (a) Supplier's Operation and Maintenance instructions
- (b) Parts list and data sheets
- (c) Calibration charts
- (d) Test certificates for hydraulic pressure tests, flame proof grading, materials, non-destructive tests, coating and lining details
- (e) Applicable drawings and details

(6) As built drawings

Folded A3-size as built drawings correctly scaled.

(7) Computer programmes and software.

Digital copies of programmes and software as required by computerised systems installed on the project as required for maintaining, updating or altering the system by the Employer or Operator.

(8) Wiring diagrams of electrical installations (separate volume).

All information that is required by the Engineer in order to complete the As-Built Drawings and to prepare a completion report for the Employer must be submitted by the Contractor to the Engineer 4 (four) weeks before the draft O&M Manual is due to be submitted by the Contractor.

C3.4.1.9 Samples

The Contractor shall, prior to placing orders, and if required by the Engineer, submit samples of all material and plant to the Engineer for approval.

Plant and material shall only be approved in writing by the Engineer and the Contractor is responsible for obtaining such approval prior to commencing with the installation.

C3.4.1.10 Contractor's Equipment

The Contractor's Equipment for construction and erection of the Works shall be adequate for the purpose required, of modern design and in good condition to carry out the Works expeditiously. Should the Engineer be of the opinion that the Contractor's Equipment is in anyway unsuitable for carrying out the Works in a manner or at a rate commensurate with the requirements of the Contract, he shall have the right to instruct the Contractor at any time during the Contract to provide additional or improved plant, tools and equipment in order to meet the specified requirements.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

C3.4.1.11 Concurrent Construction Activities

The construction of the Works will coincide with other construction activities on Site and the Contractor shall co-operate with any/all other contractors on site regarding final designs in order to determine areas of interface. The Contractors shall be required to co-operate with other contractors and shall carry out his work in such a manner to cause minimum interference and delays to other contractors.

The Contractor shall ensure that neither his operations nor those of his Sub-Contractors nor the activities of his employees shall interfere with or hinder the operations of the Employer or of other contractors and he shall indemnify the Employer against all claims arising through default of this requirement.

The Contractor shall hand over portions of the Site of the Works (whether completed or not), or completed portions of the Works, to these contractors when required by the Employer or detailed elsewhere in this document. The Contractor shall cause no interference with or delays in the execution of these other contracts.

Any service rendered or assistance given by the Contractor to these contractors, save as are provided for in the Project Specifications, shall be for their accounts only since the Employer shall in no way be responsible to the Contractor for any payments in this respect.

The Contractor shall protect all known existing services as well as all work being carried out and structures being erected by other contractors. Any damage caused to these services or structures, or any obstructions or hindrance caused to other contractors by the Contractor, and all claims arising there from, will be the sole responsibility of the Contractor.

All repair work shall be carried out at the Contractor's expense to the entire satisfaction of the Engineer.

C3.4.1.12 Training

The Contractor shall be responsible for the initial training of the Plant Operator during the testing and commissioning of the Works, as well as on-going training during the defects notification period. Training shall focus on the correct operation and maintenance of the Works and shall address the following issues, amongst others:

- Start-up, shut-down and safety procedures;
- Maintenance requirements and relevant intervals;
- Troubleshooting and corrective actions;
- Understanding all processes, plant and control methodology;
- Execution of tests, relevant calculations and calibration of plant;
- Maintenance and operation of instrumentation;
- Collection, interpretation and reporting of process data.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Once the training has been completed, all operators shall be examined by the Contractor to ensure that the subjects and training material covered has been adequately mastered. The Contractor shall subsequently compile a training report for the Engineer's approval stating the following:

- Training subjects and material covered;
- Name and ID number of all operators trained;
- Outcomes for examination of Operators;
- Final sign-off from Contractor that all training in terms of Specifications has been completed.

The Contractor's training staff shall be conversant in English and shall be knowledgeable and experienced in the manufacture, erection, testing, fault finding and maintenance of the plant installed under the Contract.

C3.4.1.13 Guarantees

All plant and materials supplied under the Contract, shall be fully guaranteed against all defects arising from faults in the design, manufacture and workmanship for a period of at least **10 years** from the date of handing over.

All plant shall be guaranteed for a period of **5 years** from the date of handing over to cover all defects attributable to inadequate corrosion protection.

All defects recorded within the above periods shall be rectified entirely at the expense of the Contractor. The attendance of the Contractor, specialists appointed by the Contractor or any subcontractor required to resolve the defect shall be required within **10 days** of notification of such defect(s).

Should any design fault become apparent to the Engineer or the Employer for a period of **5 years** after handing over of the Works, the Contractor shall deliver all components necessary to correct the fault, together with all the specialist assistance, free of charge to the Employer.

C3.4.1.14 Standards

All electrical material, plant and equipment shall be of approved manufacture and its construction, design and testing shall be in accordance with the requirements of the most recent South African National Standards, British Standards or IEC publications including all amendments issued thereto up to the date of tender. The design and installation of the material, plant and equipment shall also comply with the relevant clauses of the Occupational Health and Safety Act, 1993 (Act No 85 of 1993) and the regulations promulgated in terms of this Act, as well as the Code of Practice for the Wiring of Premises, SANS 0142.

For all material, plant and equipment that are required to conform to any national or international specification or standard, the Contractor shall submit a certificate to the Engineer, issued by an accredited testing laboratory clearly stating that the material, plant and equipment complies with the specific specification or standard.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Notwithstanding reference in this specification to the South African or British Standards and the IEC or ISO recommendations, the Contractor may submit for approval by the Engineer, material and designs conforming to other technically equivalent national standards and shall submit documentary proof in English of actual compliance therewith.

All material, plant and equipment offered under this Contract shall be selected to be equal to and similar of make as the existing material, plant and equipment installed on site as far as possible and the Contractor shall do a site inspection prior to submission of the tender to ensure that they comply with this requirement (if applicable to existing structure and buildings).

Contractor shall provide electrical plant for all motor starter panels with at least Type 2 coordinated capabilities. If moulded case circuit breakers and miniature circuit breakers are cascaded and / or discrimination all proven documentation must be supplied by the Contractor

C3.4.1.15 Quality of Materials

All material and plant shall be new and suitable for the prevailing conditions at the Site, which shall include climatic conditions as well as the conditions under which materials and plant are installed, stored and operated without distortion, deterioration or inducing undue stresses in any part such as to affect the efficiency and reliability of the plant and also without affecting the strength and suitability of the various parts for the duty which they have to perform.

All material and plant shall conform in respect of quality, manufacture, tests and performance, with the relevant requirements of the SANS or where no such standards exist, with relevant current specification of the British Standards Institution and/or relevant IEC and/or ISO publications. Where applicable, the material shall bear the stamp of the relevant standards body.

Where proprietary materials and plant are specified or required, approval of such materials or plant shall be at the sole discretion of the Engineer once the appropriate samples or technical literature have been submitted.

C3.4.1.16 Electromagnetic Interference

All plant installed under the Contract shall comply with the requirements of IEC 61000 Parts 1 to 6 Electromagnetic Compatibility (EMC).

Any plant found producing electromagnetic interference subsequent to commissioning shall be suppressed or replaced to the satisfaction of the Engineer without any additional costs to the Employer.

C3.4.1.17 Corona, Radio and TV Interference

All plant and plant shall be designed so as to minimize corona or electrical discharge and radio and TV interference and shall comply with national rules and regulations in respect to radio and TV interference.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Any plant found producing radio or TV interference subsequent to commissioning shall be suppressed or replaced to the satisfaction of the Engineer without any cost to the Employer.

C3.4.1.18 Interchangeability

Corresponding parts throughout the works shall be made to accurate tolerances that similar components or spares shall be fully interchangeable without any further alterations or adjustments being necessary.

C3.4.1.19 Labels and Notices

The following general requirements shall be applicable:

- (a) Identification labels shall be attached to all equipment, motors, control gear and all panels and equipment contained therein (if applicable);
- (b) All labels and plates shall be of an approved non-corrosive material and shall be fixed with stainless steel or nickel-plated screws of ISO metric thread form (if applicable);
- (c) Labels shall have a matt or satin finish to minimise reflection (if applicable);
- (d) Labels shall have black lettering on a white background. Danger plates shall have white lettering on a red background (if applicable);
- (e) Cables shall be labelled at both ends, at through joints and at regular intervals (if applicable);
- (f) Cables shall be labelled on both sides where the cable passes through a permanent obstruction (if applicable);
- (g) All lettering shall be in uppercase letters, except where standard abbreviations of units are used such as kVA, kWh or MPa (if applicable).

C3.4.1.20 Materials, Plant and Equipment Recovered

All materials and equipment recovered under this contract remains the property of the Employer and shall, unless explicitly otherwise agreed, be handed to the Employer for storage and safekeeping.

C3.4.1.21 Testing and Commissioning

C3.4.1.20.1 Factory Acceptance Tests

Manufacturer type or factory acceptance tests (FAT's) shall be performed on all plant and material as described in the Project Specifications.

For plant and material manufactured outside the borders of South Africa, the requirement for witnessing factory acceptance tests by a representative(s) of the Engineer and the Employer shall be clearly specified in the Project Specification and a separate payment item provided in the schedule of quantities for attendance of such tests.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

The Engineer or a duly appointed third party inspectorate reserves the right to be present at all/any tests conducted on any plant and material to be supplied under the Contract.

For any factory acceptance test, at least one (calendar) week notice shall be given to the Engineer of such test in writing.

No plant and material shall be dispatched to site prior to approval of the factory test results by the Engineer.

C3.4.1.20.2 Tests on Completion

Notwithstanding any requirements of Sub-Clause 7.4.3 [*Tests on Completion*] of the General Conditions of Contract, the following tests on completion shall be executed by the Contractor:

(a) Dry Commissioning and Testing as part of Construction

Once the construction of the Works or a Sub-section has reached the stage of completion where it can be tested, the Contractor shall give to the Engineer notice of the date at which the Contractor will be ready to carry out the Dry Commissioning of the Works or any Sub-section thereof.

Dry Commissioning shall entail the following:

- Components of the Works or Sub-section are complete and comply with the Drawings, Specifications and data as indicated in the manufacturer's documentation;
- The assembly has been carried out in compliance with the above documents and professional practice;
- Visual checking of general installation and appearance.
- Thorough check of all ergonomic (lighting and noise), maintainability and safety related aspects;
- Thorough check of flow lines of products, materials, fluid, and compressed air;
- Thorough check of electrical, hydraulic, pneumatic and electromechanical circuits;
- Thorough check of all functional and control loop tests (equipment level);
- Dry-run of every machine and checking of its operation and, if necessary, running in;
- Calibration checks and supporting documentation on all metering and monitoring equipment;
- Dry-run or no-load run of every section;
- Fixing of equipment, pipes, brackets, anchors, etc.;
- Written proof of all direction testing and alignment tests on pumps, motors and rotating equipment;
- Statutory testing requirements (Lifting, hoisting, pressure vessels etc.);
- Checking and testing of all actuators, valve and control valve settings;
- Water testing of equipment, pipes, joints;
- Water tightness and pressure tests on all water retaining structures, pressure vessels, pipelines and pipe fittings;
- Visual checking of general appearance and equipment labelling;
- Checking of all terminations;
- Verify correctness of field equipment statuses in relation to PLC and SCADA displays (if applicable);
- Testing of low voltage cables;

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

- Testing of high voltage cables;
- Checking of all safety settings;
- Directional testing of rotating elements;
- General safety of installations;
- Signals and SCADA/MMI configuration;
- Completion and issuing of all test reports and test certificates;
- Completion of lightning protection;
- Completion of cathodic protection and AC mitigation;
- Compilation of an asset register suitable for integration with the Financial and Computerised Maintenance Management system of the Employer;
- Completion and issuing of all equipment and O&M manuals including functional specifications and control philosophy;
- Supply of all critical spares and special tools on site.

(b) Wet Commissioning and Testing as part of Construction

Once the dry testing of the Works in terms of the above has been completed, each process and system will be wet commissioned, which shall include the same operations as for Dry Commissioning tests but with the plant loaded. The Employer will provide suitable water and power as set out by the Contract.

Wet Commissioning shall entail the following:

- Performance testing of all equipment at specified duties and efficiencies for at least 24 hours continuously.
- Checking of levels, flows, pressures and temperatures at minimum and maximum operating conditions for all operational scenarios;
- Temperatures of all bearings;
- Vibration of rotating elements;
- Calibration of dosing plant;
- Water tightness tests of installations at full production;
- Functional and control loop testing (process level);
- Site performance tests on individual equipment as per the testing plan;
- Performance and control tests on the entire system.

After successful completion of the Wet Commissioning of all plant and processes and the Works as a whole, the Trial Operation Period as defined below shall commence.

C3.4.1.20.3 Trial Operation Period

After successful completion of the commissioning phase and submission of the draft Operation & Maintenance manuals in the prescribed format, a 4-week Trial Operation Period shall commence during which the new Works shall be operated under the auspices of the Contractor. The Contractor shall provide full-time

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

attendance for the duration of the Trial Operation Period during normal working hours (07h00 to 18h00) and shall have an individual(s) on standby during non-working hours for any/all emergencies.

The purpose of the Trial Operation Period is to prove the functionality of Works constructed under the Contract and to do final adjustment and optimization of relevant operational settings.

The Trial Operation Period shall be declared successful if / when the Works operates as intended without any failure for a continuous period of 2 (two) consecutive weeks, at which time the Taking-Over Certificate shall be issued signifying the start of the 12-month Defects Notification Period.

C3.4.1.20.4 At the End of the Defects Notification Period

Although the Contractor will not be expected to perform routine maintenance during the Defects Notification Period, all instrumentation equipment shall be calibrated every 3 months and at the end of the Defects Notification Period.

All plant, materials and other items supplied under this Contract shall be serviced and tested at the end of the Defects Notification Period, to prove that it complies with the Specifications prior to the issuance of the Performance Certificate signifying final completion and acceptance of the Works.

C3.4.1.20.5 Guarantees of Performance

The Contractor shall guarantee the output and efficiency of all plant and machines, which guarantees shall be binding under the Contract.

The fulfillment of these guarantees shall be demonstrated at the Contractor's factory premises or a suitable off-site test facility approved by the Engineer.

All measuring instruments used in the tests shall have previously been certified by an independent testing authority, not more than one month prior to the test and to the Engineer's satisfaction.

Where guaranteed performance is specified, certified test curves shall be drawn from the test data obtained from the purchased plant and shall include for pump (as an example) head (m), quantity pumped (m³/h or l/s), efficiency (%), power consumption (kW), speed in rpm and speed/torque (rpm/kNm). The probable performance with maximum and minimum impellers shall also be indicated, as well as tested NPSH available.

Each mechanical item (e.g. pumps) shall be checked for acceptable vibration limits and noise limits during testing. The Contractor shall ensure that the mechanical item deliver the "Required minimum and maximum output", by adjustment of the plant or taking whatever action is necessary should there be any shortfall in the output measured in fulfillment of the Guaranteed Performance criteria.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Discount by the Contractor in *lieu* of under-performance of the mechanical plant relative to the Guaranteed Performance will not be acceptable.

C3.4.1.20.6 Test Plan and Reports

Method statements and test reports shall be submitted prior to and after the successful completion of each testing phase. The following documents shall be submitted in writing to the Engineer:

- Overall testing plan, including method statements and schedule of testing activities prior to commencing with dry commissioning;
- Progressive testing reports as detailed in the testing plan;
- Tests on completion:
 - Dry Commissioning Report;
 - Wet Commissioning Report;
- Method statement for the execution of the Trial Operation Period;
- Performance test report at end of Defects Notification Period;
- Failure investigation reports (where necessary) during Defects Notification Period.

C3.4.1.21 Priority of Specifications

The priority of the Specifications shall be as follows:

- (a) Scope of Work (Section C3.4): All clauses except C3.4.2 (Project Specifications).

END OF SECTION

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

VAAL CENTRAL WATER

CONTRACT NO. BW283/ARWWTW/22

REFURBISHMENT OF THE NYAKALLONG (ALLANRIDGE) WWTW: CIVIL, MECHANICAL AND ELECTRICAL, CONTROL & INSTRUMENTATION

PS CIVIL SPECIFICATIONS & SANS 1200 VARIATIONS

C3.4.2 WORKS SPECIFICATION

C3.4.2.1 Applicable national and international standards

- a) For the purpose of this Contract the latest issues of the following Standard Specifications for Civil Engineering Construction, applicable at the date of tender advertisement, shall apply -

SANS (previously SABS) 1200 A	:	General
SANS (previously SABS) 1200 AB	:	Employer's Agent's Office
SANS (previously SABS) 1200 C	:	Site Clearance (Amendment 1, 1982)
SANS (previously SABS) 1200 D	:	Earthworks (Amendment 1, 1990)
SANS (previously SABS) 1200 DB	:	Earthworks (Pipe Trenches)
SANS (previously SABS) 1200 DE	:	Small Earth Dams
SANS (previously SABS) 1200 DK	:	Gabions and Pitching
SANS (previously SABS) 1200 G	:	Concrete (Structural)
SANS (previously SABS) 1200 L	:	Medium Pressure Pipelines
SANS (previously SABS) 1200 LB	:	Bedding (Pipes)
SANS (previously SABS) 1200 LD	:	Sewers
SANS (previously SABS) 1200 M	:	Roads (General)

- b) The term "project specifications" appearing in any of the SANS (previously SABS) 1200 standardised specifications must be replaced with the term "scope of work".

- c) The variations and additions to the specifications listed in C3.4.1.2(a) are as follows:

PS A	:	General
PS C	:	Site Clearance
PS D	:	Earthworks
PS DB	:	(Pipe Trenches)
PS DE	:	Small Earth Dams

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

PS DK : Gabions and Pitching
PS G : Concrete (Structural)
PS LB : Bedding
PS LD : Sewers
PS E : Electrical
PS PMA : Mechanical
PS PB : Building

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

PS A: GENERAL

PS A 3 MATERIALS

PS A 3.1 QUALITY

Substitute the second sentence of the first paragraph of A 3.1 with the following:

Materials shall bear the official mark of the appropriate standard.

The Contractor is responsible for the cost of all testing to ascertain that the materials do comply with the specified minimum requirements of the relative materials and no additional payment will be made for such testing.

The Contractor shall inform the Employer's Agent of any control testing to be done at least 48 hours before such tests are required and must allow in his program for the time necessary for the tests and the processing of the results thereof.

PS A 4 PLANT

PS A 4.2 CONTRACTOR'S OFFICE, STORES AND SERVICES

Add the following to A 4.2:

The Contractor's Construction Manager must be contactable at all times by phone. Should use be made of radio and/or cellular-phone, these must be operational at all times with sufficient back-up batteries or recharging facilities.

There exist no housing facilities for the Contractor's work force, and arrangements must be made by the Contractor to accomplish that as well as transport. The Contractor is solely responsible for all housing, or the arranging thereof, and no payment or extension of time will be allowed because of any delay and/or work damage that may arise.

PS A 4.4 MEDICAL FACILITIES AND SAFETY EQUIPMENT

Add new sub clause A 4.4:

The Contractor shall provide a First Aid cabinet fully equipped and maintained with the minimum contents as listed in the Annexure (Regulation 3) to the General Safety Regulations of the Occupational Health and Safety Act (Act 85 of 1993), to deal with accidents and ailments which are likely to occur during the construction period.

The Contractor shall provide personal safety equipment and facilities as required by Regulation 2 of the General Safety Regulations of the Occupational Health and Safety Act (Act 85 of 1993).

The Contractor shall designate his Safety Officer and Qualified First Aider. The Contractor shall give copies of the minutes of the site safety meetings to the Employer's Agent.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

PS A 5 **CONSTRUCTION**

PS A 5.1 **SURVEY**

PS A 5.1.1 **Setting Out of the Works**

Substitute A5.1.1 with the following:

Setting out of the works is the sole responsibility of the Contractor and shall be done by a surveyor. The Contractor shall, within two (2) weeks after the site has been handed over to him, appoint a surveyor and set out the points. Any discrepancy shall immediately be reported in writing to the Employer's Agent. Any costs or subsequent costs arising from discrepancies that had not been reported to the Employer's Agent within the aforementioned period shall be the sole responsibility of the Contractor.

Setting out of the works will not be measured and paid for directly, and compensation for the work involved in setting out shall be deemed to be covered by the tendered rates for the various items of work included under the contract.

PS A 5.2 **WATCHING, BARRICADING, ELECTRIC LIGHTING AND TRAFFIC CROSSINGS**

Add the following to A 5.2:

All excavations must be barricaded as per Construction Regulations 2014 and to the satisfaction of the Employer's Agent.

PS A 5.4 **PROTECTION OF OVERHEAD AND UNDERGROUND SERVICES**

Add the following to A 5.4:

The Contractor shall as soon as possible after handing over of the site, commence with the detection of existing services, continue with it without interruption and finalise it at least seven (7) days before excavation starts at the particular section.

Detected existing services shall also be indicated on the "Record" drawings.

Where the Contractor is responsible for the cost of repairs carried out by the Employer or others, the costs will be recovered by means of a deduction from the Contractor's monthly payment certificate.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

PS A.5.7 **SAFETY**

Substitute A 5.7 with the following:

“Pursuant to the provisions of the Conditions of Contract, and without in any way limiting the Contractor’s obligations there under, the Contractor shall at its 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):

- (a) Provide to its Employees on the Site of 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 and effective measures to ensure the proper usage of such safety materials, clothing and equipment at all times; and
- (b) Provide, install and maintain of 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; and
- (c) Implement on the Site of 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; and
- (d) Implement all necessary measures as to ensure compliance of the Act by all subcontractors engaged by the Contractor and their employees engaged on the Works; and
- (e) Comply fully with all other requirements pertaining to safety as may be specified in the Contract.

The Employer and Employers Agent 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 requirement 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 inspection and shall make available for inspection, all such documents and records as the Employer’s and/or Employer’s Agent’s representative may reasonably require.

Where any such investigations reveal, or where it comes to the Employer’s Agent’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 Employer’s Agent shall, in accordance with the provision of Clause 5.11.2 of the General 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 Employer’s Agent, the breach has been rectified.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

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 Employer's Agent 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 5.13.1 of the General Conditions of Contract 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 ground for the Employer's Agent to act in terms of Sub-Clause 9.2.1.3.2 of the General Conditions of Contract and for the Employer to terminate the Contract in accordance with the further provisions of the said Clause 9.2.

PS A 5.9 TRAINING OF LOCAL LABOUR (in task)

An aim to this construction project is to provide as many temporary employment opportunities to the community of **PEARSTON** as possible. It is incumbent on the Contractor to provide the necessary core of artisans, skilled and semi-skilled personnel required to construct, supervise and adequately control the project as well as providing any necessary on-going training in basic construction skills.

PS A 5.10 WORKMEN'S COMPENSATION ACT

It is a requirement of this contract that all labour employed on the site be covered by the Workmen's Compensation Act. The Contractor is to arrange a suitable method of complying with the Act including the payment of the necessary levies.

PS A 7 TESTING

PS A 7.4 STATISTICAL ANALYSIS OF CONTROL TESTS

Substitute A7.4 with the following:

Test results shall not be evaluated by statistical methods. All results shall comply with the specified minimum requirements of the materials concerned.

PS A 8 MEASUREMENT AND PAYMENT

PS A 8.2 PAYMENT

Add the following to A 8.2:

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

PS A 8.2.5 **NEW CLAUSE: ADJUSTED PAYMENT FOR TIME-RELATED ITEMS**

The payment to the Contractor for time-related items shall be adjusted in accordance with the following formula in the event of the contract being extended by means of a variation order:

$$\text{Sum of Tendered amounts for time-related items} \times \frac{\text{Extended contract period as authorised by variation order}}{\text{Tendered contract period}}$$

The above-mentioned adjustment of the payment for time-related items shall be made in the Completion Payment Certificate and shall be the only payment for additional time-related costs.

Add the following to A 8.4:

PS A 8.4.6 **NEW CLAUSE: STANDING TIME COSTS**

- a) plant Unit: Sum per working day
- b) labour Unit: Sum per working day

The tendered sum for each item shall include full compensation for all standing time costs of the specified resource of whatever nature and approved by the Employer's Agent, which are not recoverable by way of the provision made in PS A 8.2.5 for the adjusted payment of time-related items.

For the purposes of calculating the total standing time cost, a working week shall be held to consist of five working days and a working day of 9 hours.

Payment for the partial standing of any of the scheduled resources for a day or part thereof, or the standing of a complete resource for a part day, will be made pro rata in proportion to an appropriate factor assessed by the Employer's Agent.

The amount by which the standing time costs is adjusted shall be subject to the contract price adjustment formula as defined in the conditions of contract.

The Contractor shall take note that this payment item shall only apply to delays, which **in the opinion of the Employer's Agent**, are incurred as a result of riot, commotion, politically motivated sabotage and acts of terrorism or disorder outside the Contractor's control. This item shall also apply to standing time incurred as a result of labour boycotts, except that only sub-items (a), as applicable, will be paid where the Contractor did not pay his labour for the time boycotted. Costs for delays incurred for all other circumstances shall be treated as provided for in the conditions of contract.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

The provision of this clause shall in no way prejudice the right of either the Employer or the Contractor to determine the contract in terms of the provisions of clause 10.2 of the general conditions of contract.

The Contractor shall take note that no payment will be considered for additional cost or time lost for any daily removal of plant and equipment from the site, any additional costs incurred in protecting his plant and site establishment, or loss incurred in respect of damage to construction plant, equipment and materials supplied and the works.

In the event that GCC 5.13.1 becomes applicable, the time on which such penalties are calculated shall be reduced by the total standing time approved by the Employer's Agent.

PS A 8.8.4 NEW CLAUSE: EXISTING SERVICES

Known services

- a) Locate, expose, mark and protect services on drawing. Unit: Sum
- b) Locate, expose, mark and protect services shown on site Unit: No.

Information regarding the approximate positions of services will be supplied to the Contractor. Before any construction work starts, however, it is the responsibility of the Contractor to contact the relevant authorities responsible for existing services, liaise with them and request the positions of existing services to be indicated to him. The Contractor will be solely responsible to locate these existing services by hand excavation before any machine excavation operations may commence. Any problems encountered shall be immediately brought to the attention of the Employer's Agent. After the services have been exposed and located, they must be marked and backfilled in order not to present a safety hazard. No distinction will be made between the various types of services to be exposed or the depth to which excavations are taken.

Payment for services not shown on the drawings but indicated to the Contractor on site, will be measured in cubic metre of excavation and will include for all hand excavation in all materials to expose the service, irrespective of the depth or type of service. The repair of unknown existing services damaged during construction will be paid for by the Employer. Care must be taken not to damage services during hand excavation thereof. Any remedial work will be for the account of the Contractor.

The Contractor must note that all above ground existing services (irrigation channels, overhead lines, poles, ballast to railway line etc) are defined as known services and payment for the location and protection thereof must be included in the lump sum payment for location and protection of services shown on plans (known services). The positions of existing services, insofar as they are known, are shown on the drawings. Items have been allowed in the Bill of Quantities for dealing with and protecting services.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

Treatment of existing services

Where existing services are either indicated on drawings supplied to the Contractor or indicated on site, or in the course of excavation the Contractor identifies any service, these services, as well as telephone poles, or any existing structures, shall be shored, strutted or slung and sufficiently protected to ensure that no damage be done to them until back filling has been completed. In the case of electric and telephone cables, if these are exposed during the course of excavation, the Contractor shall not refill the excavation around such cables until the cables have been inspected and passed as intact by the responsible authorities. The costs of protecting, maintaining and repairs necessitated by damage caused by the Contractor, must be included in the rates measured as specified in Clause 8.3.5 of SANS 1200 DB. (Intersect and Adjoin)

Overhead services must be protected. No additional payment for overhead services will be made and the cost must be included in the rate for excavation. Protection of services will only apply to existing services. Protection of services installed during the execution of this contract will not be paid for separately and must be included in rates for excavation and pipe laying of new pipes. Services which are within 0,15 m from each other (wall to wall) will be measured as one service with respect to exposure, crossing and working parallel to services.

Damage to services

The Contractor shall take all necessary steps to protect any existing services whatsoever against damage, which may arise as a result of his operations on site. The Contractor shall bear the cost of repairing (by the relevant authority) the damage to any service, the possible existence of which could reasonably have been ascertained by him in good time. Where the Contractor is responsible for damage for which repairs have to be carried out by the Employer or an outside authority, the costs of these repairs must be settled by the Contractor or will be recovered by means of a deduction from the Contractor's monthly Payment Certificates.

Reinstatement of services and structure damaged during construction

Should a service be damaged, the Contractor shall inform the relevant Authority and the Employer's Agent immediately. The relevant authority will either repair the service or task the contractor to repair the service under their supervision.

Should a service, which the Contractor deems to be unknown service, be damaged, the Contractor shall inform the relevant Authority and the Employer's Agent immediately and inform the Employer's Agent's representative in writing within 24 (twenty-four) hours that he considers it an unknown service. The cost of repair then will be recovered from the first payment certificate thereafter due to the contractor. Should the Employer's Agent thereafter confirm that it was an

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

unknown service, the Contractor will be recompensed in the next payment certificate plus a handling fee of 7½%. No claim for additional time, standing time or any other additional payment for the breaking of known or unknown services will be entertained.

No additional payment will be made for the care required or for any additional costs incurred by the Contractor when constructing in the proximity of existing services and structures. The Contractor must therefore allow for all such costs in his tendered rates in the Bill of Quantities.

PS A 8.9 NEW CLAUSE: OCCUPATIONAL HEALTH AND SAFETY

PS A 8.9.1 Health and Safety Measures Unit: ProvSum

The rate shall cover all costs pertaining to the provision and maintenance for the duration of the contract of the health and safety measures required in terms of Clause 5 (Principal Contractor and Contractor) of the Construction Regulations (2014). No other sum shall be paid in this respect and Tenderers must therefore ensure that adequate provision has been allowed for.

PS A 8.9.2 Health and Safety Plan Unit: ProvSum

The rate shall cover all costs pertaining to the provision and maintenance for the duration of the contract of the Health and Safety Plan as required in the Construction Regulations (2014). The rate shall include for all risk assessments required as well as for the development and implementation of safe work procedures and method statements. No other sum shall be paid in this respect and Tenderers must therefore ensure that adequate provision has been allowed for.

PS A 8.9.3 Health and Safety File Unit: ProvSum

The rate shall cover all costs pertaining to the provision and/or collection of data (drawings, design, materials, operation and maintenance manuals etc.) to be contained in the file, co-operation with other parties, compilation and maintenance of the file during the duration of the contract and the handing over of the file to the Client on completion of the contract. No other sum shall be paid in this respect and Tenderers must therefore ensure that adequate provision has been allowed for.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

PS A 8.10 NEW CLAUSE: COMMUNITY LIAISON OFFICER

a) **Employment of CLO Unit: ProvSum**

b) **Contractor's overheads, charges and profit on employment of CLO .. Unit: ProvSum**

Expenditure under this item shall be made shall be made in accordance with the General Conditions of Contract. Sub item (b) shall be deemed to be full compensation for all costs incurred by the Contractor in connection with the above item.

PS A 8.11 NEW CLAUSE: ENVIRONMENTAL MANAGEMENT PLAN

PS A 8.11.1 Cost of Environmental Management Plan Unit: Sum

The sum shall cover the Contractor's initial cost of providing and demonstrating to the Employer's Agent a suitable and sufficiently documented Method Statement based on the Client's documented Environmental Management Plan Specifications as set out under Part C3: Scope of Works of this document.

PS A.8.11.2 Complying with the Environmental Management Plan (EMP) Unit: ProvSum

The sum shall cover the cost of whatever nature, for complying with the Environmental Management Plan (EMP) Specifications as set out under Part C3: Scope of Works of this document and that is not specifically covered in PS A.8.11.1 as well as any rehabilitation as directed by the Employer's Agent.

PS A 8.12 NEW CLAUSE: ADDITIONAL ITEMS

PS A.8.12.1 Medicals Unit: Sum

The sum shall cover the complete cost of whatever nature, for entrance and exit medicals for all the Contractor's staff as well as make allowance for 4 additional medicals for the Employer's staff. Rate to include all costs, transport and lost time.

PS A.8.12.2 Training of local Labourers Unit: ProvSum

The sum shall cover the cost of training as provided by external service providers, nominated by the Contractor and approved by the Employer's Agent.

PS A.8.12.3 Contractor's overheads, charges and profit on Training of local Labourers Unit: ProvSum

The percentage shall be deemed to be full compensation for all costs incurred by the Contractor in connection with the above item.

PS A.8.12.4 Training of EME's Unit: ProvSum

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

The sum shall cover the cost of training as provided by external service providers, nominated by the Contractor and approved by the Employer's Agent.

PS A.8.12.5 **Contractor's overheads, charges and profit on Training of EME's Unit: ProvSum**

The percentage shall be deemed to be full compensation for all costs incurred by the Contractor in connection with the above item.

PS A.8.12.6 **SUM for nominated Subcontractor (ARQ) Unit: Sum**

The sum shall cover the cost of ARQ to complete the rotary drilling and reporting work as required and upon the request of the Employer's Agent.

PS A.8.12.7 **Contractor's overheads, charges and profit on nominated Subcontractor (ARQ) .. Unit: %**

The percentage shall be deemed to be full compensation for all costs incurred by the Contractor in connection with the above item.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

PS AB: EMPLOYER'S AGENT'S OFFICE

PS AB 3 MATERIALS

PS AB 3.1 NAMEBOARDS

Add the following to AB 3.1:

Name boards are to be as per drawing issued by the Employer's Agent.

PS AB 5 CONSTRUCTION

PS AB 5.1 NAME BOARDS

Add the following to AB 5.1:

Details of the name board are included in Volume 3.

The name boards shall be erected within one month after receipt of the letter of acceptance and shall be placed at the position indicated by the Employer's Agent, and kept in good repair for the duration of the contract and the defects liability period. Any damage to these boards shall be repaired within fourteen days of a written instruction issued by the Employer's Agent. No payment shall be made in terms of the contract prior to the erection of the name boards.

PS AB 5.3 KEY PERSONNEL

Add the following to AB 5.3:

The Contractor shall inform the Employer's Agent of the person to whom he has assigned duties with respect to the site in terms of the Occupational Health and Safety Act and the person(s) who are in possession of a valid certificate of competency in first aid. The Contractor shall give copies of the minutes of the site safety meeting to the Employer's Agent.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

PS C: SITE CLEARANCE

PS C 3 MATERIAL

PS C 3.1 DISPOSAL OF MATERIAL

Substitute the first sentence of C 3.1 with the following:

An area for the disposal of material obtained from clearing and grubbing, shall be disposed of at town landfill facility, approximately 800m from the furthest point on the site of works.

PS C 5 CONSTRUCTION

PS C 5.1 AREAS TO BE CLEARED AND GRUBBED

Substitute the first sentence of C 5.1 with the following:

Clearing and grubbing shall only be done in areas as instructed in writing by the Employer's Agent. Clearing and grubbing of pipeline routes, shall be limited to a 3 m wide strip. The Contractor may proceed with clearing and grubbing after hand-over of the site. Measurement and payment for clearing and grubbing shall occur for areas as required by the Employer's Agent.

Substitute the last paragraph with the following:

The Contractor shall program his work in such a manner that re-clearing will not be necessary. The cost of re-clearing shall be borne by the Contractor.

PS C 5.2 CUTTING OF TREES

Trees outside the area to be excavated for the WORKS must be left standing and undamaged, except when otherwise ordered, in writing, by the Employer's Agent.

A penalty of R50 000-00 per tree for trees damaged and/or removed will be charged.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

PS D: EARTHWORKS

PS D 3 MATERIALS

PS D 3.1.2 Classes of Excavation

Add the following to D 3.1.2:

Soft and intermediate excavation shall be classified and measured as soft excavation. Hard rock and boulder excavation shall be classified and measured as hard rock excavation.

PS D 3.3 SELECTION

PS D 3.3.1 General

Substitute the second paragraph of D 3.3.1 with the following:

The Contractor shall deal in such a way with materials from all excavations for structures and pipe trenches to ensure that usable material is not contaminated with unsuitable material. If usable material is contaminated, such contaminated material shall be removed and replaced with material of standard at least equal to the in situ usable material, all at the Contractor's expense. No additional payment shall be made in respect of this and all relevant costs shall be deemed to be included in the tendered rates.

PS D 4 PLANT

Add the following to D 4:

PS D 4.5 AVOIDING QUAGMIRE CONDITIONS

The Contractor shall prevent quagmire conditions occurring in the excavations. Should the Contractor allow quagmire conditions to develop, he shall, at his own expense, take such steps to rectify the conditions as the Employer's Agent may order.

PS D 5 CONSTRUCTION

PS D 5.1 PRECAUTIONS

PS D 5.1.2 Existing Services

PS D 5.1.2.2 Detection, location and exposure

Add the following to D 5.1.2.2:

The requirements of PS A 5.4 shall apply mutatis mutandis.

If existing services are not shown on the drawings but the existence thereof can be reasonably expected, the Contractor shall, in conjunction with all relevant authorities, determine the exact depth and location of such services before the commencement of construction. After locating

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

the exact position of services, whether indicated on the drawings or not, such services shall be deemed to be known services and the Contractor shall be liable for all costs and subsequent costs arising from the damage thereof as a result of the Contractor's activities. These services must also be indicated on the "As Built" drawings.

PS D 5.1.4 Nuisance

PS D 5.1.4.1 Dust Nuisance

Add the following to D 5.1.4.1:

The Contractor is responsible for dust control and is liable for all claims that may result from dust nuisance on all parts of the site and at all times from the date of handing over of the site to the completion date of the contract. No payment regarding the above-mentioned will be made and all costs shall be deemed to be covered by the tendered rates.

PS D 5.1.6 Road Traffic Control

Add the following to D 5.1.6:

- a) Sufficient road signs must be erected in such a way that motorists will be warned in time of works, e.g. at the closing of a street sufficient signs to direct traffic must be erected at the preceding intersection.
- b) Bypasses and/or road signs shall be provided and/or erected at all locations where the free flow of traffic is obstructed and shall be approved by the Employer's Agent before the commencement of construction. Where main roads are crossed, detours and temporary traffic signs must be provided as shown on the attached drawings.
- c) Where a trench crosses a street or any place where a trench crosses the direction of traffic flow, drums must be placed in the street and not just along the sides of the street with danger tape in between.
- d) Danger tape must be put up between drums and tied around the drums.
- e) Drums may not be filled with stones. The spacing of drums must be in such a way (maximum 5 m) that they are visible from all directions.
- f) Sufficient safety measures must be utilised for pedestrians.

PS D 5.2 METHODS AND PROCEDURES

PS D 5.2.1 Site Preparation

PS D 5.2.1.2 Conservation of topsoil

Add the following to D 5.2.1.2:

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

Removal of topsoil shall only occur in areas as approved by the Employer's Agent. The topsoil shall be conserved for use elsewhere.

PS D 5.2.2 Excavation: Add or Amend the Following Sub-Clauses

PS D 5.2.2.1 Excavations for general earthworks and for structures

Add the following to D 5.2.2.1:

Strip foundations and encasement of pipes shall be cast directly against excavated surfaces.

Materials under foundations and floors of structures which are regarded by the Employer's Agent as unsuitable for the bearing of such structures shall be removed to the depths and widths ordered. The excavated voids shall then be filled with sand compacted to 100 % of MAASHTO density, to the underside of such foundation or floors, unless a soil cement mixture in terms of PS D 5.2.3.2 is ordered by the Employer's Agent.

PS D 5.2.2.3 Disposal

Substitute the second sentence of D 5.2.2.3 with the following:

All surplus and unsuitable material shall be disposed of at the dump site.

PS D 5.2.2.4 Excavation by hand around existing services

Where hand excavation is required around existing services it shall be done within 3,0 m above and on both sides of cables and within 300 mm above and on both sides of pipes, as well as underneath the services.

PS D 5.2.4.2 Top soiling

Add the following to D 5.2.4.2:

Topsoil shall be placed on the sides and on the tops of embankments and other terraces where no paving is specified, or in areas where directed by the Employer's Agent.

PS D 5.2.4.3 Grass or other vegetation

Add the following D 5.2.4.3:

Planting shall be carried out at the earliest convenient stage of the construction and shall be arranged to suit the seasonal weather conditions. Undue humps and hollows shall be smoothed out before planting is commenced.

a) Grassing

Stools or runners of "Kikuyu" or other grass approved by the Employer's Agent shall be planted by forming trenches 75 mm deep at 300 mm intervals along lines at right angles

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

to the direction of maximum slope, laying the stools or runners at intervals not exceeding 150 mm along the trenches and closing the trenches in such a way to cover the grass entirely. After planting the surface shall be lightly rolled with a hand roller with a maximum mass of 150 kg.

PS D 8 MEASUREMENT AND PAYMENT

PS D 8.1 BASIC PRINCIPLES

Add the following to D 8.1:

The rates for excavation shall also cover the cost of dealing with any storm-water or subsurface water, which may appear in the excavations.

PS D 8.3 SCHEDULED ITEMS

PS D 8.3.2 Bulk Excavation

Add the following sub items to D 8.3.2:

a) **Excavate in all materials and use for embankment or backfill or dispose, as ordered Unit: m³**

d) **Excavate and dispose of unsuitable material from excavation bottom Unit: m³**

The rate shall cover the cost of complying with all the precautions required in terms of D 5.1 in addition to the cost of excavation of the additional depth in any material and the disposal of the unsuitable material as specified in PS D 5.2.2.3.

e) **Extra-over 8.3.2(a) for trimming and compacting terraces Unit: m²**

The rate includes for the trimming and compacting of horizontal and sloping sides of the terraces before top soil and grass is placed, including for the removal of large stones and rubble to form a uniform surface.

PS D 8.3.8.1 c) Excavate by hand in soft material to expose existing services Unit: m³

Add the following to D 8.3.8.1(c):

Excavation by hand to expose existing services shall only be measured and paid for if so ordered in writing by the Employer's Agent. After the excavation of trial holes to determine the exact position and depth of existing services, at intervals as required by the Employer's Agent, the excavation to a level of 300 mm above such services shall be measured and paid for as normal excavation, independent of the depth of such excavation. Only excavation within 300 mm of the existing services will be measured and paid for as excavation by hand and then only if ordered

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

in writing by the Employer's Agent. The rate shall also include the backfilling of the excavations and compaction thereof.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

PS DB: EARTHWORKS - PIPE TRENCHES

PS DB 3 MATERIALS

PS DB 3.1 Classes of Excavation

Replace D 3.1.2 (b) with the following :

No intermediate or boulder class A or B classification in any excavation will be applicable to this contract and excavation will only be classified as soft excavation or hard rock excavation. All material not classified as hard rock as per the applicable SANS 1200 specification will be classified as soft excavation.

PS DB 3.6 MATERIALS FOR REINSTATEMENT OF ROADS AND PAVED AREAS

PS DB 3.6.1 Subbase And Base

Substitute DB 3.6.1 with the following:

Where trenches cross or run adjacent to surfaced roads and paved areas of which the surfaces are scheduled to be reinstated, the material excavated from the existing base and/or subbase pavement layer(s) shall be set aside and used in the reconstruction of the subbase layer. Where applicable new material complying with the requirements of SANS 1200 MF shall be used in the reconstruction of the base layer. Any shortfall in material for the reconstruction of the subbase layer shall be made up by the use of material complying with the requirements of SANS 1200 ME.

PS DB 3.6.5 Concrete Pavement

The concrete pavement shall be of the same thickness as that of the existing pavement or be at least 100 mm thick grade 20 MPa/19 mm concrete, cast in panels with maximum dimensions of 2 m x 2 m.

PS DB 3.6.6 Brick Pavement

The existing brick paving shall be re-used and damaged bricks shall be replaced with bricks of the same grade, texture and colour.

PS DB 4 PLANT

PS DB 4.1 EXCAVATION EQUIPMENT

Add the following to DB 4.1:

All excavations exceeding the specified widths, shall be backfilled with approved selected material. No payment shall be made for this and all relevant costs shall be deemed to be included in the tendered rates.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

PS DB 4.4 DEWATERING EQUIPMENT

One set of dewatering equipment shall consist of pumps, pipes, well points and other equipment necessary for keeping the trenches sufficiently free from water for dewatering of excavations up to 4 m depth and a trench length of 45 m for both sides or 70 m on one side.

PS DB 5 CONSTRUCTION

PS DB 5.1 PRECAUTIONS

PS DB 5.1.3 Accommodation of Traffic and Access to Properties

Add the following to D 5.1.3:

PS DB 5.1.3 (c) Where trenching has to be undertaken in, alongside or across existing roads the works shall be carried out strictly in accordance with requirements of the road authorities or the Employer.

Where trenches are in the road reserves, compaction of backfill must be to a minimum of 93% MOD AASHTO density. No additional payment will be certified for compaction in road reserves unless a specific item for compaction in road reserves has been included in the Schedule of Quantities.

Trench excavation for road crossings shall be completed and backfilled before the construction of the base layer (final layer) may commence.

The Contractor shall provide all necessary bridging materials in order to avoid interference with the use of roads, footpaths, etc. The Contractor shall make available on the site suitable steel plates, at least 2 m x 1 m x 10 mm thick, steel or timber joists and bridges at all times and in sufficient quantities to be laid across open excavated trenches as bridges wherever such bridges are considered necessary by the Employer's Agent. Where deals or boards are used as bridges they must be battened underneath to prevent tipping.

Where, in the opinion of the Employer's Agent, the exigencies of traffic render it necessary, the Employer's Agent shall be at liberty to order the Contractor to reduce the length of open excavation or to gain access to the pipeline at other points and the Contractor shall provide safe access at necessary points across the trench. The Contractor shall not be entitled to any claim for loss or damage or extension of time by reason of such condition being imposed nor in respect of assuring that the services to properties remain unimpeded.

PS DB 5.1.3(d) Items in the Schedule of Quantities have been provided for the protection of structures where the centre line of the trench is within two (2) meters of a structure, fence or boundary wall (where applicable). Payments, which will be measured in linear metres along the centre line of the trench, will be made for the protection of these structures.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

Telephone and electricity poles within 2 m of the centre line of the trench will be measured as equivalent to 1,0 metres of boundary (brick and masonry) wall each. The above payment items will be regarded to compensate for the protection of these structures, all hand excavation within erf properties, slower progress, restricted access, confined working space, everything included.

Notwithstanding the above, all structures more 2,0 metres from the centre line of the trench must also be protected. No payment for these will be made and compensation therefore will be regarded as included in the excavation rates.

PS DB 5.2 MINIMUM BASE WIDTHS SPECIFIED

Substitute paragraph (b) of DB 5.2 with the following:

The minimum base width for all pipes with a diameter less than 125 mm shall be 600 mm plus the outside diameter of the pipes, irrespective of the depth at which they are laid, except for subsurface drains where the width shall be 400 mm and for house water connections where the width shall be 300 mm.

PS DB 5.4 EXCAVATION

Add the following to DB 5.4:

Excavation and backfilling of pipe trenches on sidewalks in the residential area shall be done in such a way as to ensure the least possible disruption to the public and entrances to properties. No additional payment shall be made for this and all relevant costs shall be deemed to be included in the tendered rates. Electric cable trenches shall be dug in lengths as requested by the electrical contractor, subject to a maximum of 300m for all trenches.

The provisions of PS D 5.2.2.4 shall apply mutatis mutandis for hand excavation.

PS DB 5.4.1 Excavation of Trenches

Unless otherwise permitted in writing by the Employer's Agent, not more than 200 metres of trench shall be opened in advance of pipe laying and backfilling operation. No trench may be left open during the builder's holiday (Christmas period) and the Easter holiday period and the Employer's Agent has the right to order the Contractor to close such trenches, or to arrange for the closing of such trenches for the account of the Contractor. No alternative safety precautions over these periods for open trenches, such as barricading and lighting, shall be allowed.

Trench excavation for road crossings shall commence prior to the construction of the sub-base layer in the case of bituminous or premix surfaced roads and the gravel wearing course in the case of gravel surfaced roads.

PS DB 5.4.3 Over excavation/Over break/Side Sloping

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

Should any portion of a trench, anchor block, manhole or valve chamber excavation, the bottom of a trench or foundation be excavated to a greater width or depth than specified, whether in soft material, hard material or rock, the Contractor shall, if instructed by the Employer's Agent, at his own expense, be required to fill in the excess excavation with 15 MPa concrete under structures or suitable material from excavations or borrow pits, compacted to 93% Mod AASHTO density in the other excavations. No payment for over excavation, overbreak or the backfilling thereof to the above specifications, from whatever cause, shall be made. Excavation shall be measured according to the nett lengths and depths as shown on the plans.

Unless flatter side slopes have been specified in the contract documents, no additional excavation, backfill or reinstatement of surfaces will be paid for (other than according to the dimensions in the specifications) in sand, clay or any material. Compensation therefore will be deemed to be included in the rates for the items for excavation or reinstatement of the surfaces.

PS DB 5.4.4 Slips and Falls

The Contractor shall be responsible for making good at his own expense any damage resulting from slips, settlement of backfill, falls or caving-in, and shall at his own cost, fill in all cavities thus caused with dry rubble or concrete or soil-cement mix or soil whichever and of whatever mix may be ordered by the Employer's Agent to suit the reasonable requirements of the case.

PS DB 5.4.5 Timbering and Shoring

The Contractor shall assume full responsibility for the safety of all excavations and shall, adopt all measures necessary to secure this end, either by timbering and shoring or, in the case of excavation not in paved areas, by side sloping of the ground. All timbering and shoring must be of sufficient strength and must be suitably arranged to permit carrying out the Contract Works including the laying and jointing of pipes, and the Employer's Agent's decision as to this shall be binding upon the Contractor, who shall immediately proceed to rectify any timbering and shoring that is deemed by the Employer's Agent to be of such a character as will impede or impair the work.

Where trenches are timbered and shored, they shall be left thus until after the laying and jointing, testing and approval of pipes. The timbering and shoring shall strictly comply with the regulations as given in the Government Gazette Extraordinary No 667 (Regulation Gazette No 261).

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

PS DB 5.6 **BACKFILLING**

PS DB 5.6.2 **Material For Backfilling**

Substitute "from trench excavations" in the first paragraph of DB 5.6.2 with "from trench, channel or street excavations".

PS DB 5.6.3 **Disposal Of Soft Excavation Material**

Add the following to DB 5.6.3:

All surplus and unsuitable material as described in DB 5.6.3 shall be disposed of at the spoil site, (as described in PS D 5.2.2.3) and levelled.

PS DB 5.7 **COMPACTION**

PS DB 5.7.2 **Areas Subject To Traffic Loads**

Add the following to DB 5.7.2:

Sand backfilling shall be compacted to 100 % of MAASHTO density.

PS DB 8 **MEASUREMENT AND PAYMENT**

PS DB 8.3 **SCHEDULED ITEMS**

PS DB 8.3.2 **Excavation**

PS DB 8.3.2 **a) Excavate in all materials for trenches, backfill, compact and dispose of surplus material**
 **Unit: m**

Add the following to D 8.3.2(a):

The depth of excavation in street reserves shall be measured from the final finished level.

In cases where services lay parallel to steep slopes, the depth of the excavation will be measured along the centre of the trench (on the route of the service).

The rate shall also provide for the fact that the excavation width in sand will be wider than normal and that fast excavation and backfill will reduce ground water seepage.

i) Electric cable trenches

Excavation for electric cables not laid with other services will be measured and paid for separately under the relevant depth increments. The rate shall provide for excavation, preparing trench lengths as requested by the electrical subcontractor, backfilling and compaction thereof.

The rate shall also make provision for the possibility that long trenches need to be prepared for the electrical Contractor to lay full cable lengths (up to 300 m) and immediate backfilling after the installation of the cable (same day) to prevent theft.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

ii) Combined trenches

The rate for excavation and backfilling of trenches with more than one service, shall allow for trench widths as set out in PS DB 5.2 and the bill of quantities. Extra bedding and fill blanket will be measured as in the case of normal pipe trenches.

The depth increment for combined trenches is determined by the deepest pipe in the trench.

PS DB 8.3.2 **c) Excavate unsuitable material from trench bottom Unit: m³**

Delete "and the disposal" in the heading of DB 8.3.2(c) and in the last paragraph.

PS DB 8.3.2 **d) Hand excavation and backfill Unit: m³**

The provisions of PS DB 8.3.2(a), DB 8.3.2(b) and PS DB 8.3.2(c) shall apply mutatis mutandis for hand excavation.

Payment shall only be made if so ordered by the Employer's Agent.

PS DB 8.3.2 **e) Extra-over PS DB 8.3.2(a) for temporary stockpiling of material Unit: m³**

Temporary stockpiling of material will only be measured and paid for if ordered so in writing by the Employer's Agent and if it is not contaminated with unsuitable material.

The rate shall provide for the handling and stockpiling of the material within the free haul distance.

DB 8.3.3 Excavation Ancillaries

PS DB 8.3.3.1 **Make up deficiency in backfill material (provisional) Unit: m³**

Add the following to DB 8.3.3.1:

d) Stockpile Unit: m³

Add the following to the last paragraph of DB 8.3.3.1:

No payment will be made for the transport of material from commercial sources or sources outside the site that the Contractor has selected.

PS DB 8.3.3.3 **Compaction in road reserves Unit: m³**

Add the following to DB 8.3.3.3:

This item is only applicable to the backfill above the bedding and fill blanket.

PS DB 8.3.4 Particular Items

a) Shore trench opposite structure or service Unit: m

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

Add the following to DB 8.3.4(a):

Separate items shall be provided for shoring on both sides and on one side of trenches.

The tendered rate shall allow for additional excavation for shoring as well as for the design of effective shoring.

PSDB 8.3.4b) Temporary works : Control water inflow

Substitute DB 8.3.4(b) with the following:

- 1) Provide equipment **Unit: Set**
- 2) Operate and maintain **Unit: Set days**
- 3) Remove equipment **Unit: Set**
- 4) Remove, move and reinstall existing sets of equipment **Unit: Set**

The rate for (1) above shall cover the cost of providing the necessary plant and materials, fully erected and operative on site for a set of equipment as described in PS DB 4.4.

The rate for (2) above shall cover the cost of operating and maintaining the pumps, well points sheeting, close lumbering and other equipment, as applicable, for 24 hour a day. The amount of days allowed for shall be the accumulated amount of set days of all sets. Pro-rata set days will be measured where a set is not used and maintained for a full 24 hour day. The set shall be in operation 24 hours a day from installation till removal to be measured and paid for otherwise no payment shall be made.

PS DB 8.3.5 Existing Services That Intersect Or Adjoin A Pipe Trench

PS DB 8.3.5 a) Services that intersect a trench Unit: No

Add the following to DB 8.3.5(a):

Existing services with a depth of cover exceeding 300 mm, measured from the bottom of excavation to the top of the existing service shall not be measured and paid for. There will be distinguished between existing trunk services and existing erf connection.

The rate shall also allow for the following costs:

- I. Sufficient photo's have to be taken of existing services and handed over to the Employer's Agent before they are being crossed, if there is a possibility of a difference in opinion over the condition of those services, especially on private property.
- II. If such a service is damaged, it has to be repaired to its original condition or if possible, to a standard agreed to in writing with the relevant owner. This agreement has to be approved by the Employer's Agent.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

III. If such a service is removed, it has to be replaced as per original.

PS DB 8.3.5 b) **Services that adjoin a trench** **Unit: No or m**

Add the following to DB 8.3.5 (b):

The unit "number" will only be used for services such as poles and trees.

No payment will be made for overhead services that do not rest directly on the ground except where allowance is made for this in the schedule of quantities.

Existing services that rest directly on the ground e.g. poles, trees, walls and structures are handled in the same way as underground services, but the axis of the service will be determined as follows:

The vertical axis is defined as the nearest side or corner of the existing structure to the excavation, measured at the point where the structure and natural ground level intersect.

The horizontal axis will be at the point where the structure and the natural ground level intersects. In this instance, where the excavation falls above the 45° line but within 1,0 meter horizontally from the structure, the service will also be measured as adjoining.

If the structure, according to the above-mentioned, does not qualify as an adjoining service but the foundation of the structure is such that if a 45° line drawn from the nearest bottom corner thereof cuts through the excavation, the structure will be measured as an adjoining service **if approved by the Employer's Agent.**

There will be distinguished between existing trunk services and existing erf connection.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

PS G: CONCRETE (STRUCTURAL)

PS G 3 MATERIAL

PS G 3.2 CEMENT

PS G 3.2.1 Applicable Specifications

Substitute G 3.2.1 with the following:

All cement types shall comply with the requirements of SANS 50197-1.

Where Malmesbury hornfels (shale) is used as aggregate in concrete, a blend (by mass) of 50 % CEM II 42,5 or CEM II 42,5R and 50 % milled granulated blast-furnace slag shall be used in the concrete mix.

PS G 3.2.3 Storage of Cement

Add the following to G 3.2.3:

Separate storage facilities shall be provided for the various types of cement specified. Consignments of cement shall be used in the same sequence as that in which they are delivered to site. No cement shall be used which has been stored on site for a longer period than 6 (six) weeks. All cement so stored for a longer period than 6 (six) weeks, all cement damaged in any way, and all cement which does not comply with the specification, shall be removed immediately and permanently from the site.

PS G 3.5.2 Air-entraining Agents

Substitute G 3.5.2 with the following:

Air-entraining agents shall not be used in concrete.

PS G 5 CONSTRUCTION

PS G 5.2.1 Classification of Finishes

Add the following to G 5.2.1:

The following surface conditions are required on the various portions of the finished concrete:

(a) Rough

Concealed surfaces and surfaces more than 150 mm below final ground level.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

PS G 5.5 **CONCRETE**

PS G 5.5.1.5 **Durability**

Substitute G 5.5.1.5 with the following:

Concrete shall be so proportioned to ensure that the water/cement ratio does not exceed 0,5 and, to ensure workability, water-reducing admixtures of approved manufacture shall be used in preference to increasing the cement content.

PS G 5.5.1.7 **Strength concrete**

Add the following to G 5.5.1.7:

The grade of strength concrete and the maximum nominal size of coarse aggregate for each portion of the works, shall be indicated on the drawings.

PS G 5.5.9 **Adverse Weather Conditions**

Add the following to G 5.5.9.1:

No material having a temperature of below 5 °C shall be used for concrete, and no concrete shall be deposited when the ground or air temperature is below 2 °C. Furthermore, if the air or ground temperature is likely to fall below 2 °C within 12 (twelve) hours after depositing of concrete, no concreting shall be done without the written consent of the Employer's Agent. If such consent is given the Contractor shall heat the aggregate stockpiles and mixing water, and defrost the formwork and reinforcement.

PS G 5.5.10.4 **Wood-floated finish**

Where wood floating is specified or scheduled, the surface shall first be given a finish as specified in **G 5.5.10.2** and after the concrete has hardened sufficiently, it shall be floated to a uniform surface free from trowel marks. The screeded surface shall be wood-floated by hand, only sufficiently to produce a uniform surface free from screed marks.

PS G 5.8.3 **Batching and Mixing**

Cement shall be measured by mass or in full pockets of 50 kg each and aggregate shall be measured by volume in approved measuring boxes or barrows.

The aggregate shall be moist or wetted before the cement is added. Where drum mixers are used, about 20 % of the water shall be poured into the drum before the aggregate and cement are loaded. The mixing time in the drum shall be about 45 to 50 seconds.

The quantity of water added shall be just sufficient to form a smooth grout which will adhere to and completely coat each and every particle of aggregate, and which is just wet enough to ensure that, at points of contact of aggregate, the grout will run together to form a small fillet to

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

bond the aggregate together. The mix shall contain no more than 20 litres of water for every 50 kg of cement.

Mixing shall be done in an approved batch-type mechanical mixer, but small quantities may be hand mixed.

PS G 5.8.4 Placing

The concrete shall be worked sufficiently to ensure that it will completely fill the space to be concreted and that adjacent aggregate particles are in contact with one another.

PS G 8 MEASUREMENT AND PAYMENT

PS G 8.1 MEASUREMENT AND RATES

PS G 8.1.3 Concrete

Add the following to G 8.1.3.1(d):

Strip foundations and fence post foundations shall be cast directly against the sides and bottoms of excavations. No payment shall be made for additional concrete in over-break.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

PS LB: BEDDING (PIPES)

PS LB 1 SCOPE

PS LB 1.1 SCOPE

Add the following to LB 1.1:

This specification also covers the bedding required for electric cables and cable ducts.

PS LB 3 MATERIALS

PS LB 3.1 Selected granular material

Substitute LB 3.1 with the following:

Selected granular material shall be an aggregate, sand or granular material, all of a non-cohesive nature and free from any organic material, of which the grading analysis shows 100 % passing a 13,2 mm sieve and not more than 5 % passing a 0,075 mm sieve.

In very wet conditions and if so ordered by the Employer's Agent, a non-plastic crushed material should be used for bedding cradle.

PS LB 3.2 Selected fill material

Substitute LB 3.2 with the following:

The requirements of PS LB 3.1 shall apply mutatis mutandis.

PS LB 3.3 Bedding

Add the following to LB 3.3:

All pipes shall be classified as rigid pipes and shall be laid on a Class C bedding except water connections, which shall be classified as flexible pipes. Cable bedding is specified separately.

PS LB 3.6 Polyethylene warning tape

The danger tape shall be manufactured from Grade XJF 46/60 polyethylene at least 0,4 mm thick and with a nominal width of 230 mm, and which is completely impregnated with a light orange pigment reasonably matching colour no B26 of SANS 1091.

A black triangle and lightning flashes for electricity, as depicted on sign WW7 of SANS 1186, as well as the words "DANGER, GEVAAR, INGOSI" shall be printed clearly and permanently onto the tape. The whole pattern shall be repeated every 1 m.

The quality of all materials employed shall be such as to ensure the permanency of the tape under all environmental and soil conditions, as well as the stability of the orange pigmentation and the lettering and warning symbols.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

PS LB 5 **CONSTRUCTION**

PS LB 5.1 **GENERAL**

PS LB 5.1.4 **Compacting**

Substitute "90 % of MAASHTO" in LB 5.1.4 with "93 % of MAASHTO (100 % for sand)".

PS LB 8 **MEASUREMENT AND PAYMENT**

PS LB 8.1 **PRINCIPLES**

PS LB 8.1.1 **Supply of Bedding Materials Measured Separately**

Add the following to LB 8.1.1:

Except for electric cables payment for bedding material and selected fill material is only made if the selected trench-excavation material cannot be used in the same position as bedding material but has to be obtained from another part of the site of works or designated borrow pits, or from commercial sources.

PS LB 8.1.3 **Volume of Bedding Material**

Add the following to LB 8.1.3 :

The volume of bedding material shall be measured nett, ie the gross volume of the pipe is to be deducted. No payment will be made for any bedding material required to backfill overbreak beyond the specified depths and widths. All bedding material will be measured in m³.

PS LB 8.1.4 **Separate Items for Cradle And Blanket**

Substitute LB 8.1.4 with the following:

No distinction shall be made as regards material for the bedding cradle and selected fill blanket, and the material shall comply with the requirements for material for bedding cradle.

PS LB 8.1.5 **Disposal of Displaced Material**

Add the following to LB 8.1.5:

Surplus displaced material shall be dumped and levelled at the spoil site.

PS LB 8.2 **SCHEDULED ITEMS**

Add the following to LB 8.2 :

- (a) Notwithstanding the provisions of the payment clause the freehaul distance for the supply
- (b) of bedding material from trench excavation or any other excavation necessary shall be 3,0 km. Where the material is obtained from trench or other excavations within a haul distance of 1,0 km from the point of use payment will be made under Sub-Clause 8.2.1,

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

conversely where material is obtained from trench or other excavations greater than 1,0 km from the point of use, payment will be made under Sub-Clause 8.2.2.2. The Employer's Agent must be notified in advance of the source to be used.

Commercial sources shall include off-site sources selected by the Contractor.

PS LB 8.2.2 Supply Only Of Bedding By Importation

PS LB 8.2.2.3 From commercial sources

Add the following to LB 8.2.2.3:

c) Bedding for wet conditions **Unit: m³**

The requirements of PS LB 3.1 for bedding in wet conditions must be noted. Payment will only be applicable if ordered by the Employer's Agent.

PS LB 8.2.2.4 From stockpile (provisional)

a) Selected granular material **Unit: m³**

b) Selected fill material **Unit: m³**

The rate shall cover the cost of obtaining, handling and transport regardless the distance, of the required bedding material from the stockpile, the delivery thereof at positions that are spaced along the trench in such a way as suits the working method of the Contractor, as well as the removal of material displaced by this importation within a free-haul distance of 3 km.

PS LB 8.2.5 Overhaul Of Material For Bedding Cradle And Selected

Fill Blanket **Unit: m³.km**

Substitute LB 8.2.5 with the following:

a) Limited overhaul **Unit : m³**

b) Long overhaul **Unit : m³km**

Except that the volume is calculated according to LB 8.1.3, the requirements of D 8.3.6 or DA 8.3.3, as applicable, shall apply for overhaul.

PS LB 8.3 PROTECTIVE CONCRETE SLABS FOR CABLES Unit: No

The provisions of G 8.6 shall apply mutatis mutandis.

PS LB 8.4 POLYETHYLENE WARNING TAPE Unit: m

The rate shall cover the cost of the supply, handling and placing of the tape.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

PS LD: SEWERS

PS LD 1 SCOPE

Add to Clause 1.1 : "Drawings Numbered LD-2 to LD-8 are replaced by the NMBM Standard Detail Drawings"

PS LD 3 MATERIALS

PS LD 3.1 PIPES, FITTINGS, AND PIPE JOINTS

PS LD 3.1.5 uPVC pipes and fittings

Add the following to LD 3.1.5:

uPVC sewer pipes and fittings shall be 400 kPa Structured Wall Sewer Pipes and shall comply with SABS 1601 Type 1. Erf connections shall be 110 mm dia 200 kPa Structural Wall Sewer Pipes.

PS LD 3.5 MANHOLES, CHAMBERS, ETC.

PSLD 3.5.1 Bricks

Delete in the first line "general purpose (Special) burnt" and replace by "facing (28 MPa min. strength)."

PS LD 3.5.2 Precast Concrete Sections

Add the following to LD 3.5.2:

Precast concrete sections with an inside diameter of at least 1 000 mm shall be used for manholes.

Where the angle between the inlet and outlet of the manhole deviates by more than 45 ° from the straight or where more than one inlet enter a manhole, the invert level of the outlet shall be 30 mm lower than the lowest inlet invert level.

The 1,95 m diameter lower sections of the pump sumps shall comply with SABS 677 Class C.

Sectional spun concrete cylinders shall have been manufactured from dolomitic aggregate.

PS LD 3.5.3 Prefabricated A.C. Manholes

Delete the contents of Clause 3.5.3 and replace with the following :

"These will not be permitted."

PS LD 3.5.4 Concrete

Dolomitic aggregate is not required for cast in situ concrete.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

PS LD 3.5.7 Step Irons

Substitute LD 3.5.7 with the following:

Step irons shall be installed in all manholes deeper than 1,2 m. Step irons shall consist of polypropylene coated 12 mm high tensile steel, such as Calcamite or similar. The installation of the step irons shall be in accordance with the specification of the manufacturer.

PS LD 3.5.8 MANHOLE COVERS AND FRAMES

Replace LD 3.5.8 with the following:

Medium duty concrete manhole covers and frames complying with the relevant SABS specifications shall be used in erven and non-trafficked areas.

Heavy duty concrete manhole covers and frames, shall be used in trafficked areas.

Precast concrete roof slabs, cover slabs, levelling rings and covers shall comply with the applicable requirements of SABS 1294 and the strength requirements specified on the drawings. The elements shall be manufactured in accordance with the details shown on the drawings using concrete consisting of dolomitic aggregate.

PS LD 3.6 MARKER POSTS

Add the following to LD 3.6:

Marker posts consisting of a 1 m length of fibre-cement pipe shall be planted directly above of the end cap at the connection point. The one end of the pipe must extend to 500 mm above the natural ground level and shall be painted red. The bottom end of the marker post shall be connected to the end cap with a piece of wire.

PS LD 5 CONSTRUCTION

PS LD 5.4 CONNECTIONS TO MANHOLES

Add the following to LD 5.4:

If the gradient of a pipe is more than 1:10, a vertical bend shall be used to connect up to the manhole. The Contractor shall take care that no low point is formed in the pipe as a result of the bend. If a pipe lies at a gradient of 1:10 (5,71°), a 11,25° bend cannot be used since a bend with an angle larger than the grade of the pipe will result in a low point. It is the responsibility of the Contractor to shorten the bend in order to create the required angle.

For pipes with a gradient of up to 1:10, the angle can be taken up by a joint in the manhole and if required, also by the joint between the short-length and first full pipe.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

PS LD 5.4.1 Connection into Existing Manholes

(New Clause)

An appropriate item has been allowed in the Schedule of Quantities to cover all costs connected with the making of this connection.

LD 5.6 MANHOLES, INSPECTION CHAMBERS, ETC

PS LD 5.6.1 General

Substitute LD 5.6.1(a) with the following:

1. Final cover levels of manholes in streets and paved areas shall be to the same level as the street or paved area.
2. On side walks, lawns and garden areas the cover level shall be 20 mm above the final ground level.
3. In midblock sewers it shall be 50 mm above ground level.
4. In the veld 100 mm above natural ground level.

If a manhole is positioned at a low point or in a hollow where stormwater infiltration may occur, the manhole cover level must be raised to a level to avoid the danger of infiltration, or to a level as agreed with the Employer's Agent.

PSLD 5.6.2.3 Benching

Delete "1:3 cement mortar" and replace by "concrete topping consisting of 1 part cement, 2 parts sand and 3 parts 7 mm concrete stone, by mass. The sand proportion may be varied between 1 1/2 and 2 1/2 to obtain ideal workability."

PS LD 5.6.3 Step Irons

Add the following to LD 5.6.3:

In the case of sand traps the lowest step iron will be installed 300 mm above the floor of the manhole. An additional step iron shall be installed on the opposite side of the sand trap at the same level as the lowest step iron, as shown on the drawings.

PS LD 5 CONSTRUCTION

PS LD 5.6.7 Cast in Situ Concrete Manholes

Refer to Municipal Standard Detail Drawings for details.

20 MPa strength concrete shall be used. Aggregate size may be 19 mm or 13 mm to suite Contractor. Dolomitic aggregates are not required.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

When the concrete is mixed on site, an approved rotary mixer, suitable in size for a batch containing cement in increments of one sack of 50 kg, shall be used. The Contractor's method of batching of the ingredients shall be to the approval of the Employer's Agent's Representative. Samples of the materials to be used shall be submitted for approval. The proportions of cement, coarse and fine aggregate and water necessary to produce the 20 MPa concrete shall be determined and submitted to the Employer's Agent's Representative together with the results of compressive strength tests, before the Contractor will be allowed to use site mixed concrete in the construction of manholes.

The Contractor shall bear the costs of determining the proportions of the mix and making and testing cubes for this purpose. If the Contractor submits reliable test records of concrete made from the same materials and mix proportions which he proposes to use, then the Employer's Agent may waive all or part of the strength tests required above to verify that the concrete mix design which the Contractor proposes to use is satisfactory.

The Contractor shall carry out his own testing during the construction of the Works to ensure that the concrete being used complies with the Specification. The Employer's Agent's Representative shall carry out such test check testing as he requires and the Contractor shall render any assistance necessary in taking of samples and the carrying out of tests.

All concrete being placed shall be vibrated by means of approved vibrators. Curing shall be by means of the application of a natural resin based liquid curing compound complying with ASTM C309-74. When the surface to be cured is to receive further concrete it shall be cured with water only, by sprinkling, spraying or ponding such as to maintain it in a continuously wet condition.

If the concrete is found to be cracked, honeycombed, soft or defective in any way, or if cube test strength results do not comply with the requirements, then the concrete shall be rejected. Rectification shall be by removal of the defective portion and replacement with sound concrete.

If the manhole is constructed in more than one lift the construction joint formed shall in addition to being prepared as specified in sub- clause 5.4.5.4 of SABS 1200 GA, be reinforced with 8 No 12 mm diam. x 300 mm long mild steel dowel bars, cast in to a depth of 150 mm, placed centrally in the joint face and equally spaced about the circumference.

PS LD 5.6.8 **Finished Cover Levels**

(New Clause)

Unless otherwise ordered or dimensioned explicitly on the working drawings, the level of the top surface of the cover shall be

- flush with the final surface of a carriageway, footway or any paved areas
- 50 mm above the surface of a grassed or gravelled verge, or service lane

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

- 250 mm above the finished ground level for manholes situated at the midblock of private or municipal property.
- 500 mm above ground level in undeveloped open space.

PS LD 5.6.9 Rectification of Infiltration of Water

Any infiltration visible in the manhole channels, pipe ends or benching shall be rectified by demolishing the base and rebuilding. Rectification of infiltration through the walls and/or joints may be attempted only by externally applied measures, failing which the manhole shall be demolished and rebuilt.

PS LD 5.9 CONNECTING SEWERS

PS LD 5.9.1 Location And Details

Add the following to LD 5.9.1:

Erf connections shall be installed on the exact positions as indicated on the drawings and shall extend 1 m into the erf where it shall be blanked off with an end cap.

All connecting sewers shall be laid at a gradient of 1:60, except where otherwise ordered by the Employer's Agent.

This excludes midblock sewers where connections on the topographical high side can be laid at steeper gradients to end at a minimum depth of 1,2 m or at such greater depth that any point on the erf is able to be connected.

PS LD 5.9.2 Marker Posts

Marker posts are not required

PS LD 5.9.4 Connection of New to Existing Reticulation

(New Clause)

The contractor shall under no circumstances connect the new reticulation into the existing without the prior written instruction of the Employer's Agent. This instruction will only be given after acceptance, by the Employer's Agent, of the sewer lines and manholes of the new reticulation upstream of the connection point. Connections will usually be made just prior to the start of the Defects Liability Period.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

PS LD 6 **TOLERANCES**

PS LD 6.2 **Overall Centre-Line Control and Manhole Location**

Delete in second line " ± 300 " and replace by " ± 100 ". Manhole positions, as shown on the drawings, are critical. Any required deviation by the Contractor, in excess of the tolerance, must be authorized by the Employer's Agent.

PS LD 7 **TESTS**

PS LD 7.1 **GENERAL**

Add the following to LD 7.1.5:

All tests shall be repeated after the completion of backfilling of pipe trenches.

PS LD 7.1.4 **Add the following to LD 7.1.4:**

The Contractor will be responsible for the supply of all test equipment, water for testing purposes, etc. and will bear all costs in respect of testing work required under this contract. Only laboratory tests carried out by approved laboratories will be accepted in respect of specialised density tests.

Gravity mains and the sewer house connections up to the toilet building shall be tested in accordance with SABS 1200 LD. Tests will not be paid for separately and the costs thereof shall be deemed to be included in the unit rates for the supply and lay of pipes unless a separate item is provided for this purpose. The Employer's Agent or his Representative will only be called to witness a test after the Contractor has satisfied himself that the pipeline will pass the test.

A torch and mirror test will be used for alignment. To be acceptable, the visibility of the plug/reflector shall be at least 50%.

The Contractor shall provide and keep in good repair all necessary testing apparatus, expanding plugs, stoppers, air bags, etc of such sizes as may be necessary to fit openings together with any plant, materials and labour that may be required for the complete and proper testing of the sewers.

The tests and acceptance/rejection criteria detailed in clause LD 7.2 will be applicable.

PS LD 7.1.5 **Add the following to LD 7.1.5 :**

On completion of the backfilling of trenches, the pipelines will again be tested for grade, direction, line and appearance of inner surface, depth and water tightness, in the presence of the Employer's Agent or his Representative.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

PS LD 7.1.6 Delete wording of Clause (c) and replace by :

"A torch and mirror test shall be carried out on all pipe lengths, in both directions".

PS LD 7.2 TEST AND ACCEPTANCE/REJECTION CRITERIA

PS LD 7.2.6 Water tightness of Manholes

Replace LD 7.2.6 with the following:

On completion of a manhole, a water tightness test will be called for by the Employer's Agent at the Contractor's expense as follows:

The manhole shall be tested by filling internally to cover level with water and allowing sufficient time for absorption. The manhole will have passed the test provided that the drop of the water level in the manhole is less than 50 mm per 24 hour period per metre in depth of the manhole measured from the channel invert to the top of the water level.

(A shorter test time may be allowed by the Employer's Agent's Representative (minimum 3,0 hours) in which case a pro-rata drop will be calculated.

The test pressures on manholes which have been backfilled shall be increased by the equivalent of the exterior hydrostatic pressure caused by surrounding ground conditions.

The Contractor shall provide all the necessary testing apparatus and materials and shall carry out the tests. The Contractor shall request the Employer's Agent to observe only when he himself is satisfied that the manhole will pass the test.

PS LD 7.2.7 Rectification of Infiltration of Water

Any infiltration visible in the manhole, manhole channels, pipe ends or benching, shall be rectified by demolishing the base and rebuilding. Rectification of infiltration through the walls and/or joints may be attempted only by externally applied measures, failing which the manhole shall be demolished and rebuilt.

PS LD 7.2.8 Workmanship

The Contractor will be required to build one prototype manhole and one prototype toilet complete to specification as shown on the drawings. The Employer's Agent will inspect the completed structure and only after written permission from the Employer's Agent, the Contractor will be allowed to proceed with the construction of the remaining structures, to the same standard and workmanship.

No additional payment will be made and the cost of this manhole and toilet shall be paid under the relevant item in the SOQ.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

PS LD 7.2.9 Torch and Mirror Test

(New Clause)

For the pipeline to be acceptable the visibility of the plug/reflector shall be at least 50% of its area.

PS LD 7.2.10 Acceptance Criteria

(New Clause)

The acceptance of the pipe length or manhole shall depend upon whether it satisfies the criteria set out in SABS 1200 LD clauses 6, 7 and the PS clauses above.

Where pipes other than vitro clay pipes are laid, only tests carried out on the pipelines after completion of the backfilling to ground level (excluding surface restoration) and completion of the construction of manholes to roof height, including benching, will be considered for acceptance purposes.

In the case where vitro clay pipes are being laid, no pipelines are to be covered prior to inspection and approval by the Employer's Agent. Once the pipeline has been laid and bedded in the compacted bedding cradle (to half pipe) between control points, the Employer's Agent must be called out to inspect the installation. The Contractor is to provide the necessary equipment in order for the Employer's Agent to adequately assess that the pipeline has been laid to the specified tolerances. Further, an air test, in accordance with the specifications, is to be conducted and witnessed by the Employer's Agent prior to the placing of the Fill Blanket

PS LD 8 MEASUREMENT AND PAYMENT

PS LD 8.2 SCHEDULED ITEMS

PS LD 8.2.1 Supply, Lay, Joint, Bed and Test Pipeline

Add : "The measured quantity of completed pipe length will only be included in the payment certificate when the pipeline has satisfied the test after the completion of the backfill to ground level - See PS LD 7.2.8. Prior to this, payment will be made as materials on site."

PS LD 8.2.2 Extra-over Item 8.2.1 For Specials Unit: No

Add the following to LD 8.2.2:

The tendered rate for bends in mains shall include, over and above the cost of the material, the cost of the labour and cutting of the bends to the required angle, finishing of the cut edge and the painting thereof with bitumen.

The bends scheduled in the schedule of quantities are only measured according to standard sizes and the number of bends required. It remains the responsibility of the Contractor to cut the bends to the desired angle.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

PS LD 8.2.3 **Manholes** Unit: No

Add the following to LD 8.2.3:

Manholes shall be measured complete as indicated on the drawings and the rate shall be all inclusive for benching, cover and frame, and it shall make provision for all additional excavation and backfilling.

Manholes deeper than 1,5 m shall be provided with an additional concrete base, if specified by the Employer's Agent. All costs involved in additional excavation, backfilling, material and labour shall be included in the rate for the additional base. These bases will be measured as an extra-over item and shall not be included with manholes.

The depth of manholes as mentioned in the schedule of quantities, shall be measured from the final cover level to the outlet invert level (flow level).

Sand traps shall be measured and paid for as for manholes. Separate items shall be scheduled for sand traps.

PS LD 8.2.6 **Erf Connections** Unit: No

Substitute LD 8.2.6 with the following:

There will be distinguished between the various connections to different main-pipe diameters, as well as between the various depth increments. The depth increment for the connection shall be determined by the depth of the junction.

The rate shall be all inclusive and shall cover the cost of excavation, backfilling, bedding, pipes and fittings. An extra-over item for variation in pipe lengths is provided for connections, shorter or longer than specified and shall include the necessary excavation, bedding, backfilling, all material, etc. and will be also be measured under depth increments in the schedule of quantities.

The depth increment for the extra pipe lengths shall be determined by the depth of the end caps. If the deviations are negative, payment shall be reduced accordingly.

The rate for new erf connections on existing sewers shall also cover the cost of additional excavation and backfilling around the mains, cutting of pipes, handling of sewage flow, etc.

Imported material for bedding, fill blanket and main fill shall be measured and paid for under the relevant items for mains.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

PS LD 8.2.7 Encasing Of Pipes In Concrete Unit: m³

Add the following to LD 8.2.7:

The tendered rate for the encasing of pipes in concrete applies for the railway crossing and shall be all inclusive for all additional labour to lay the sewer in the channel, encase it in concrete and shall include steel reinforcement, joints, etc.

PS LD 8.2.8 Anchor Blocks Unit: m³

Add the following to LD 8.2.8:

Payment for anchor blocks shall be made for pipes with gradients steeper than 1:10 and shall be measured in m3.

PS LD 8.2.11 Connection To Existing Sewers Unit: No

Add the following to LD 8.2.11:

Separate items will be scheduled for each diameter of connecting pipe.

The tendered rate shall include full compensation for connecting the proposed pipe, any additional channelling and benching associated with the connection, cutting the pipe to suit the connection, supplying and building in the short junction pipe, extra couplings, dealing with existing flow, preventing foreign material from entering the sewer and making the connection.

The excavation for pipelines, pipes, backfilling and manholes shall be measured separately.

Where a direct connection is made to an existing pipe, the rate covers all labour involved in

PS LD 8.2.16 EO for Variation in pipe lengths Unit: m

Extra over item PS LD 8.2.6 for variation in pipe lengths for connections longer than specified and shall include the necessary excavation, bedding, back filling and all pipework.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

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Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

PS PB : BUILDING WORK

PS PB 1. SCOPE

This section specifies the general requirements for the construction of buildings.

PS PB 2. INTERPRETATIONS

PS PB 2.1 SUPPORTING SPECIFICATIONS

- (a) Project Specification;
- (b) SABS 1200 A or SABS 1200 AA as applicable;
- (c) SABS 1200 C;
- (d) SABS 1200 D or SABS 1200 DA as applicable;
- (e) SABS 1200 G or SABS 1200 GA or SABS 1200 GB as applicable.

PS PB 2.2 GENERAL

Building work shall be carried out in accordance with the National Building Regulations and Building Standards Act, 1977, and these specifications.

References to specifications and codes of practice of the South African Bureau of Standards shall be taken to be references to the latest edition of such specifications and codes of practice as amended. Where possible the SABS mark shall appear on all articles, materials or items where it is required to comply with such SABS specification.

PS PB 2.3 COMMERCIAL PRODUCTS

In all instances where the Contractor handles, stores, uses, applies or fixes commercial products, the work shall be strictly carried out according to the instructions of the manufacturer of such products.

PS PB 2.4 SAMPLES

The Contractor shall furnish without delay, such samples as called for or may be called for by the Engineer. Materials or workmanship not corresponding with approved samples, may be rejected by the Engineer and shall be removed from the works at the cost of the Contractor.

PS PB 3. MATERIALS

PS PB 3.1 CEMENT

Cement for masonry work comply with the requirements of SANS EN 431-1 and cement for concrete work shall be CEM I portland cement or CEM III blast-furnace cement complying with the requirements of SANS EN 197-1.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

Separate storage facilities shall be provided for the various types of cement.

PS PB 3.2 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 mortar, plaster or floor screed.

PS PB 3.3 LIME

Lime shall be hydrated bedding mortar lime complying with the requirements of SABS 523.

PS PB 3.4 AGGREGATE

Sand for plaster and mortar shall comply with the requirements of SABS 1090, whereas the aggregates for normal and granolithic floor creeds shall comply with the requirements of BS1199 and BS1201 respectively.

PS PB 3.5 BURNT CLAY BRICKS

Burnt clay bricks shall comply with the requirements of SABS 227 and shall also be equal in all respects to the three samples of each type of brick furnished by the Contractor prior to commencement of the works and as approved by the Engineer.

General purpose (special) bricks shall be used in foundation walls and lintels.

The colour and texture of face bricks shall be as specified in the project specifications. Care shall be taken to avoid damage to arises and faces during transport and handling.

Fire bricks shall be of well burnt refractory fire clay, resistant to spalling and cracking and of same size as the ordinary bricks.

PS PB 3.6 CONCRETE MASONRY UNITS

Pre-cast concrete masonry units shall comply with the requirements of SABS 1215 and shall be solid unless specified otherwise in the project specifications.

PS PB 3.7 CALCIUM SILICATE MASONRY UNITS

Calcium silicate masonry units shall comply with the requirements of SABS 285.

PS PB 3.8 WALL TIES

Wall ties shall comply with the requirements of SABS 28.

PS PB 3.9 AIR BRICKS

Air bricks shall be well-burnt terra-cotta air bricks in external faces of walls and 250 mm x 150 mm rectangular gypsum air bricks covered with copper mosquito gauze in internal faces.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

PS PB 3.10 **BRICK REINFORCEMENT**

Brick reinforcement shall be hard drawn mild steel comprising two 3,15 mm diameter wires spaced 75 mm apart and 2,8 mm diameter cross wires spaced at not exceeding 300 mm apart welded to main wires.

PS PB 3.11 **QUARRY TILES**

Quarry tiles shall be of approved quality, even in thickness, truly square, free from cracks, twists and blemishes and uniform in colour and unless otherwise specified, shall be of approved red colour.

PS PB 3.12 **CERAMIC TILES**

Glazed ceramic tiles for walls shall comply with the requirements of SABS 22 and, unless otherwise specified, shall be white, size 150 mm x 150 mm x 6,5 mm thick.

Ceramic tiles for floors shall comply with the requirements of SABS 1449 and, unless otherwise specified, shall be unglazed, size 240 mm x 115 mm x 20 mm thick and of approved colour.

PS PB 3.13 **CONCRETE PAVING SLABS**

Concrete paving slabs shall be precast units of grade 25 MPa/13 mm concrete and shall be of approved manufacture, at least 50 mm thick and sizes 250 mm x 250 mm minimum and 600 mm x 600 mm maximum.

Concrete slabs shall be even in thickness, truly square, free from cracks, twists and blemishes, with a uniform natural cement colour and surface finished smoothly in the mould and shall also be equal in all respects to the samples furnished by the Contractor prior to commencement of the works and as approved by the Engineer.

PS PB 3.14 **DAMP-PROOF MEMBRANE**

Damp-proof membrane under floors, unless otherwise specified, shall be of polyethylene sheeting complying with the requirements of SABS 952 as Type C-plain surfaces specified therein, 250 microns in dry areas and 375 microns in wet areas.

PS PB 3.15 **DAMP-PROOF COURSE IN WALLS**

Horizontal and vertical damp-proof course, unless otherwise specified, shall be of bituminous sheeting complying with the requirements of SABS 248 and as Type FV (Fibre Base) sheeting or as Type GH (Hessian Base) sheeting specified therein, or of polyethylene sheeting complying with the requirements of SABS 952 and as Type A-plain surfaces 450 microns or as Type B-embossed surfaces 375 microns as described therein.

PS PB 3.16 **TREATMENT OF TIMBER**

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

All timber shall be given a preservative treatment suitable for the duty for which the timber is intended in accordance with SABS code of practice 05, and no untreated timber shall be used. The preservative treatment shall not impair the final finish. The timber shall be impregnated throughout. When surface coating is specified, the compounds applied on the surfaces of the timber shall form an unbroken film.

PS PB 3.17 STRUCTURAL TIMBER

Structural timber, unless otherwise specified, shall be of South African softwood (pine) complying with the requirements of SABS 563 or SABS 1245 and, unless otherwise specified or shown on the drawings, shall be of Grade 4 and shall be marked as laid down in the specification.

Roof battens and other structural timbers not less than 50 mm or more than 65 mm in width and not less than 38 mm or more than 50 mm thickness, shall be of South African softwood (pine) complying with the requirements of SABS 653.

All structural timber shall bear the full standardisation mark of the South African Bureau of Standards.

The tolerance by which "actual" dimensions may vary from the "nominal" dimensions specified or stated on drawings of South African sawn structural softwood, shall be as laid down in SABS 563, SABS 653 and SABS 1245 where relevant.

PS PB 3.18 TIMBER FOR JOINERY

Softwood for joinery shall comply with the requirements of SABS 1359 and hardwood with the requirements of SABS 1099.

Timber for joinery shall be of clear grade, unless otherwise specified. Counter tops and other tops, where only one face side is visible, shall be of semi-clear grade timber.

PS PB 3.19 FRAMED AND LEDGED BATTEN DOORS

(a) Softwood doors

To be 44 mm thick framed and ledged batten doors complying with the requirements of SABS 545, but the timber shall comply with the requirements of SABS 1359 and shall be of clear grade.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

(b) **Hardwood doors**

To be 44 mm thick framed and ledged batten doors complying with the requirements of SABS 545, but the timber shall comply with the requirements of SABS 1099 and shall be of clear grade. The hardwood shall be solid without any laminations.

PS PB 3.20 **FLUSH DOORS**

Flush doors shall be solid laminated, chip core or hollow-core as specified and shall comply with the requirements of SABS 545. All glue used in the manufacture of the doors shall comply with the requirements of the above specification.

Unless otherwise specified, face veneers shall be rotary cut, and shall be of timber specified or where doors are to be painted shall be of timber suitable for painting.

Edge-strips to conceal the vertical edges of doors shall be not less than 10 mm thick and of the same timber as face veneers; edge strips to meeting edges of doors in two leaves where edges are to be rebated, shall be not less than 20 mm thick.

Faces of doors shall be machine-sanded to a smooth and even surface.

All glueing together of core strips and glueing on of veneers, edge-strips, etc. shall be done under hydraulic pressure.

The top and bottom edges of doors showing end grain, shall be sealed with lacquer, or other suitable material, before leaving the manufacturer's works, and similarly sealed after doors are fitted into frames if the edges of doors are disturbed during fitting.

PS PB 3.21 **IRONMONGERY**

All ironmongery shall be of best quality and shall be approved by the Engineer, before fixing.

Screws for fixing of articles shall be of similar metal than the articles.

Locks shall comply with the requirements of SABS 4 and shall be supplied with two keys each.

Unless otherwise specified, interior and exterior doors shall be fitted with two and four lever heavy-duty mortice locks respectively, which shall be master-keyed.

No key shall pass a second lock. On no account shall the keys be delivered with the doors or locks to the building site. Failure to observe these instructions may entail the provision of new locks and keys.

PS PB 3.22 **HOT-DIP GALVANISING TO STEELWORK**

Where prescribed, all steelwork built in as the work proceeds, shall be hot-dip galvanised after fabrication and before leaving the manufacturer's works, in accordance with SABS 763.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

Where they occur, site welds shall be zinc sprayed in order that the zinc coating be even and continuous over all surfaces.

PS PB 3.23 PRESSED STEEL DOOR FRAMES

Pressed steel door frames shall comply with the requirements of SABS 1129 and shall be constructed of 1,6 mm thick mild steel sheeting, pressed or rolled to the required shapes, properly mitred, welded and reinforced.

Frames shall be of widths required to suit the thickness of walls into which they are built and shall be fitted with suitable tie-bars and braces at bottom, and lugs for building in, three to each jamb of frames without fanlights and four to each jamb of frames with fanlights.

Where fanlights are shown over doors, the frames shall be fitted with transoms of pressed or rolled steel sheet as above and rebate for fanlights and for doors if required.

The rebates in frames and transoms for doors and fanlights shall be of width required to suit the thickness of doors and fanlights.

Frames shall each be fitted in the rebate of one jamb with a pair of approved 100 mm steel butt hinges, and transom to opening fanlights hung at bottom shall each be fitted with a pair of approved 75 mm steel butt hinges, all set flush into recesses in frames and either fixed with countersunk screws or securely welded on.

Frames shall be holed as and where required for screws fixing fanlight openers, keeps of spring catches, etc. Where fanlights are shown to be fixed into frames, the frames shall be holed in the rebates, for screws, securing the fanlights, four to each frame.

Frames shall each be fitted in one jamb, with approved chromium plated or stainless steel (unless otherwise specified) adjustable striking plate keep, boxed in at back of frame with sheet metal box welded on, and not less than two rubber buffers.

All welding shall be cleaned off smooth and flush on exposed faces and frames shall be cleaned and primed as described for steel windows before leaving the manufacturer's works.

PS PB 3.24 STEEL DOORS, SIDELIGHTS AND FANLIGHTS

Steel doors, sidelights and fanlights shall, in the case of stock types, comply with the requirements of SABS 727, and in the case of purpose made types with the constructional and other requirements of the above specification wherever applicable, and shall in addition be equipped with the following:

- (a) Suitable weather bars where required to render doors, etc., perfectly watertight;

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

- (b) Suitable lugs, or holes at the same spacing as the standard fixing lugs, for screwing frames to plugs in the concrete, where frames of doors, etc. are to be fixed to concrete columns, beams, etc.,
- (c) A primer as described for steel windows, except where hot-dip galvanising is prescribed.

Doors, sidelights and fanlights, unless otherwise shown shall be of "one piece" construction, but where shown to be in two or more "one piece" units, the units shall be coupled together with standard coupling-mullions and/or transoms.

Bottom openings in doors and sidelights shall be fitted with kicking plates of one thickness of 1,6 mm thick mild steel sheet fixed with metal beads.

Frames of outward opening doors shall be fitted at bottom with sills of door framing section (stepped sills) and of inward opening doors with metal ties, welded to frames, for embedding in thresholds (flush sills).

Stock doors, sidelights and fanlights shall be of the types shown on drawings and purpose made doors, sidelights and fanlights shall be constructed to the forms and sizes shown on drawings.

Unless otherwise specified, the doors shall be of not less than 33 mm universal sections and the sidelights and fanlights of standard 25 mm sections.

Fanlights shall be hung and fitted as described for steel windows in clause 3.39.

PS PB 3.25 **BALANCE TYPE STEEL DOOR**

The balance type steel door shall be of the "back track" type tip-up door, constructed of not less than 0,8 mm thick mild steel sheeting, pressed to form troughed or fluted pattern horizontal panels, each approximately 200 mm wide, all strongly reinforced at back with 1,2 mm thick top hat section mild steel braces and/or stiffeners and provided all round exposed edges with 1,2 mm thick mild steel channels, all properly welded together and with all welding cleaned off smooth and flush.

The door is to be hung on two galvanised flexible steel cables of not less than 5 mm diameter, connected at lower ends to 125 mm diameter steel encased counterweights of such length and mass as will balance the door in the full open position and connected at upper ends to door unit by passing cables over 140 mm diameter bushed cast aluminium pulleys, securely fixed to 2,50 mm thick mild steel top plates.

The movement of door is to be controlled by means of sintered metal rollers, (nylon rollers are not acceptable) securely fixed at top and centre of outer edges to door unit to operate in horizontal and vertical runner guides respectively. The guides are to be formed of

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

37 mm x 32 mm x 25 mm mild steel channels and with vertical channels fitted at upper ends with horizontal channels, welded on to form back track for top rollers. Each vertical channel is to be four times bolted to jamb of door opening and each horizontal channel is to be secured in position to internal wall with mild steel angle bracket, twice bolted to wall to form rigid construction.

The counterweights to door to be encased with 2,50 mm thick mild steel cover plates, each the full height of door and securely fixed to wall and channel guide.

Door to be fitted near bottom with cast aluminium lifting handle for operating the door and with chromium plated locking handle, complete with control rods and with striking plate bolted to lintel, over door opening. The locking handle is to be operated from outside and is to be provided with two keys.

Before leaving the manufacturer's works, all metal is to be given a protective priming coat of paint in accordance with the requirements of SABS 909.

PS PB 3.26 **STEEL WINDOWS**

Stock residential and industrial type steel windows shall comply with the requirements of SABS 727 and all other types both stock and purpose made shall comply with the constructional and other requirements of the above specification wherever applicable, and shall in addition be equipped with the following:

- (a) Suitable weather bars where required to render the windows perfectly watertight;
- (b) Suitable lugs, or holes at the same spacing as the standard fixing lugs, for screwing frames to plugs in the concrete where frames of windows are to be fixed to concrete columns, beams, etc.;
- (c) Windows and components, except where specified to be hot-dip galvanised, shall before leaving the manufacturer's works, be cleaned by acid pickling rinsing and drying, as laid down in SABS code of practice 064, or by other approved means, to remove all scale, rust, grease, oil and foreign matter and then primed with red oxide zinc chromate primer complying with the requirements of SABS 909, applied by dipping or by means of spray gun.

Ventilators hung at side to open out in windows above ground floors and not accessible for cleaning from an adjoining opening ventilator in the same window or from verandas, balconies and the like, shall be hung on projecting hinges.

Windows, unless otherwise specified, shall be of "one piece" construction, but where shown to be in two or more "one piece" units, shall be coupled together with standard coupling mullions and/or transoms.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

Windows shall be fitted with solid brass handles, stays, catches and other fittings, those to windows constructed of universal sections having polished finish and to all other windows rumbled finish. The fittings shall be fixed in such a way as to be removable after windows are glazed.

PS PB 3.27 RESILIENT FLOOR FINISHINGS

Semi-flexible vinyl (vinyl-fibre) floor tiles shall comply with the requirements of SABS 581; flexible vinyl (PVC) floor tiles and sheeting shall comply with the requirements of SABS 786 and thermoplastic (asphaltic) floor tiles shall comply with the requirements of SABS 586. Unless otherwise described, the flooring shall be of marbled pattern and of approved light colour and tiles shall be 230 mm x 230 mm or 250 mm x 250 mm in size.

Vinyl cove skirtings shall be of approved manufacture and colour and unless otherwise stated, 70 mm in height.

PS PB 3.28 GLASS FOR GLAZING

Glass for glazing shall comply with the requirements of CKS 55.

Glass not exceeding 0,75 square metre surface area of glass pane, shall be flat drawn clear sheet glass of "QQ" quality (ordinary glazing quality) and of 3 mm thickness.

Glass exceeding 0,75 square metre and up to 1,5 square metres surface area of glass pane, shall be clear float glass of "GG" quality (glazing quality) and of 4 mm thickness.

Laminated safety glass for glazing shall be of "SQ" quality (selected glazing quality) and of 6 mm thickness unless otherwise specified. If high impact strength glass is used, whether cut to size or not, the stencil mark is to appear in a prominent place on the glass.

Toughened safety glass for glazing up to 3 square metres shall be, unless otherwise specified, of 4 mm thickness and must be ordered to the correct size as toughened glass cannot be cut, and each piece of glass to be marked in a clear and permanent fashion. (For bigger sizes, manufacturer's instructions are to be followed).

Any pane of glass installed in any door shall, where not made of safety glass, be not more than 1 m² in area and shall have a nominal thickness of not less than 6 mm.

Obscure glass for glazing, unless otherwise specified, shall be Arctic or other similar approved figured rolled glass, of a nominal thickness of not less than 3 mm for glass panes up to a surface area of 0,75 square metre and not less than 5 mm over 0,75 square metre.

Putty for glazing shall comply with the requirements of SABS 680, of Type I for glazing in wood and of Type II for glazing in steel windows, doors, etc. Putty used for glazing in unpainted hardwoods, shall be tinted to match the colour of the wood.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

PS PB 3.29 **PAINTS**

All materials for paint work for which South African Bureau of Standards specifications have been published, shall comply with the requirements of such specifications and shall bear the standardisation mark of the South African Bureau of Standards on the container or packing. Materials for paint work for which no SABS specifications have been published shall be of brand and manufacture approved by the Engineer.

All materials for paint work must be brought on to the site in unopened containers and no adulteration will be allowed.

Undercoats for paint work shall be as supplied by the manufacturer of the paint being used for the finishing coat.

Paints shall be suitable for application on the surfaces on which they are to be applied, and those used externally shall be of exterior quality or suitable for exterior use.

If necessary, paints shall be strained free from skins and similar impurities immediately before application.

The various primers, undercoats, paints and distempers shall comply with the requirements of the specifications quoted hereunder and shall be of the type of grade stated, viz:

(a) **Primers**

(i) For wood:

SABS 678. Type I shall be used on exterior woodwork and Type III on interior woodwork.

(ii) For metal:

Dip or spray application (red oxide zinc chromate). For steel windows, doors, door jambs, and other articles normally dip or spray primed in the manufacturer's works: SABS 909.

Brush application (zinc chromate). For all metal surfaces primed on site and then painted: SABS 679, Type I.

(iii) For structural steel (red lead):

SABS 312, Type II, Grade I.

(iv) For galvanised iron:

SABS 912.

(v) For galvanised metal surfaces and surfaces of non-ferrous metals:

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

Wash primer (metal etch primer) : SABS 723.

(b) **Undercoats**

For all surfaces under HIGH GLOSS, OIL GLOSS, FLAT and EGGSHELL finishing paints : SABS 681, Type II.

(c) **Paints**

- (i) High gloss : SABS 630
- (ii) Oil gloss : SABS 631
- (iii) Flat and eggshell : SABS 515
- (iv) Emulsion paint (interior) : SABS 633, Grade I
- (v) Emulsion paint (exterior) : SABS 634, Synthetic Polymer Base Type, but pure acrylic resin base for fibre cement surfaces
- (vi) Aluminium paint : SABS 682, Grade II
- (vii) Roof paint : SABS 683, Type B
- (viii) Structural steel paint : SABS 684, Type B
- (ix) Epoxy tar : SABS 801 (types as specified)

(d) **Distemper**

SABS 322

(e) **Varnish for interior use**

SABS 887, Type I with eggshell finish.

PS PB 4. **PLANT**

PS PB 4.1 **GENERAL**

The Contractor shall have at his disposal the normal plant necessary for the proper and neat completion and rounding off of all facets of the building work.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

PS PB 5. **CONSTRUCTION**

PS PB 5.1 **BRICKLAYER**

5.1.1 **Cement Mortar**

Cement mortar shall, unless otherwise specified, be composed of four parts by volume of sand and one part by volume of cement for normal brickwork, and three parts by volume of sand and one part by volume of cement 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. Care shall be taken in mixing cement mortar to remove from the mixing machine or platform any old mortar that has already set, as such mortar must not be incorporated in any new batch.

Cement mortar shall be produced in such quantities as can be used before commencing to set, as no cement mortar that has once commenced to set shall be used in any way.

5.1.2 **Brickwork**

Brickwork, wherever practicable and not otherwise specified, shall be built in English bond. No false headers shall be used, and none but whole bricks employed, except where legitimately required to form bond.

The brickwork, unless otherwise specified, shall be built in 4:1 cement mortar. Brick arches and brick lintels shall be built in 3:1 cement mortar.

The bricks shall be laid on a solid bed of mortar and all joints thoroughly grouted up solid throughout the whole width of each course.

The brickwork shall be carried up in a uniform manner, no portion being raised more than 1,2 m above an adjacent portion.

The bricks shall be well saturated with water, in the stack or dump, approximately two hours before being used. The tops of walls left off, shall be well wetted before work is recommenced.

All rough and fair cutting and cutting of splays, skew backs, chamfers, etc., shall be properly performed.

All necessary openings for pipes, etc., shall be formed or left and made good after pipes, etc., are fixed in position.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

Walls generally shall be taken up two courses above panelled ceilings in the same mortar as the wall below and cut between ties, etc.

Where hollow concrete masonry units are used brick-force shall be built into the walls every third course. Mortar for hollow concrete masonry units shall consist of one part cement, two parts lime and nine parts sand by volume. All cavities below floor level shall be filled with Grade 15 MPa/19 mm concrete.

5.1.3 **Mortar Joints**

Mortar joints to brickwork generally shall be 10 mm in thickness.

The joints in brickwork receiving plaster, tiling or similar finishings, shall be raked out whilst the mortar is soft to form key for the plaster or mortar backing. The depth of the raking out will depend on the condition of the bricks; the rougher the bricks on face the shallower the raking out and the smoother the bricks the deeper the raking out.

The joints in brickwork shall be flushed off where walls are to be bagged, in readiness for the bagging.

5.1.4 **Brickwork In Thicknesses**

Walls built in two or three thicknesses shall be tied together with and including metal ties of sufficient length to allow not less than 75 mm of each end to be built into brickwork and shall be spaced not more than 1 m apart to every third course and staggered.

5.1.5 **Brickwork In Linings**

Linings to concrete shall be tied with and including 4 mm diameter galvanised crimped wire ties of necessary length to allow 75 mm to be bedded into concrete and 75 mm of the other end to be built into brickwork and evenly spaced 1 m apart to every third course and staggered.

5.1.6 **Half Brick Thick Walls**

Half brick thick walls shall be built in 4:1 cement mortar and reinforced with 75 mm wide brick reinforcement, one row to every eighth course in height, and built 100 mm into main connecting walls. The reinforcement shall be lapped 150 mm at end joints, where these are necessary, and 75 mm at angles.

5.1.7 **Cavity Walls**

Cavity walls, unless otherwise specified, shall be built with two half brick thicknesses of brickwork in stretcher bond with 50 mm cavity between, and the two thicknesses tied together with 200 mm long metal wall ties of the butterfly type, spaced at not more than 1 m centres alternately to every third course of brickwork.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

Unless otherwise specified, the brickwork shall be built in 4:1 cement mortar.

The cavities shall be carried up from one course of brickwork below damp course level up to two courses below wall plate level, unless otherwise shown or specified. The brickwork above cavities shall be built solid, and where 270 mm thick shall be cut and well bonded where possible. Cavities in foundation walls of cavity walls shall be filled with Grade 15 MPa/19 mm up to 150 mm below the damp-proof course level.

The cavities shall be kept free of all rubbish, mortar droppings and projecting mortar.

The tops of walls shall be covered with planks or sacking during wet weather to prevent rain from entering the cavities.

The cavities shall not be ventilated.

At door, windows and other openings, the cavities shall be stopped 110 mm back from jambs of openings with the inner thickness of brickwork returned and stopped against the outer thickness and not bonded to same. A 110 mm wide strip of damp-proof sheeting as described for damp-proof course in clause 3.15 shall be built in between the two thicknesses in the joint formed by the return and the outer thickness. The damp-proof strip shall be lapped at least 50 mm on to the sheeting between the two thicknesses of sills and between the two thicknesses of lintels.

Sills to windows shall be divided into external and internal thicknesses with strips of damp-proof sheeting as above, built in line with the damp-proof sheeting in jambs and extending 100 mm beyond the jambs of openings.

The lintels shall be provided with damp-proof sheeting as described under lintels.

Unless otherwise specified, cavities shall be stopped one course below and one course above and 110 mm from sides of openings for air bricks and the like.

5.1.8 Reinforced Brick Lintels

Reinforced brick lintels shall be built with sound machine made bricks, in 3:1 cement mortar, with all vertical and horizontal joints filled solid with mortar throughout the required number of courses and to a distance of at least 330 mm on either side of the clear opening.

The number of courses in lintels over the various size openings shall be as specified in table hereunder, and reinforcing steel wires or rods shall be built into the first horizontal joint over the bottom course as laid down therein, viz.:

LINTEL SPAN	NUMBER OF COURSES	REINFORCEMENT

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

Not exceeding 1 m	4	One row of 75 mm wide brick reinforcement for each half brick width soffit.
Over 1 m tot 1,5 m	6	One row of 75 mm wide brick reinforcement for each half brick width soffit.
Over 1,5 m tot 2,1 m	7	Three 6,3 mm diameter mild steel rods for each half brick width of soffit.

The reinforcing wires and rods shall be of length at least equal to the width of the clear opening plus 330 mm at each end. The reinforcement shall be evenly spaced in the brick joints, with the outer wires or rods having at least 20 mm cover from face of brickwork.

Brick lintels in 270 mm thick cavity walls shall be built in two half brick thicknesses in stretcher bond, with inner face of outer thickness for a depth of three courses above soffit, covered with sheeting as for damp-proof course, the full length of lintels, and space between the two thicknesses for the depth of the sheeting filled in solid with Grade 15 MPa/19 mm concrete. Where cavities continue above lintels, the sheeting shall be taken up and turned on to top of first course of brickwork to inner thickness of wall, above the concrete filling in lintels.

The lintels, except where built over pressed steel door frames and the like, shall be supported on temporary formwork left in position for at least fourteen (14) days.

5.1.9 **Beam Filling**

Beam filling, unless otherwise specified, shall be half brick thick, built in similar mortar as used in the walls below, cut in between roof timbers and carried hard up to underside of roof covering, and flushed up in mortar.

5.1.10 **Bagged Finish To Brickwork**

Bagged finish to brickwork, if done whilst the mortar in joints is still soft, shall be formed by rubbing over the wall surfaces with wet rough sacking, until all joints and crevices are filled up and an even surface is obtained. Mortar, as used for building the brickwork, shall be added as may be necessary.

If bagging to walls is done after the mortar in joints has set the wall surfaces shall be rubbed over with wet rough sacking as above, but cement grout shall be added as necessary to fill up the joints and crevices and to obtain an even surface.

5.1.11 **Building in Brick Work**

Ends of timbers, hold-fasts, cramps, gratings, air bricks, dowels, etc., shall be built-in in cement mortar.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

Door and window frames and the like shall be set up in positions for building in and securely strutted to prevent distortion whilst the brickwork, lintels, etc., are being built.

Pressed steel door frames shall be grouted in solid at back with cement mortar as the work proceeds.

Wood slips, fixing bricks, hoop iron, roof ties, etc., shall be built in as the work proceeds.

Ventilators shall be built into openings formed in the walls, in 3:1 cement mortar, and grouted in solid with similar mortar and wall finishes made good if disturbed.

Wood frames to doors, windows, etc., shall be set up in position for building in as described and built in as the work proceeds with cramps to jambs of 1,6 mm thick galvanised hoop iron, 32 mm wide, with ends turned 50 mm up against stiles of frames and each twice screwed to frame, and built 450 mm into wall with end turned up into brickwork joint. Cramps shall be built in approximately 0,3 m up from bottom and approximately 0,3 m down from head of frames and intermediately at not exceeding 0,85 m apart. No frame shall have less than two cramps to each jamb irrespective of height.

Cramps to frames in 270 mm thick cavity walls shall be cranked as necessary and built into inner and outer thicknesses of walls alternately.

The stiles of wood door frames, and similar frames not having sills framed in, shall be doweled to concrete, brick, stone and similar thresholds with 10 mm diameter mild steel dowels 75 mm long, one to each stile.

5.1.12 **Securing Of Roofs**

Roof trusses shall be fixed at each support to walls with ties of 1,2 mm thick galvanised hoop iron, 30 mm wide, built 750 mm deep into brickwork or embedded 300 mm deep into concrete or wrapped around bottom layer of reinforcing in a reinforced concrete beam and, unless otherwise specified, wrapped over truss and fixed with four galvanised nails, 60 mm long and taken up to and lapped round the nearest purlin and well spiked thereto.

5.1.13 **Bedding And Pointing**

All door, window and similar frames shall be bedded and pointed in 3:1 cement mortar. All wall plates shall be set true and level and bedded in 4:1 cement mortar.

Steel door and window frames shall be carefully pointed all round and made perfectly watertight.

Where steel door and window frames are specified to be pointed with mastic compound they shall be pointed all round externally with an approved waterproof compound, of such composition that it will not stain surrounding surfaces, and that it will adhere tenaciously, remain plastic without sagging or running, be capable of accommodating any normal movement of the

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

joint sealed, and will receive paint without "bleeding". The pointing material shall be forced into the joints, which shall have been previously prepared to receive same, by means of a pressure gun, or by other suitable method, all in accordance with the manufacturer's instructions.

5.1.14 Faced Brickwork

Faced brickwork shall be built fair and the joints shall be square recessed to a depth of approximately 6 mm, formed with a square jointing tool well pressed into the joints as the work proceeds.

The Contractor shall construct a test section of 10 m² which shall be approved by the Engineer, before continuing with faced brickwork.

Face bricks shall be sorted by the brick manufacturer at his yard or by the Contractor on the site, to ensure that proper mixing of the bricks within the colour range of each type of facing brick being used is obtained; sudden changes in the general colour of face work in any one type of facing brick will not be acceptable.

Sand in mortar for all faced brickwork shall all be from one source.

Faced brickwork shall be kept perfectly clean and rubbing down of the brickwork shall not be allowed. Scaffold boards shall be turned back during rain to avoid splashing. Soiled brickwork shall be cleaned at the Contractor's expense, and the cleaning method shall be approved by the Engineer.

5.1.15 Fibre Cement Sills

Sills shall be in single lengths cut between reveals, fitted with fixing lugs and solidly bedded in 3:1 cement mortar with a slight projection beyond the finished wall face below.

Internal sills shall be level. External sills shall be set sloping on cut brickwork or on fine concrete filling under.

5.1.16 Laying Of Quarry Tiles

Joints to paving shall be continuous in both directions.

Tiles shall be solidly bedded and jointed in 3:1 cement mortar with joints, unless otherwise specified, 6 mm wide and slightly pointed with a round jointing tool. Tiles shall be well soaked in water before fixing and thoroughly cleaned off after fixing.

Tiles in sills, copings, etc., shall be set with slight projection over finished wall face, and where full tiles do not fit into the length, two cut tiles shall be used, symmetrically placed as directed.

5.1.17 Installation Of Electrical Service

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

The Contractor shall embed in the concrete and/or brickwork, as the work proceeds, all conduits, boxes, etc., which will be fixed in position by the electricians, and must cut all necessary chases and holes in walls for conduits and form recesses in walls for distribution boards, all in the positions directed, notwithstanding whether the installation of the electrical service is carried out by the Contractor or under a separate contract. Alternatively, distribution boards may be built into walls as the work proceeds, providing prior approval is obtained from the Engineer.

The Contractor shall afford every facility and shall render reasonable assistance to the electricians in carrying out their work, and shall make good where necessary, in all trades, after installation has been completed.

5.1.18 **Installation Of Mechanical Equipment**

Where the installation of mechanical equipment is carried out under a separate contract the Contractor shall arrange for the building in of special fittings, leaving holes and openings or forming chases in floors, walls, etc., for pipes, cables etc., and for the building in of pipes, sleeves, pipe clips, bolts, etc., as required or directed.

All cutting of holes through finished floors, walls, etc., after the concrete or mortar has set, must be avoided as far as possible, and the Contractor must give ample notice to the Engineer who will ascertain the exact positions where pipe sleeves, pipes, pipe clips, etc., are to be built in.

5.1.19 **Protect And Clean Down Brickwork, Etc.**

Angles of face brickwork, reveals, steps, etc., liable to damage shall be covered up and protected during the progress of the remaining work, and any damage done shall be made good at the Contractor's expense and to the satisfaction of the Engineer.

Face brickwork and brick and tile sills, copings, etc., shall be cleaned down as the work proceeds, and surfaces liable to be soiled by mortar or plaster splashes during the progress of the remaining work shall be covered with paper, pasted on, or by other approved means. At completion of the works the coverings shall be removed and the surfaces again cleaned down to the satisfaction of the Engineer.

Any detergent or other materials used in the cleaning down of face brickwork, etc., shall be of such nature that will not harm adjoining paint and other finishings in any way.

All tile and other pavings shall be thoroughly cleaned off after laying to remove all traces of mortar and other substances, covered up and protected from damage during the progress of the works, and again cleaned off at completion.

PS PB 5.2 **TILER**

5.2.1 **Laying Of Glazed Ceramic Wall Tiles**

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

The tiles shall be fixed direct to walls in 3:1 cement mortar with horizontal and vertical joints continuous, and shall have all joints rubbed in solid with neat white cement grout. Tiles shall be well soaked in water before fixing and thoroughly cleaned off after fixing.

Unless otherwise specified, the wall tiling shall project approximately 4 mm beyond face of adjoining plaster with all exposed edges finished with glazed rounded edge tiles.

Tiling shall be returned into reveals of openings and on to window sills, and shall be butted at internal angles and provided with glazed rounded edged tiles to external angles, unless otherwise specified.

All necessary cutting to tiles shall be properly performed.

Walls shall be well wetted before tiling is commenced.

5.2.2 **Laying Of Ceramic Floor Tiles**

Ceramic tiles shall be bedded to a true and even surface on 3:1 cement mortar and with joints not exceeding 2 mm wide.

After the tiles have been allowed to set for a period of not less than twenty four hours the joints shall be grouted in to with approved epoxy compound, or acid proof cement mortar.

PS PB 5.3 **PLASTERER AND PAVIOR**

5.3.1 **Cement Plaster**

Cement plaster for one coat work on walls shall be composed of four parts of sand and one part of cement for internal work, and five parts of sand and one part of cement for external work, all by volume, and mixed as described for cement mortar in clause 5.1.1.

Cement plaster on concrete surfaces shall be composed of three parts by volume of sand and one part by volume of cement.

5.3.2 **Forming Key To Concrete For Plaster Finish**

All surfaces of concrete receiving plaster, or similar finishings, shall be well wetted and wire brushed immediately after the formwork is removed and slushed over with 2:1 cement grout to form key for the finish, to the approval of the Engineer. The slushing to be allowed to set hard before the finish is applied.

Other methods may be used if approved by the Engineer.

Particular care shall be taken in forming the key for plaster where steel shuttering is used, and if considered necessary the surface of the concrete shall be hacked.

5.3.3 **Thickness Of Plaster**

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

Plaster on walls shall be not less than 12 mm or more than 20 mm in thickness, and plaster on concrete ceilings and beams shall be not less than 9 mm or more than 16 mm in thickness, unless otherwise specified.

5.3.4 Application Of Plaster

Walls shall be well wetted before plastering is commenced.

The surfaces of internal plaster shall be steel trowelled to a smooth, even and true finish. External plaster shall be finished to a true and even surface with a wood float. All plaster surfaces shall be free from blemish.

Plaster shall be returned into reveals and soffits of openings, and all angles shall be true and straight with salient angles slightly rounded.

The rendering coat of plaster in two coat work shall be approved by the Engineer before the setting coat is applied, and notice shall be given to the Engineer when it is ready for inspection.

All cracks, blisters and other defects shall be cut out and made good and the whole left perfect at completion.

NB - See clause 5.3.2 for forming key for plaster on concrete.

5.3.5 Normal Screeds To Floors

Concrete sub-floors finished with wood mosaic, vinyl sheeting and tiles, and similar finishings, shall be screeded with 3:1 cement mortar, of thickness required, but in no case less than 12 mm, and steel trowelled to a true and smooth surface suitable to receive finishings.

The screeding shall be laid before the concrete sub-floors have matured otherwise the exposed surfaces of concrete shall be thoroughly cleaned with a wire brush, and a coat of neat cement grout applied immediately before the screeding is laid.

The screeding shall be laid in good time to allow of it being perfectly dry when the finishings are laid.

No traffic shall pass over nor shall any building operations take place on the screeding without proper covering first being provided.

5.3.6 Granolithic Screeds

Granolithic screeds shall be composed of two parts by volume of cement and three parts by volume of aggregate with sufficient water added to obtain a consistency as dry as may be practicable. The screed shall be rendered with a wood float and struck off with a steel trowel after set has commenced.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

Granolithic screeds to floors, treads of steps, thresholds, and similar horizontal surfaces unless otherwise specified, shall be not less than 25 mm thick. Granolithic screeds to stair risers, sides of kerbs, and other vertical surfaces, shall, unless otherwise specified, be not less than 20 mm thick. Exposed salient angles of granolithic screeds shall be neatly rounded to approximately 20 mm radius, unless otherwise specified.

The granolithic screeds shall be laid before the concrete sub-floor has matured otherwise the exposed surface of concrete shall be thoroughly cleaned with a wire brush, and a coat of neat cement grout applied immediately before the granolithic screed is laid.

The granolithic screeds shall be laid in panels not exceeding 9 m² in area, and joined to lines of panels and lined into smaller squares as directed with sunk V-joints. The joints between the panels shall coincide with joints in the concrete sub-floor where possible.

Where granolithic screed is to be tinted it shall be laid in two layers, a lower layer laid to within 6 mm of the finished level, and an upper layer into which the requisite quantity of approved colouring pigment shall have been mixed. **No dusting on of colouring material will be allowed.**

All granolithic work shall be done by experienced workmen, and shall be protected from injury caused by rain or other extreme weather for twelve hours after being laid, and against too rapid drying whilst hardening, by being covered with wet sacks, or other suitable material, and shall be protected from injury and discolouration during the progress of the remaining work.

Edges of granolithic floors butting against different floor finishings, and edges of margins, etc. shall be true and sharp, and shall be protected by fixing temporary wood strips, which shall remain, in position until the commencement of the laying of the adjoining flooring material.

5.3.7 **Reedings To Steps, Etc.**

The treads of granolithic finished steps and upper surfaces of granolithic finished external thresholds shall be rendered non-slip by reeding same near front edges for a width of 100 mm stopped 100 mm from ends.

5.3.8 **Power Floated Finish**

Power floated finish to floors etc., unless otherwise specified, shall be floated mechanically to smooth and even surfaces before the concrete has set. Small surfaces and inaccessible places to be floated by hand in a similar way. Under no circumstances is cement mortar to be added while floating the concrete.

5.3.9 **Laying Of Concrete Paving Slabs And Paving Bricks**

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

Concrete paving slabs and paving bricks shall be bedded and jointed on a layer of 30 mm clean dry river sand. Joints shall be 6 mm wide, continuous in both directions, filled solidly with 3:1 cement mortar and slightly pointed with a round jointing tool. Lengths in excess of 10 metres shall be provided with expansion joints.

PS PB 5.4 WATERPROOFING

5.4.1 Damp-Proof Course In Walls

The damp-proof course shall be the full thickness of walls above foundations and shall be laid without longitudinal joints. At end joints, angles and intermediate junctions the sheeting shall be lapped 150 mm.

Where so specified all laps in the damp-proof course shall be sealed over the whole area of laps, to an approved method. Care shall be taken not to tear or otherwise damage the sheeting.

5.4.2 Damp-Proof Membrane

The damp-proof membrane under floors, etc., shall be laid in the widest practical widths to minimise joints and shall be turned up, dressed to load bearing walls and if applicable lapped with the damp-proof course in the walls. All joints shall be sealed with pressure sensitive tape applied over the leading edge of the joint.

5.4.3 Expansion Joints

Expansion joints shall be at least 10 mm wide and filled in with approved bitumen impregnated soft board or closed cell expanded polyethylene strip. Expansion joints shall be sealed with a two component poly-sulphide joint sealer, 12 mm deep, according to instructions of the manufacturers.

PS PB 5.5 CARPENTER AND JOINER

5.5.1 Protection Of Timber On Site

Timber stored on site shall be properly stacked when received, and adequately protected against extremes of weather and exposure to the sun, until required for use.

5.5.2 Wrought Faces

Exposed woodwork, unless otherwise specified, shall be wrought to a smooth surface, and properly sand-prepared to remove all machine or other tool marks.

For each wrought face on structural timber, an allowance will be made off the "nominal" dimensions specified or stated on the drawings, as follows:

- (a) 2,5 mm for "nominal" dimensions up to and including 76 mm;

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

- (b) 3,5 mm for "nominal" dimensions over 76 mm.

For each wrought face on joinery timber, an allowance will be made off the "nominal" dimensions specified or stated on the drawings, as follows:

- (a) 3 mm for "nominal" dimensions up to and including 76 mm;
(b) 5 mm for "nominal" dimensions over 76 mm.

The above will be the nett allowances permitted off the "nominal" dimensions specified or stated on the drawings and will not be additional to the tolerances specified for sawn timbers.

All exposed angles of wrought woodwork, unless otherwise specified, shall be arris rounded. The term "arris rounded" denotes that the angles shall be rounded off to approximately 3 mm radius.

Angles of wrought woodwork specified to be angle rounded shall be rounded off to 6 mm radius, unless otherwise shown on the drawings, and shall include, in framed joinery, for housed and mitred joints.

5.5.3 Framed Joinery

Where the word "Framed" is used it is to include for all mortice and tenon joints, dovetail joints, grooves, stop grooves, rebates, stop rebates, housings, notchings, etc., including housing ends of shelves, divisions, etc.

5.5.4 Joinery

Joinery work shall be put in hand immediately after the order has been given to commence work, or after the receipt of detail, where such are to be supplied, and shall not be wedged or glued up until just before fixing in the building.

No framed joinery for services situated inland shall be manufactured in the humid coastal belt, and no framed joinery for the services situated in the coastal belt shall be manufactured inland. This applies to both purpose made and stock joinery.

All exposed softwood timber in joinery which is not to be painted shall be free from large, loose or dead knots, knot holes, checks, splints, wane or other defects, and in joinery which is to be painted shall be free from all defects other than those which can be filled or otherwise made good in such a way as will not impair the paint finish. All exposed hardwood joinery timber shall be free from all knots, knot holes, checks, splints or other defects and, unless otherwise specified, shall also be free of sapwood.

Purpose made joinery shall be manufactured strictly in accordance with detail drawings.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

Stock joinery shall be of approved quality. Joinery shall not be primed until it has been inspected and approved.

Skirting, rails and the like shall be in long lengths. Heading joints where necessary shall be splayed. Counter tops, table tops, drainers, and the like, shall be formed with wide boards, jointed with grooved, cross-tongued and glued joints or with grooved rebated and glued joints of approved type; cross-tongues shall be stopped 25 mm back from ends where ends are exposed to view. The boards shall be in single lengths to top, etc., but where this is not possible the heading joints shall be staggered and jointed as above.

Skirting, rails, angle moulds and beadings of all kinds, shall be close fitted, mitred or scribed at angles, and securely fixed; skirtings, rails and the like shall be fixed with hardened steel or other suitable nails driven into the brickwork or shall be nailed to wall plugs spaced at not more than 700 mm apart. Glazing beads and the like shall be mitred at angles and, unless otherwise specified, shall be fixed with panel pins.

PS PB 5.6 **METALWORK**

5.6.1 **Manufactured Steelwork Generally**

Welding is to be done electrically in the most up to date manner by skilled workmen and cleaned off on completion.

All welds are to be welded with welding rods of the same chemical composition as the tubes, rods, bars, etc., to be welded and all external welds are to be filed clean and smooth.

Welding to be continuous fillet welding to all exposed edges unless otherwise described.

No scaffolding shall be allowed to rest on or fixed to steel windows, doors, frames, etc., in any way.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

PS PB 5.7 RESILIENT FLOOR FINISHINGS

5.7.1 Laying And Fixing

Vinyl sheeting and tiles and such like floor finishings shall be laid in strict accordance with the manufacturer's instructions, on a perfectly dry and clean screeded surface, using an adhesive supplied or recommended by the manufacturer of the flooring material, and rolled with a suitable roller to ensure complete adhesion of the material. The flooring shall be cut where required and neatly fitted against adjoining floors, thresholds, etc. Vinyl skirtings shall be close fitted to floors and walls, butted at end joints, neatly mitred at internal angles and dressed round external angles, and fixed with adhesive as for flooring.

Unless otherwise described, sheet flooring shall be in standard widths with cut sheets at sides of floors as necessary.

PS PB 5.8 GLAZIER

5.8.1 Fixing Of Glass

Glass fixed with glazing beads in unpainted hardwood doors shall be bedded on strips of rubber, velvet, leather, or felt turned over on to both sides of glass in the rebates to form a soft packing between the glass and the woodwork. In all other cases the glass shall be well bedded in back putty in the rebates.

Glass rebates, other than in unpainted hardwood doors, shall be primed before glazing.

Glass panes exceeding 0,5 m² in surface area and fixed with putty only in wood doors, sashes and the like shall be secured in addition with glazing sprigs, and in steel windows and doors with glazing pegs or clips inserted in holes in the steel framing.

Glass panes shall have adequate clearance between the edges of glass and the rebates.

Putty shall be carefully trimmed and cleaned off with front putty worked to within 3 mm of the sight lines.

PS PB 5.9 PAINTER

5.9.1 Preparatory Work

(a) General

All floors must be swept clean and walls dusted down, and surfaces not being painted such as face brickwork, sills, floors and stained woodwork covered up and protected against spotting, before any painting is commenced.

No sweeping or dusting shall be done whilst painting is in progress or whilst paint is still wet.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

(b) **On woodwork**

Woodwork being painted shall be well brushed down, knots treated with knotting, and all surfaces primed, stopped with hard stopping and rubbed down to an even surface ready to receive the paint.

Woodwork being oiled or stained shall have all plaster stains, pencil marks and other surface discolourations and blemishes carefully removed, and stopped with tinted stopping and well rubbed down.

(c) **On metalwork**

All metal surfaces being painted, except steel structures shall be cleaned of all rust, scale and dirt by scraping or by means of steel wire brushes; also all oil and grease shall be removed and a perfectly clean surface obtained. If necessary the surface shall be decreased immediately before applying the priming coat, by the use of a suitable grease-removing solvent; any salt deposits on the metal surfaces as may occur in industrial and marine atmospheres shall be removed by the use of a suitable detergent and the surface then thoroughly rinsed and allowed to dry.

New galvanised metal surfaces and surfaces of all non-ferrous metals, which are to be painted, shall be cleaned down as above and given one coat of wash primer (metal etch primer).

Protective coatings on new galvanised metal surfaces, applied by the manufacturers to prevent storage stain and white rust, shall be completely removed by the use of a suitable cleaning agent and the surfaces thoroughly rinsed and allowed to dry, before the surfaces are primed or painted.

After cleaning off rust on metalwork those portions so affected shall be treated with an approved rust inhibitor.

(d) **On plaster**

All plastered wall, ceiling and such like surfaces being painted or distempered shall be filled where necessary with suitable stopping or patching plaster and the whole rubbed down ready to receive the finishings.

(e) **On ceilings**

Boarded ceilings, cover strips and cornices being painted or distempered, shall be filled where necessary with suitable stopping and all nail heads in ceilings, cover strips and cornices being distempered shall be primed with flat paint.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

5.9.2 Surfaces To Be Dry

All plastered wall, ceiling and similar surfaces shall be perfectly dry and in a fit state to receive the finishings, before the work is put in hand.

5.9.3 Priming

Wood, metal and other surfaces normally primed before being painted shall be prepared and primed as before described in readiness to receive the specified paint system.

Backs of wood door and similar frames and surfaces of other new or re-fixed joinery in contact with brickwork, etc., and built in as the work proceeds, shall be primed before building in whether the articles are to be painted or not, to prevent moisture seeping into the wood from the mortar bedding.

Wood surfaces shall be knotted, primed and stopped before being coated with emulsion paint or distemper.

Tongued and grooved and rebated edges of boards in batten doors, and other suchlike inaccessible parts of joinery shall, before the joinery is assembled, be primed or where the joinery is to receive a finish other than paint, be given one coat of such other finishing material.

Priming to external structural timbers shall be applied before the timbers are fixed in position and shall include all wrought surfaces, such as backs of fascia and barge boards.

5.9.4 Application Of Paint

All coats of paint shall be thoroughly dry before subsequent coats are applied and rubbed down where necessary.

All work shall be finished to colour approved by the Engineer. The tints of undercoats shall approximate those of the finishing colour and in order to indicate the number of coats applied and to avoid misses when applying a succeeding coat, a slight difference shall be made in tint of each coat.

Priming on wood surfaces shall be by brush application. Priming on surfaces other than wood shall be by brush application or if in the opinion of the Engineer, the primer and the surfaces are considered suitable for roller application, the primer may be so applied. Priming applied by brush application shall be well brushed in to obtain maximum penetration.

Undercoat and finishing coats may be applied by brush or roller.

The use of spray gun on site for application of paint will not be permitted, except in the case of cellulose and other special cases where spraying is the accepted method of application; in cases where spraying is permitted all surrounding surfaces shall be properly masked.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

The finishing coat on woodwork and metalwork, unless otherwise specified, shall be of high gloss paint. All materials shall be used in strict accordance with the manufacturer's instructions.

PS PB 5.10 PROTECTION AND CLEANING OF WORKS

The Contractor shall provide all necessary dust sheets, covers, etc., and shall exercise all necessary care to prevent marking surfaces of walls, floors, ceilings, glass, electrical fittings, etc., and shall keep all parts of the works perfectly clean and free at all times from spotting, accumulation of rubbish, debris or dirt arising from the operations. Any surface disfigured or otherwise damaged shall be completely renovated or replaced as necessary, to the Engineer's approval, by the Contractor at his own expense.

The Contractor shall test all doors, fanlights and windows and all other fittings for proper operation and effect the required rectification prior to the handing over of the building.

The premises shall be left clean and fit for occupation at the completion of the work.

PS PB 6. TOLERANCES

PS PB 6.1 BASIS OF MEASUREMENT

6.1.1 General

Permissible deviations will apply in the case of linear dimensions, position, and level. The Contractor shall construct each of the various parts of the works within the limits of the applicable permissible deviations set out in clause 6.2 unless some other degree of accuracy is required in terms of the project specification or is shown on the drawings.

6.1.2 Methods Of Measurement Of Deviations

Certain deviations will be measured as set out below:

- (a) Any deviation from flatness of a plane surface, will be measured as the maximum deviation of the surface from any straight line of length 3 m joining two points on the surface, determined by means of a straight edge the ends of which are supported on identical blocks of suitable thickness placed one over each of the points.
- (b) Any abrupt change in a continuous surface, including a local depression or peak in a floor or wall, will be measured as specified in (a) above.
- (c) Out-of-squareness of a corner or an opening or an element such as a column will be measured by taking the longer of two adjacent sides as the base line, and determining any departure from the perpendicular of the side at either end of this base line.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

PS PB 6.2 PERMISSIBLE DEVIATIONS

The permissible deviations for elements or components shall be as follows:

- (a) Position on plan of any edge or surface measured from the nearest grid line or agreed centre line ± 25 mm
- (b) Linear (other than cross-section) dimensions ± 30 mm
- (c) Cross-section dimensions $-10 + 20$ mm
- (d) Level (deviation from designed level with reference to the nearest transferred datum (TD) of the upper or lower surface, as may be specified, of any slab or other element or component) ± 10 mm
- (e) Out-of-squareness of a corner or an opening or an element such as a column (See clause 6.1.2(c)) for short side of length:
 - (i) up to and including 0,5 m ± 5 mm
 - (ii) over 0,5 m up to and including 2 m ± 15 mm
 - (iii) over 2 m up to and including 4 m ± 20 mm
- (f) Exposed surface (including floor slabs and paving):
 - (i) Flatness of plane surface ± 5 mm
 - (ii) Abrupt changes in a continuous surface ± 5 mm
- (g) Exposed surface to be plastered or receive normal or granolithic screeds:
 - (i) Flatness of plane surface ± 10 mm
 - (ii) Abrupt changes in a continuous surface ± 5 mm
- (h) Surface of plaster and normal or granolithic screeds ± 5 mm

PS PB 7. TESTS

PS PB 7.1 GENERAL

The Engineer shall have free access to the works for taking samples and carrying out tests. The Contractor shall render any assistance necessary. If so required, the Contractor shall provide storage and protection of such samples on site.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

PS PB 8. **MEASUREMENT AND PAYMENT**

PS PB 8.1 **GENERAL**

8.1.1 All items in this section will be measured by number, square metre or linear metre completed and the tendered rates shall include full compensation for the supply, delivery, handling and installation of all materials, the provision of all necessary labour and supervision, transport, plant, equipment and incidentals necessary to complete, protect and maintain the works as specified or as shown on the drawings.

8.1.2 Where a lump sum is required for a complete structure the tendered rate shall include all items and contingencies, as specified in this section or as shown on the drawings.

PS PB 8.2 **SCHEDULED ITEMS**

8.2.1 **Brickwork** **Unit: m²**

Brickwork will be measured on the centre line of the walls. Areas occupied in walls by windows and doors will be excluded from the areas measured, and corners and intersections common to more than one brick wall will be measured once only.

The rate shall cover the cost of brickwork complete as specified, including test sections where specified, pointing, providing brick lintels, brick reinforcement and ties, etc., the building in of conduits, beams, pipe sleeves, doors and windows, the raking out of joints and the filling of cavities in cavity walls and walls constructed of hollow concrete masonry units, below floor level and elsewhere where specified.

The test section for faced brickwork as specified in clause 5.1.14 shall only be paid for if approved by the Engineer and, if rejected, shall be removed at the Contractor's expense.

8.2.2 **Air Bricks**

(a) External air bricks **Unit: No**

(b) Internal air bricks **Unit: No**

The rate shall cover the cost of providing and building in the air bricks as specified.

8.2.3 **Bagged Finish To Brickwork** **Unit: m²**

The rate shall cover the cost of providing rough sacking, additional cement grout as required and finishing the bagging as specified.

8.2.4 **Window Sills**

(a) External (describe) **Unit: m**

(b) Internal (describe) **Unit: m**

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

The rate shall cover the cost of providing and building in face bricks, fibre cement sheets or any other material prescribed, as well as all accessories specified.

8.2.5 **Tiling** **Unit: m²**

The rate shall cover the cost of providing all material and the laying and grouting of tiles, complete as specified.

8.2.6 **Plaster Work** **Unit: m²**

The rate shall cover the cost of the construction of the plaster work, including the supply of all materials, mixing, applying, finishing, forming reveals, joints, etc., complete as specified.

8.2.7 **Floor Screeds**

(a) Normal screeds **Unit: m²**

(b) Granolithic screeds **Unit: m²**

The rate shall cover the cost of the construction of the floor screeds, including the supply of all materials, mixing, laying, finishing, the forming of nosings, reedings, skirtings, etc. and, where the concrete sub-floor has matured, of the brushing and applying a cement grout, complete as specified.

8.2.8 **Paving** **Unit: m²**

The rate shall cover the cost of providing paving slabs or bricks, sand bedding and joint filling and expansion joint material and of constructing the paving.

8.2.9 **Waterproofing**

(a) Damp-proof course in walls **Unit: m**

(b) Damp-proof membrane under floors **Unit: m²**

The unit shall be the net length or area of waterproofing installed. The length or area of overlaps shall not be measured for payment.

The rate shall cover the cost of providing and laying all material as specified, including the sealing of all laps and joints, complete as specified.

8.2.10 **Expansion Joints** **Unit: m**

The rate shall cover the cost of providing and installing all filling and sealing material and of the forming of expansion joints, complete as specified.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

8.2.11 Joinery

- (a) Doors (type and size indicated) **Unit: No**
(b) Skirtings (size indicated) **Unit: m**
(c) Other items (describe or indicate drawing number) **Unit: No or m**

The rate shall cover the cost of the supply of all material, manufacture, cutting, waste, fixing and installation of the joinery items, complete as specified.

The rate for doors shall also cover the cost of the door frames and all accessories, such as hinges, hooks, bolts, locks, latches, etc., and of damp-proof course on both sides and above door frames in cavity walls, as specified.

8.2.12 Metalwork **Unit: No**

The rate shall cover the cost of supplying all material, manufacture, applying priming coat of paint or galvanising, as specified, delivery and building in of units, including burglar proofing where specified, locks, catches, glazing, etc., and of damp-proof course under all windows and on both sides and above frames in cavity walls, as specified.

8.2.13 Resilient Floor Finishings

- (a) Vinyl-fibre, PVC, or thermoplastic floor tiles (specify) **Unit: m²**
(b) Vinyl cove skirting **Unit: m**

The rate shall cover the cost of supplying all material and adhesives required and the laying of the floor finishings.

8.2.14 Painting **Unit: m² or Sum**

Only the surface covered by the final finishing coat shall be measured.

The rate shall cover the cost of surface preparation, supplying and applying all the coats of paint, repairing any damaged surfaces, and all materials necessary for completing the work.

8.2.15 Electrical Installation **Unit: Sum**

The rate shall cover the cost of supplying and building in of all equipment such as switchboards, conduits, wires, cables, sockets, light fittings, etc., cutting recesses, chases and holes in walls as required and repairing any damaged surfaces after installation, including testing of the installation.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

8.2.16 **Miscellaneous** **Unit: No, Sum or m**

The rate shall cover the cost of all workshop detail drawings, where prescribed, material, plant, tools and labour to complete the scheduled items complete, as detailed, including corrosion protection and/or painting, as specified, and building in.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

VAAL CENTRAL WATER

CONTRACT NO. BW283/ARWWTW/22

**REFURBISHMENT OF THE NYAKALLONG (ALLANRIDGE) WWTW:
CIVIL, MECHANICAL AND ELECTRICAL, CONTROL & INSTRUMENTATION**

MECHANICAL SPECIFICATIONS

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

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Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

1 GENERAL

The specifications herein covers the requirements for the design, supply, delivery, offloading, installation, testing, commissioning, handing over and upholding during the defects notification period.

The requirements set out herewith are the minimum anticipated and the Contractor shall be responsible to ensure that the equipment proposed is suitable in all respects for the duties and specifications herein.

1.1 Documentation - Supplied by the Contractor

Full particulars of the material and equipment offered shall be submitted at the time of tendering. All information requested shall be supplied on the Data Sheets in this Tender. Any additional information shall be given in accordance with the specific tender conditions; and all drawings, sketches, pamphlets, etc., shall be submitted with the Tender.

1.2 Documentation – Drawings

The Contractor shall supply the Engineer, with fully dimensioned drawings of the plant and equipment within as short a time as possible, but not exceeding the time as stipulated in the relevant Conditions of Contract.

The Contractor will indicate on the drawings the position and sizes of all foundations, bolt holes, openings in walls or floors and other special features, which might affect construction of the works, in order for the Engineer to arrange the necessary concrete work, foundations, bolt holes, openings for pipes, cable ducts, etc., to ensure proper erection and installation of the plant and equipment.

Any cutting or alteration of structural work arising from inadequate or incorrect dimensions and particulars afforded by the Contractor, or through late receipt of such particulars, will be arranged by the Engineer to be carried out as he thinks fit at the expense of the Contractor concerned under this Contract.

1.3 Import Permits

No special import permits will be available for the importation of plant and equipment under this Contract. Tenderers shall tender therefore on the understanding that if they are awarded the Contract, the plant and equipment will be supplied ex local stocks or that importation will be taken from their own permit quota.

Preference will be given to Tenderers offering plant and equipment of local manufactures.

1.4 Packing

All plant, equipment, apparatus and pipe-work likely to be damaged in loading or unloading, or through chafing or through being subjected to pressure, or likely to deteriorate through exposure to the atmosphere, is to be suitably packed to prevent such damage.

1.5 Quality Of Material And Acceptance

Any material and/or workmanship which is found to be unsound, damaged or contrary to the mechanical specification, or which is found during the defects liability period or during tests in situ to be defective, or in any

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

way contrary to the mechanical specification due to causes within the Contractor's control and responsibility shall be rejected.

All material rejected by the Engineer shall be replaced or repaired by the Contractor at his own expense to the instructions and satisfaction of the Engineer.

1.6 Operating and Maintenance Manual

The Contractor shall prepare and supply an Operating and Maintenance Manual for the successful operation and maintenance of the successfully installed plant and equipment. A draft of the Operating and Maintenance Manual shall be submitted after commissioning to the Engineer for approval. The draft shall then be corrected, if required, and three sets of the Operating and Maintenance Manual shall be submitted to Engineer. The Engineer will only then accept the plant and equipment as completed.

Listed below are the content required for the Operating and Maintenance Manual.

Section	Title	Content
1.	System Description	A comprehensive description of the system including schematic diagrams, where required for clarification.
2.	Commission Data	The results of all checks and measurements as recorded during the commissioning period shall be included and shall be compiled in such a manner that every check and measurement is clearly defined.
3.	Operating Instructions	Pre-start checklist for each individual plant. Starting and stopping instructions. Plant running checklist. Safety precautions to be taken. Manual operation. Operator's duties.
4.	Mechanical Equipment	Description of all major items of equipment with the make, model number, names, addresses and telephone numbers of the supplier, manufacturer or their agents. Design capacities of all equipment including selection parameters, selection curves, capacity tables etc. Manufacturer's brochures and pamphlets. Schedule of spares with part numbers recommended to be held in stock by the owner. Pressure vessel (e.g. receiver) test certificates.
5.	Maintenance Instructions	Schedule of maintenance particulars. Part numbers of all replacement items. Capacity curves of driven equipment. Sizes, types and lengths of drive couplings. Serial numbers of principal pieces of equipment.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Section	Title	Content
6.	Electrical Equipment	The following information shall be provided for all electrical equipment whether switchboard or field mounted. Electrical equipment schedule with make, model number, rating, commissioning setting and name, address and telephone number of suppliers. Maintenance instructions. Manufacturer's brochures and pamphlets.
7.	Instrumentation and Control	Description of each individual control system. Control equipment schedule with make, model number, rating, commissioning setting and name, address and telephone number of suppliers. Manufacturer's brochures and pamphlets. Maintenance instructions.
8.	Drawings	Paper prints of all Contractor's drawings (mechanical and electrical) updated to "As built" drawings. The Contract will be considered incomplete until all tests have been conducted to the satisfaction of the Engineer and all drawings and manuals have been handed over to the Engineer.

1.7 Programme of Work

The Contractor shall prior to carrying out any Scope of Work in the Contract, submit a methodology for each portion of the Scope of Works to the Engineer for approval. The methodology should also at all times be aligned with the Project Programme, and vice versa.

The Engineer may, from time to time, by order in writing, without in any way invalidating the contract or giving to the Contractor any claim for additional payment, require the Contractor to proceed with the execution of the works in such order as in his opinion may be necessary, and may alter the order and suspend any part of the work at such time and times as he may deem desirable in terms of the applicable Conditions of Contract.

When the work must of necessity be carried out in conjunction with the work of other Contractors or with that of the Employer, it shall be co-ordinated and arranged in such a manner so as to interfere as little as possible with the progress of such other work, and so as to offer every reasonable facility to other Contractors or to departmental employees of the Employer.

1.8 Civil and Structural Works

The civil and structural works to accommodate the plant and equipment will generally be provided by a third party under a separate Contract or as part of the same comprehensive Contract in advance of the delivery of the mechanical and electrical plant and equipment. It will be the responsibility of the Contractor to provide the third party and or Civil Contractor in writing with all requirements for structural openings, fixing holes or any construction related matter affecting the mechanical installation, well in advance of any construction of such

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

related building sections. Any cost forthcoming due to failure of the Contractor to comply, including any remedial action, will be for the account of the Contractor.

The Contractor may not make any structural openings or modifications to the buildings/structures without prior written approval by the Engineer.

1.9 Handling

The Contractor shall make his own arrangements for handling and transporting all plant and equipment to the site in a proper and careful manner to avoid damage. Any damage to the plant and equipment during handling and transportation will be for the account of the Contractor.

1.10 Storage

The Contractor shall be responsible for properly storing and protecting all plant and equipment against damage by water, weather, fire and any other interference before and during erection. Any damage to the plant and equipment during storage will be for the account of the Contractor.

1.11 Erection, Adjustment and Operation

This Contract is to include for the erection, adjustment, putting into proper working order and upholding of all plant and equipment supplied by the Contractor.

The erection of the plant and equipment is to be carried out under a skilled and experienced erector and the plant and equipment, when erected is to be of neat and workmanlike appearance, solidly and evenly supported true to line and level, plumb and in proper working order.

The erection of plant and equipment to include, proper grouting in of all bolts, pipes, fittings and holes left by the Civil Contractor for the reception of equipment and pipes.

In the event of the Contractor not commencing erection when required by the Engineer, or his speed or quality of erection not being to the satisfaction of the Engineer, the Employer shall in addition to any remedial action provided for under the applicable Conditions of Contract, have the right to commence erection or to assist in or to complete erection with his own staff, or to engage another Contractor to do the work, in which case all expenditure so directly incurred by the Employer, plus the addition of twenty (20) percent thereon for administration and supervision will be debited to the Contractor and shall be recoverable from him in such manner as the Employer may elect.

On completion of erection, the Contractor needs to:

- Clean all exposed metalwork
- Polish parts to be left bright
- Paint all other parts
- Finish off neatly all grouting and painting
- Clean and tidy the site area

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

After completion of erection, the Contractor is to operate the plant and equipment for the prescribed period as stipulated in the Conditions of Contract, Specification or Tender Data or in absence of such, at least for seventy-two (72) hours or such longer time as may be necessary in order to put all plant and equipment into proper adjustment and working order, using for this purpose the water and electricity provided free of charge by the Employer.

Before calling the Engineer for acceptance testing for handing over the plant and equipment, the Contractor is to ensure that every part of the plan and equipment is operating satisfactorily. The plant and equipment will only be taken over after the procedures as provided for in the relevant Conditions of Contract have been met, or in absence of such Conditions of Contract, once the Engineer is satisfied that the installation is completed, and the plant performs to specification or as otherwise agreed in writing by the Engineer or Employer.

In the event of the Contractor being unable to test and adjust the plant and equipment at the time of installation through circumstances beyond his control, it may be necessary for him to return to site later to undertake this work. An item has been provided in the Bill of Quantities to cover the cost of returning to site, if ordered by the Engineer to do so, in order to carry out this work.

The completion date will be taken as the date provided for in the relevant Conditions of Contract.

1.12 Training

The Contractor must provide training for the Employer's operators in the operation and maintenance of the plant and equipment installed by the Contractor, prior to and as a condition for taking over.

This training must be in a structured format providing hands on training and not only on a demonstration basis. The following documentation must be submitted to the Engineer as proof of training:

- Proof of request to the Employer to identify the relevant employees who must receive training.
- Schedule from the Employer of employees who must receive training, an agreed date for training and confirmation by the Employer that all such employees have been notified.
- A brief summary of training provided, signed by the relevant employee, must be submitted to the Employer with copies to the Engineer.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

2 FABRICATION

2.1 Carbon Steel

Steelwork shall be constructed, fabricated and erected in accordance with SABS Standard Building Regulations, Chapter 6, "Structural Steelwork", and with SANS 1200 H where applicable.

2.1.1 Fabrication and Assembly

The Contractor may use welded or bolted construction in agreement with the Engineer, specified differently in the Standard. All structural steel both before and after fabrication shall be, within the tolerances specified under tolerances and shall be flat, straight (unless required to be formed to another shape) and free from twists.

2.1.2 Cutting

Cutting of rolled steel joists and channel sections shall be by sawing. Cutting of angles, flats and plates shall be by sawing, shearing or cropping. Flame cutting will not be permitted.

All edges shall be free from any defects or distortions and any notch or similar defect shall be removed by grinding.

2.1.3 Finish

Edges shall be rounded to a radius of at least 2 mm. Weld spatter and other protrusions shall be removed.

2.1.4 Inspections

The Contractor shall arrange for the Engineer to inspect fabrications, including fabricated pipework, in the fabrication workshop and prior to corrosion protection.

2.2 Stainless Steel

Fabrication of stainless steels and 3CR12 shall follow the recommendations in "The Stainless Steel User Manual" and "The 3CR12 Fabrication Guide" issued by Columbus Stainless. Only fabricators experienced with stainless steel will be considered acceptable. Such fabricators shall use permanently dedicated storage and fabrication areas and shall use machines, tools and handling equipment suited and permanently dedicated to this type of material.

2.2.1 Fabrication and Assembly

The Contractor may use welded or bolted construction in agreement with the Engineer, specified differently in the Standard. All structural steel both before and after fabrication shall be, within the tolerances specified under tolerances and shall be flat, straight (unless required to be formed to another shape) and free from twists.

2.2.2 Cutting

Cutting of rolled steel joists and channel sections shall be by sawing. Cutting of angles, flats and plates shall be by sawing, shearing or cropping. Flame cutting will not be permitted.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

All edges shall be free from any defects or distortions and any notch or similar defect shall be removed by grinding.

2.2.3 Finish

Surfaces which become contaminated with steel or otherwise stained or otherwise marked so as to be of uneven colour, shall be cleaned by pickling or electro-cleaning rather than by grinding.

2.2.4 Inspections

The Contractor shall arrange for the Engineer to inspect fabrications, including fabricated pipework, in the fabrication workshop.

2.3 Testing

All tests shall be conducted in the presence of the Engineer. The Contractor shall be responsible for all tests and for all expenses incurred in this regard.

Should any portion of the work fail to pass a test, the fault or faults shall be made good by the Contractor at his own expense according to methods approved by the Engineer. After repairs have been completed, the work shall again be tested at the Contractor's expense.

All expenses related to shop and pre-delivery tests will be deemed to be included in the tendered rates for the supply and delivery of equipment. The costs related to field and in-situ tests will be deemed to be included in the tendered rates for the installation, field testing and commissioning of equipment.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

3 WELDING

3.1 Scope

This section covers all aspects related to welding.

3.2 Standards

Standard	Title
SANS 455:2011	Covered electrodes for the manual arc welding of carbon and carbon manganese steels
BS EN1011-1:2009	Welding. Recommendations for welding of metallic materials. General guidance for arc welding
BS EN1011-2:2001	Welding. Recommendations for welding of metallic materials. Arc welding of ferritic steels
BS4677:1984	Specification for arc welding of austenitic stainless steel pipework for carrying fluid
BS2633:1987	Specification for Class I arc welding of ferritic steel pipework for carrying fluids
BS2971:1991	Specification for class II arc welding of carbon steel pipework for carrying fluids
BS806:1993	Specification for design and construction of ferrous piping installations for and in connection with land boilers
API 1104	Standard for welding pipelines and related facilities

3.3 Welders

Standard	Title
BS4872-1:1982	Specification for approval testing of welders when welding procedure approval is not required. Fusion welding of steel
BS4872-2:1976	Specification for approval testing of welders when welding procedure approval is not required. TIG or MIG welding of aluminium and its alloys

Welders shall be experienced competent artisans approved in accordance with BS4872.

3.4 Welding Practice

3.4.1 Continuous Welding and Elimination of Crevices

Welding shall be continuous on all sides of any joint. All crevices, including those arising from welding on one side only, shall be eliminated. This requirement applies to the welding of all metals and, in this respect, it should be noted that welding deformation results from incorrect welding procedure rather than from continuous welding.

In special cases only, non-continuous welding might be approved in writing by the Engineer. The resulting crevices shall be sealed with the following Paint Systems:

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

System 1:		
	Preparation & Coating Method	DFT
	Blast steel surface to ISO-Sa3 in accordance with ISO 8501	
Coats	Polyamine/amide cured coal tar epoxy Carboline Bitumastic 50 or equivalent	1000µm

System 2:		
	Preparation & Coating Method	DFT
	Blast steel surface to ISO-Sa3 in accordance with ISO 8501	
Coats	Two-part solvent free epoxy Sigmaline 523 or equivalent	600µm

3.4.2 Weld Appearance

Welding shall be free of blowholes, projections, pinholes, splatter and undercuts and all welding flux shall be removed. All weld spatter and other sharp imperfections shall be removed prior to abrasive blasting. Prior to painting, weld beads with a surface irregularity exceeding 3 mm or with sharp crests having a radius under 2 mm shall be ground. Weld grinding must not be performed on 304L or 316L stainless steel, however, unless unavoidable and in approval by the Engineer.

3.4.3 Site Welding

Site welding shall be kept to a minimum and shall only be undertaken with the approval of the Engineer.

3.4.4 Stainless Steel Welding

Stainless steels shall be welded strictly as recommended in "The Stainless-Steel User Manual" issued by Columbus Stainless. Austenitic stainless steels to be welded shall be of the low carbon grade (i.e.: 304L, 316L, etc.). The welding rods used shall be the most suitable for the metal and purpose.

3.4.5 3CR12 Welding

3CR12 shall be welded strictly as recommended in "The 3CR12 Fabrication Guide" issued by Columbus Stainless. The welding rods used shall be the most suitable for the metal and purpose. Type 309 stainless steel welding rods shall be used for welding 3CR12 unless otherwise approved in writing by the Engineer.

3.5 Testing

All tests shall be conducted in the presence of the Engineer. The Contractor shall be responsible for all tests and for all expenses incurred in this regard.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

Should any portion of the work fail to pass a test, the fault or faults shall be made good by the Contractor at his own expense according to methods approved by the Engineer. After repairs have been completed, the work shall again be tested at the Contractor's expense.

All expenses related to shop and pre-delivery tests will be deemed to be included in the tendered rates for the supply and delivery of equipment. The costs related to field and in-situ tests will be deemed to be included in the tendered rates for the installation, field testing and commissioning of equipment.

3.5.1 Pipe Welding

3.5.1.1 Shop Welds

To prove the procedures, radiographic examination shall be made on 100% of the welded seams of the first pipe of each type. If unsatisfactory results are obtained, the successive pipes shall be radiographically examined until the procedures are found to be acceptable. Thereafter one pipe from each lot of 50 pipes shall be radiographically examined.

Irrespective of the above, each and every coil-joining butt weld for helically formed pipes, a 400 mm length from each end of every longitudinal weld seam of every pipe, and all welded seams of all specials shall be tested radiographically.

3.5.1.2 Field Welds

The Contractor shall supply all equipment and materials on the site and also personnel to conduct the radiographic examination in accordance with the requirements of API 1104 in respect of the full length of 10% of the circumferential welds made by hand welding and 2.5% of the circumferential welds made in accordance with to an approved automatic process during the installation of pipes and specials.

3.5.1.3 Defects

Cracks, a lack of complete penetration or a lack of complete fusion shall be considered as being injurious defects, and defective field welds shall be repaired in accordance with API 1104. The full length of all repairs shall be radiographically tested.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

4 CORROSION PROTECTION

4.1 Scope

This section covers corrosion protection of mechanical and electrical components in general and for materials or coatings for specific components. The requirements of this specification are additional to any corrosion protection that may be covered under any other section of these specifications. In the case of discrepancies between this section and the drawings, this section shall have preference.

Where alternative specifications are given to cover areas of high or low corrosivity and the environment of the component in service is not known, the specification for high corrosivity shall be used.

4.2 Application

4.2.1 Painting Contractor

Surface preparation and coating application shall be carried out by suitably trained and experienced industrial painting contractors who are fully equipped and staffed to do such work in their own covered premises strictly in accordance with the paint manufacturer's recommendations. Before proceeding with the corrosion protection coatings, the Contractor shall submit the name of the painting sub-contractor and the proposed works supervisor for approval by the Engineer.

4.2.2 Site Painting

Surface preparation and coating application shall not be done on site except for minor repairs, for application of the final aesthetic coat, where specifically called for in the specification or where permitted by the Engineer.

4.2.3 Stainless Steel Painting

It is not usually necessary to paint 316 stainless steel. If corrosion of 316 stainless steel does occur and depending on the appearance or extent of the problem, the Engineer may call for pickling, electro-cleaning, painting or replacement of the item at no additional cost. Painting may however be required if contaminated or stained surfaces cannot be properly cleaned or where stitch welding has been approved.

4.3 Quality Control

4.3.1 Quality Control Plan and Records

The Contractor shall provide a Quality Control Plan which shall include all steps in the surface preparation and corrosion protection process plus technical datasheets for all products proposed.

Records of compliance with the Quality Control Plan shall be maintained.

4.3.2 Responsibility

The Contractor is responsible for the quality of the work and materials used, irrespective of any quality surveillance that may be carried out by the Engineer.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

4.3.3 Rectification

If unacceptable work is found on site, the full area determined by the Engineer with that unacceptable area shall be redone after the Contractor has submitted a proposed Method Statement.

4.3.4 Inspections

The Contractor shall arrange for the coating application on fabricated steelwork to be inspected throughout by the Engineer. The Engineer may approve inspections by an independent competent person (hereinafter called the Inspector) appointed by and at the cost of the Contractor. Inspections shall be adequate to ensure compliance with the Specification and shall be done at the following stages as a minimum:

Coating (Hot-Metal Spray, Paint, etc.)

- After fabrication, but before surface preparation.
- After surface preparation, but before application of the first coat.
- After application of the final hot-metal sprayed coating or after application of the paint primer or first coat (as applicable).
- After the final factory applied paint or sealing coat.

Hot-Dip Galvanizing

- After fabrication, but before hot-dip galvanizing.
- After hot-dip galvanizing.

Duplex Protection (Hot-Dip Galvanizing and Coating)

- After fabrication, but before hot-dip galvanizing.
- After hot-dip galvanizing, but before application of the first coat.
- After application of the primer.
- After the final Site-applied paint coat.

4.3.5 Witness of Inspections

If the coating is to be done by an inspector other than the Engineer, the Contractor shall, nevertheless, arrange for the Engineer to witness the inspections at the latter's discretion.

4.3.6 Dry Film Thickness

Standard	Title
SANS2808:2008	Paints and varnishes - Determination of film thickness

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

The dry film thickness of any coat or coating system shall be determined in accordance with SANS 2808. The test method defines that the instrument is to be calibrated on a substrate that represents the surface to be coated.

4.3.7 Inspection report

A written report of the inspections, prepared by the Inspector and signed by both the Inspector and the Contractor, shall be submitted for appraisal by the Engineer before delivery of the equipment to Site.

4.3.8 Inspector

Inspectors appointed by the Contractor shall hold an appropriate qualification from one of the following:

- Corrosion Institute of Southern Africa.
- South African Institute of Welding.
- South African Institute for Non-Destructive Testing.
- South African Qualification and Certification Committee.

4.4 Surface Preparation

4.4.1 Imperfections

Welding shall be free of blowholes and all welding flux removed. All weld spatter, sharp edges and other imperfections shall be removed prior to abrasive blasting. Prior to painting, weld beads with a surface irregularity exceeding 3 mm or with sharp crests having a radius under 2 mm shall be ground. Weld grinding must not, however, be performed on stainless steel. Areas to be painted shall be free of crevices.

4.4.2 Cleanliness

The provision of acceptable cleanliness entails not only the removal of existing mill scale, coatings and/or corrosion product, but also the removal of surface contaminants such as oil, grease and soluble salts. Water soluble salts present on the steel before application of the primer shall not exceed 10 µg/cm².

4.4.3 Abrasive Blasting

Before coating, all new steel surfaces shall be abrasive blast cleaned in accordance with Section 4.3 of SANS 10064 to a preparation grade of ISO-Sa3 in accordance with ISO 8501. The blast profile, measured in accordance with SANS 5772 (dial gauge), shall be in the range of 50 to 75 µm. The abrasive shall comply with SANS 10064 and shall be free from all traces of oil, grease, foreign matter and corrosive contaminants such as chlorides, etc. The blasted surface shall be cleaned and degreased as required. The prepared surface shall be given the first coat of the painting system within 4 hours after blasting.

In instances where stainless steel and 3CR12 are to be painted, the surface shall be suitably abrasive blasted prior to primer application.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

4.4.4 Between Coats

Between coats or with previously painted surfaces in good condition, all traces of oils, greases, soluble salts and corrosive air borne contaminants shall be thoroughly washed from the surface to be painted using a detergent type cleaning agent, rinsed and dried. The previous coat shall then immediately be lightly sanded or otherwise prepared as recommended by the paint manufacturer, wiped clean, dried and painted. Solvents are not acceptable as a surface cleaning agent.

4.4.5 Hot Dip Galvanized Surfaces

Hot-dip galvanized surfaces to be painted shall not be passivated and shall be free from white rust and shall be cleaned with an approved water based galvanizing cleaner using non-metallic abrasive pads until a "water break free" surface is obtained. The surface shall then be thoroughly rinsed with clean potable water to remove all residues and dried immediately prior to painting. Where necessary to obtain adhesion a sweep blast of the surface shall be done after cleaning.

4.5 Metal Coatings and Duplex Coatings

4.5.1 Hot Dip Galvanizing

Standard	Title
SANS121:2011	Hot dipped galvanized coatings on fabricated iron and steel articles – Specification and test method

- Coatings shall be to the thicknesses detailed in the specification.
- Hot-dip galvanized material which is to remain unpainted shall be passivated as specified in SANS 121. Items to be painted after hot-dip galvanizing shall be air dried and not passivated.
- Hot-dip galvanized material shall be substantially free from white rust when it is erected on site. Stacking and storing shall always be done in a manner to prevent white rust forming.
- Damage to hot-dip galvanizing caused by welding, grinding, etc. is not acceptable. Repair to hot dip galvanizing damaged by handling or transport shall be done by cleaning the area and applying 3 coats of a zinc rich primer giving a dry film thickness of at least 100 µm and containing at least 94 % zinc in the dried film. If the Engineer considers that damage is excessive, such items shall be replaced on the expense of the Contractor.
- Welding after hot-dip galvanizing is not acceptable.
- The Contractor shall supply a galvanizer's guarantee or test certificate prior to installation.

4.5.2 Duplex Systems

Preparation and application of organic coatings on hot-dip galvanizing shall be done in accordance with the Hot Dip Galvanizers Association Southern Africa's Code of Practice for Surface Preparation and Application of Organic Coatings.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

The duplex system shall be as follows:

- Hot-dip galvanizing; without passivation of the zinc coating.
- Application of one coat of an epoxy primer (two part; for hot-dip galvanised surfaces) with a DFT of 75 µm.
- Polyurethane enamel finishing coat (two part) with a DFT of 50 µm; done on site after suitable repair to the primer.

4.5.3 Hot Metal Sprayed Coatings

Standard	Title
SANS2063:2008	Thermal spraying – Metallic and other inorganic coatings – Zinc, aluminium and their alloys

- The minimum coating thickness for both aluminium and zinc shall be 150 µm. Greater thicknesses may be detailed in the specification.
- The thickness shall be checked on every surface plane at points not more than 300 mm apart for small articles and 500 mm for large articles. Angles shall be checked along all 4 surfaces, channels along all 6 surfaces, pipes in 4 planes. The minus tolerance on thickness in isolated areas shall also not exceed –10 % and such low areas shall not be larger than 50 mm in diameter.
- The time between surface preparation and coating shall be shortened from 4 hours to 2 hours at any application area closer than 10 km from the coast.
- Unless otherwise specified, all hot-metal coatings shall be sealed and coated immediately after hot-metal spraying. The system shall consist of a low viscosity sealant, which is applied until absorption is complete, followed by a suitable coating system.

4.5.4 Systems

4.5.4.1 System 1: Immersion Application

System 1: Immersion Application		
	Preparation & Coating Method	DFT
Sealer	Epoxy zinc Sigmacover 522 or equivalent	60µm
1st Coat - Under	Epoxy pipe coating Sigmaguard 720 or equivalent	125µm
2nd Coat - Final	Epoxy pipe coating Sigmaguard 720 or equivalent	125µm
Total		310µm

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

4.5.4.2 System 2: Non-Immersion Application

System 2: Non-Immersion Application		
	Preparation & Coating Method	DFT
Primer	Two-part epoxy primer Intergard 269, Carboline Rustbond Penetrating Sealer, or equivalent	40µm
1st Coat - Under	Chemical resistant vinyl copolymer Carboline Polyclad 938 HB, or equivalent	70µm
2nd Coat - Final	Chemical resistant vinyl copolymer enamel Carboline Polyclad 938 HB, or equivalent	40µm
Total		150µm

4.5.4.3 System 3: Crane beams, gantries, etc.

System 3: Crane beams, gantries, etc.		
	Preparation & Coating Method	DFT
Primer	Two-part epoxy primer Carbolin Rustbond Penetrating Sealer, Intergard 269, or equivalent	40µm
1st Coat - Under	Two-part polyurethane enamel	35µm
2nd Coat - Final	Two-part polyurethane enamel	35µm
Total		110µm

4.5.4.4 System 4:

System 4:		
	Preparation & Coating Method	DFT
Primer	Micaceous oxide pigmented polyamide cured epoxy Sigmacover 522, or equivalent	80µm
1st Coat - Under	Solvent borne modified acrylic coating Sigma Topacryl coating, or equivalent	70µm
2nd Coat - Final	Solvent borne modified acrylic finish Sigma Topacryl finish, or equivalent).	45µm
Total		195µm

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

4.6 Paint Coatings

4.6.1 Paint Quality

Paint shall be of best quality, of approved manufacture and brand and comply with the requirements of the relevant SANS (South African National Standards) or BS Specifications.

4.6.2 Procurement

All materials in a paint system shall be purchased from one paint manufacturer.

4.6.3 Packaging

All coating materials shall be delivered in the manufacturer's original, sealed containers of maximum 25 litre capacity, clearly marked with the following:

- Manufacturer's name.
- Product Brand and Reference Number.
- Batch Number, which may incorporate the date of manufacture.
- Date of manufacture, unless already incorporated in the batch number.
- Abbreviated instructions for storage and use of the material, which shall include mixing ratios of components for multi-component materials, minimum temperature of application, method of application, and minimum and maximum overcoating times where applicable.

4.6.4 Confirmation of Suitability

Contractors shall obtain confirmation from their paint suppliers that, when using their paints, the systems specified are technically correct and suitable for the application and the material being coated.

4.6.5 Environmental Conditional Constraints

Paint shall not be applied if:

- The conditions are windy or dusty.
- The surface temperature is less than 10 °C.
- The surface temperature is less than 3 °C above dewpoint.
- The surface temperature is above 35 °C.
- The conditions are contrary to the manufacturer's recommendations.
- The relative humidity is 85% or above (the determination of humidity may be made using moisture sensitive hair-type gauges, electronic gauges or sling psychrometers (whirling hygrometers) having a resolution of at least 1% humidity. Electronic gauges shall have calibration certification not more than 6 months old. Moisture sensitive hair-type and analogue gauges shall have a calibration certificate not more than 1 month old. The

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

accuracy of thermometer used in sling psychrometers shall be tested by placing at least 4 thermometers displaying temperatures within half a degree Centigrade of a mean shall be used).

4.6.6 Mixing

Coating materials shall be mixed thoroughly by a power stirrer.

In the case of two-pack materials, each component shall be thoroughly stirred separately. The two components shall then be mixed together in the proportions supplied by the manufacturer until the mixture is completely homogeneous. The use of part of the contents is not acceptable.

In the case of solvent based epoxy materials, the mixed material shall be allowed to stand for the induction period recommended by the material manufacturer.

4.6.7 Painting

Paints shall be applied strictly in accordance with the manufacturer's instructions by tradesmen skilled in this class of work. Thinning of paint shall only be allowed for spray application and the manufacturer's recommended thinners shall be used.

4.6.8 Stripe coats

All edges and welds shall be provided with at least one stripe coat. This coat shall, preferably, be the same as the primer but can be the same as the intermediate coat.

4.6.9 Coating of Hidden Areas

Areas which will be inaccessible after erection and surfaces resting on floors shall receive the full paint system prior to erection.

4.6.10 Contact Surfaces

Contact surfaces shall be treated with one of the following systems, the system being chosen to suit the application:

- Surfaces shall be prepared and primed and brought together while the paint is still wet; or,
- Each surface shall be provided with one coat of inorganic zinc silicate; or,
- Surfaces shall be provided with a mastic or sealant; or,
- Surfaces shall be provided with insertion rubber or other gasket material.

4.6.11 Crevices

Crevices will not be permitted. Where unavoidable crevices are accepted by the Engineer, such crevices shall be sealed with either a coal tar product which can be applied at thicknesses of up to 1 000 µm such as Carboline Bitumastic 50 or equivalent; or a two-part solvent free epoxy which can be applied at thicknesses of up to 600 µm such as Sigmeline 523 or equivalent.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

4.6.12 Encased Items

Metal to be encased in concrete shall be painted externally up to 30 mm inside the concrete section, leaving the remainder bare so as to facilitate bonding with the concrete.

4.6.13 Protection of Machined Surfaces

Where painting of machined surfaces is not possible or advisable, these surfaces shall be coated with an approved proprietary anti-corrosion compound giving 12 months protection under operating conditions. Shaft ends and machined mating or mounting surfaces or pads shall be so coated and shall not be painted.

4.6.14 Coating Thicknesses

The dry film thickness shall be measured using a non-destructive thickness testing machine and shall comply with the Specification.

- 90 % of all thicknesses measured shall comply with the minimum requirements of the Specification.
- Up to 10 % of all readings may be below the specified minimum thickness, but may not be less than 80 % of the specified minimum thickness.

4.6.15 Repair

Painted areas damaged during transportation, erection or any means whatever shall be repaired as follows:

- Rusted spots shall be removed and cleaned by means of a wire brush or emery paper to a bright metal finish.
- Surrounding paint which is still intact shall be feathered for a distance of 50 mm beyond the damaged area.
- Spot priming and repair shall consist of all the coats previously applied and shall overlap the undamaged area.

4.6.16 Protection on Site

Proper and adequate use of cover sheets and other means shall be made to protect the existing paintwork from damage and from metal dust and sparks when welding, grinding, and wire brushing on site. Similarly, effective steps shall be taken to prevent spillage or splashing or other damage to floors, walls and equipment when painting on site and any damage or mess caused shall be corrected at the Contractor's cost.

4.6.17 Final Coat

A continuous, smooth finish with a uniform colour is required.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

4.6.18 Final Colour Code / Colour Marking

Standard	Title
SANS1091:2012	National colour standard
SANS10140-1:2008	Identification colour markings Part 1: General
SANS10140-2:2008	Identification colour markings Part 2: Identification of hazards and equipment in work situations
SANS10140-3:2017	Identification colour markings Part3: Contents of pipelines

Items made of stainless steel may be left unpainted provided the surface is of uniform self-colour without blemishes, rust, marks or stains. If blemished, the surfaces must either be painted or cleaned by pickling and/or electro-cleaning (not grinding or other mechanical means).

4.6.19 Systems**4.6.19.1 System 1: Large immersed steel fabrications**

System 1: Large immersed steel fabrications (Suitable for steel items subject to immersion, semi-immersion and non-immersion such as tanks, pipes, etc.)		
	Preparation & Coating Method	DFT
	Blast steel surface to ISO-Sa3 in accordance with ISO 8501	
1st Coat - Under	Two-part low solvent, high solids, polyamine/amide cured epoxy	120µm
2nd Coat - Intermediate	Two-part low solvent, high solids, polyamine/amide cured epoxy	120µm
3rd Coat - Final	Two-part low solvent, high solids, polyamine/amide cured epoxy	120µm
Total		360µm

4.6.19.2 System 2: Large immersed steel fabrications

System 2: Large immersed steel fabrications (Suitable for steel items subject to immersion, semi-immersion and non-immersion such as tanks, pipes, etc.)		
	Preparation & Coating Method	DFT
	Blast steel surface to ISO-Sa3 in accordance with ISO 8501	
1st Coat - Under	Two-part low solvent, high solids, polyamine/amide cured epoxy	120µm
2nd Coat - Intermediate	Two-part low solvent, high solids, polyamine/amide cured epoxy	120µm
3rd Coat - Final	Two-part low solvent, high solids, polyamine/amide cured epoxy	120µm
Non-chalking surface	Two-part polyurethane enamel	40µm



Contractor



Witness 1



Witness 2



Employer



Witness 1



Witness 2

System 2: Large immersed steel fabrications

(Suitable for steel items subject to immersion, semi-immersion and non-immersion such as tanks, pipes, etc.)

	Preparation & Coating Method	DFT
	Carboline 134 or equivalent	
Total		400µm

4.6.19.3 System 3: Large immersed steel fabrications**System 3: Large immersed steel fabrications**

(Suitable for steel items subject to immersion, semi-immersion and non-immersion such as Archimedes screw pumps, large tanks, etc.)

	Preparation & Coating Method	DFT
	Blast steel surface to ISO-Sa3 in accordance with ISO 8501	
1st Coat - Under	Polyamine/amide cured coal tar epoxy	140µm
2nd Coat - Intermediate	Polyamine/amide cured coal tar epoxy	140µm
3rd Coat - Final	Polyamine/amide cured coal tar epoxy	140µm
Total		420µm

4.6.19.4 System 4: Non-Immersed Steel – Coastal Atmosphere**System 4: Non-Immersed Steel – Coastal Atmosphere**

	Preparation & Coating Method	DFT
	Blast steel surface to ISO-Sa3 in accordance with ISO 8501	
Primer	Two component zinc epoxy	100µm
1st Coat - Under	Two component epoxy	150µm
2nd Coat - Final	Two-part polyurethane enamel	50µm
Total		300µm

4.6.19.5 System 5: Non-Immersed Steel – Moderate Atmosphere**System 5: Non-Immersed Steel – Moderate Atmosphere**

	Preparation & Coating Method	DFT
	Blast steel surface to ISO-Sa3 in accordance with ISO 8501	
1st Coat - Under	Inorganic zinc silicate	75µm
2nd Coat - Intermediate	Epoxy	75µm
3rd Coat - Final	Two-part polyurethane enamel	50µm
Total		200µm



Contractor



Witness 1



Witness 2



Employer



Witness 1



Witness 2

4.6.19.6 System 6: Hot Dip Galvanized Steel (Duplex)

System 6: Hot Dip Galvanized Steel (Duplex)		
	Preparation & Coating Method	DFT
	After hot dip galvanizing, do not passivate	
Primer	Two-part epoxy	75µm
1st Coat - Final	Two-part polyurethane enamel	50µm
Total		125µm

4.6.19.7 System 7: Repair to coating on Steel and Cast Iron (Maintenance Coating)

System 7: Repair to coating on Steel and Cast Iron (Maintenance Coating) (Suitable as a maintenance coat over weathered coatings and partial failed coatings)		
	Preparation & Coating Method	DFT
	Surface preparation shall include, as a minimum, removal of all loose mill scale, non-adherent rust and loose paint prior to wire brushing and de-greasing and shall comply with ISO-St3 (ISO 8501) or with SSPC-SP3 (Steel Structures Painting Council of the USA).	
1st Coat - Under	Two-part aluminium filled epoxy	100µm
2nd Coat - Intermediate	Epoxy	150µm
3rd Coat - Final	Two-part polyurethane enamel	50µm
Total		300µm

4.6.19.8 System 8: Cast Iron Components

System 8: Cast Iron Components (Suitable for motors, gearboxes and other cast iron components)		
	Preparation & Coating Method	DFT
	Blast steel surface to ISO-Sa21/2 in accordance with ISO 8501	
Primer	High build epoxy	100µm
1st Coat - Final	Two-part polyurethane enamel	60µm
Total		160µm

4.6.19.9 System 9: Steel (Dry applications up to 200°C)

System 9: Steel (Dry applications up to 200°C)		
	Preparation & Coating Method	DFT
	Blast steel surface to ISO-Sa3 in accordance with ISO 8501	
Sealer/Coat	Two-part micaceous iron oxide pigmented	60µm



Contractor



Witness 1



Witness 2



Employer



Witness 1



Witness 2

System 9: Steel (Dry applications up to 200°C)		
	Preparation & Coating Method	DFT
	polyamine/amide cured epoxy	
Sealer/Coat	Two-part micaceous iron oxide pigmented polyamine/amide cured epoxy	60µm
Total		120µm

4.6.19.10 System 10: Steel (Potable water up to 100°C)

System 10: Steel (Potable water up to 100°C)		
	Preparation & Coating Method	DFT
	Blast steel surface to ISO-Sa3 in accordance with ISO 8501	
Sealer/Coat	Two-part micaceous iron oxide pigmented polyamine/amide cured epoxy	80µm
Sealer/Coat	Two-part micaceous iron oxide pigmented polyamine/amide cured epoxy	80µm
Sealer/Coat	Two-part micaceous iron oxide pigmented polyamine/amide cured epoxy	80µm
Total		240µm

4.6.19.11 System 11: Steel and Cast iron (Dry applications up to 540°C)

System 11: Steel and Cast iron (Dry applications up to 540°C)		
	Preparation & Coating Method	DFT
	Blast steel surface to ISO-Sa3 in accordance with ISO 8501	
1st Coat - Under	Modified silicon	40µm
2nd Coat - Intermediate	Modified silicon	40µm
3rd Coat - Final	Modified silicon	40µm
Total		120µm

4.6.19.12 System 12: Steel Grating (Where HDG is not feasible)

System 12: Steel Grating (Where HDG is not feasible)		
	Preparation & Coating Method	DFT
	Blast steel surface to ISO-Sa21/2 in accordance with ISO 8501	
1st Coat - Final	Class flake resin (Dipping in catalysed resin)	
Total		

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

4.6.19.13 System 13: Fusion Bonded Epoxy

System 13: Fusion Bonded Epoxy (Suitable for immersed objects, cast iron valve bodies, pipework, etc.))		
	Preparation & Coating Method	DFT
	Blast steel surface to ISO-Sa21/2 in accordance with ISO 8501	
1st Coat - Final	Fusion bonded epoxy	300µm
Total		300µm

4.6.19.14 System 14: Hot Applied Thermoplastic

System 14: Hot Applied Thermoplastic (Suitable for immersed objects, cast iron valve bodies, pipework, etc.))		
	Preparation & Coating Method	DFT
	Blast steel surface to ISO-Sa21/2 in accordance with ISO 8501	
1st Coat - Final	Synthetic thermoplastic polyamide	300µm
Total		300µm

4.6.19.15 System 15: Repair of Coatings on Submerged Steelwork

System 15: Repair of Coatings on Submerged Steelwork		
	Preparation & Coating Method	DFT
	Abrade corroded areas to St 2 in accordance with ISO 8501. Feather existing coating and lightly abrade existing coating. Clean and degrease surfaces to be coated and allow to dry.	
1st Coat - Under	Solvent free epoxy	300µm
2nd Coat - Intermediate	Solvent free epoxy	300µm
3rd Coat - Final	Solvent free epoxy	300µm
Total		900µm

4.6.19.16 System 16: Thick coating for Complex Systems

System 16: Thick coating for Complex Systems		
	Preparation & Coating Method	DFT
	Clean and degrease surfaces to be coated and allow to dry.	
1st Coat - Under	Two-part solvent free epoxy (Sigmaline 523 or equivalent)	300µm
2nd Coat - Final	Two-part solvent free epoxy (Sigmaline 523 or equivalent)	300µm

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

System 16: Thick coating for Complex Systems		
	Preparation & Coating Method	DFT
Total		600µm
OR		
	Clean and degrease surfaces to be coated and allow to dry.	
1st Coat – Under/Final	Single-part cold applied coal tar coating (Carboline Bitumastic 50 or equivalent)	100µm
Total		1000µm

4.7 Testing

All tests shall be conducted in the presence of the Engineer. The Contractor shall be responsible for all tests and for all expenses incurred in this regard.

Should any portion of the work fail to pass a test, the fault or faults shall be made good by the Contractor at his own expense according to methods approved by the Engineer. After repairs have been completed, the work shall again be tested at the Contractor's expense.

All expenses related to shop and pre-delivery tests will be deemed to be included in the tendered rates for the supply and delivery of equipment. The costs related to field and in-situ tests will be deemed to be included in the tendered rates for the installation, field testing and commissioning of equipment.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

5 PLANT AND EQUIPMENT

5.1 General

All materials used in the manufacture and construction of plant and equipment shall be new, unused and shall be the best of their respective kinds, suitable for working at the pressures and temperatures involved under all working conditions without deteriorating or distorting or the setting up of undue stresses in any part. No welding, burning, filling or plugging of defective castings shall be permitted without the written approval of the Engineer.

The Contractor shall ensure that the materials are selected in accordance with the best engineering practice to suite the working conditions and extreme corrosive environments. Any material showing signs of corrosion, tuberculation or pitting before expiry of the defect's liability period shall be replaced by the Contractor at this own expense with materials to the Engineer's approval.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

6 STEELWORK

6.1 Scope

This section specifies the design, supply, fabrication, protection and installation of access steelwork, support frames, steel covers, recta-grid grating, access ladders and grouting into the Building/ Structures.

6.2 Standards

Standard	Title
SANS1431:2007	Weldable structural steels Grade 300W
SANS1700-1-1:2010	Fasteners Part 1: Terminology and nomenclature Section 1: Bolts, screws, nuts and accessories
SANS1700-2-1:2003	Fasteners Part 2: Screw threads Section 1: ISO general purpose screw threads - Basic profile - Metric screw threads
SANS1700-3-1:1996	Fasteners Part 3: Forms, dimensions and designations Section 1: Bolts, screws, studs and nuts - Symbols and designations of dimensions
SANS1700-4-1:2003	Fasteners Part 4: Tolerances Section 1: Tolerances for fasteners - Bolts, screws, studs and nuts - Product grades A, B and C
SANS1700-5-1:2011	Fasteners Part 5: General requirements and mechanical properties Section 1: Mechanical properties of fasteners made of carbon steel and alloy steel - Bolts, screws and studs
SANS10094:2017	The use of high-strength friction-grip bolts
BS4190:2001	Specification ISO metric black hexagon bolts, screws and nuts.
SANS10140:1991	Handrailing and balustrading (safety aspects)
BS5395-1:2010	Stairs Code of practice for the design of stairs with straight flights and winders
BS5395-2:1984	Stairs, ladders and walkways. Code of practice for the design of helical and spiral stairs
BS5395-3:1985	Stairs, ladders and walkways. Code of practice for the design of industrial type stairs, permanent ladders and walkways
BS5395-4:2011	Stairs Code of practice for the design of stairs for limited access

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Standard	Title
SANS10160	Basis of structural design and actions for buildings and industrial structures

Steelwork shall be legible marked with the markers name or trademark and identification marks.

The design of structural steelwork, where undertaken by the Contractor, shall comply with the requirements of SANS10160, and shall apply to all structural work made from other metals where relevant.

6.3 Fasteners - Bolts, Nuts and Washers

Diameter of fasteners shall be limited to M16, M20 and M24 unless specifically noted otherwise on the drawings.

Bolts and nuts shall be stainless steel or equivalent approved 4,8 quality in accordance with the requirements of SANS1700-5. High tensile bolts and nuts shall be 8,8 quality in accordance with the requirements of SANS1700-5.

Friction grip bolts and nuts shall comply with the requirements of SANS 10094.

The length of the bolts shall be such that when the bolt is in position and fully tightened the bolt shall project beyond the nut; this projection shall be not more than two threads.

Two washers of the same material as the bolt shall be provided with each bolt and nut.

All nuts and bolts may be gauged by the Engineer and nuts or bolts not complying with BS4190 will be rejected.

6.4 Grid Flooring

Grid flooring shall be provided in accordance with the details and positions as shown on the drawings. All grid flooring shall be of panels fabricated with a non-slip profile or finish.

Fibre glass grid flooring shall be of open grating type and not less than 38mm in depth. The mesh size shall not be less than 38mm x 38mm. Openings and holes for valve spindles, pump brackets, etc, shall be cut to the approval of the Engineer.

Steel grid flooring shall be of open grating type and not less than 38mm in depth. The mesh size shall not be less than 38mm x 38mm. The bearer bar pitch shall not be greater than 40mm. The bearer bars shall be across the shorter span. Openings and holes for valve spindles, pump brackets, etc, shall be cut and banded to the approval of the Engineer prior corrosion protection. Steel grid flooring and frames shall be mild steel hot dipped galvanized after fabrication.

GRP grid flooring shall include an anti-slip coating.

Grid flooring will be supplied in compliance with the Occupational Safety Act, Act No 85 of 1983.

6.5 Access Ladders

Access ladders shall be provided in accordance with the details and positions as shown on the drawings. The access ladders shall provide access to platforms that will enable accessibility to pipes/ valves/ equipment.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

Access points to the head of ladders from platforms and walkways shall be protected by self-closing gates or by chains. No part of the ladders shall project into the passageway.

The width between strings shall be between 350 mm and 450 mm. A minimum clear space of 250 mm must be allowed behind the rungs. The diameter of the rungs shall be approximately 25 mm and these shall be formed from high tensile steel reinforcing bar. Additional rungs shall be provided in the same horizontal plane as the top rung in order to close the gap between the platform and the ladder. Sufficient rungs shall be provided to ensure a maximum gap of 75 mm. These top rungs shall be at the same level as the floor or platform to which access is being provided.

The vertical distance between the ladder support brackets shall not exceed 1 800 mm. The strings shall extend to 1 100 mm above the floor or platform and shall be matched with any handrail protections at this level.

All rises in a flight shall be uniform. The top rung shall be level with the top platform or landing. The height chosen for the rise shall be between 225 mm and 255 mm.

The height of a ladder should not exceed 6 000 mm. Greater heights shall be provided with intermediate landings between each 6 000 mm ladder section. If the height between start and end levels is over 4 000 mm, the ladder shall be fitted with a safety cage. The safety cage shall extend at least 1 000 mm above the higher landing. The cage shall afford firm support along its whole length for the back of the person climbing the ladder, and for which purpose no part of the cage shall be more than 700 mm away from the level of the rungs.” (as per OHS General Safety Regulations). The cage shall comprise no fewer than seven vertical elements. Strings, rungs and support members shall be of solid structural sections (e.g. flat bar, round bar, square bar, angles, etc.) and no hollow sections will be accepted for any part of the ladder.

Access ladders will be supplied in compliance with the Occupational Safety Act, Act No 85 of 1983.

6.6 Staircases

Staircases shall be provided in accordance with the details and positions as shown on the drawings. The staircases shall provide access to platforms that will enable accessibility to pipes/ valves/ equipment. Each staircase shall be fastened with at least four bolts at its top to a structure, wall or beam. The bottom of each staircase shall be founded on a concrete base to which it shall be fastened with at least four bolts. The width of all staircases measured between the handrails shall, unless otherwise shown on the drawings, not be less than 900 mm.

Staircases will be supplied in compliance with the Occupational Safety Act, Act No 85 of 1983.

6.7 Handrails, knee rails and stations

Handrails and stanchions shall be of the ball type and shall be neatly finished with no visible joints.

Handrails and knee rails shall be 1 000 mm and 500 mm respectively. Handrails and knee rails shall not be less than 32 mm diameter.

Stanchions will be spaced a minimum of 1 500 mm apart on straight sections.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

Stanchion feet which are attached to metallic surfaces shall have minimum dimensions of 150 mm X 60 mm X 8 mm. Two fasteners of minimum size M16, shall be used to secure each foot. Neatly fitting packing, Denso tape or equivalent, shall be fitted under stanchion feet to prevent the formation of crevices.

Stanchion feet which are attached to non-metallic surfaces shall have minimum dimensions of 150 mm X 150 mm X 10 mm. In instances where the horizontal surface to which the foot is to be fastened is less than 150 mm wide, the foot shall be designed to be seated on at least two surfaces. Four fasteners of minimum size M16, shall be used to anchor the foot. Non-shrink, cementitious grout shall be applied under the foot just prior to final tightening of nuts.

Where kickplates are required by legislation, these shall extend to 150 mm above the walkway level.

Handrailing, knee railing and stanchions will be supplied in compliance with the Occupational Safety Act, Act No 85 of 1983.

6.8 Lifting equipment

6.8.1 General

Lifting equipment shall comply with the following general requirements:

- The design, fabrication and installation of lifting equipment shall be fully in compliance with the Occupational Safety Act, Act No 85 of 1983.
- Lifting equipment shall be designed, constructed and installed in accordance with a national or internationally accepted technical design standard.
- The guidelines given in the Southern African Steel Construction Handbook may be used where applicable and where these do not conflict with the internationally accepted technical design standard:
- Test certificates shall be provided for all items of lifting equipment.
- The safe working load (SWL) shall be permanently marked on all items of lifting equipment.
- Lifting equipment and installations shall be inspected and shall be tested over the complete lifting range using a test load.
- Unless otherwise specified in the internationally accepted technical design standard, the test load shall be:
 - at least 125 % of the SWL for equipment with a SWL of up to 10 tonne SWL;
 - at least 110 % of the SWL for equipment with a SWL of 10 tonne and above.
- High-tensile and alloy steel chains shall have a factor of safety of at least four. Other chains shall have a factor of safety of at least five.
- Steel-wire ropes shall have a factor of safety of at least six. Man-made fibre ropes or woven webbing shall have a factor of safety of at least six. Natural fibre ropes shall have a factor of safety of at least ten.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

- Anchor fasteners for securing steel structures to concrete shall have a diameter of not less than M16 and shall be Stainless Steel 316L or better.
- Base plates for columns which form part of lifting gantries shall be secured with a minimum of four anchor bolts.
- Hollow steel sections such as pipes and tubing are not acceptable as structural members unless the section is fully closed by welding.
- Contractor shall note that many aspects, such as fabrication, welding, corrosion protection and fasteners, shall be in accordance with the requirements of other clauses in this specification (including General Works).

6.8.2 Steel Gantries

In addition to the general requirements for lifting equipment, steel gantries shall comply with the following:

- The same national or internationally accepted technical design standard used for the design of the crawl beam or crane shall be used for designing the gantry which supports the crane or crawl beam.
- Columns shall be cross-braced and/or “triangulated” in more than one plane. In other words, columns shall not be cantilevered in any vertical plane.
- Gantry steelwork shall be mild steel and hot dip galvanised. If this is not feasible refer to Section: Corrosion Protection for coating specification.

6.8.3 Hoists

In addition to the general requirements for lifting equipment, hoists shall comply with the following:

- Hoists shall be provided with an overload prevention device; e.g. a clutch which slips upon overloading. Powered hoists shall comply in all applicable respects with Driven Machinery Contract (Version 2016) Section D C3.6 Annexes Standard Specifications for Mechanical Works 83 Regulation 18 of the Occupational Health and Safety Act.
- Powered hoists shall hold the load stationary upon power failure.
- The bottom hook shall swivel on a ball or roller bearing through 360° and the bearing shall have a protective skirt. The hook shall be fitted with a safety latch.
- Lifting chain is preferred, but corrosion-protected steel wire rope is acceptable.
- Chain boxes shall be provided for holding unloaded lengths of lifting chain.
- Wire rope hoists shall comply with the following:
 - Drum diameter shall be at least 25 times the wire rope diameter.
 - Drums shall have no more than three layers of wire rope when fully wound up.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

- Drums shall have no fewer than three full turns of wire rope remaining when the hook is at the lowest design level.

6.8.4 Lifting davits

In addition to the general requirements for lifting equipment, lifting davits shall comply with the following:

- Lifting davits shall be column mounted with swivelling booms and shall be designed to suit the application. Each lifting davit shall be provided with a winch rigidly fixed to the davit at a convenient height and position.
- Lifting davit shall be designed for a SWL at least 50 % above the load requirements of the equipment installation.
- Guide pulleys shall be provided to suit the arrangement. These pulleys shall be machined with a groove having a radius 5 % to 7,5 % greater than the rope radius and with a flare angle of 52°. The pulley effective diameter shall be not less than 25 times the wire rope diameter. The groove depth shall be twice the rope diameter or greater.
- The lifting davit shall either be manufactured of Stainless Steel 316L or better, or of carbon steel, hot-dip galvanized and painted. All fasteners, pins, shafts, shackles, hooks, etc., shall be of Stainless Steel 316L, or better. Guide pulleys and shafts shall be made of Stainless Steel 316L or better, or other approved corrosion resistant material, and shall use suitable non-metallic bearings which do not require lubrication.
- The swivelling arrangement shall be properly designed for easy operation, shall be accurately fitted and shall not be subject to corrosion problems. Bushes made of nylon, "Vesconite" or other suitable non-metallic material shall be used, and any metallic rubbing mating face shall be Stainless Steel 316L.
- Operating cross bars, locking arrangements, fixing arrangements, etc., shall not represent a hazard to passers-by. If necessary, operating levers shall be hinged so that they can be swung out of the way when not in use.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

7 PIPEWORK

7.1 Scope

This section covers the supply, delivery, installation, testing, commissioning and payment item descriptions for pipework.

7.2 Standards

7.2.1 Fibre Reinforced Cement Pipes and Fittings

7.2.1.1 Standards

Standard	Title
SANS1223:2014	Fibre-cement pressure pipes and couplings
BS486:1966	Specification for asbestos-cement pressure pipes
BS1832:1991	Specification for compressed asbestos fibre jointing

7.2.1.2 Details

Fibre reinforced cement pipes shall comply to SANS 1223.

7.2.1.3 Jointing

Fibre reinforced cement pipes shall be joined in accordance with the manufacturer's instructions.

Fibre reinforced cement pipes can be joined by:

- Fibre reinforced cement three ring sleeve couplings
- Cast iron short collar couplings where pipe ends have been cut

After cutting a fibre reinforced cement pipe to suit the position of a valve or fitting, the Contractor shall use an approved field-turning apparatus to turn the cut ends to suit the coupling sleeve, as filling of the ends of a fibre reinforced cement pipe will not be permitted.

Where cast iron detachable couplings are used, a gap of 10 mm, central to the coupling, shall be left between the pipe ends to allow for expansion when the pipes are filled and have absorbed moisture.

Where fibre reinforced cement pipe is joined to plain ended steel pipes, fibre reinforced cement adaptors are to be used.

Fibre reinforced cement fittings will not be allowed. Cast iron fitting to be used.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

7.2.2 Steel Pipes and Fittings

7.2.2.1 Standards

Standard	Title
SANS62-1:2013	Part 1: Pipes suitable for threading and nominal size, not exceeding 150mm
SANS62-2:2013	Part 2: Screwed pieces and pipe fittings of nominal size, not exceeding 150mm
SANS719:2011	Electric welded low carbon steel pipes for aqueous fluids (large bore)
SANS1476:2013	Fabricated flanged steel pipework

7.2.2.2 Details

Steel pipes shall comply with SANS62 and SANS719.

- Up to 150ND – SANS62 (Heavy Class – Refer to drawings)
- Over150ND – SANS719 (Class B– Refer to drawings)

Pipework up to 600ND shall be designed according to SANS1476.

Pipe wall thickness, based on rating, will be specified by the Engineer.

7.2.2.3 Jointing

Steel pipes and fittings shall be joined in accordance with the manufacturer's instructions.

7.2.3 Stainless Steel Pipes and Fittings

7.2.3.1 Standards

Standard	Title
ASTM A312/ SA312	Standard specification for seamless, welded and heavily cold worked austenitic stainless-steel pipes Schedule 10
ASME A403/SA403	Wrought Austenitic Stainless Steel Piping Fittings Schedule 10

7.2.3.2 Details

Stainless steel pipes shall comply with ASTM312.

Pipework and fittings – ASTM312/403 (Schedule 10)

7.2.3.3 Jointing

Stainless steel pipes and fittings shall be joined in accordance with the manufacturer's instructions.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

7.2.4 Ductile Pipes and Fittings

Standard	Title
SANS1835:2017	Ductile iron pipes, fittings, accessories and their joints for use in high- and low-pressure systems for portable and foul water
BS EN 969:2009	Ductile iron pipes, fittings, accessories and their joints for gas pipelines. Requirements and test methods

7.2.4.1 Details

Ductile iron pipes shall comply to SANS1835.

7.2.4.2 Jointing

Ductile iron pipes and fittings shall be joined in accordance with the manufacturer's instructions.

7.2.5 Malleable Cast Iron Pipes and Fittings

Standard	Title
SANS14:1994	Malleable cast iron fittings threaded to ISO 7-1

7.2.5.1 Details

Malleable cast iron pipes shall comply to SANS14.

7.2.5.2 Jointing

Malleable cast iron pipes and fittings shall be joined in accordance with the manufacturer's instructions.

7.2.6 UPVC Pipes and Fittings

Standard	Title
SANS966:2019	Components of pressure pipe systems Part 1: Unplasticized poly (vinyl chloride) (PVC-U) pressure pipe systems

7.2.6.1 Details

uPVC pipes shall comply to SANS966 and shall carry the SABS mark. The Contractor manufacturing and installing the pipework shall satisfy the requirements of ISO 9001. The rated maximum working pressure at operating conditions of the class of pipe selected shall not be less than 1.5 times the actual maximum operating pressure. Suitable protection must be provided to achieve the required design life of 50 years, when exposed to U.V light.

7.2.6.2 Jointing

uPVC pipes and fittings shall be joined in accordance with the manufacturer's instructions.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

7.3 Referenced Specifications

Fabrication	X
Welding	X
Corrosion Protection	X

7.4 Connection to existing pipelines

Wherever a new reticulation system or pipeline joins up with an existing network or pipeline, the Contractor shall notify the Engineer in good time as to when the connection will be required. The work will be carried out by the contractor who shall supply all nuts, bolts, gaskets and labour to perform the coupling.

7.5 Flushing and Sterilization of Pipelines

7.5.1 Pipeline: Potable Water

After each pipeline has been successfully tested, it shall be thoroughly flushed out with clean water until all sediment and other foreign matter has been removed.

The pipeline shall then be filled with water containing 0,015 grams per litre of chloride of lime. The solution shall be allowed to flow slowly into the pipeline until it fills it completely and shall be left there for at least 24 hours.

The pipeline shall then be thoroughly and repeatedly flushed with clean water until the water, which is flushed from the pipeline, complies with the requirements of the Employer.

7.5.2 Pipeline: Dosing of Liquid Chemicals

After each pipeline has been tested, it shall be thoroughly flushed out until all sediment and other foreign matter has been removed. Water shall be used for flushing-out purposes, provided that the water is suitable as a dilutant for the chemical which the pipeline is ultimately intended to convey. If water is not suitable as a dilutant, the undiluted chemical shall be used for flushing purposes. If it is practicable to dilute the chemical with a dilutant which is non-detrimental to the materials of the pipeline, the Contractor may do so. However, the dilution percentage shall be subject to approval by the Engineer.

During flushing, the pipeline shall not be subject to pressures exceeding 1,5 times the maximum design working pressure of the pipeline.

Upon completion of the flushing operation, the Contractor shall empty the flushing liquid from the pipeline and shall then clean it and leave it ready for the Employer to feed the correctly diluted chemical into the pipeline for commissioning.

The Contractor shall ensure that no spillages whatsoever occur during flushing and cleaning and he shall clean up any such spillages in a manner approved by the Engineer. The Contractor will be held responsible for all damages caused by spillages and he shall enforce all safety precautions in the handling of hazardous chemicals.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

Commissioning shall commence only after the Contractor has received written notice from the Engineer that the chemical solution has been delivered and that commissioning can proceed.

7.5.3 Pipeline: Raw or Treated Sewerage

After each pipeline has been successfully tested, it shall be thoroughly flushed out with clean water until all sediment and other foreign matter have been removed.

7.5.4 Pipeline: Gaseous Media

After each pipeline has been successfully tested, it shall be thoroughly flushed out with clean water until all sediment and other foreign matter have been removed.

Pipelines for the conveyance of gaseous media such as air-blower pipelines, methane-gas pipelines, chlorine-gas pipelines, etc, shall be blown clean with compressed air, or flushed with water, or a non-reactive chemical solution, after having been successfully tested.

7.5.5 Pipeline: Cleaning

Clearing of the pipelines shall be as follows:

- Pipelines up to 150 mm in diameter
 - These pipelines shall be directly connected to a contaminant-free compressed air supply, capable of maintaining a linear air-flow velocity of not less than 5m/s through the pipeline section with the largest nominal bore. All fittings which reduce the nominal bore, such as restrictions, orifices, nozzles, etc, or form recesses in the pipe invert like check valves, etc, shall be removed. These shall immediately be reinstalled after the air-flushing operation and after they have been blown clean with compressed air.
 - During the air-flushing operation, all in-line valves on the particular section being flushed shall be fully open. The air flow shall be maintained until all foreign objects or particles trapped inside the pipeline has been blown out at the open end. If drainage or scour valves are installed on the particular section being flushed, these valves shall be opened and closed in succession to promote the removal of dirt and foreign material as quickly as possible.
- Pipelines larger than 150 mm and up to 600 mm in diameter
 - These pipelines shall be treated as pipelines for liquids containing raw or treated sewage as specified above, and shall afterwards be ventilated with compressed air until the entire pipeline is internally dry.
- Pipelines larger than 600 mm in diameter
 - These pipelines shall be manually cleaned by brushing and the use of compressed air. Adequate ventilation shall be provided by using compressed air to ensure the removal of suspended dust particles and to ensure compliance with safety requirements. Cleaning operations shall progress in the same direction as the flow of the ventilation currents.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

7.6 Testing

All tests shall be conducted in the presence of the Engineer. The Contractor shall be responsible for all tests and for all expenses incurred in this regard.

Should any portion of the work fail to pass a test, the fault or faults shall be made good by the Contractor at his own expense according to methods approved by the Engineer. After repairs have been completed, the work shall again be tested at the Contractor's expense.

All expenses related to shop and pre-delivery tests will be deemed to be included in the tendered rates for the supply and delivery of equipment. The costs related to field and in-situ tests will be deemed to be included in the tendered rates for the installation, field testing and commissioning of equipment.

7.6.1 Hydrostatic Testing of Steel Pipes

Prior to the application of protective coatings and linings, each pipe shall be subjected to an approved hydrostatic test at a test pressure determined as follows:

$$P = \frac{2000tF}{D}$$

Where:

P	Test pressure in kPa
F	85% of the guaranteed minimum yield strength in MPa for the steel plate
D	Outer diameter of the pipe in mm
t	Wall thickness in mm.

Hydrostatic testing shall not be done until all aspects of fabrication have been completed. The pressure shall be applied steadily by an approved method and shall be maintained, without variation, for a period of time as agreed by the Engineer to allow proofing and inspection.

Should water sweat or ooze from any part, or any defect of any other nature be discovered, the pipe shall be emptied, and the defect made good. The pipe shall then be retested. Should a pipe, after repair, fail to pass the second hydraulic test, the Engineer may order its rejection.

7.6.2 Hydraulic or Pneumatic Field Testing of Pressure Pipes

Hydraulic or pneumatic testing shall commence only after the permanent thrust blocks have attained their specified strength. The contractor shall provide all the necessary testing equipment, including pressure-testing domes, blank flanges, the pump or compressor, meters, temporary valves, etc, for the conducting of the tests on the various pipes. Water for testing purposes will be provided free of charge by the Employer.

After the trench has been partly backfilled, and before the trench is filled in at the pipe joints and the fittings, the pipelines shall be tested in sections between isolating valves, end caps, blank flanges or other isolating devices at a pressure of 1,5 times the design maximum working pressure.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

In the case of fibre-cement pipelines, each section shall be filled with water 24 hours before the pressure is applied.

In the case of water pipes care shall be taken to ensure that all the air is expelled from the line to be tested after it has been filled and before the test commences.

7.6.3 Visible or Audible Leaks

The test pressure shall be maintained for a period of at least 3 hours (or such longer period as may be necessary for the inspection of the pipeline) by means of a suitable pump or compressor, during which period all pipes, specials, joints and fittings shall be carefully inspected for leaks. All visible or audible leaks shall be made good and any pipe, special or fitting found to be defective shall be removed and replaced at the expense of the Contractor, and such replacement material shall be tested at the expense of the Contractor after having been installed.

In the case of pipes with a nominal diameter of less than 400 mm, the test period may be reduced proportionally to the nominal diameter of the pipe, provided that the test period shall not be less than 1 hour.

7.6.4 Permissible Leakage Rates

The test pressure shall be maintained for a further period of 1 hour after the completion of the test period, during which time the volume of water required to be pumped into the pipeline for maintaining the pressure shall be measured.

No additional water shall be required in the case of continuously welded steel pipes, and in other cases the volume shall not exceed the value, in litres, calculated from the appropriate formula below:

$$V = F \times d \times L \times \sqrt{P}$$

Where:

V	Maximum volume in litres that may be added to maintain pressure
F	Multiplication factor: = 0,075 for fibre cement pipes = 0,01 for jointed pipes in steel, uPVC and HDPE = 0 for all other pipes
d	Diameter of pipe in millimetres
L	Length of test section in kilometres
P	Test pressure in MPa

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

8 VALVES

8.1 Scope

This section covers the supply, delivery, installation, testing and commissioning of manually and electrically or pneumatic actuated valves.

8.2 Requirements

All valves shall comply with the following (unless inapplicable or alternative is stipulated in Datasheets):

- Valves shall be designed and constructed to ensure reliable operation after long periods of non-operation.
- Valves shall be double-flanged unless unavailable or otherwise specified.
- Valves and their method of actuation shall be designed to operate under the full pressure rating of the valve.
- If not obvious from the configuration, all valves, including valves with gearboxes and valves with actuators, shall be provided with an indication of the current position as well as an indication of the closing and/or the opening direction.
- Spindle covers shall be provided for valves with rising spindles.
- The specific application shall be considered in the corrosion protection of valves.
- Spindles will be Stainless Steel 316, or better.
- Cast iron valve components, including valve bodies, shall be protected with System – “Fusion Bonded Epoxy” or System – “Hot-Applied Thermoplastic”.
- Metal plating of ferrous materials is not an adequate corrosion protection system for valves.
- Lever handles on small bore valves and position indicator plates shall be cast iron.
- Fasteners shall be of Stainless Steel 316, or better. This applies to all fasteners on the body of the valve and its gearbox. Pipework flange bolts are specified elsewhere.

8.3 Standards

8.3.1 Gate Valves

Refer to Datasheet.

8.3.2 Non-Return Valves

Refer to Datasheet.

8.3.3 Penstocks/Sluice Gates

Refer to Datasheet.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

8.4 Referenced Specifications

Fabrication	X
Welding	X
Corrosion Protection	X

8.5 Valve Closing Direction

Industry	Valve Closing Direction
Water	Anti-Clockwise closing
Wastewater and all other	Clockwise closing

8.6 Actuators

Manual operation, by lever, handwheel, etc., shall be provided on all actuators unless otherwise specified.

Metal plating of ferrous materials, (e.g. zinc or cadmium plating) is not an adequate corrosion protection system for items such as actuator shafts and such items shall be provided with an additional coating of a semi-setting, thick protective layer, such as a suitable Tectyl product, or equivalent.

8.6.1 Electrical Actuators

Refer to Datasheets (If applicable).

The actuator motor and gearbox shall form one integrated unit. Motors shall be for three phase, 400 Volt, 50 Hz supply, shall be Class F insulated (or better) and shall have an embedded thermostat for overload protection. The complete unit, including installation work, glands and controls shall be ingress protected to IP 68 unless otherwise specified.

If the opening or closing period is specified (e.g. to avoid water hammer) this period shall be achieved, without pulsing, by incorporating a suitable gear ratio to allow the motor to operate from fully open to fully closed without stop/starts.

For open/shut duties, the continuous actuator torque rating shall be at least 200 % of the start-opening or shut-off torque, whichever is higher, specified by the valve manufacturer for this application (after the gearbox mechanical advantage has been taken into account). For modulation duties, the continuous actuator torque rating shall be at least 400 %.

Design Requirements:

- Double sealed housings are preferred.
- Only direct, gear-driven units will be accepted.
- Open/close limits on the valve or sluice shall have adjustable set points.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

- The valve or sluice position on modulating units shall be infinitely variable, so that any position can be selected.
- Control of valves shall be by means of non-rising spindles unless otherwise specified.
- The gear case shall be isolated from valve or sluice thrust.
- The actuator shall be capable of operating effectively at any angle.
- No plastic or nylon gears will be accepted.
- Oil-bath lubrication is preferred for the gearbox.
- Permanently sealed bearings are preferred.
- The actuator shall be protected by means of a torque switch, an instantaneous reversal protection circuit and a jammed valve motor protection circuit.
- For high-speed applications, torque limiting brakes shall be supplied to prevent excessive valve seat loading.
- Indications for response times (fully closed to fully open) to be provided.

8.6.2 Pneumatic Actuators

Refer to Datasheets (If applicable).

Actuators shall be fabricated of non-corrosive materials and shall be mounted using stainless steel mounts and couplings. Fasteners shall be of stainless steel.

Unless the system configuration clearly does not require it, automatic spring-closing shall be provided to ensure that the valve closes (if open) or remains closed (if closed) upon power failure or failure of the air supply. The spring shall be of stainless steel.

Linear actuators shall be provided with stainless steel cylinder piston, cylinder rod and attachments. For open/shut duties, continuous actuator force rating shall be at least 200 % of the start-opening or shut-off force, whichever is higher, specified by the valve manufacturer for this application (after any mechanical advantage has been taken into account). For modulation duties, continuous actuator force rating shall be at least 400 %.

For open/shut duties of rotational actuators, continuous torque rating shall be at least 200 % of the start-opening or shut-off torque, whichever is higher, specified by the valve manufacturer for this application (after any mechanical advantage has been taken into account). For modulation duties, continuous actuator torque rating shall be at least 400 %.

The air supply upstream of each actuator shall be fitted with a filter-regulator unit with an automatically operating water drain trap.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

8.7 Leakage Detection – Penstocks

Leakage testing shall be done under maximum expected pressure and after all installation work has been completed. No leakage between the penstock frame and the structure shall be acceptable.

- The acceptable leakage rate shall be:
 - 0.015 l/s/m of seating perimeter/3 m pressure head (for off-seating penstocks);
 - 0.008 l/s/m of seating perimeter/3 m pressure head (for on-seating penstocks).
- On head pressure up to 5m, acceptable leakage rates shall be:
 - Less than 0.1 l/ m of seal periphery for wedge type gates,
 - Less than 0.3 l/ m of seal periphery for all other types of control gates and
 - Less than 0.5 l/m of seal periphery for stop boards or bulkheads
- For head pressure 5m and above, acceptable leakage rates shall be calculated using the following formula:
 - $R_{lm} = 0.1 + 0.0H_{os}$
 - Where:
 - H_{os} = on/off – seating head, in metres
 - R_{lm} = leakage rate in litres/minutes per metre of seal

8.8 Testing

All tests shall be conducted in the presence of the Engineer. The Contractor shall be responsible for all tests and for all expenses incurred in this regard.

Should any portion of the work fail to pass a test, the fault or faults shall be made good by the Contractor at his own expense according to methods approved by the Engineer. After repairs have been completed, the work shall again be tested at the Contractor's expense.

All expenses related to shop and pre-delivery tests will be deemed to be included in the tendered rates for the supply and delivery of equipment. The costs related to field and in-situ tests will be deemed to be included in the tendered rates for the installation, field testing and commissioning of equipment.

8.8.1 Visual Inspection

Visual, operational and dimensional inspection of valves as well as inspection of protective coatings will be carried out by the Engineer and/or the Manufacturer in the Manufacturers workshops prior to the despatch of valves to site.

Inspection by the Engineer shall in no way relieve the Manufacturer of any of his obligations to design, manufacture and supply valves strictly in accordance with the Specification.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

8.8.2 Hydrostatic Testing

All hydrostatic tests will be witnessed by the Engineer and the Manufacturer will give at least one-week prior notification to the Engineer of the proposed dates for such tests.

Valve bodies will be close end tested to at least 1,5 times the working pressure. Test pressures will be maintained for at least 5 minutes and valve bodies will be watertight in all respects at the test pressure.

Assembled valves will be open-end tested to 1,5 x working pressure for materials strength and soundness. Valves will be drop tight from both directions over the complete range of pressures from 0 to 1,5 x working pressure.

Each valve will be supplied with a test certificate certifying that it complies in all respects with the requirements of this Specification.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

9 FLANGES

9.1 Scope

This section covers the requirements for use of flanges.

9.2 Standards

Standard	Title
SANS1123: 2017	Pipe Flanges Table 1000/3 or 1600/3 (Depending on the design)
EN 1092-1:2001	Flanges and their joints Circular flanges for pipes, valves, fittings and accessories, PN designated Part 1: Steel flanges
EN 1092-2: 1997	Flanges and their joints Circular flanges for pipes, valves, fittings and accessories, PN designated Part 1: Cast Iron flanges
BS 4504-1:1969	Circular flanges for pipes, valves and fittings (PN designated) - Ferrous
BS10:2009	Specification for flanges and bolting for pipes, valves and fittings

Flange rating will be specified by the Engineer. Flanges shall be machined flat, i.e. without a raised joint face. Before the machined surfaces become affected by rust, they shall be coated with a mixture of white lead and tallow or other approved protective composition.

9.3 Referenced Specifications

Fabrication	X
Welding	X
Corrosion Protection	X

9.4 Testing

All tests shall be conducted in the presence of the Engineer. The Contractor shall be responsible for all tests and for all expenses incurred in this regard.

Should any portion of the work fail to pass a test, the fault or faults shall be made good by the Contractor at his own expense according to methods approved by the Engineer. After repairs have been completed, the work shall again be tested at the Contractor's expense.

All expenses related to shop and pre-delivery tests will be deemed to be included in the tendered rates for the supply and delivery of equipment. The costs related to field and in-situ tests will be deemed to be included in the tendered rates for the installation, field testing and commissioning of equipment.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

10 GASKETS

10.1 Scope

This section covers the requirements for use of gaskets.

10.2 Standards

Standard	Title
BS 2494: 1990	Specification for elastomeric seals for joints in pipework and pipelines
BS-1832: 1991	Specification for compressed asbestos fibre jointing

Gaskets used on flange joints shall be of rubber or compressed asbestos fibre at least 3 mm thick complying respectively with BS 2494 or BS 1832, as applicable. Full face gaskets shall be used for full face flanges. Inner bolt circle gaskets shall be used on raised face flanges and when clamping items such as wafer type valves between flanges inside the bolt circle. Properly designed O-ring seals are also acceptable.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

11 PIPEWORK AND VALVE SUPPORTS

11.1 Scope

This section covers the requirements for the support of pipework and valves.

For fabricated pipe supports and puddle pipes it relates to the design, manufacturing, supply, delivery, installation and/or erection of pipe supports and puddle pipes.

For encased concrete pipes and thrust blocks it related to the design, procure (rebar and concrete), formwork, casting and concrete curing of encased concrete pipes and thrust blocks.

11.2 Referenced Specifications

Fabrication	X
Welding	X
Corrosion Protection	X

11.3 Pipe Supports

Proposed designs of pipe supports shall be submitted to the Engineer for acceptance prior to manufacture.

Specific pipe support requirements are:

- Steel supports shall be fabricated from heavy duty hot-rolled steel sections. The complete assembly shall be hot dip galvanised after all fabrication is completed.
- Welds shall be "all-round".
- Each foot shall feature at least four anchor fasteners.
- For cantilevered pipe supports, the spacing between anchor fasteners shall be not less than one third of the cantilevered length.

The spacing between pipe supports shall be as follows:

Approximate distances between pipe support for steel pipe	
Pipe Diameter (ND)	Distance Between Supports (mm)
0 – 15	800
20 – 50	1 500
65 – 100	2 500
125 – 200	3 500
250 – 500	5 000
> 500	6 000
Distance between supports must be halved for pipe materials other than carbon steels and stainless steels.	

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Pipe supports shall be so located that when an item of mechanical equipment is removed, the associated valves and pipework are still adequately supported. Supports shall be provided close to heavy items such as valves. No external loads shall be placed on items of mechanical equipment such as pumps, compressors, etc. Adequate provision shall be made for expansion and contraction due to variations in temperature or pressure.

3 mm thick neoprene strips shall be placed between pipes and supports or clamps to protect the paintwork and limit corrosion. Where roller or sliding supports are used to accommodate movement, suitable wear blocks shall be fixed to the pipe to prevent damage.

Floor pipe supports shall be aligned using a nut above and below the foot. A space of at least 20 mm shall be left between the foot and the floor and this space shall be filled using non-shrink grout in accordance with the manufacturer's recommendations once alignment has been completed.

Alternative designs and installations may be submitted by the Contractor. Wall pipe supports shall be similar.

Concrete pipe supports shall be constructed after installation of the pipework and temporary supports shall be provided by the Contractor in positions which will not interfere with the construction of the concrete supports. Concrete pipe supports can be constructed before installation of the pipework if approved by the Engineer. 3 mm thick neoprene strips shall be placed between pipes and supports or clamps to protect the paintwork and limit corrosion.

11.4 Puddle pipes

Proposed designs of puddle pipes shall be submitted to the Engineer for acceptance prior to manufacture.

Where puddle pipes are encased in civil structures the Contractor shall ensure that sufficient precautions have been taken for corrosion protection. Unless otherwise specified in the specification, all puddle pipes that terminate inside a liquid containing sump/container shall be manufactured from Stainless Steel 304L or 316L, with the necessary insulated flanges, gaskets, galvanic corrosion protection requirements installed where required.

11.5 Encasing of pipes

Where specified or ordered by the Engineer, pipes shall be fully encased in accordance with the drawings. During concreting, pipes shall be supported near their ends on suitable pedestals and shall be suitably anchored where necessary to prevent uplift. All spaces under and around the pipes shall be properly filled with concrete.

No part of the concrete casing shall be closer than 150 mm to any flexible joint and concreting between joints shall be carried out in one continuous operation. The concrete shall be raised equally on both sides of the pipe.

Where shown on the drawings or ordered by the Engineer, soilcrete shall be used to encase the pipes fully and shall be placed in the same manner as concrete casing.

Care shall be taken to prevent concrete or soilcrete from entering flexible joints. Encasing the pipes shall only be carried out after the pipeline has been tested and passed and while the pipeline is still full of water. Formwork

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

shall be used where necessary to ensure that flexible joints remain uncased, and payment for such formwork shall be deemed to be included in the rates tendered for the encasing of the pipe.

11.6 Thrust blocks

Thrust blocks shall be constructed in accordance with the drawings and/or the Contractor's pipeline design at tees, bends, terminal valves and end caps and where otherwise directed by the Engineer. All flexible couplings shall be supported in the thrust directions by means of thrust blocks.

The sides and bottoms of excavations against which thrust blocks are cast shall be sound and undisturbed, and all loose material shall be removed. Excess excavations shall be filled with concrete simultaneously with the concreting of the thrust block and shall not be paid for unless the excess excavations have been authorized.

Care shall be taken to leave all pipe joints accessible, and no pipeline shall be tested unless the concrete has attained its full strength. Formwork shall be used to ensure the accessibility of joints.

Unless otherwise directed, no thrust blocks shall be constructed where steel pipes with flanged or welded joints are used.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

12 BEARINGS

12.1 Scope

Bearing systems shall be designed to provide safe start-up and shut-down, under normal stoppages as well as electrical supply failure, without damage.

Unless prevented from running in a particular direction, rotational bearings shall be designed to support shaft rotation in both directions.

12.2 Standards

Standard	Title
BS ISO 281: 2007	Rolling bearings. Dynamic load ratings and rating life.

12.3 Design and Selection

Ball and roller bearings shall generally be selected for a design life of 100 000 – 200 000 hours; i.e. the bearing manufacturer's category for machines required to work with a high degree of reliability 24 hours per day.

12.4 Application

Bearings shall be chosen primarily to suit the equipment manufacturer's requirements and the plant's design conditions, but the following guidelines shall be considered:

- Greased lubricated bearings are generally acceptable for units with power ratings up to 100 kW.
- Units with power ratings between 100 kW and 1 000 kW shall preferably be provided with rolling element bearings.
- Units with power ratings above 1 000 kW and with high speed shafts shall preferably be provided with plain bearings (oil-film type). Plain bearings shall be provided with oil ring lubrication or positively fed lubrication.

12.5 Protection

12.5.1 Thermal Alarms

Thermal alarms on bearing systems shall be set in accordance with the specific instructions of the equipment manufacturer or, if it necessary for these to be set on Site, such alarms shall be set after no less than 24 hours of operation have occurred.

12.6 Lubrication

12.6.1 Grease Lubrication

Where greasing points are not easily accessible, grease lines shall be piped to an easily accessible position for manual greasing. Each grease point shall be provided with completely separate pipework.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

A distributor shall be provided where motorised lubrication is provided to more than one destination. The distributor shall be a positive displacement device which ensures equal, successive lubrication to all destinations. Pipework for grease distribution shall be of stainless steel or non-ferrous metal.

12.6.2 Oil Lubrication

Where oil lubrication is provided, the Contractor is responsible for the initial oil fill and the first oil change, including flushing, draining and filling, after an initial run-in period not exceeding 3 months.

Oil level indicators shall be fitted for visual checking. Drain cocks, including Stainless Steel 316L fittings where necessary to permit convenient draining, and plugged at the end, shall be provided for oil reservoirs exceeding 1,5 litre capacity. Drains shall be from the lowest point and syphon type drains are unacceptable.

Lubrication systems shall be designed to exclude dirt and moisture. Air vents on the oil reservoir shall incorporate filters. Drain facilities shall always be provided.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

13 DRY WELL PUMPING EQUIPMENT

13.1 Scope

This section covers the design, supply, delivery, installation, testing and commissioning for dry-well pumping equipment.

All duties contained in the Tender Document should be confirmed by the Contractor.

13.2 Standards

Standard	Title
SANS1123: 2017	Pipe Flanges Table 1600/3 – Refer to drawings
BS10:2009	Specification for flanges and bolting for pipes, valves and fittings
BS 5315:1991	Hose clamps (worm drive type) for general purpose use (metric series)

13.3 Referenced Specifications

Corrosion Protection	X
Electrical Motors	X

13.4 Technical Requirements

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.

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 Safety Act, Act No 85 of 1983.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

Pumps shall be statically, dynamically and hydraulically balanced, at the manufacturer's workshop, to within the design operating range.

Pump's handling sewage, primary sludge, activated sludge or a similar product shall be capable of handling a solid size of 75 mm diameter or greater.

13.4.1 Pump Suction Pipework

Pump suction pipework requirements are:

- Velocity to be attained at less than or equal to 1.5m/s.
- No air leaks allowed or should be prevented.
- Eccentric reducer to be used unless otherwise specified by the Engineer.
- Isolation valve type (gate, butterfly, etc.) to be specified by the Engineer.
- Strainer allowance to be specified by the Engineer (If applicable).
- Bellmouth sizing to be confirmed by the Engineer prior to fabrication. Bellmouth and suction pipework material to be Stainless Steel 316 or better or in the case of other materials, it shall be coated to a minimum of 300µm with an approved abrasion and corrosion protection system

13.5 Pump Components

The Contractor shall take cognisance of the operating environment and the properties of the pumped medium, when selecting a pump and the materials of manufacturing of the different pump components. The removal of pump components may in no way interfere with the pipework.

13.5.1 Pump Casings

Pump casings shall be manufactured from high-grade cast steel or grey iron, rigidly secured to a plate or base, and shall be coated to a minimum of 300µm with an approved abrasion and corrosion protection system. The casing shall be selected for a minimum of 1000 kPa or 1,5 times the actual discharge pressure, whichever is the greater.

13.5.2 Shaft

The shaft shall be manufactured of high tensile steel. Where the shaft passes through the stuffing boxes it shall be fitted with removable wear-resistant sleeves. The shaft shall be designed so that the running speed is well below the first critical speed, and the complete rotor shall be accurately balanced after assembly.

13.5.3 Impeller

The impeller shall be screw or semi open and all parts of the impeller inaccessible to machining shall have a smooth finish. The impeller shall be hydraulically, statically and dynamically balanced.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

13.5.4 Bearings

Bearing systems shall be designed to provide safe start-up and shut-down, under normal stoppages as well as electrical supply failure, without damage.

Only ball or roller bearings shall be installed. All bearings shall be designed for an L_{10h} basic life of not less than 100 000 hours.

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.

13.5.5 Wearing Rings

Wearing rings shall be easily replaceable.

13.5.6 Shaft Seals

13.5.6.1 Gland Packing

Pumps shall be fitted with stuffing boxes and shall have packings of adequate depth. 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.

13.5.6.2 Mechanical Seals

Pumps shall be fitted with single or double flushed mechanical seals. The mechanical seals shall be of the axial direction, face type 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, whichever is specified. Mechanical seals shall have silicon or tungsten carbide sealing faces.

Pump shafts shall be hardened and accurately ground where the seal bears on the shaft.

13.5.6.3 Application

Liquid with little to no solids (non-aggressive liquids) up to 200 kPa discharge pressure:

Shaft sleeve with packed gland or mechanical seal.

Liquid with little to no solids (non-aggressive liquids) at pressures above 200 kPa or corrosive liquids at any pressure:

316 stainless steel shaft sleeves with mechanical seal.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

Liquids with solids in suspension at any pressure

Mechanical seal or packed gland with hardened and/or protected stainless steel shaft sleeve and grease seal. If a mechanical seal is specified, the pump gland shall be arranged to suit a clean water flush. A throttle bushing made of a suitable non-corrosive, self-lubricating material shall restrict the flushing water flow into the pump. Mechanical seals for such applications shall have silicon or tungsten carbide sealing faces.

13.5.7 Accessories

13.5.7.1 Plate

Label Properties	
Material	Stainless Steel
Thickness	0.5mm
Length	100mm
Width	50mm

13.5.7.2 Plate Information

Information on Plate	
Employer Name	Vaal Central Water
Treatment Works Name	Nyakallong (Allanridge) WWTW
Location	E.g. PST supernatant feed to Trickling Filters
Contract No.	Provided by Employer
Employer Serial No.	Provided by Employer
Flow Rate (m ³ /Hr)	
Head (m)	
Efficiency (%)	

The label shall be affixed to the pump exterior with an approved adhesive or other method over its full back surface after the completion of corrosion protection on the pump. It may follow the shape of the pump exterior over areas suited for the bending of flat surfaces excluding sharp folds. Under no circumstances shall the label plate influence, damage or otherwise have other detrimental effects on the corrosion protection system.

13.5.7.3 Guards

Guards will be supplied in compliance with the Occupational Safety Act, Act No 85 of 1983.

13.5.7.4 Lifting Eyes

Pumps shall be fitted with lifting eyes if the mass of the pump is more than 25 kg.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

13.5.7.5 Pressure Gages

Pressure tapping points shall be provided near the suction and discharge connections of each pump. All pumps supplied shall be fitted with glycerine-filled pressure gauges on the suction and delivery sides.

The pressure gauge 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 no 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 except for 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 minimise vibration on the pressure gauge.

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.

13.5.8 Pump Baseplate/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 Civil Contractor. 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.

13.6 Lubrication

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 Operation and Maintenance Manuals.

Bearings shall be grease lubricated and adequately sealed against the ingress of moisture or dirt.

13.7 Rotational Speed

The pump shall have a rotational speed not exceeding 1 450 RPM unless specified otherwise by the Engineer. If a higher rotational speed than specified is required by the Contractor, then the deviation will have to be motivated in a covering letter or in the datasheet.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

13.8 Installation

The pump shall be mounted on a base plate. The base plate shall be fastened to the concrete floor with at least six chemical anchors. The chemical anchors to be used and method of installation shall be approved by the Engineer.

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.

13.9 Testing

13.9.1 General

The complete testing including provision of test facilities, instruments and dummy loads as well as fuel shall form part of this Contract.

The Engineer reserves the right to call for:

- Test certificates and reports from the manufacturer's quality control laboratory or an independent test laboratory such as SABS, and/or
- Site inspection, customer reports/references and user's interviews, and/or;
- Full engineering, design and component selection details in order to check the correctness of the service life claimed

The Engineer shall be notified two weeks in advance of any tests in order that a representative can be sent to witness these tests.

The test instruments provided shall in all cases be of high quality and suitable to adequately access the quantities being measured or the equipment being tested. The test equipment remains the property of the Contractor.

13.9.2 Site Tests

The testing to be performed on the site is divided into two sections as follows:

- Before the tests on completion commence, the Contractor shall test the plant and equipment as described below to ensure that the equipment has been installed correctly.
- When the Contractor is satisfied that his plant and equipment is in running order, the tests on completion will commence as described below.

Before starting up any section of the plant, equipment or filling of tanks and sumps with process liquid, the Contractor shall:

- Clean out the tanks, pipes, fittings, equipment or structures.
- Arrangements with other Contractors to remove their building rubble from the structures.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

- Check that all safety devices and alarms have been set and activated.
- Check that all nuts have been tightened correctly.
- Check that all the equipment is complete and ready for start-up.
- Check that the plant has been installed correctly.
- Ensure that the operating and maintenance manuals have been handed over to the Engineer.

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 service, including refilling all the lubricating oils as well as 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 the site to do so.

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 pre-commissioning and commissioning tests. The Contractor shall not conduct an official pre-commissioning and commissioning test without the Engineer being present or his approval to do so. All equipment tested shall conform to the requirements specified.

13.9.3 Pre-Commissioning Tests

Testing and commissioning of plant and equipment on site shall be carried out by experienced personnel under the Contractor's supervision. All pre-commissioning tests and checks shall be agreed with the Engineer prior to the commencement thereof.

13.9.4 Commissioning Tests

When all pre-commissioning tests have been completed and accepted by the Engineer, then only can commissioning tests proceed.

The Contractor shall conduct all the tests required to satisfy the Engineer that the plant and equipment can perform in accordance with the specification and shall make allowance therefor in his tendered rates and prices.

The Contractor will request from the Engineer at least four weeks before commissioning tests commence, the commissioning sheets for all the equipment installed by the Contractor. These commissioning sheets shall be completed by the Contractor during the commissioning period and all items listed shall be entered. The commissioning sheets shall form the basis for the commissioning report.

Commissioning test shall be undertaken over a trouble-free period of at least thirty consecutive calendar days. The thirty-day tests-on-completion period will commence with a day-one test and terminate with a day-thirty test in compliance with the commissioning report. 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 and equipment required for ensuring that it operates as specified.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

Valid calibration certificates shall be available for all testing equipment on the site during the commissioning period.

During this period, the Contractor shall instruct and train the operating staff in the correct procedures of operating the plant and equipment under all circumstances of operation, including emergency conditions, the correct servicing of every part of plant and equipment, 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.

Commissioning of the plant and equipment (which includes the thirty days between the day-one and day-thirty tests) shall include operating under normal conditions, which shall adequately prove that all the specifications are met. All safety devices, standby 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 defect's liability or maintenance period if the performance of any equipment supplied under this Contract is suspected by the Engineer to be substandard. Such tests shall be for the Contractor's account and shall comply with the requirements specified. Copies of updated commissioning report shall be provided to the Engineer within two days after a test has been performed.

Note that if any equipment should fail during the thirty-day tests-on-completion period, the equipment shall be repaired or replaced by the Contractor, and testing and commissioning will commence from scratch, followed with a resubmission of the commissioning report.

The commissioning report will be signed off by the Engineer and Employer only when training has been provided to the staff and all other contractual requirements have been met.

Practical completion and final completion 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.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

14 WET WELL PUMPING EQUIPMENT

14.1 Scope

This section covers the design, supply, delivery, installation, testing and commissioning for wet-well pumping equipment.

All duties contained in the Tender Document should be confirmed by the Contractor.

14.2 Standards

Standard	Title
SANS1123: 2017	Pipe Flanges Table 1600/3 – Refer to drawings
BS10:2009	Specification for flanges and bolting for pipes, valves and fittings

14.3 Referenced Specifications

Corrosion Protection	X
Electrical Motors	X

14.4 Technical Requirements

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.

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 Safety Act, Act No 85 of 1983.

Pumps shall be statically, dynamically and hydraulically balanced, at the manufacturer's workshop, to within the design operating range.

Pump's handling sewage, primary sludge, activated sludge or a similar product shall be capable of handling a solid size of 75 mm diameter or greater.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

Pumps shall be designed to be suitable for submersion in water up to a depth of 10 m.

14.5 Pump Components

The Contractor shall take cognisance of the operating environment and the properties of the pumped medium, when selecting a pump and the materials of manufacturing of the different pump components. The removal of pump components may in no way interfere with the pipework.

14.5.1 Pump/Motor Casings

Pump casings shall be manufactured from high-grade cast steel or grey iron, rigidly secured to a pedestal, and shall be coated to a minimum of 300µm with an approved abrasion and corrosion protection system. The casing shall be selected for a minimum of 1000 kPa or 1,5 times the actual discharge pressure, whichever is the greater.

14.5.2 Pump/Motor connection

The motor shall be close coupled to the pump and separated from the pump casing by an oil chamber.

14.5.3 Shaft

The shaft shall be manufactured of Stainless Steel 316 or better. The shaft shall be designed so that the running speed is well below the first critical speed.

14.5.4 Impeller

The impeller shall be manufactured from Stainless Steel 316 or better or in the case of other materials, it shall be coated to a minimum of 300µm with an approved abrasion and corrosion protection system. The impeller shall be hydraulically, statically and dynamically balanced. No holes may be drilled in the impeller to balance it with regards to mass distribution.

14.5.5 Bearings

Bearing systems shall be designed to provide safe start-up and shut-down, under normal stoppages as well as electrical supply failure, without damage.

Only permanently sealed ball or roller bearings shall be installed. All bearings shall be designed for an L_{10h} basic life of not less than 100 000 hours.

14.5.6 Wearing Rings

Wearing rings shall be easily replaceable.

14.5.7 Shaft Seals

14.5.7.1 Mechanical Seals

Pumps shall be fitted with double flushed mechanical seals. The mechanical seals shall be of the axial direction, face type seals and shall isolate the motor from the oil chamber. The rotating seal face shall be mounted on a

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

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, whichever is specified.

Pump shafts shall be hardened and accurately ground where the seal bears on the shaft.

14.5.7.2 Application

Mechanical seal with hardened and/or protected stainless steel shaft sleeve and grease seal. Mechanical seals shall have silicon or tungsten carbide sealing faces.

14.5.8 Motor

The motor for an immersible pump shall be provided with an integral jacket cooling system designed for non-immersed operation at full power. The cooling fluid shall inhibit corrosion and shall be self-contained, i.e. shall not rely on an external flow system. The cooling fluid shall not be the pumped liquid itself. Positive circulation of the cooling fluid within the jacket is preferred.

14.5.9 Hoisting Facilities

The following components are required for wet well pump stations:

Components	Material
Holding Down Bolts	Stainless Steel 316L
Guiderails and fixing brackets	Stainless Steel 316L
Lifting Gantry / Lifting Davit	Carbon Steel – Hot Dipped Galvanized)
Hoist cable or chain	Stainless Steel 316L

14.5.10 Accessories

14.5.10.1 Plate

Label Properties	
Material	Stainless Steel
Thickness	0.5mm
Length	100mm
Width	50mm

14.5.10.2 Plate Information

Information on Plate	
Employer Name	Vaal Central Water
Treatment Works Name	Nyakallong (Allanridge) WWTW
Location	E.g. HT underflow to Division Box

					
Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

Contract No.	Provided by Employer
Employer Serial No.	Provided by Employer
Flow Rate (m³/Hr)	
Head (m)	
Efficiency (%)	

The label shall be affixed to the pump exterior with an approved adhesive or other method over its full back surface after the completion of corrosion protection on the pump. It may follow the shape of the pump exterior over areas suited for the bending of flat surfaces excluding sharp folds. Under no circumstances shall the label plate influence, damage or otherwise have other detrimental effects on the corrosion protection system.

14.5.10.3 Lifting Eyes

Pumps shall be fitted with lifting eyes situated such that it hangs upright while being lifted by means of a cable.

14.5.10.4 Cable

Length of power cable supplied to suit the installation shown in the drawings, shall not be less than 10 m in length. The unterminated end of the cable shall be properly sealed prior to installation and final termination to prevent the ingress of water into the cable and electric motor.

14.6 Rotational Speed

The pump shall have a rotational speed not exceeding 1 450 RPM unless specified otherwise by the Engineer. If a higher rotational speed than specified is required by the Contractor, then the deviation will have to be motivated in a covering letter or in the datasheet.

14.7 Installation

The pump shall be mounted on a pedestal. The pedestal shall be fastened to the concrete floor with at least six chemical anchors. The chemical anchors to be used and method of installation shall be approved by the Engineer.

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.

14.8 Testing

14.8.1 General

The complete testing including provision of test facilities, instruments and dummy loads as well as fuel shall form part of this Contract.

The Engineer reserves the right to call for:

- Test certificates and reports from the manufacturer's quality control laboratory or an independent test laboratory such as SABS, and/or

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

- Site inspection, customer reports/references and user's interviews, and/or;
- Full engineering, design and component selection details in order to check the correctness of the service life claimed

The Engineer shall be notified two weeks in advance of any tests in order that a representative can be sent to witness these tests.

The test instruments provided shall in all cases be of high quality and suitable to adequately access the quantities being measured or the equipment being tested. The test equipment remains the property of the Contractor.

14.8.2 Site Tests

The testing to be performed on the site is divided into two sections as follows:

- Before the tests on completion commence, the Contractor shall test the plant and equipment as described below to ensure that the plant and equipment has been installed correctly.
- When the Contractor is satisfied that his equipment is in running order, the tests on completion will commence as described below.

Before starting up any section of the plant, equipment or filling of tanks and sumps with process liquid, the Contractor shall:

- Clean out the tanks, pipes, fittings, equipment or structures
- Arrangements with other Contractors to remove their building rubble from the structures
- Check that all safety devices and alarms have been set and activated
- Check that all nuts have been tightened correctly
- Check that all the equipment is complete and ready for start-up
- Check that the plant has been installed correctly
- Ensure that the operating and maintenance manuals have been handed over to the Engineer.

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 service including refilling all the lubricating oils as well as 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 the site to do so.

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 pre-commissioning and commissioning tests. The Contractor shall not conduct an official pre-commissioning and

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

commissioning test without the Engineer being present or his approval to do so. All equipment tested shall conform to the requirements specified.

14.8.3 Pre-Commissioning Tests

Testing and commissioning of plant and equipment on site shall be carried out by experienced personnel under the Contractor's supervision. All pre-commissioning tests and checks shall be agreed with the Engineer prior to the commencement thereof.

14.8.4 Commissioning Tests

When all pre-commissioning tests have been completed and accepted by the Engineer, then only can commissioning tests proceed.

The Contractor shall conduct all the tests required to satisfy the Engineer that the plant and equipment can perform in accordance with the specification and shall make allowance therefor in his tendered rates and prices.

The Contractor will request from the Engineer at least four weeks before commissioning tests commence, the commissioning sheets for all the equipment installed by the Contractor. These commissioning sheets shall be completed by the Contractor during the commissioning period and all items listed shall be entered. The commissioning sheets shall form the basis for the commissioning report.

Commissioning test shall be undertaken over a trouble-free period of at least thirty consecutive calendar days. The thirty-day tests-on-completion period will commence with a day-one test and terminate with a day-thirty test in compliance with the commissioning report. 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 and equipment required for ensuring that it operates as specified. Valid calibration certificates shall be available for all testing equipment on the site during the commissioning period.

During this period, the Contractor shall instruct and train the operating staff in the correct procedures of operating the plant and equipment under all circumstances of operation, including emergency conditions, the correct servicing of every part of plant and equipment, 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.

Commissioning of the plant and equipment (which includes the thirty days between the day-one and day-thirty tests) shall include operating under normal conditions, which shall adequately prove that all the specifications are met. All safety devices, standby 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 defect's liability or maintenance period if the performance of any equipment supplied under this Contract is suspected by the Engineer to be substandard. Such tests shall be for the Contractor's account and shall comply with the requirements specified. Copies of updated commissioning report shall be provided to the Engineer within two days after a test has been performed.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

Note that if any equipment should fail during the thirty-day tests-on-completion period, the equipment shall be repaired or replaced by the Contractor, and testing and commissioning will commence from scratch, followed with a resubmission of the commissioning report.

The commissioning report will be signed off by the Engineer and Employer only when training has been provided to the staff and all other contractual requirements have been met.

Practical completion and final completion 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.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

15 ELECTRICAL MOTORS

15.1 Scope

This section covers the design, supply, delivery, installation, testing and commissioning of all electrical motors incorporated in any equipment supplied under this Contract.

Refer to Datasheets.

15.2 Standards

Standard	Title
SANS1804-1:2012	Induction motors. Part 1: IEC requirements
SANS1804-2:2012	Induction motors. Part 2: Low-voltage three-phase standard motors
BS EN 60034-1:2010	Rotating electrical machines. Rating and performance.
BS EN 60034-2-3: 2017	Rotating electrical machines. Specific test methods for determining losses and efficiency of converter fed AC motor.
BS EN IEC 60034-14:2018	Rotating electrical machines. Mechanical vibration of certain machines with shaft heights 56 mm and higher. Measurement, evaluation and limits of vibration severity.
BS 3790:2006	Specification for belt drives. Endless wedge belts, endless V-belts, banded wedge belts, banded V-belts and their corresponding pulleys.

15.3 Referenced Specifications

Corrosion Protection	X

15.4 Design

Motors shall be standard squirrel cage or slip-ring motors, suitable for both "continuous running duty", Duty Class S1, and "intermittent periodic duty", Duty Class S3. The motor shall have a minimum degree of protection of IP55, and totally enclosed fanned cooled (IC 0141). Submersible motors shall be suited for submersion up to a depth of 1,5 times the depth of submersion shown on the drawings for each application.

The motor windings shall be copper conductors insulated with Class F material (100 °C rise capability) with Class B temperature rise (80 °C). The motor shall be suitable for 6 starts per hour, two of which shall be consecutive.

All electric motors shall be rated for operation on a 3-phase, 4-wire, 400/230 volt, 50 Hz, AC supply at sea level, with an ambient temperature of up to 40 °C.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

The rated power of the motor shall be selected to be not less than 15 % in excess of the designed power requirement of the associated plant unless the motor forms part of a packaged unit and/or where the size of the motor is specified and/or as otherwise approved by the Engineer.

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. Motor manufacturers must be warned that the motors are to be installed in an extremely corrosive and often damp environment. All motors shall therefore be adequately protected against corrosion.

15.5 Rotational Speed

The motors shall have a rotational speed not exceeding 1 450 RPM unless specified otherwise by the Engineer. If a higher rotational speed than specified is required by the Contractor, then the deviation will have to be motivated in a covering letter or in a datasheets.

15.6 Motor Efficiency

The efficiency of all motors shall be guaranteed by the Contractor. 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.

15.7 Power Factor

The power factor of motors with a capacity of 20 kW or more shall not be less than 0,85 under all operating conditions.

15.8 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 workshop. The ratio of axial to radial vibration shall not exceed 0.5.

15.9 Motor Components

15.9.1 Motor Frame

Motor frames shall be of the totally enclosed fan cooled type with cast iron yoke frames and cast-iron end covers. Sheet steel is not acceptable for fan cowls, and these shall be of cast iron, tough plastic or stainless steel. The end covers and yoke shall be properly machined, and each cover shall locate on a spigot register to ensure concentricity and parallelism.

15.9.2 Bearings

All motors shall, wherever possible, be provided with pre-lubricated sealed bearings.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

Bearings shall be of grease lubricated roller and/or ball type, provided with grease nipples (with extension tubes where access is restricted) and sealed to suit external use. Bearings shall require only one lubrication per year. Motors required for external use shall be fully weatherproofed.

Bearing systems shall be designed to provide safe start-up and shut-down, under normal stoppages as well as electrical supply failure, without damage. Bearings shall be protected against eddy currents and shall be capable of withstanding vibrations caused by unbalanced loads.

Only ball or roller bearings shall be installed. All bearings shall be designed for an L_{10h} basic life of not less than 100 000 hours.

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 or equipment and the motor.

Bearings shall be positively sealed against water penetration.

Bearing numbers shall be given for all bearings in the pumps to facilitate replacement.

Submerged motors shall have dynamically balanced rotors supported by maintenance-free, sealed-for-life ball bearings.

15.9.3 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.

15.9.4 Terminal Boxes

Terminal boxes shall be top mounted wherever possible and arranged for cable entry from either side. The two ends of each stator winding shall be "brought out" to the terminal box. Squirrel cage motors shall be wired to permit both direct-on-line and star-delta starting.

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.

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. 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.

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.

Submerged motors shall have terminal boxes that are waterproof and suited for submergence up to the depth specified by the manufacturer.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

15.9.5 Thermistors

Motors of 55 kW and up to (but not including) 150 kW, as well as motors for variable speed drives shall be provided with thermistors embedded in the windings of each phase. The thermistor tails shall be "brought out" to separate terminals mounted near the motor winding terminal block.

15.9.6 Resistance Temperature Detector (RTD's)

Motors rated at 150 kW and above, both fixed and variable speed, shall be provided with PT 100 type RTDs. Two RTDs shall be provided per phase winding. All six shall be incorporated into the control system; three to provide monitoring and three to provide high temperature trip functions.

15.9.7 Heaters

Motors of size 75 kW and above shall be fitted with "pocket" heaters. The heater shall be mounted at the bottom of the motor frame and shall be replaceable without dismantling the motor. These shall be arranged to switch on when the motor stops operating and switch off when it starts operating.

15.10 Coupling

Motors shall be coupled direct to the equipment to be driven by means of approved couplings and/or gearboxes. Vee-belt and chain drives will be considered by the Engineer.

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.

15.10.1 Direct Drives / Couplings

Shaft couplings shall be selected to reduce transmission of misalignment forces and of torsional oscillations between the driving and driven machine. Couplings shall, wherever practical, be of the rubber-tyre or rubber compression type, keyed to the shafts. The driven equipment and electric motor shall be aligned to within 0,05 mm for equipment rated in excess of 100 kW, and to within 0,25 mm for equipment rated below 100 kW, both radially and axially, to avoid vibration.

Elastomeric elements shall be urethane based. Flexible metallic elements shall be of stainless steel. Couplings shall not require lubrication.

Spacer couplings shall be used in all cases where this will assist maintenance. Care shall be taken to ensure that the axial clearance between coupling flanges is well within the range specified by the supplier. The clearance shall lie not closer than 25% of the allowable range from either the lower or higher limits. No thrust shall be transferred from the motor to the driven equipment or vice versa.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

All couplings shall be covered with a sturdy guard that covers but does not touch moving parts. The guard shall be bolted in position and shall be easily removable. Coupling guards shall be in compliance with the Occupational Safety Act, Act No 85 of 1983 and shall be to the approval of the Engineer.

Direct, flexible couplings shall be maintenance-free.

After installation, the alignment of all couplings shall be checked by the Contractor in the presence of the Engineer. Alignment shall be accurate and to the approval of the Engineer.

15.10.2 Belt Drives

Belt drives shall only be used if approved by the Engineer. This clause only deals with V-belts. V-belt drives shall be designed to suit the power rating of the motor using service factors appropriate to the driving and driven machinery. V-belt drives shall be designed, manufactured and installed, utilizing taperlock pulleys with taperlocks keyed to the shaft.

Where alternative pulley diameters can be selected, preference must be given to the larger pulley diameters to minimize the belt loading on bearings. Suitable and accessible methods for adjusting the tension of the belts shall be provided. The driving and driven pulleys and belts shall be enclosed in a single sturdy guard which allows visual inspection of the belt condition with the guard fitted. The guard shall be easily removable for belt maintenance. Belts shall be easily removed and installed for maintenance purposes and shall be to the approval of the Engineer. Bearings shall be designed for an L10 life exceeding 100 000 hours.

Tenderers shall ensure that the bearing arrangements of driving and driven machinery are designed to cope with the loads imposed by vee-belt drives and shall incorporate lay shafts where necessary.

Lay shafts shall be supported by bearings mounted in bearing housings which are adequately sealed and fitted with grease nipples. Bearing units incorporating open, shielded bearings are not acceptable. Tenderers shall submit their design calculations and drawings for lay shaft arrangements for acceptance by the Engineer. The Contractor shall install at least two belts per coupling if belt drives are approved.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

16 GAUGES

16.1 Standards

Standard	Title
SANS 1062:2010	Pressure and vacuum gauges

16.2 General

Gauges shall comply with the following:

- Gauges shall be of durable industrial construction. Case and bezel shall be of stainless steel unless this material is unsuitable.
- Scale markings shall be radial, plain, straight, black lines on a white background and shall be spaced so that one scale division represents approximately 1 % - 1,5 % of the maximum scale value in values of 1, 2 or 5 multiplied by any power of 10 to suit the maximum operating rating.
- On circular gauges the scale shall be concentric and the maximum and minimum scale values shall be near the bottom of the gauge, with the scale symmetrically disposed about the vertical centre line of the gauge.
- The tip of the pointer shall be of the knife edge type extending across the scale divisions and shall be as close as practical to the dial.
- Wherever applicable, gauges shall be clearly strip marked in green to indicate the normal operating range and in red to indicate the non-permissible range of values. Such markings shall always be on the inner scale face and not on the glass face.
- The units of measurement shall be clearly marked on the dial. A printed label of approved non-corrosive material indicating the duty of the gauge shall be neatly fixed on or near the gauge.

16.3 Installation and Mounting

Gauges shall be installed and mounted in accordance with the following:

- Gauges shall be mounted vertically and in such a position that they can be easily read from floor level.
- Flanged nozzles for gauge tappings shall be provided on the parent pipework. Nozzles shall comply with the requirements of the Clause "Pipework".
- Gauges for permanent equipment installations, such as for centrifugal and reciprocating pumps, shall not be mounted directly on pipework but shall be mounted on a wall or on a pedestal stand so as to minimise vibration. Gauge cocks shall be provided at each end of the connecting pipework.
- Pressure gauges shall be fitted with an isolating and air bleed cock.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

- Pressure gauges used on sewage, sludge, powder, chemical or other applications where blockage or corrosion of the gauge is possible shall be fitted with a diaphragm type chemical seal, both being liquid filled. The portion of the seal in contact with the process liquid shall be of a suitable non-corroding material and, when solids are handled, shall have a large threaded socket connection not smaller than 1" BSP.
- Gauges for liquids containing solids shall have the nozzle on the side of the parent pipe and the configuration shall allow easy cleaning of the passageways.

16.4 Pressure Gauges

Pressure gauges shall comply with the following:

- Pressure, vacuum or compound gauges shall comply with SANS 1062. Gauges shall be of Accuracy class 1.6 and Durability grade A unless otherwise specified. The gauges shall bear the Standards South Africa mark.
- Gauges shall have a scale diameter of not less than 100 mm.
- Calibration shall be in kilo Pascals with the full scale reading between 1,5 and 2 times maximum actual operating pressure except where otherwise specified. The full scale reading for a gauge on the discharge leg of a centrifugal pump shall be higher than the pump shut-off head.
- All gauges shall be suitable for continuous operation and shall be liquid filled on all pump applications and where fluctuations in pressure may cause damage.
- Gauges shall not be mounted directly on equipment subject to vibration. Gauges in pump stations shall not be mounted directly on the pipework and shall be connected to the pressure tapping point by small diameter stainless steel pipework.
- For dry locations indoors, the casing may be reinforced plastic or epoxy coated aluminium and the elastic element and shank of stainless steel. For damp indoor locations, particularly in any location where sewage is flowing, and for all locations outdoors, the gauges shall be weatherproof and have the cases and other metal components of Stainless Steel 316.
- When used on steam lines a siphon shall be fitted between the steam line and the gauge which shall be filled with water before putting the gauge into service.

16.5 Temperature Gauges

Temperature gauges shall comply with the following:

- Temperature gauges shall have dials not less than 120 mm diameter. Accuracy shall be + 1 % of reading or better.
- The gauges shall be fitted vertically into removable Stainless Steel 316 wells and the gauges shall be removable without leakage from the pipe or vessel. Protrusion into a pipeline shall be kept to a minimum.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

When handling sludge, sewage or other abrasive liquids the protrusion shall not exceed 15 mm and in this case the wells shall also be of a heavy duty abrasion resistant type.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

VAAL CENTRAL WATER

CONTRACT NO. BW283/ARWWTW/22

**REFURBISHMENT OF THE NYAKALLONG (ALLANRIDGE) WWTW:
CIVIL, MECHANICAL AND ELECTRICAL, CONTROL & INSTRUMENTATION**

ELECTRICAL, CONTROL & INSTRUMENTATION SPECIFICATIONS

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

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Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

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Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

1 GENERAL

The specifications herein covers the requirements for the design, supply, delivery, offloading, installation, testing, commissioning, handing over and upholding during the defects notification period.

The requirements set out herewith are the minimum anticipated and the Contractor shall be responsible to ensure that the equipment proposed is suitable in all respects for the duties and specifications herein.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

2 SCOPE OF WORKS

The existing electrical, control and instrumentation installation is in a relative good condition with some maintenance work needed. The Scope of Work for this part of the project is to bring the electrical, control and instrumentation equipment installed back to a fully functional operational state, install the additional electrical, control and instrumentation equipment required and commission the works to comply with the latest norms and standards.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

3 MOTOR CONTROL CENTRES AND DISTRIBUTION BOARDS

Extensions to the existing Motor Control Centres (MCCs) and Distribution Boards (DB's) shall be provided for at the following locations:

Item	Type	Indoor/Outdoor	Location
1.	MCC-1	Indoor	Control Room Building
2.	MCC-2	Outdoor	BNR Reactor (Aerobic Basin)
3.	MCC-3	Outdoor	SSTs & RAS Pump Station
4.	MCC-4	Outdoor	Sludge Collection Pump Station
5.	MCC-5	Outdoor	BNR Reactor (Anaerobic/Anoxic Basin)

New MCCs and new DBs shall be provided for at the following locations:

Item	Type	Indoor/Outdoor	Location
1.	MCC-6	Indoor	Chlorine Dosing Facility

3.1 Existing MCC's and DB's

3.1.1 MCC-1: Control Room Building

Scope of Work:

- Add 1x new cubicles

Equipment Required:

Equipment	Qty	Description	Identification
1x Cubicle FEEDER to MCC- ¹	1	60Amp continuous current rated TP (triple pole) type Isolator complete with open / closed auxiliary contacts to Schneider Electric	Main Breaker
	Set	60/1 Amp current transformer.	Current Inputs
	3	2 Amp HRC fuse holders and fused links.	Voltage inputs
	4	315Amp continuous current rated HRC fuse holders and fused links.	Surge arrestors connection fuses
	3	2Amp continuous current rated HRC fuse holders and fused links	Indicator Lamp Protection
	3	Robust LED indicator lamps connected load side of the circuit breaker	Indicators for 3 Phase (Red , White and Blue Indications)

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

3.1.2 MCC-2: BNR Reactor (Aerobic Basin)Scope of Work:

- Add 2 x new cubicles
- Install remote I/O modules in new tier
- Switch to communicate with main PLC

Operation:

Parameter	Description
Type	DIN rail mounted network module and I/O modules complete with power supply.
Signal Cables	Fibre optic cable communication cables.
Protocol	Modbus Ethernet

Equipment Required:

Equipment	Qty	Description	Identification
1x Cubicle UPS Supply	1	20 Amp SP door interlocked MCCB	
	1	Selector switch for normal/UPS power selection	Maintenance purposes
	1	A UPS equal and similar to Meissner Power Systems that will provide battery standby power for at least one hour during a power failure must be supplied and installed under this contract. The UPS shall be installed inside panel and shall be well ventilated.	UPS
	All	Relays and contactors for automatic transfer to UPS power once the UPS power is restored	
	All	Terminal connections for UPS unit	
	All	UPS monitoring functions as specified	
	1	15 Amp SP MCCB	Remote I/O supply
	1	15 Amp SP MCCB	24V DC supply

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

Equipment	Qty	Description	Identification
1x Tier Remote I/O	1	10Amp SP door interlocked MCCB	
	1	230V/24DC stabilized power supply for 24V DC inputs to remote IO modules. (Power supply shall have adequate capacity for the application)	
	1	10Amp SP MCCB	Remote I/O
	1	Managed fibre ring Ethernet switch	Communications
	1	Unmanaged 8 port Ethernet switch of the same brand as the managed fibre ring switch	Communications
	1	Ethernet patch leads. Test and connect existing optical fibre	
	1	Modbus Ethernet communication module	
	1	Power supply module	
	1	Backplane to suite the application	
	1	16 channel, 24VDC digital input module	
	1	16 channel, 24VDC digital output module	
	2	8 channel, 4-20mA analogue input modules	
	1	4 channel, 4-20mA analogue output module	
	All	Surge arrestors from all field equipment 4-20mA	

Testing and Commissioning

Equipment	Qty	Scope of Work
Motor starter for front rake screen	1	Settings, network and functionality
FMU 90 level instrument and transmitter	1	Settings and functionality
Soft starters hardwire signals to main PLC for vertical fixed surface aerators	4	Settings and functionality
Motor starters for a-recycle pumps	2	Settings, network and functionality
Motor starters for WAS pumps	2	Settings, network and functionality

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

New Supervisory and Control I/O's

DESCRIPTION	RTD IN	Analog In	Analog Out	24V DC In	24V DC Out	Network Link
WAS Pump No. 1						1
WAS Pump No. 2						1
Tilting weir		1	1	2		
DO measuring		2		2		
Mixed Liquid Suspended Solids measuring		1		1		
Flow and level measuring		4		4		

3.1.3 MCC-3: SSTs & RAS Pump StationScope of Work:

- Add 2x new cubicles
- Install remote I/O modules in new tier
- Switch to communicate with main PLC

Operation:

Parameter	Description
Type	DIN rail mounted network module and I/O modules complete with power supply.
Signal Cables	Fibre optic cable communication cables.
Protocol	Modbus Ethernet

Equipment Required:

Equipment	Qty	Description	Identification
1x Cubicle UPS Supply	1	20 Amp SP door interlocked MCCB	
	1	Selector switch for normal/UPS power selection	Maintenance purposes
	1	A UPS equal and similar to Meissner Power Systems that will provide battery standby power for at least one hour during a power failure must be supplied and installed under this contract. The UPS	UPS

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

Equipment	Qty	Description	Identification
		shall be installed inside panel and shall be well ventilated.	
	All	Relays and contactors for automatic transfer to UPS power once the UPS power is restored	
	All	Terminal connections for UPS unit	
	All	UPS monitoring functions as specified	
	1	15 Amp SP MCCB	Remote I/O supply
	1	15 Amp SP MCCB	24V DC supply

Equipment	Qty	Description	Identification
1x Tier Remote I/O	1	10Amp SP door interlocked MCCB	
	1	230V/24DC stabilized power supply for 24V DC inputs to remote IO modules. (Power supply shall have adequate capacity for the application)	
	1	10Amp SP MCCB	Remote I/O
	1	Managed fibre ring Ethernet switch	Communications
	1	Unmanaged 8 port Ethernet switch of the same brand as the managed fibre ring switch	Communications
	1	Ethernet patch leads. Test and connect existing optical fibre	
	1	Modbus Ethernet communication module	
	1	Power supply module	
	1	Backplane to suite the application	
	1	16 channel, 24VDC digital input module	
	1	16 channel, 24VDC digital output module	
	2	8 channel, 4-20mA analogue input modules	
	1	4 channel, 4-20mA analogue output module	
	All	Surge arrestors from all field equipment 4-20mA	

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

Testing and Commissioning

Equipment	Qty	Scope of Work
Motor starter for SST Bridges	2	Settings, network and functionality
FMU 90 level instrument and transmitter	6	Settings and functionality
Pressure transmitter hardwiring to main PLC	2	Functionality
Motor starters for s-recycle pumps (RAS Pumps)	2	Settings, network and functionality

New Supervisory and Control I/O's

DESCRIPTION	RTD IN	Analog In	Analog Out	24V DC In	24V DC Out	Network Link
Flow and level measuring		6		6		

3.1.4 MCC-4: Sludge Collection Pump StationScope of Work:

- Add 4x new cubicles
- Install remote I/O modules in new tier
- Switch to communicate with main PLC

Equipment Required

Equipment	Qty	Description	Identification
1x Cubicle WAS Pump B	1	1.5kW TP continuous current rated motor protection MCCB complete with extended rotary handle for door interlocking [Mechanical operating handle for circuit-breaker, including door interlock, self-aligning spindle and padlocking facility] (Estimated and shall be coordinated with mechanical contractor to ensure correct supplies to mechanical equipment)	Main Breaker
	1	1.5kW Type 2 Coordination Direct-on-line motor starter MCCB Forward/reverse complete with sensitive quick reacting overload device as specified by screen manufacturer (Estimated and shall be coordinated with mechanical contractor to ensure correct supplies to mechanical equipment)	DOL Starter

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

Equipment	Qty	Description	Identification
	Set	Continuous current rated current transformer: Plus	Current inputs
	3	2 Amp HRC fuse holders and fused links: Plus	Voltage inputs
	All	Run, Trip and ready LED's	Indicator Lights
	1	Running hour meter	Running hours
	1	Manual-off-auto-remote selector switch: Plus	Selector Switch
	1	Set of Stop/Start push buttons: Plus	Stop/Start Push Buttons
	1	Mains operated timer to limit starts per hour: Plus	Limit Starts
	All	Power factor capacitors shall correct to a minimum of 98%, complete with all accessories (Fuses, Circuit breaker and Contactor) to complete the installation: Plus	Power Factor capacitors
	1	C&I motor protection relay complete with converter, with at least the following settings equal or similar to Schneider Electric Tesys U: ○ Electric Tesys U: ○ Thermal Overload Protection ○ Thermal Memory ○ Pre-Loading ○ Locked Rotor Protection ○ Jam Protection ○ Current Unbalance Protection ○ Phase Loss Protection ○ User-Selectable Auto Reset ○ Underload / Dry Run Protection ○ Restart Timer ○ Restart Contact ○ Phase Rotation Protection ○ Over voltage Protection ○ Under voltage Protection ○ Voltage Phase Symmetry ○ Latched LED Trip Indication Communications module must be provided, communication links with PLC/DCS Units. The communication interface must comply with either of the following: ○ Profibus-DP ○ ProfiNet ○ Industrial Ethernet ○ Modbus TCP/IP	Protection Settling on Relay

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Equipment	Qty	Description	Identification
		Under no circumstances, shall the use of proprietary protocols be allowed.	

Equipment	Qty	Description	Identification
1x Cubicle Recirculation Pump B	1	3kW TP continuous current rated motor protection MCCB complete with extended rotary handle for door interlocking [Mechanical operating handle for circuit-breaker, including door interlock, self-aligning spindle and padlocking facility] (Estimated and shall be coordinated with mechanical contractor to ensure correct supplies to mechanical equipment)	Main Breaker
	1	3kW Type 2 Coordination Direct-on-line motor starter MCCB Forward/reverse complete with sensitive quick reacting overload device as specified by screen manufacturer (Estimated and shall be coordinated with mechanical contractor to ensure correct supplies to mechanical equipment)	DOL Starter
	Set	Continuous current rated current transformer: Plus	Current inputs
	3	2 Amp HRC fuse holders and fused links: Plus	Voltage inputs
	All	Run, Trip and ready LED's	Indicator Lights
	1	Running hour meter	Running hours
	1	Manual-off-auto-remote selector switch: Plus	Selector Switch
	1	Set of Stop/Start push buttons: Plus	Stop/Start Push Buttons
	1	Mains operated timer to limit starts per hour: Plus	Limit Starts
	All	Power factor capacitors shall correct to a minimum of 98%, complete with all accessories (Fuses, Circuit breaker and Contactor) to complete the installation: Plus	Power Factor capacitors
	1	C&I motor protection relay complete with converter, with at least the following settings equal or similar to Schneider Electric Tesys U: ○ Electric Tesys U: ○ Thermal Overload Protection ○ Thermal Memory ○ Pre-Loading ○ Locked Rotor Protection ○ Jam Protection ○ Current Unbalance Protection ○ Phase Loss Protection	Protection Settling on Relay

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

		○ User-Selectable Auto Reset ○ Underload / Dry Run Protection ○ Restart Timer ○ Restart Contact ○ Phase Rotation Protection ○ Over voltage Protection ○ Under voltage Protection ○ Voltage Phase Symmetry ○ Latched LED Trip Indication Communications module must be provided, communication links with PLC/DCS Units. The communication interface must comply with either of the following: ○ Profibus-DP ○ ProfiNet ○ Industrial Ethernet ○ Modbus TCP/IP Under no circumstances, shall the use of proprietary protocols be allowed.	

Operation:

Parameter	Description
Type	DIN rail mounted network module and I/O modules complete with power supply.
Signal Cables	Fibre optic cable communication cables.
Protocol	Modbus Ethernet

Equipment Required:

Equipment	Qty	Description	Identification
1x Cubicle UPS Supply	1	20 Amp SP door interlocked MCCB	
	1	Selector switch for normal/UPS power selection	Maintenance purposes
	1	A UPS equal and similar to Meissner Power Systems that will provide battery standby power for at least one hour during a power failure must be supplied and installed under this contract. The UPS shall be installed inside panel and shall be well ventilated.	UPS
	All	Relays and contactors for automatic transfer to UPS power once the UPS power is restored	

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

Equipment	Qty	Description	Identification
	All	Terminal connections for UPS unit	
	All	UPS monitoring functions as specified	
	1	15 Amp SP MCCB	Remote I/O supply
	1	15 Amp SP MCCB	24V DC supply

Equipment	Qty	Description	Identification
1x Tier Remote I/O	1	10Amp SP door interlocked MCCB	
	1	230V/24DC stabilized power supply for 24V DC inputs to remote IO modules. (Power supply shall have adequate capacity for the application)	
	1	10Amp SP MCCB	Remote I/O
	1	Managed fibre ring Ethernet switch	Communications
	1	Unmanaged 8 port Ethernet switch of the same brand as the managed fibre ring switch	Communications
	1	Ethernet patch leads. Test and connect existing optical fibre	
	1	Modbus Ethernet communication module	
	1	Power supply module	
	1	Backplane to suite the application	
	1	16 channel, 24VDC digital input module	
	1	16 channel, 24VDC digital output module	
	2	8 channel, 4-20mA analogue input modules	
	1	4 channel, 4-20mA analogue output module	
	All	Surge arrestors from all field equipment 4-20mA	

Testing and Commissioning

Equipment	Qty	Scope of Work
Motor starter for Sludge Feed Pump	1	Settings, network and functionality
FMU 90 level instrument and transmitter	3	Settings and functionality

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

Equipment	Qty	Scope of Work
Motor starters for final effluent pump	1	Settings, network and functionality

Supervisory and Control I/O's

DESCRIPTION	RTD IN	Analog In	Analog Out	24V DC In	24V DC Out	Network Link
Flow and level measuring		5		5		
Pressure measuring		2		2		

3.1.5 MCC 5: BNR Reactor (Anaerobic/Anoxic Basin)Testing and Commissioning

Equipment	Qty	Scope of Work
Motor starters for vertical mixers	4	Settings, network and functionality

3.2 New MCC's and DB's**3.2.1 MCC-6: Chlorine Dosing Facility**MCC Requirements

Parameter	Description
Type	Indoor type floor standing on plinth, powder coated 304 stainless steel frame mounted with lockable front doors, the motor control panel must have a minimum IP rating of 55.
Supply	1 x 35mm ² 4core Aluminium PVC/SWA/PVC Cable from MCC-5
Colour	Painted Light Orange – B26 (SANS 1091:2012) external, White arc-free internal (see Painting and Finishing).
Fault Level	6kA
Sectioning	Multi-section, Form 3b or Form 4 to SANS IEC 60439.
Spare	30% for future extensions space.
Cable Entry	Incoming and Outgoing – Bottom. MCC gland plates shall be 3CR12 sheet steel.
Base	Single 100 x 50 x 6mm thick channel iron base with mitred corners and cross-bracing between every 2nd tier, hot-dipped galvanised.

Scope of Work:

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

- New MCC
- Install remote I/O modules
- Communicate with main PLC

Operation:

Parameter	Description
Type	DIN rail mounted network module and I/O modules complete with power supply.
Signal Cables	Fibre optic cable communication cables.
Protocol	Modbus Ethernet

Equipment Required:

Equipment	Qty	Description	Identification
1x Cubicle Incomer	1	40Amp continuous current rated TP (triple pole) type Isolator complete with open / closed auxiliary contacts to Schneider Electric	Main Breaker
	4	50Amp tint copper bus bars [appearance shall be aluminium], suitable clamps shall be used, and no drilling shall be allowed on the busbars [cubic system shall be used].	3 Phase + N
	1	30Amp tint copper bus bars [appearance shall be aluminium], suitable clamps shall be used, and no drilling shall be allowed on the busbars [cubic system shall be used].	Earth
	Set	40/1 Amp current transformer.	Current Inputs
	3	2 Amp HRC fuse holders and fused links.	Voltage inputs
	1	Front panel mounted LCD digital display supply network analyser comprising of combined voltage, current, maximum demand power measurement and power factor correction measurement complete with network card.	Network analyser
	4	315Amp continuous current rated HRC fuse holders and fused links.	Surge arrestors connection fuses
	1	Three Phase combined class 1&2 surge arrestor unit connection type 2 as per SANS 10142-1 2009 equal or similar to DEHNGuard DV M TT 255 with remote indicator panel & remote signalling contacts connected to the SCADA	Surge arrestor plus signals
	3	2Amp continuous current rated HRC fuse holders and fused links	Indicator Lamp Protection
	3	Robust LED indicator lamps connected load side of the circuit breaker	Indicators for 3 Phase (Red ,

 Contractor

 Witness 1

 Witness 2

 Employer

 Witness 1

 Witness 2

Equipment	Qty	Description	Identification
			White and Blue Indications)
	1	Relay for under voltages, phase sequence, and phase loss in three phase	Protection Relay

Equipment	Qty	Description	Identification
1x Cubicle Distribution Board (DB)	1	20Amp continuous current rated MCCB with door interlock (setting set to Amp) including C&I trip unit.	Main Breaker
	1	10A SP CB (1 on each phase)	Outside Lights
	1	10A SP CB	Photocell with integral Contactor for external lights
	1	10A SP CB	Photocell Bypass
	1	20Amp TP Earth Leakage (30mA): Plus	Circuits on EL
	1	20A DP continuous current rated CB) 230V supply (White)	Plug circuit
	2	10A SP continuous current rated CB) 230V supply (Blue)	Light circuit

Equipment	Qty	Description	Identification
2x Cubicle Chlorine Dosing Pumps	1	1.1kW TP continuous current rated motor protection MCCB complete with extended rotary handle for door interlocking [Mechanical operating handle for circuit-breaker, including door interlock, self-aligning spindle and padlocking facility] (Estimated and shall be coordinated with mechanical contractor to ensure correct supplies to mechanical equipment)	Main Breaker
	1	1.1kW Type 2 Coordination Direct-on-line motor starter MCCB Forward/reverse complete with sensitive quick reacting overload device as specified by screen manufacturer (Estimated and shall be coordinated with mechanical contractor to ensure correct supplies to mechanical equipment)	DOL Starter
	Set	Continuous current rated current transformer: Plus	Current inputs
	3	2 Amp HRC fuse holders and fused links: Plus	Voltage inputs
	All	Run, Trip and ready LED's	Indicator Lights
	1	Running hour meter	Running hours

 Contractor

 Witness 1

 Witness 2

 Employer

 Witness 1

 Witness 2

Equipment	Qty	Description	Identification
	1	Manual-off-auto-remote selector switch: Plus	Selector Switch
	1	Set of Stop/Start push buttons: Plus	Stop/Start Push Buttons
	1	Mains operated timer to limit starts per hour: Plus	Limit Starts
	All	Power factor capacitors shall correct to a minimum of 98%, complete with all accessories (Fuses, Circuit breaker and Contactor) to complete the installation: Plus	Power Factor capacitors
	1	C&I motor protection relay complete with converter, with at least the following settings equal or similar to Schneider Electric Tesys U: ○ Electric Tesys U: ○ Thermal Overload Protection ○ Thermal Memory ○ Pre-Loading ○ Locked Rotor Protection ○ Jam Protection ○ Current Unbalance Protection ○ Phase Loss Protection ○ User-Selectable Auto Reset ○ Underload / Dry Run Protection ○ Restart Timer ○ Restart Contact ○ Phase Rotation Protection ○ Over voltage Protection ○ Under voltage Protection ○ Voltage Phase Symmetry ○ Latched LED Trip Indication Communications module must be provided, communication links with PLC/DCS Units. The communication interface must comply with either of the following: ○ Profibus-DP ○ ProfiNet ○ Industrial Ethernet ○ Modbus TCP/IP Under no circumstances, shall the use of proprietary protocols be allowed.	Protection Settling on Relay
	All	Monitoring and control equipment.	Control & Monitoring functions

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Equipment	Qty	Description	Identification
	All	Relays, auxiliary contacts, indicating lights, wiring and reset buttons necessary for the following	
		Interlocking with emergency stop station.	E-Stop
		Interlocking with Free Chlorine Meter and Flow Meter for dosing control. Note: No Flow = No dosing	Dosing Control

Equipment	Qty	Description	Identification
2x Cubicle Calcium Hypochlorite Dosing Pumps	1	1.1kW TP continuous current rated motor protection MCCB complete with extended rotary handle for door interlocking [Mechanical operating handle for circuit-breaker, including door interlock, self-aligning spindle and padlocking facility] (Estimated and shall be coordinated with mechanical contractor to ensure correct supplies to mechanical equipment)	Main Breaker
	1	0.25kW Type 2 Coordination Direct-on-line motor starter MCCB complete with sensitive quick reacting overload device as specified by screen manufacturer (Estimated and shall be coordinated with mechanical contractor to ensure correct supplies to mechanical equipment).	DOL Starter
	Set	Continuous current rated current transformer.	Current inputs
	3	2 Amp HRC fuse holders and fused links.	Voltage inputs
	All	Run, Trip and ready LED's.	Indicator Lights
	1	Running hour meter.	Running hours
	1	Manual-off-auto-remote selector switch.	Selector Switch
	1	Set of Stop/Start push buttons.	Stop/Start Push Buttons
	1	Mains operated timer to limit starts per hour.	Limit Starts
	All	Power factor capacitors shall correct to a minimum of 98%, complete with all accessories (Fuses, Circuit breaker and Contactor) to complete the installation.	Power Factor capacitors
	1	C&I motor protection relay complete with converter, with at least the following settings equal or similar to Schneider Electric Tesys U: - Electric Tesys U: - Thermal Overload Protection - Thermal Memory - Pre-Loading	Protection Settling on Relay

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Equipment	Qty	Description	Identification
		○ Locked Rotor Protection ○ Jam Protection ○ Current Unbalance Protection ○ Phase Loss Protection ○ User-Selectable Auto Reset ○ Underload / Dry Run Protection ○ Restart Timer ○ Restart Contact ○ Phase Rotation Protection ○ Over voltage Protection ○ Under voltage Protection ○ Voltage Phase Symmetry ○ Latched LED Trip Indication Communications module must be provided, communication links with PLC/DCS Units. The communication interface must comply with either of the following: ○ Profibus-DP ○ ProfiNet ○ Industrial Ethernet ○ Modbus TCP/IP Under no circumstances, shall the use of proprietary protocols be allowed.	
	All	Monitoring and control equipment.	Control & Monitoring functions
	All	Relays, auxiliary contacts, indicating lights, wiring and reset buttons necessary for the following	
		Interlocking with emergency stop station.	E-Stop
		Interlocking with Free Chlorine Meter and Flow Meter for dosing control. Note: No Flow = No dosing	Dosing Control

Equipment	Qty	Description	Identification
1x Cubicle Calcium Hypochlorite Mixer	1	1.1kW TP continuous current rated motor protection MCCB complete with extended rotary handle for door interlocking [Mechanical operating handle for circuit-breaker, including door interlock, self-aligning spindle and padlocking facility] (Estimated and shall be coordinated with mechanical contractor to ensure correct supplies to mechanical equipment)	Main Breaker

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Equipment	Qty	Description	Identification
	1	0.55kW Type 2 Coordination Direct-on-line motor starter MCCB complete with sensitive quick reacting overload device as specified by screen manufacturer (Estimated and shall be coordinated with mechanical contractor to ensure correct supplies to mechanical equipment)	DOL Starter
	Set	Continuous current rated current transformer.	Current inputs
	3	2 Amp HRC fuse holders and fused links.	Voltage inputs
	All	Run, Trip and ready LED's.	Indicator Lights
	1	Running hour meter.	Running hours
	1	Manual-off-auto-remote selector switch.	Selector Switch
	1	Set of Stop/Start push buttons.	Stop/Start Push Buttons
	1	Mains operated timer to limit starts per hour.	Limit Starts
	All	Power factor capacitors shall correct to a minimum of 98%, complete with all accessories (Fuses, Circuit breaker and Contactor) to complete the installation.	Power Factor capacitors
	1	C&I motor protection relay complete with converter, with at least the following settings equal or similar to Schneider Electric Tesys U: ○ Electric Tesys U: ○ Thermal Overload Protection ○ Thermal Memory ○ Pre-Loading ○ Locked Rotor Protection ○ Jam Protection ○ Current Unbalance Protection ○ Phase Loss Protection ○ User-Selectable Auto Reset ○ Underload / Dry Run Protection ○ Restart Timer ○ Restart Contact ○ Phase Rotation Protection ○ Over voltage Protection ○ Under voltage Protection ○ Voltage Phase Symmetry ○ Latched LED Trip Indication Communications module must be provided, communication links with PLC/DCS Units. The	Protection Settling on Relay

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

Equipment	Qty	Description	Identification
		communication interface must comply with either of the following: ○ Profibus-DP ○ ProfiNet ○ Industrial Ethernet ○ Modbus TCP/IP Under no circumstances, shall the use of proprietary protocols be allowed.	
	All	Monitoring and control equipment. All equipment necessary for remote motor status, speed monitoring and control.	Control & Monitoring functions
	All	Relays, auxiliary contacts, indicating lights, wiring and reset buttons necessary for the following	
	All	Non latch action push button for screen manual operation in reverse selection.	Manual push button
		Interlocking with emergency stop station.	E-Stop
		Interlock in manual as well as automatic mode of operation the mixer motor shall be interconnected with the level sensor/transmitter in the CaHCl tank to stop if the tank is empty.	

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

Equipment	Qty	Description	Identification
1x Cubicle UPS Supply	1	20 Amp SP door interlocked MCCB	
	1	Selector switch for normal/UPS power selection	Maintenance purposes
	1	A UPS equal and similar to Meissner Power Systems that will provide battery standby power for at least one hour during a power failure must be supplied and installed under this contract. The UPS shall be installed inside panel and shall be well ventilated.	UPS
	All	Relays and contactors for automatic transfer to UPS power once the UPS power is restored	
	All	Terminal connections for UPS unit	
	All	UPS monitoring functions as specified	
	1	15 Amp SP MCCB	Remote I/O supply
	1	15 Amp SP MCCB	24V DC supply

Equipment	Qty	Description	Identification
1x Cubicle Remote I/O	1	10Amp SP door interlocked MCCB	
	1	230V/24DC stabilized power supply for 24V DC inputs to remote IO modules. (Power supply shall have adequate capacity for the application)	
	1	10Amp SP MCCB	Remote I/O
	1	Managed fibre ring Ethernet switch	Communications
	1	Unmanaged 8 port Ethernet switch of the same brand as the managed fibre ring switch	Communications
	1	Ethernet patch leads. Test and connect existing optical fibre	
	1	Modbus Ethernet communication module	
	1	Power supply module	
	1	Backplane to suite the application	
	1	16 channel, 24VDC digital input module	
	1	16 channel, 24VDC digital output module	
	2	8 channel, 4-20mA analogue input modules	

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Equipment	Qty	Description	Identification
	1	4 channel, 4-20mA analogue output module	
	All	Surge arrestors from all field equipment 4-20mA	

Equipment	Qty	Description	Identification
Optic fibre cable	150	12 core single mode SWA cable	Optic fibre

Equipment	Qty	Description	Identification
2x Cubicle Spare		30% Size Requirement)	

New Supervisory and Control I/O's

DESCRIPTION	RTD IN	Analog In	Analog Out	24V DC In	24V DC Out	Network Link
Chlorine Dosing Pump No. 1						1
Chlorine Dosing Pump No. 2						1
Calcium Hypochlorite Dosing Pump No.1						1
Calcium Hypochlorite Dosing Pump No.2						1
Vertical Mixer						1
Flow and level measuring		1		1		
Free chlorine measuring		1		1		

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

4 ELECTRICAL INSTALLATION IN BUILDINGS

4.1 Scope

New electrical installation for the following buildings:

Item	Type	Indoor/Outdoor	Location
1.	DB	Indoor	Housing Facility

4.2 Light Fittings

All luminaires must be approved by the Engineers representative prior to the installation of or any order being placed. Only light fittings as well as all light fitting components carrying the SABS mark of approval will be acceptable. All fluorescent light fittings shall be equipped with electronic control gear.

Type	Description
Type A	55W LED enclosed dust, moisture, vandal and corrosion proof luminaire. The luminaire shall consist of a high-pressure die-cast marine grade aluminum body with a robust clear polycarbonate diffuser and shall be designed to operate 55W LED's lamps. Equal or similar to Roughguard from Beka.
Type C	18W LED Bulkhead warm white enclosed dust, moisture, vandal and corrosion proof luminaire. The luminaire shall consist of a high-pressure die-cast marine grade aluminum body with a robust clear polycarbonate diffuser and shall be designed to operate 18W LED's lamps. Equal or similar to Bekabulk from Beka.
Type G	208W warm white LED Floodlight. The luminaire consists of an LED engine, power supply and spigot compartment. It shall be secured by stainless steel latches and an access screw. The LED engine, consisting of the LED light source and the power supply, shall be easily replaceable. Both compartments are rated IP66. C&I temperature monitoring prevents overheating of LEDs and power supply, positioned directly next to LEDs. The luminaire housing shall be manufactured of marine grade aluminum. Equal or similar to LEDFlood from Beka.

4.3 DB: Housing Facility

The new DB in the Housing Facility supplied and installed under this contract feeds from MCC 1.

DB Requirements

Parameter	Description
Type	Indoor weather proof surface mounted distribution board with front access doors only.
Supply	16mm ² 3core PVC SWA PVC cables connected to the feeder circuit breaker in the Control Building MCC-1.
Colour	White
Fault Level	5kA

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

Equipment Required:

Equipment	Qty	Description	Identification
	1	63Amp continuous current rated MCCB with Earth Leakage (30mA).	Main Breaker
	1	10A SP CB	Outside Lights
	1	10A SP CB	Photocell with integral Contactor for external lights
	1	10A SP CB	Photocell Bypass
	1	20A DP continuous current rated CB) 230V supply (White)	Plug circuit
	2	10A SP continuous current rated CB) 230V supply (Blue)	Light circuit
	1	10A SP CB	Outside Lights
	1	10A SP CB	Photocell with integral Contactor for external lights

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

5 SITE LIGHTING

5.1 Scope

The site lighting shall be upgraded by replacing the existing luminaires on the high mast poles with new LED type flood light fittings under this contract. The existing power supply to the high mast lights will be reused.

2 x New high mast lights, complete with 6 x light fittings of TYPE G including power supply will be provided to the Sludge Drying Beds, with new supply cables running from MCC-4

5.2 High Mast Lighting

6 x light fittings of TYPE G manufacture above must be installed in the place of the existing 7-x high mast indicated on the drawings.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

6 MULTICORE CABLES AND EARTH WIRES

6.1 Scope

Schedules of cables associated with sections of works are listed in the bill of quantities under the relevant sections.

- All earth wires shall be bare copper conductors, unless otherwise specified and cables shall be of the type as listed in the bill.
- These cables are only a guide and Tenderers must make due allowance for all cabling to complete the works in its entirety.
- It is assumed that the site has all the supply and signal cables required, but allowance has been added.

6.2 Installation of Cables

The cable length (Unit: m) indicated in the following schedule is measured from one termination point to another termination point per cable length. To determine the total length of cable, cables in parallel must be multiplied by the number of cables installed in parallel.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

7 SOFTWARE DEVELOPMENT

The tenderer will allow for programming of the new additions on the existing PLC and SCADA system software with all the I/O's listed above. Changes must be made the current software to accommodate process changes. The development must include mimic screens, report screens, alarms screens and trending of all I/O's. The changes must allow for a fully functional works, including the old and new mechanical, electrical, control and instrumentation equipment.

All motor starter monitoring and control information must be displayed on the SCADA and HMI.

The following signals must be programmed as a minimum for each motor starter:

- Tesys T ready
- Estop T healthy
- Drive healthy
- Auto/Manual
- Feedback healthy
- Comms healthy
- Tesys T healthy
- Process interlocks healthy
- Safety interlocks healthy
- Run interlocks healthy
- Starts per hour
- Analog signals must be logged and displayed on the HMI and SCADA

It is imperative that the tenderer must utilize a specialist Schneider system integrator. The system integrator must utilize it's own PLC development software license. The SCADA and HMI mimics must be similar to the current installation to ensure same feel as the existing operation of the works.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

8 LEVEL AND FLOW MEASURING EQUIPMENT

Tenderers must allow for an electronic intelligent level transmitters that shall be supplied and installed on a grade 304 stainless steel bracket and inside a ventilated grade 304 stainless steel enclosure. Level and flow measuring will be done by either a flume or weir. The level transmitter and flow controller must be capable of calculating such level and flow measurement.

The current instrumentation used is the Endress and Hauser Prosonic S FMU90. The same or similar are preferred. Tenderers must allow probe type level control systems complete with grade 304 stainless steel probes supplied and installed.

Field mounted level sensors/transmitters shall be installed complete with local surge protection and earthing.

8.1 Level Transmitter

Kiosk Requirements:

Parameter	Description
Type	Outdoor powder coated 304 stainless steel frame mounted with lockable front door and transparent window for meter reading purposes. Transparent window must be covered with top hinged powder coated 304 stainless steel cover for ultraviolet protection of level controller.
Supply	2.5mm ² x 3 core PVC SWA PVC cable plus 10mm ² bare copper earth plus 1mm ² x 4pr twisted PVC SWA PVC (individually and overall screened)
Colour	Painted Light Orange – B26 (SANS 1091:2012) external, White arc-free internal (see Painting and Finishing).
Fault Level	5kA

Equipment Required:

Equipment	Qty	Description	Identification
Level Sensor/Transmitter & Controller	1	5Amp Continues Rated SP MCCB	Main
	All	Single Phase class 2 surge arrestor unit connection type 2 as per SANS 10142-1 equal or similar to Dehnguard. DVMTT255 with remote indicator panel & remote signalling contacts connected to the PLC/SCADA.	Surge arrestor
	All	Ultrasonic level controller equal and similar to Endress and Hauser FMU90 and one sensor/transmitter unit mounted on grade 304 stainless steel bracket inside a ventilated 304 stainless steel bracket enclosure in front of a flume or weir for level measurement, including cabling and all accessories.	Level and flow measuring

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

Equipment	Qty	Description	Identification
	All	Terminals and interconnecting monitoring and control wiring	Connection
	All	Signal & Data Surge protection unit suitable for the application equal or similar to Blitzductor XT from DEHNguard.	Signal & Data Surge Protection

8.2 Electromagnetic Flow Meter

Kiosk Requirements:

Parameter	Description
Type	Outdoor powder coated 304 stainless steel frame mounted with lockable front door and transparent window for meter reading purposes. Transparent window must be covered with top hinged powder coated 304 stainless steel cover for ultraviolet protection of flow controller.
Supply	2.5mm ² x 3 core PVC SWA PVC cable plus 10mm ² bare copper earth plus 1mm ² x 4pr twisted PVC SWA PVC (individually and overall screened)
Colour	Painted Light Orange – B26 (SANS 1091:2012) external, White arc-free internal (see Painting and Finishing).
Fault Level	5kA

Equipment Required:

Equipment	Qty	Description	Identification
Electromagnetic Flow Meter & Flow Controller	1	10Amp Continues Rated SP MCCB	Main
	All	Single Phase class 2 surge arrestor unit connection type 2 as per SANS 10142-1 equal or similar to Dehnguard. DVMTT255 with remote indicator panel & remote signalling contacts connected to the PLC/SCADA.	Surge arrestor
	All	Electromagnetic Flow Meter and Controller equal and similar to Endress and Hauser Promag 400 installed inline of pipeline & FMU90 mounted on grade 304 stainless steel bracket, including cabling and all accessories.	Electromagnetic Flow Meter and Controller
	All	Front panel mounted LCD display for instantaneous flow and totalized flow counter.	Display
	All	Electromagnetic Flow Controller installed in an enclosure.	
	All	Terminals and interconnecting monitoring and control wiring	Connection
	All	Signal & Data Surge protection unit suitable for the application equal or similar to Blitzductor XT from DEHNguard.	Signal & Data Surge Protection

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

9 PRESSURE MEASURING EQUIPMENT

9.1 Pressure Transmitter

Kiosk Requirements:

Parameter	Description
Type	Outdoor powder coated 304 stainless steel frame mounted with lockable front door and transparent window for meter reading purposes. Transparent window must be covered with top hinged powder coated 304 stainless steel cover for ultraviolet protection of controller.
Supply	2.5mm ² x 3 core PVC SWA PVC cable plus 10mm ² bare copper earth plus 1mm ² x 4pr twisted PVC SWA PVC (individually and overall screened)
Colour	Painted Light Orange – B26 (SANS 1091:2012) external, White arc-free internal (see Painting and Finishing).
Fault Level	5kA

Equipment Required:

Equipment	Qty	Description	Identification
Pressure Sensor/Transmitter and Controller	1	10Amp Continues Rated SP MCCB	Main
	All	Single Phase class 2 surge arrestor unit connection type 2 as per SANS 10142-1 equal or similar to Dehnguard. DVMTT255 with remote indicator panel & remote signalling contacts connected to the PLC/SCADA.	Surge arrestor
	All	Pressure transmitter similar to Endress and Hauser Cerabar PMC71, including cabling and all accessories.	Pressure Transmitter & Controller
	All	Terminals and interconnecting monitoring and control wiring	Connection
	All	Signal & Data Surge protection unit suitable for the application equal or similar to Blitzductor XT from DEHNguard.	Signal & Data Surge Protection

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

10 ANALYTICAL MEASURING EQUIPMENT

10.1 DO Analyser

Kiosk Requirements:

Parameter	Description
Type	Outdoor powder coated 304 stainless steel frame mounted with lockable front door and transparent window for meter reading purposes. Transparent window must be covered with top hinged powder coated 304 stainless steel cover for ultraviolet protection of controller.
Supply	2.5mm ² x 3 core PVC SWA PVC cable plus 10mm ² bare copper earth plus 1mm ² x 4pr twisted PVC SWA PVC (individually and overall screened)
Colour	Painted Light Orange – B26 (SANS 1091:2012) external, White arc-free internal (see Painting and Finishing).
Fault Level	5kA

Equipment Required:

Equipment	Qty	Description	Identification
DO Analyser and Controller	1	10Amp Continues Rated SP MCCB	Main
	All	Single Phase class 2 surge arrestor unit connection type 2 as per SANS 10142-1 equal or similar to Dehnguard. DVMTT255 with remote indicator panel & remote signalling contacts connected to the PLC/SCADA.	Surge arrestor
	2	DO Analyser and DO Controller similar to Endress and Hauser Oxymax COS61D, including cabling and all accessories.	DO Analyser & Controller
	All	Calibration module and calibration cylinder	Calibration
	All	Terminals and interconnecting monitoring and control wiring.	Connection
	All	Signal & Data Surge protection unit suitable for the application equal or similar to Blitzductor XT from DEHNguard.	Signal & Data Surge Protection

10.2

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

10.3 MLSS Analyser

Kiosk Requirements:

Parameter	Description
Type	Outdoor powder coated 304 stainless steel frame mounted with lockable front door and transparent window for meter reading purposes. Transparent window must be covered with top hinged powder coated 304 stainless steel cover for ultraviolet protection of controller.
Supply	2.5mm ² x 3 core PVC SWA PVC cable plus 10mm ² bare copper earth plus 1mm ² x 4pr twisted PVC SWA PVC (individually and overall screened)
Colour	Painted Light Orange – B26 (SANS 1091:2012) external, White arc-free internal (see Painting and Finishing).
Fault Level	5kA

Equipment Required:

Equipment	Qty	Description	Identification
MLSS Analyser & Controller	1	10Amp SP + NI Continues Rated SP + N Isolator mounted in IP65 weatherproof casing.	Main
	All	Single Phase class 2 surge arrestor unit connection type 2 as per SANS 10142-1 equal or similar to Dehnguard. DVMTT255 with remote indicator panel & remote signalling contacts connected to the PLC/SCADA.	Surge arrestor
	1	MLSS Analyser and Controller similar to Endress and Hauser Turbimax CUS51D, including cabling and all accessories.	MLSS Analyser & Controller
	All	Calibration module and calibration cylinder	Calibration
	All	Terminals and interconnecting monitoring and control wiring.	Connection
	All	Signal & Data Surge protection unit suitable for the application equal or similar to Blitzductor XT from DEHNguard.	Signal & Data Surge Protection

10.4

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

10.5 Free Chlorine Analyser

Kiosk Requirements:

Parameter	Description
Type	Outdoor powder coated 304 stainless steel frame mounted with lockable front door and transparent window for meter reading purposes. Transparent window must be covered with top hinged powder coated 304 stainless steel cover for ultraviolet protection of controller.
Supply	2.5mm ² x 3 core PVC SWA PVC cable plus 10mm ² bare copper earth plus 1mm ² x 4pr twisted PVC SWA PVC (individually and overall screened)
Colour	Painted Light Orange – B26 (SANS 1091:2012) external, White arc-free internal (see Painting and Finishing).
Fault Level	5kA

Equipment Required:

Equipment	Qty	Description	Identification
MLSS Analyser & Controller	1	10Amp SP + NI Continues Rated SP + N Isolator mounted in IP65 weatherproof casing.	Main
	All	Single Phase class 2 surge arrestor unit connection type 2 as per SANS 10142-1 equal or similar to Dehnguard. DVMTT255 with remote indicator panel & remote signalling contacts connected to the PLC/SCADA.	Surge arrestor
	1	Free Chlorine Analyser and Controller similar to Endress and Hauser, including cabling and all accessories.	Free Chlorine Analyser & Controller
	All	Calibration module and calibration cylinder	Calibration
	All	Terminals and interconnecting monitoring and control wiring.	Connection
	All	Signal & Data Surge protection unit suitable for the application equal or similar to Blitzductor XT from DEHNguard.	Signal & Data Surge Protection

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

11 THE SUPERVISORY CONTROL AND DATA ACQUISITION SOFTWARE PACKAGE (SCADA)

11.1 Scope

The existing Adroit SCADA system shall be upgraded with all the refurbished works monitoring and control functions.

11.2 SCADA Software Requirements

11.2.1 Report Generation

Tenderers shall provide reporting software for the Adroit SCADA system that shall provide a means to generate reports from the SCADA data over a selectable period and provision shall be made for at least the following reports.

- Energy consumption
- Chemical dosing
- Motor run hours
- Equipment failure (maintenance report)

11.2.2 SCADA Hardware Requirements

The existing SCADA system is in the Control Room next to the PLC/MCC Room of the Control Building. Communication to the PLC system is done via Ethernet cable.

The SCADA Computer 19 inch rack must be moved from the c to the PLC/MCC Room of the Control Building with all new hardware as described. This 19-inch rack must be re-utilized.

The SCADA computer must be upgraded to the following specification as a minimum:

- Rackmount - 1 to 4U
- Intel12/13 generation I7 processor
- 4*DDR5 4800MHz UDIMM,support 128GB
- Display:1*VGA, 1*HDMI
- Hard disk: 1GB

A KVM switch to extend the keyboard; mouse and screen to the Control Room must be installed in the 19-inch rack in the PLC/MCC Room of the Control Building.. This will safeguard the SCADA computer hardware from control activities and will allow the SCADA computer hardware to function in a controlled environment. The existing 21-inch screen will be re-utilized in the PLC/MCC Room of the Control Building.

The SCADA UPS must be replaced with an inverter type backup system with LiFePO4 battery of at least 5kWh and must also be installed in the PLC/MCC Room of the Control Building.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

The current Citect SCADA software must be upgraded to the latest version with support license for at least 24 months. The SCADA application software must be imported into the new version of Citect and must be fully tested.

All new equipment must be represented on the SCADA. This includes signals as listed and logging, trending and alarming. All analogue signals must be logged and trended as a minimum requirement.

All existing and new signals and devices on the works must be fully commissioned for complete monitoring and control functions from the SCADA.

11.2.3 Configuration of the SCADA Software

Tenderers shall allow for the configuration of the existing Adroit SCADA System in the PLC/MCC Room with all the available information on the refurbished works.

The existing works overview shall be upgraded to include the refurbished works. A works section shall be selectable on the overview mimic screen.

The existing standards must be followed as to allow for similar operation and feel compared to the existing works. All monitoring and control functions must be equivalent to the refurbished system.

All analogue signals must be logged and trended as a minimum requirement. All devices stop, start and trip events must be logged.

The tenderer will compile a Functional Control Description (FCD) for the PLC, HMI and SCADA System. The process control philosophy in this tender will be addressed in this FCD.

The following software functions will be detailed in the FCD:

- Control sequences
- Device and process interlocks
- Device and process trips and alarms
- Trending and logging
- Operational and control set points

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

VAAL CENTRAL WATER

CONTRACT NO. BW283/ARWWTW/22

REFURBISHMENT OF THE NYAKALLONG (ALLANRIDGE) WWTW: CIVIL, MECHANICAL AND ELECTRICAL, CONTROL & INSTRUMENTATION

PCA: MULTICORE CABLES AND EARTHWIRES

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Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

PCA MULTICORE CABLES AND EARTHWIRES

PCA 1 SCOPE

This specification includes the manufacturing, delivery, transport, handling, protection, storage, installation, successful commissioning and upholding during the Defects Liability Period.

The applicable scope of the works covered by this section shall be defined in the Variations and Additions to the Standard and Particular Specifications Section C3.4.2 and relevant Tender drawings.

PCA 2 CONDITIONS TO SERVICE

The cable will be installed in an industrial plant, indoors and outdoors, in conduit, on cable trays and cable ladders, in cable trenches and directly buried in ground as indicated on the cable route drawings and/or cable schedule.

PCA 3 STANDARDS AND TESTS

Cables shall conform to and be in accordance with the latest applicable South African Bureau of Standards Codes and Standards:

The following Standard Specifications and drawings shall apply:

SANS 97	-	Medium voltage cables
NRS 013	-	Medium voltage cables
NRS 053	-	Medium voltage cable joints and termination kits
NRS 016	-	Code of practice for earthing of low voltage distribution systems
SANS 10142	-	Code of Practice for the wiring of Premises
SANS 1507	-	Electrical cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1900/3300V)
SANS 1339	-	XPLE Cables

PCA 4 CONSTRUCTION DETAILS

PCA 4.1 Low Voltage Cables

All multi core cables shall be stranded metal annealed copper conductor, PVC insulated, PVC bedded, single wire armoured and PVC sheathed in accordance with SANS 1507 -1990 as amended to date for cables with copper conductors and insulated for 500/3300 volt grade.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

Cables for status and analog signals shall consist of the requisite size and number of copper twisted pairs, individually and overall screened, PVC sheathed, steel wire armoured and PVC covered, complying with the requirements of SANS 1507 where applicable.

Cables and earth wires for a specific application shall be selected strictly in accordance with the requirements laid down in SANS 10142 in respect of current rating and voltage drop. Where practicable the earth continuity conductor shall form an integral part of the cable.

PCA 4.2 Medium Voltage Cables

These cables shall be manufactured in accordance with NRS. 013-1991 and comply with SANS 97 - 1991. All the 11 kV cables shall have copper conductors and shall be suitable for use on an unearthed system.

Three core cables shall be of the fully impregnated belted type. The cable shall have a helical fibrous bedding, lead alloy E sheath, single wire armor and a PVC serving as laid down in the Variations and Additions to the Standard and Particular Specifications, all in accordance with SANS 97 - Table 18. Single core cable shall be fully impregnated, screened general purpose cable with copper conductors suitable for an earthed system. The cables shall be in accordance with Table 11 of SANS 97, shall have a lead alloy E sheath and a PVC anti-electrolytic over sheath. (Type PEC)

PCA 4.3 Fiber Optic Cables

The cables shall have a GRP center strengthening member, colour coded fibers in gel filled loose tubes, surrounded by interstitial water blocking gel, aramid strengthening member, paper binder, polyethylene bedding sheath, plastic coated corrugated steel type armor and polyethylene water resistant outer sheath.

The steel armor shall be polymer coated and bonded to the sheath.

The fiber shall be manufactured from pure silica cladding, minimally doped with Phosphorous and Fluorine to achieve a matched cladding and a graded Germanium doped silica core. The primary coating shall consist of two layers of UV curable acryline resin.

Attenuation uniformity shall be checked at both 850nm and 1300nm with a pulse width not exceeding 1 micro s. Fibers with points or steps of discontinuity greater than 0,3dB shall be rejected. For fiber lengths in excess of 1km the attenuation coefficient over the length of fiber shall not vary by more than 0,3dB/km.

The fiber shall withstand a mechanical strain of at least 8N for 1 second and shall have an attenuation increase of less than 0.005dB/turn under a bend resistance test using 100 turns around a 75mm diameter mandrel.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

The fiber optic cable shall be of the multi mode type with fiber size of 50/125 for multi mode operation. Single mode cables shall be acceptable for longer distance communication paths

Work includes the furnishing of all labor, material, equipment, services and the performance of all operations necessary for designing, fabrication, testing and delivery

All materials and equipment to be supplied and installed under this contract shall be new and of the best quality available.

All materials and equipment shall comply with the requirements laid down in the latest editions of the BS, SABS and IEC specifications and their amendments (if any) as well as those laid down in this specification. Where items bearing the SABS mark, are available for any of the materials and equipment specified, only materials bearing the said mark, will be acceptable.

PCA 5 JOINTING OF CABLES

PCA 5.1 Low Voltage Cables

Joints will only be allowed where more than one full drum length of cable is necessary to complete a specific circuit and must be restricted to the absolute minimum. All joints shall be made to the best practice by competent cable jointers using first class material. The contractor shall maintain the electrical continuity of the armoring in an approved manner at all straight through joints.

Heat shrinkable cable joint kits that will suit the relevant cable size shall be used for all low voltage cable joints

PCA 5.2 Medium Voltage Cables

On 11 kV cables, straight joints shall be made by means of heat-shrinkable straight through joints for unearthed paper insulated cables up to 11 kV. All cable joint kits shall comply with NRS 053 Specifications

The joints shall be made to the manufacturer's instructions and with materials stipulated in such instructions.

The cores of the cable shall be joined colour to colour or number to number.

PCA 5.3 Fiber Optic Cables

Joints in fiber optic cable must be avoided as far as possible due to losses in signal strength when jointed.

The joints shall be made to the manufacturer's instructions and with materials stipulated in such instructions.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

PCA 6 TERMINATION OF CABLES

PCA 6.1 Low Voltage Cables

Low voltage cables shall be terminated with cable glands manufactured of bronze and comprising a barrel with sealing washer and bush nut screwed into one end and a compression nipple with wire clamping ring screwed onto the other end. The opposite end of the compression nipple must have a male electrical thread with locknut. The glands shall be suitably sized for the relevant cables, be of the adjustable type complete with armor clamps and with watertight neoprene shrouds.

Cable terminating glands for outdoor use shall be IP68 rated and provided with waterproofing double inner seals as well as waterproofing seals on nipples. Cable termination glands for high humidity and possible temporary water submerged conditions as for instance in filter lower gallery areas at water treatment plants shall also be IP68 rated with waterproofing double inner seals as well as waterproofing seals on nipples.

Cable armoring shall be earthed at each end but may not be used as earth continuity conductor.

PCA 6.2 Medium Voltage Cables

Medium voltage cable terminations shall be heat shrinkable termination kits and shall comply with NRS 053 Specifications.

The cable terminations shall be made to the manufacturer's instructions and with materials stipulated in such instructions.

PCA 6.3 Fiber Optic Cables

Fiber optic cables shall be terminated by means of suitable glands, ST connections and bus terminals capable of direct connection to the bus interfaces on the bus stations. These bus stations will be housed in separate panels of various motor control centers.

PCA 7 CONCRETE CABLE SLABS

The cable slabs supplied and installed under this Contract shall be formed solidly out of concrete with steel reinforcing and shall have dimensions of 1 000 x 350 x 100mm. Alternative block sizes will be considered. The following concrete mixture is desired:

- 1.Portland cement (dry) - 1 part per volume
- 2.Clean dry river sand - 3 parts per volume
- 3.Crushed stone (size 10 mm) - 6 parts per volume

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

PCA 8 CABLE TRAYS AND CABLE LADDERS

Heavy duty cable trays and cable ladders manufactured from hot dipped galvanized steel or grade 304 stainless steel, as specified in the Variations and Additions to the Standard and Particular Specifications, shall be supplied and installed as indicated on the drawings. The height of the cable ladder sides shall be 76 mm with the width to suit the number and size of cables to be installed. The supports for the cable racks or trays shall be as per the OEM's specifications with a minimum spacing as per the OEM's specification and recommendations.

PCA 9 INSTALLATION OF CABLES

PCA 9.1 Cable Trenches

The contractor will be responsible for the excavation, bedding, back-filling, consolidating and making good of all cable trenches along the routes indicated on the drawings, with the exception of those sections of the cable routes where it is specifically indicated on the accompanying drawings that open cable ducts will be provided by others. The Contractor however will be responsible for the bedding and filling soil in cable ducts where necessary. A sealing screed to cover the cable duct shall be provided by others unless otherwise stated in the Variations and Additions to the Standard and Particular Specifications and relevant drawings.

NOTE: Tenderers shall acquaint themselves fully with the nature and formation of the ground in which the cables are to be laid, before submitting a Tender. No subsequent claim for extras due to lack of knowledge in this respect will be entertained by the Employer.

Cable trenches for L.T. power and lighting cables shall be deep enough to facilitate the laying of these cables at a depth of 750 mm below final ground level.

Trenches for H.T. power cables shall be deep enough to facilitate the laying of these cables at a depth of 1 m below ground level. The floors of all cable trenches shall be smooth and free from boulders and sharp rock projections.

Plastic danger tape shall be installed in all cable trenches 300 mm above the cables for cable protection during future excavations.

Each cable shall be laid in a bedding of river sand or sifted soil 75 mm over and 75 mm below the cable. Clayey soil will not be accepted as bedding.

No cable trench shall be back-filled before the cable(s) in the trench has been inspected and approved by the Engineer.

PCA 9.2 Under Ground Cable Pipes

Cable pipes will be supplied and installed by others unless indicated otherwise on the drawings.

Each cable pipe shall be sealed by the Contractor under this Contract at both ends by means of bitumen impregnated jute bags or similar material, after the cable has been installed.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

PCA 9.3 Cable Slabs

Where electrical cables cross above other services such as water pipes, sewerage pipes, other electrical cables, pilot cables and telephone cables or where danger exists that cables may be damaged due to excavations by others cables shall be protected by means of reinforced concrete slabs. The concrete slabs shall protect the cable for at least 0,5 m in both directions of the crossing.

Where electrical cables cross underneath other services such as water pipes, sewerage pipes, post office cables etc. a concrete slab shall be placed above and axial with the other service and should the free space between the two services be less than 300 mm an additional slab shall be placed axial with the electrical cable between the two services.

Where cables are laid down a grading and a possibility exist that the cables might be washed open due to rain, then cable slabs shall be placed on top of the cables for the entire length of the grading.

The concrete slabs shall be supplied and installed under this Contract.

PCA 9.4 Cable Crossing with Other Services

PCA 9.4.1 GENERAL

Where a cable is laid above another service it shall not be less than 750 mm below ground level, and if this is not possible, the cable shall be laid underneath the other service and shall be protected by means of concrete slabs in the manner prescribed. The deeper or shallower positions of the cable shall only apply for a distance of 1m on both directions of the crossing.

If it is not possible to cross underneath the other service the matter shall be referred to the Engineer for a decision.

PCA 9.4.2 CLEARANCES

The following minimum clearances shall be maintained between electrical cables and other services:

	VERTICAL	HORIZONTAL
Telkom cables	0,3m	0,3m
Other water pipes	0,3m	0,3m
Sewerage pipes	0,3m	0,8m
Storm water pipes	0,3m	0,6m
Other Electrical cables	150mm	150mm

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

PCA 9.5 Cables must be Laid without Delay

The cables shall be laid with the minimum of delay to backfill the trenches as soon as possible.

The Contractor shall, however, not backfill the trench until each length of cable has been tested, inspected and approved by the Engineer.

Only one cable shall be laid at a time and the Contractor shall ensure that cables already laid are not damaged.

PCA 9.6 Method

All cables shall be handled with the utmost care and shall be laid in accordance with the best methods observed in good modern practice. All cables shall be run out on rollers in order to prevent abrasion and no cable shall be dragged along the ground. No cable shall be bent to a radius of less than 12 times its overall diameter.

(a) In Concrete Ducts

Cables shall be laid neatly parallel with each other on the floor of the duct with the maximum spacing. Any other cables shall be installed on cable ladders secured to the vertical sections of the cable ducts.

(b) On cable ladders

Cable shall be installed neat and parallel with each other with the maximum spacing. On Horizontal sections the cables shall be secured to the cable ladders with intervals of not more than 2m. On vertical sections or where the cable ladders are installed at an angle the cables shall be secured to the cable ladders with intervals of not less than 500mm with suitable strapping material approved by the Engineer.

Either stainless steel or hot dipped galvanized steel cable strapping material shall be used on outdoor cable installations depending on the cable rack or ladder material.

Sections of the cable ladders shall be electrically connected, and provision shall be made for crimping and expansion of the racks.

(c) In Trenches

Two or more L.T. cables in the same trench shall be laid in a straight line and in parallel and not less than 75mm apart between cable route turning points, except where otherwise approved. Cable routes shall always follow routes parallel to permanent structures to facilitate as built information.

H.T. cables in the same trench shall be laid parallel and not less than 150mm apart, except where otherwise approved.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

All L.T. power cables shall be laid 750mm below final ground level and H.T. power cables shall be laid 1m below final ground level.

The contractor shall provide 3m slack at each end in each run of power cable and its associated earth wire and bury the same in the ground as near to the relevant end as possible. Where the cables and earth wires are to be installed in open ducts outside buildings, the slack shall be coiled in the ducts.

The separation between any signal cable and the nearest parallel power cable shall not be less than 150mm.

(d) Against Walls

Cables and earth wires to be installed on walls, where approved by the Engineer, shall be neatly installed on heavy-duty hot dipped galvanised steel cable racks. Cables and earth wires on outside walls shall be installed in a similar manner or in suitably sized hot dipped galvanised conduit from 300 mm below up to 2,4 m above final ground level or as required. These conduits shall be secured to the walls by means of hot dipped galvanised steel bat holders at intervals not exceeding 600 mm. (Hospital Saddles).

Saddles shall only be secured by means of round-headed hot dipped galvanised screws and plugs of an approved type. (Wood will not be accepted as plugging material.) Plugs will not be allowed in joints between bricks.

(e) On Poles

Cables and earth wires to be installed on poles shall be secured to the poles at intervals not exceeding 600 mm by means of 25 mm x 1,5 mm adjustable Grade 304 Stainless Steel straps. Each cable together with its associated earth wire shall be installed in a suitably sized stainless-steel pipe or channel from 300 mm below up to 2,4 m above ground level. This pipe or channel shall be secured to the pole by means of 25 mm x 1,5 mm adjustable stainless-steel straps at intervals not exceeding 600 mm. To avoid metallic action between different materials a Neoprene rubber strip shall be installed between the pole and the strap.

(f) Cable Channels on Structures and in Buildings

Where cable channels have been provided on structures and in buildings these must be backfilled with river sand by the contractor.

(g) Cables connected to motors and other equipment

Cables and earth wires connected to motors and other equipment shall be secured between the cable channels, cable rack or cable tray to the point of termination by means of a heavy-duty hot

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

dipped galvanised type of cable support. The cable shall be secured to the cable support by means of steel straps or other acceptable strapping material.

PCA 9.7 Inspection of Cables and Cable Trenches

After the cables have been installed and spaced on top of the 75mm thick layer of sand in the trenches, the installation shall first be inspected and approved by the Engineer before the trenches may be refilled. Should the Contractor not meet with the requirement, or if he fails to give the Engineer sufficient notice of an inspection, portions of the trenches or the complete trench shall have to be re-excavated by the Contractor at his own expense for inspection by the Engineer.

A logbook with three copies per page shall be kept by the Contractor on the site, in which each part of the installation that has been inspected can be recorded after inspection and approval.

PCA 9.8 Backfilling of Trenches

Once the cable has been laid, straightened, inspected, approved and covered with the top layer of bedding soil, the trenches shall be backfilled with soil which does not contain more than 40 % rock or shale and will pass through a sieve with 100 mm diameter holes that has been approved by the Engineer.

The backfilling of cable trenches shall be done in layers of 150 mm and shall be compacted and consolidated to 95 % modified AASHTO. Tests shall be carried out to ensure the required compaction at the cost of Contractor.

The Contractor shall maintain the closed-up sections of the cable trenches in a proper, safe condition for the duration of the contract. Where the soil in the trenches subsides, it shall be refilled and compacted to the satisfaction of the Engineer.

PCA 10 INSTALLATION OF CABLE TRAYS AND CABLE LADDERS

The cable ladders shall be secured on suitable lengths which shall be suspended from the roof slab by means of suitable lengths 8mm Dia threaded hot dipped galvanized steel rods or secured to the walls with suitable sized hot dipped galvanized steel Rawl type bolts and shall be secured to the channel sections by means of two hot dipped galvanized nuts and washers.

The different parts of the trays and ladders must be thoroughly bonded electrically and mechanically to each other.

The cable trays and ladders shall be installed neatly, level and square/parallel to walls.

Cable straps suitable for the specific cable shall be employed to secure the cable onto the tray. Outdoor cable straps shall be stainless steel and cables shall be secured on intervals not exceeding 600mm. Cables on cable trays or ladders in outdoor environments shall be covered with removable cable tray or ladder covers of similar material.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

PCA 11 CABLE SUPPORTS TO MOTORS AND OTHER EQUIPMENT

Cables to motors and other electrical equipment shall be supported by means of hot dipped galvanized or 304 SS, similar on the material of the rack or tray cantilever brackets and cable supports. Cables shall be strapped to these supports by means of acceptable strapping material. (outside installations shall always be Stainless steel strapping)

PCA 12 WIRE TRUNKING

Heavy duty hot dipped galvanised wire trunking of sufficient dimensions shall be installed against all large capacity pump set concrete plinths for installation of pump set protection sensor monitoring cables. The monitoring cables shall be installed in hot dipped galvanized conduit from the trunking to the sensor position.

PCA 13 SENSOR TERMINATION CUBICLE

All large capacity pump set sensor cables shall be terminated in a powder coated mild steel frame mounted termination cubicle with lockable front door secured against the pump set plinth. DIN rail mounted cable conductor termination blocks shall be installed inside the termination cubicle for cable conductor termination.

PCA 14 CABLE MARKERS

Cable ends shall be properly labeled with reference to equipment, section of plant and other requirements specified by the client at both cable ends.

Cable markers with lead labels cast into the top of the cable markers shall be supplied and installed along the cable routes under this Contract as follows:

Along straight runs of the route, not further than 25m apart.

At turns - one on each side of the turning point, 900mm from such turning points.

At each branch, 3 markers - i.e. one on each side of the branch, 900mm from the branch.

The cable markers shall be installed deep enough to ensure that the top of the marker will protrude 50mm above final ground level.

PCA 14.1 Name Tags

Identification tags shall be attached to all cable ends. The tags shall be secured to cables by means of cable ties to the approval to the Engineer.

Cables shall be tagged at either end, whether the end terminates in a distribution board or an end box.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

All cable cores and internal panel wiring shall be identified at both ends by means of durable colour coded wire marking ferrules in accordance with numbering systems in cable and wiring diagrams. Only closed ring interlocking type identification ferrules shall be used.

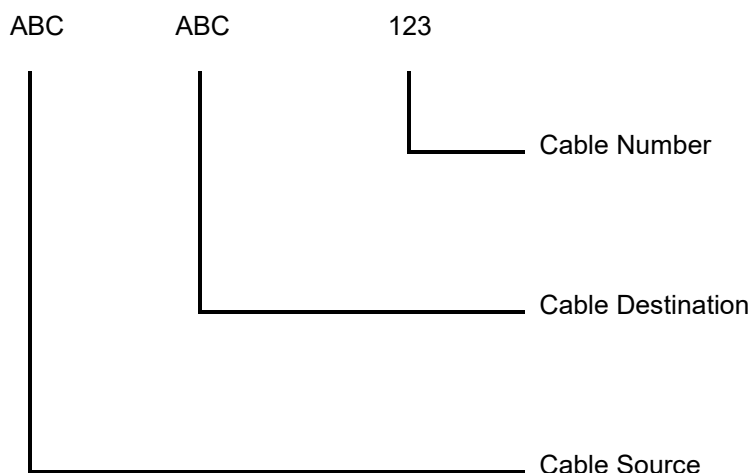
Outdoor tags shall be of stainless steel or brass type and shall be secured by means of similar strapping material.

Tags mounted indoors or protected by an enclosure shall be made of Ivorene or similar sandwich material with black letters on a white background.

All lettering and text shall be approved by the Engineer.

Letter sizes must be compatible with the application and shall not be smaller than 8mm.

(a) Cable Naming Convention



(b) Table of Areas

Example of area abbreviations:

ILW	-	Inlet works
IMC	-	Inlet motor control centre

(c)

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

(d) Example of cable schedule

Cable Number	From	To	Grade (V)	Size mm ²	No. of cores	Length (m)
ILW-IMC-001	Inlet works	Inlet motor control centre	400	185	4	55
IMC-SCR-001	Inlet works MCC	Screen 01	400	10	4	25

PCA 15 WARNING TAPES

Warning tape shall be installed along all trench excavated cable routes 300mm above the cables.

Warning tape shall have a minimum width of 300mm and have a bright orange colour with the wording "Danger". The minimum thickness shall be 800 gauge.

PCA 16 EARTH WIRES

Earth wires shall be installed with L.T. cables as and were indicated on the drawings or specified herein and shall consist of bare hard-drawn copper wire.

These earth wires shall be installed at the same depth as the relevant cables, with at least 75 mm clearance between any earth wire and the nearest cable, unless specifically approved otherwise.

No joint will be allowed in any run of earth wire.

Each earth wire shall be terminated at each end by means of a suitably sized bolted lug either sweated or crimped onto the wire. The lugs shall be bolted onto the relevant earth bars or earthing terminals.

PCA 17 TESTING OF CABLES

PCA 17.1 Low Voltage Cables

On each completed section of laid and jointed cable, the insulation shall be tested to approval with an approved "Megger"-type instrument of not less than 500 V.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

PCA 17.2 Medium Voltage Cables

On each completed section of laid and jointed high-tension cable a high voltage test shall be carried out. The test shall be performed according to SABS 97 of 1991. Alternating or direct current may be used.

A certificate shall be submitted confirming the successful testing of the relevant cable.

PCA 18 ROUTE PLANS TO BE SUBMITTED BY THE CONTRACTOR

On completion of the works, but before the certificate of completion will be issued, the contractor shall submit to the Engineer, route plans in electronic format indicating in a satisfactory manner:

- (a) The exact cable routes with reference to fixed points (e.g. buildings);
- (b) The exact lengths of cable (HT and LT) installed between terminating points and between joints where relevant; and
- (c) With reference to fixed points, the exact positions of cable joints (e.g. buildings).

Electronic copies of the various plans for the marking up of the information required will be supplied to the contractor on request.

PCA 19 MEASUREMENT AND PAYMENT

The bidder must obtain an electronic Cable Schedule and Schedule of Rates for cables. in Microsoft Excel from the engineer. The bidder must complete the Schedule of Rates for cables, this will automatically calculate the Supply, Install and Commissioning values for the Cables. A hard copy of the Schedule of Rates must be signed by a person duly authorized to sign and submitted with the returnable schedules. A hard copy of the Cable Schedule must also be signed by a person duly authorized to sign and submitted with the bid. An electronic copy that corresponds with the hard copies must also be submitted to the engineer by the successful bidder.

Measurement and payment will be done in accordance with the methods stated below:

PCA 19.1 Supply and Delivery to Site

<u>Pay Item</u>	<u>Unit</u>
(a) Supply and delivery to site of cables, danger tape, jointing and terminating materials and all earth wires, as per the Cables schedule supplied electronically	Sum
(b) Supply and delivery to site of cable route markers	Each

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

(c) Supply, delivery to site of concrete cable slabs	Each
(d) Supply, delivery to site of cable name tags	Sum
(e) Supply, delivery to site of cable trays, ladders and wire trunking	Sum
(f) Supply, delivery to site of cable supports to motors and other electrical equipment	Sum
(g) Supply, delivery to site of pump set sensor termination cubicles	Sum

PCA 19.2 Installation

<u>Pay Item</u>	<u>Unit</u>
(a) Trench excavations, laying of cables, installing danger tape, jointing and terminating of cables, back filling and compaction of cable trenches including all earth wires	Sum
(b) Installation of cable route markers	Each
(c) Installation of concrete cable slabs	Each
(d) Installation of cable name tags	Sum
(e) Installation of cable trays, ladders and wire trunking	Sum
(f) Installation of cable supports to motors and other electrical equipment	Sum
(g) Installation of pump set sensor termination cubicles	Sum

PCA 19.3 Commissioning

<u>Pay Item</u>	<u>Unit</u>
(a) Testing and commissioning of cables	Sum
(b) Updating, verifying and submission of Electronic Cable schedules with Tag numbers and final agreed lengths	Sum
(c) Drawing up of as built cable route plans	Each

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

VAAL CENTRAL WATER

CONTRACT NO. BW283/ARWWTW/22

REFURBISHMENT OF THE NYAKALLONG (ALLANRIDGE) WWTW: CIVIL, MECHANICAL AND ELECTRICAL, CONTROL & INSTRUMENTATION

PMC MOTOR CONTROL CENTERS

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Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

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Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

PMC MOTOR CONTROL CENTRES AND DISTRIBUTION BOARDS

PMC 1 SCOPE

This specification includes the design, manufacturing, delivery, transport, handling, protection, storage, installation, successful commissioning and upholding during the Defects Liability Period.

The applicable scope of the works covered by this section shall be defined in the Variations and Additions to the Standard and Particular Specifications Section C3.4.2 and relevant Tender drawings.

The following information regarding the switch- and distribution boards shall be submitted with each tender.

- (a) The name and address of the switchboard manufacture.
- (b) Full technical details and descriptive literature regarding all equipment and instruments offered;
- (c) Three paper prints of an outline drawing of each board indicating the main overall dimensions and general lay-out of the boards; and
- (d) Three paper prints of an outline drawing of the front end processor cabinet indicating the main overall dimensions, general layout and type of material employed on the face of the panel.

PMC 2 CONDITIONS TO SERVICE

The motor control centres shall be installed indoors and outdoors on an industrial plant.

PMC 3 STANDARDS AND TESTS

The motor control centres shall conform to and be in accordance with the latest applicable South African Bureau of Standards Codes and Standards:

The following Standard Specifications and drawings shall apply:

SANS 10142	-	Code of Practice for the wiring of Premises
BS 159	-	Bus bars
SANS 1195	-	Bus bars
SANS 1091	-	Paint colour
BS 3938	-	Current Transformers

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

SANS 60044	-	Current Transformers
NRS 029	-	Current Transformers
BS 89	-	Ammeters
BS 638	-	Welding cables
SANS 1576	-	Welding cables
SANS 156	-	Moulded Case Circuit Breakers
SANS 767	-	Earth leakage protection units
SANS 1574	-	Electric cables and flexible cords
NRS 002	-	Graphical symbols for electrical power, telecommunications and electronic diagrams
SANS 1213	-	Mechanical cable glands
SANS 1433-1	-	Terminal blocks having screw and screwless terminals
SANS 1433-2	-	Flat push-on connectors
SANS 1473-1	-	Low-voltage switchgear and control gear assemblies: Type-tested and partially type-tested assemblies
SANS 1473-2	-	Low-voltage switchgear and control gear assemblies: Busbar trunking systems
SANS 1619		Small power distribution units (ready boards) for single-phase 230V service connections
SANS 1765		Safety of distribution boards
SANS 10292	-	Earthing of low-voltage distribution systems
SANS 60439-2	-	Low-voltage switchgear and control gear assemblies: Particular requirements for busbar trunking systems
SANS 60439-4	-	Low-voltage switchgear and control gear assemblies: Particular requirements for assemblies for construction sites
SANS 60947-2	-	Low-voltage switchgear and control gear: Circuit breakers
SANS 60947-3	-	Low-voltage switchgear and control gear: Switches and disconnectors

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

SANS 60947-4-1	-	Low-voltage switchgear and control gear: Contactors and motor starters (Electromechanical)
SANS 60947-4-2	-	Low-voltage switchgear and control gear: Contactors and motor starters (semiconductor motor controllers)
SANS 60947-4-3	-	Low-voltage switchgear and control gear: Contactors and motor starters (For non motor loads)
SANS 60947-5-1	-	Low-voltage switchgear and control gear: Electromechanical control circuit devices
SANS 60947-5-2	-	Low-voltage switchgear and control gear: Electrical emergency stop device with mechanical latching function
BS 89	-	Ammeters

PMC 4 CONSTRUCTION

Distribution and motor control boards with a short-circuit withstand current rating of 10kA and higher shall comply with all type test requirements by either self-certification by the manufacturer, type test certification of the manufacturer must be submitted, or by means of a Certificate of Compliance issued by an Accredited person for type-tested assemblies.

The board shall be designed for front access only unless stated otherwise in the Variations and Additions to the Standard and Particular Specifications.

The board shall be of the free standing floor mounted cubicle type with IP 55 insect proofed enclosure, constructed of at least 2mm steel on a rigid channel iron or similar frame, and shall be bolted down in position by means of M16 high tensile stainless steel bolts grouted into the concrete floor of the pump station building. The bolts shall be inside the board.

The overall height of the board shall not exceed 2100mm and the overall depth shall not be less than 450mm and shall not exceed 600mm. The construction of the board shall be such that future extension panels may be fitted on both sides and alterations can be done without major changes to the board. (Modular construction will be preferred.)

The board shall be provided with readily removable covers on the sides and hinged panels on the front.

All removable covers shall be suitably braced and reinforced to ensure rigidity.

All hinged panels shall be reinforced to ensure rigidity and shall be provided with heavy duty rust proof hinges.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Each door shall be supplied with completely concealed hinges, each fastened with not less than four (two on each side) brass bolts and nuts. In the case of double doors the first door shall be locked with two slides on the inside, onto the kiosk shell. The second door shall close over a drip proof gutter shaped lip on the first one.

The doors shall be provided with a locking system suitable for padlocking. The locking system shall consist of a 3-way locking mechanism locking the door at the top, middle and bottom.

All switch gear, instruments and equipment for the control of any specific motor or other electrical device, shall be mounted flush behind a common hinged panel, with only operating handles, push buttons and instrument faces protruding through neatly machine punched holes in the panel.

Motor starter panels shall be a segregated system with each motor starter housed in a separate panel complete with door interlocked main switch. Where motor starter panels are installed on top of each other cable access shall be provided from the side of each panel by means of a common cable marshalling panel. Provision shall be made for pre-wiring between the starter panel and cable connectors inside cable marshalling panel to facilitate site cable connections.

The board shall be provided with readily removable, sectionalized, rigidly supported unpainted 3CR12 cable end support gland plates along the entire length of the board and at least 230mm above floor level.

Space shall be provided for future switchgear and equipment where specified.

The board shall be suitably sized to accommodate without cramping, all the switchgear and equipment specified.

Screwed-on engraved labels in English shall be provided below all switchgear and equipment on and in the panels, to facilitate identification.

The board shall be provided with one set of four solid, copper bus bars in the top section and extending over the entire length of the board. Provision shall be made at the end of each busbar for future extensions.

Bus bars shall comply with the requirements of BSS 1433 and the relevant clauses of BSS 159.

Bus bars shall be rigidly supported at suitable intervals to prevent undue damage resulting under short circuit conditions. Ceramic or other approved busbar insulators shall be used. The bus bars shall be arranged horizontally with the longer sides of the cross-sections in the vertical plane and one behind the other, in the horizontal plane, at 90mm centers.

Bus bars shall be clearly and indelibly marked in the middle of the bus bar Red, White and Blue for the three phases and Black for Neutral.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Connections to bus bars shall be effected by means of cable lugs and suitably sized cadmium-plated, high tensile steel bolts and nuts with cadmium-plated cup washers or lock washers. Spare connections shall be provided complete with bolts, nuts, washers and spring washers.

All screws, studs, bolts, nuts and washers used for these boards shall be Cadmium plated. The use of self-tapping screws will not be permissible. A solid copper earth bar shall be provided inside the board above the gland plate along the entire length of the board.

The earth bar shall have a cross-section of at least 150 mm² depending on the main bus bar sizes.

The earth bars shall be drilled and provided with 6mm dia and 10mm dia cadmium plated, high tensile steel bolts and nuts, complete with cadmium-plated washers and cup washers or lock washers, for making the earth connections. The earthing positions shall be evenly spaced along the entire length of each busbar.

The outdoor motor control boards shall be constructed of at least 2 mm powder coated 3CR12 steel complying with the specification for indoor boards, but shall be not more than 1500mm high. Vermin proofed IP 54 rated ventilation openings shall be provided in doors and side panels.

Where electronic equipment such as transmitting I/O units are incorporated in an outdoor distribution- and motor control board, this equipment shall be installed in a separate and special compartment and all wiring shall be terminated on rail mounted terminal strips for field connection of all monitoring and control cables.

This compartment shall if necessary consist of an outer and inner shell with at least 10 mm insulation or polystyrene between the inner and outer shell all round to keep the temperature inside the compartment at least 5 ° C below the temperature surrounding the compartment in summer complete with ventilation fans.

The doors of this compartment must be labeled: "Electronic Equipment".

Sufficient provision for breathing and heat dissipation must be made in this compartment.

PMC 5 GENERAL REQUIREMENTS

PMC 5.1 Internal wiring

The internal wiring of the boards shall consist of colored PVC-insulated conductors of adequate copper cross-section, which shall be neatly installed horizontally and vertically in PVC trunking. Numbered ferrules of an approved type (clip on type not acceptable), shall be provided on each end of each wire, to facilitate the tracing of circuits.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Control circuits shall be colour coded as follows;

A.C. Live	-Red
A.C. Neutral	-Black
110V D.C. Positive	-Grey
110V D.C. Negative	-Grey
24V D.C. +ve	-Brown
24V D.C. -ve	-Orange
4-20mA	-Purple
All other voltages	-Violet
Status signals	-Pink
Earth	-Green and yellow

PMC 5.2 Electronic Equipment

Where electronic equipment such as transmitting I/O units are incorporated in a distribution- and motor control board, this equipment shall be installed in a separate and special compartment.

Sufficient room shall be provided for the rail mounted terminal strips and all wiring shall be terminated on these rail mounted terminal strips for field connection of all monitoring and control cables.

The door must be labeled: "ELECTRONIC EQUIPMENT".

PMC 5.3 Cable terminations

Cable terminations shall be suitable to accommodate the cable or cables for each circuit as specified. This applies not only to the number of cores, size and conductor material, but also to the type and construction of the cables.

Cable terminations shall be complete with the necessary clamps, glands, terminating and other accessories. Heat shrink cable ends must be complete with all accessories.

Mechanical cable glands for control and auxiliary cables shall be suitable for PVC/PVC/SWA/PVC type cables. The armoring shall be clamped firmly to ensure a reasonably good electrical connection and to prevent the cables from being pulled out easily. Each gland shall be complete with a neoprene shroud and one locknut.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

PMC 5.4 Labeling of Switchboards and Motor Control Boards

A screwed on engraved label of the black on white "trefolite" type shall be provided below each item of equipment on the front panel of each board as well as on the chassis in close proximity to the relevant equipment to identify such equipment in the English language in 6 mm high lettering.

Each board shall further be provided with a screwed on reverse engraved yellow Perspex nameplate with black 20 mm high lettering to identify the board in the English language on the outside of the door at the top thereof.

PMC 5.5 Motor starter panels

Each starter shall be contained in its own separate compartment in the motor control board.

PMC 5.6 Treatment and painting of metal parts

All metal parts shall be treated before powder coating in accordance with standard corrosion protection standards and the appropriate coating system shall be selected for the specific application. Motor control centre outer surfaces shall be powder coated colour B26, SANS 1091. (Electric orange)

PMC 6 MOTOR STARTERS AND ACCESSORIES FOR SWITCHBOARDS

PMC 6.1 Direct-on-Line starters (400V motors)

These starters shall be of the manually operated (locally and remotely) type and each starter shall be contained in its own separate compartment on the relevant motor control board.

Each of these units shall comprise amongst other the following components:

- (a) 1Only mains fused switch/circuit breaker connected to the busbars of the board and interlocked with the door of the compartment to prevent opening of the door with the switch closed and to prevent closing of the switch with the door open
- (b) 1Set of HRC control fused links with carriers and basis where necessary;
- (c) All necessary relays as required
- (d) 1Only mains contactor;
- (e) 1Set of START and STOP push buttons;
- (f) 1Only mains operated timing device to limit starts per hour; and
- (g) 1Only power factor correction capacitor unit for motors of 5 kW and more.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

The following protective and indicating devices complete with the necessary suitably rated potential fuses, current transformers, test blocks and auxiliary relays;

- (a) 1Only electronic type motor protection relay for motors of 7,5kW or more or as specified;
- (b) 1Only motor under current relay (Where specified)
- (c) 1Only instantaneous indicating ammeter for motor current;
- (d) 1Only ammeter selector switch for motors of 5 kW or more;
- (e) 3Only Current transformers for motors of 5 kW or more;
- (f) 1Only running hour meter;
- (g) 1Only anti-cycle timer; and
- (h) 1Only thermister relay for motors of 22kW or more
- (i) 1Only Start delay timer for motors of 15kW and higher
- (j) 1Only blue LED type indicator light to indicate the time delayed starting period
- (k) 4Only LED type indicator lights as follows Yellow - 'Supply on'; Green - 'Motor Running'; Amber - 'Motor Tripped'; Blue – 'Motor start delay'; Red - "Emergency stop engaged" and Green – 'Healthy'

It shall further be possible to trip and lock out the starter by means of a remote stop button to be provided at the relevant motor.

Provision shall also be made for locking the mains fused switch handle in the OFF position.

PMC 6.2 Star/Delta Starters (400V motors)

These starters shall be of the automatic star/delta type and each starter shall be contained in its own separate compartment on the relevant motor control board.

Each of these units shall comprise amongst others provided for direct-on-line starters the following components as:

- (a) 1Only Mains Contactor;
- (b) 1Only Star Contactor;
- (c) 1Only Delta Contactor;
- (d) 1Only Star to Delta timer of the clockwork or electromagnetic type;
- (e) 1Only Mains operated timing device to limit the starts per hour;
- (f) 1Set START and STOP pushbuttons

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

- (g) 1Only Three phase Power Factor Correction Capacitor unit for motors of 5kW or more
- (h) All necessary relays

PMC 6.3 Variable Speed Drives

These variable speed drives shall each be contained in its own separate panel, manufactured and equipped to the satisfaction of the variable speed drive manufacturer to suit their own requirements with regard to ventilation of the variable speed drive. Small drives below 1kW can be combined into one panel but sufficient ventilation by means of extractor fans must always be allowed for

The variable speed drive panel shall be equipped with ventilation fans and air filters. The ventilation fan shall be interlocked with the relevant motor and shall only be in operation when the motor is running. Failure of the ventilation fan shall stop the motor and a visible indication of the cause of the failure shall be provided on the panel.

The frequency converter shall make use of flux vector control without encoder or tacho generator feedback and shall incorporate direct torque control technology so that the overall effectiveness of the drive shall only be limited by the performance of the motor.

Semi-conductor switching shall be determined by the values of flux and torque and shall not have a predetermined pattern as in conventional pulse width modulation flux vector drives.

Each of these drives shall comprise amongst others the following components:

- (a) 1Only main isolator/circuit breaker that shall be interlocked with the door of the panel to prevent opening of the door with the switch closed and to prevent closing of the switch with the door open
- (b) 3Only ultra rapid fuses rigidly connected to the load side of the above mentioned mains isolator and the rating of which shall comply with the manufacturers specifications for the drive
- (c) 1Only direct torque control frequency converter
- (d) 1Only door mounted control panel complete with cable connections (also for small drives)
- (e) 1Set of START and STOP push buttons for manual control of small drives
- (f) One dial type potentiometer for manual speed control.
- (g) 1Only manual/off/auto selector switch for manual control of small drives
- (h) 1Only Thermister relay for motors of 22kW or more

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

- (i) 1Only external EMC line filter
- (j) All equipment necessary for remote emergency stop device.
- (k) All bus system interface equipment necessary for remote speed control via a monitoring and control SCADA system as well as PLC control.
- (l) All equipment necessary for remote motor status and speed monitoring.
- (m) LED type red "Emergency stop engaged" indicator light

A 3CR12 steel gland plate must be provided at least 250mm above floor level for cable connections.

The control panel shall be the user interface for monitoring, adjusting parameters and controlling the drive operation. It shall be possible to:

- (a) Enter start-up data into the drive.
- (b) Control the drive with start, stop and reference signals.
- (c) Display actual values of motor performance.
- (d) Display information on at least the five most recent faults.

The drive shall satisfy the following technical requirements.

- (a) The static speed control error shall not exceed $\pm 0,5\%$ of motor nominal speed.
- (b) Fundamental power factor shall be at least 0,97 at nominal load.
- (c) Efficiency shall be at least 98% at nominal power level.
- (d) The drive shall operate satisfactorily under all ambient temperature conditions between -5°C and $+ 40^{\circ}\text{C}$ at an altitude of 1260m above sea level and humidity up to saturation point.
- (e) The drive shall provide output protection for motor overload, over current, short circuit at start, earth fault, missing motor phase and over frequency.
- (f) The drive shall satisfy the following minimum harmonic voltage limits: Total harmonic distortion of 6%, odd harmonic distortion of 4% and even harmonic distortion of 2%. The Contractor shall measure these harmonic distortion parameters after commissioning of the system and if the equipment fails to comply with this requirement, the Contractor will have to rectify the same to the satisfaction of the Engineer.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

- (g) The drive shall be equipped with an AC choke for harmonic current reduction and shall be placed on the AC side of the rectifier bridge in order to protect the rectifier semiconductors against power line transients.
- (h) Torque step rise time shall typically be less than 5ms.
- (i) Stringent precautions must be taken in the design of the protection equipment to assure adequate lightning and surge protection.

PMC 6.4 Electronic Soft Starters

The soft starter shall be installed in the relevant motor starter panel but sufficient ventilation by means of extractor fans must always be allowed for and shall be interlocked with the relevant motor and shall only be in operation when the motor is running. A bypass contactor for motor running conditions is a requirement and shall either form part of the soft starter or shall be a separate unit.

The soft starter shall have soft start and stop programmable capabilities with torque and current control. The normal motor protection facilities such as over/under-current, start limit, long start time, electronic overload, phase loss and phase sequence and load loss shall be available.

At least a 2 line 16 character LCD display unit with control function keys shall form part of the soft starter and shall preferably be separate motor starter front panel mountable. The LCD unit shall display all statistical data and trip conditions and shall allow functional key changes to programmable parameters.

The full motor protection capabilities shall be maintained when motor is operating in bypass contactor mode.

RS 485, MODBUS, PROFIBUS communication shall be possible.

PMC 6.5 Induction Soft Starters

The induction type soft starter shall be installed in the relevant motor starter panel but sufficient ventilation by means of extractor fans must always be allowed for and shall be interlocked with the relevant motor and shall only be in operation when the motor is running. A bypass contactor shall be provided to bypass the soft starter.

The series impedance type starter shall incorporate reduced starting current and ensure gradual increase in the motor terminal voltage in smooth step-less manner.

The design of the induction soft starter shall allow the motor to generate adequate starting torque to overcome the load torque and friction to ensure smooth acceleration.

The soft starter shall allow five starts per hour.

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PMC 6.6 Mains surge arrestors

The surge arrestors shall be Type 2 and voltage compatible to the relevant installation and shall be able to withstand a lightning impulse current wave form 8/20 μ s at a maximum discharge current of 40kA.

Each distribution board shall be equipped with mains surge arrestors.

PMC 6.7 Moulded case circuit breakers

All moulded case circuit breakers shall be as specified in the schedules of equipment for distribution boards and shall comply with the requirements of SANS Specification no. 156.

The required frame sizes or rupturing capacities required are specified in the schedules for each board.

Each circuit breaker shall be provided with non-adjustable time-delayed trips.

These circuit breakers shall be fitted with copper terminal collector bars where more than one cable tail has to be terminated on the same terminal.

PMC 6.8 Fused switches

All fused switches shall be of the "load-breaking" and "fault-making" type complying with BS-5419 where applicable and fitted with HRC cartridge fused links to BSS-88. Auxiliary contacts shall be provided where relevant for signal purposes.

PMC 6.9 Current limiting circuit breakers

The current limiting circuit breakers shall be capable of remaining in service and of carrying their normal rated current after having interrupted the maximum short circuit current of 200 kA rms at least three times.

The current limiting circuit breaker shall be equal and similar to the specified Merlin Gerin type.

PMC 6.10 Current transformers

All current transformers shall be of the air insulated type complying in all respects with the requirements laid down in BS 3938: 1973.

The contractor shall carefully select the ratio, burden and accuracy class to suit its specific application in accordance with the recommendations and requirements of BS 3938.

PMC 6.11 Indicating instruments

All indicating instruments shall comply with the requirements laid down in BS 89: Part I: 1970 for instruments of a 2,5 Accuracy Class. All indicating instruments shall have 96mm square dials.

Contractor

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The maximum demand ammeters shall be of the 6A combined maximum demand registering and instantaneous indicating type having MISC movement and thermal demand indication with an integrating time lag of 15 minutes. The ammeter scales shall be direct reading with a full-scale deflection corresponding to 120% of the rated primary current of the relevant current transformer. Each ammeter shall be clearly and indelibly marked to indicate the colour of the phase to which it is connected.

The ammeters for motor starters shall be 5A instantaneous indicating meters with MISC movement and direct reading scales. The meters shall be able to withstand over currents resulting under starting conditions and the full load current of the relevant motor shall be clearly marked in red on the face of the meter.

Voltmeters shall be of the direct reading moving iron suppressed zero type.

The power factor meters shall indicate from 0,7 lagging to 0,7 leading.

The running hour meters shall have cyclometer dials indicating up to 5 digits and two decimals. (12345,67)

PMC 6.12 Instrument selector switch

A four-position rotary type instrument selector switch shall be mounted directly below the relevant instrument in such a way that only the selector knob and indicator plate are on the panel, and the switch itself is behind the panel.

The selector knob shall consist of Bakelite, and shall have an arrow engraved on it, indicating the switch position.

The switch shall have a positively driven switching mechanism.

The indicator plate shall consist of Bakelite and shall have the positions for the three phases and "OFF", engraved on it in 5mm high lettering.

PMC 6.13 Contactors

All contactors shall be of the totally enclosed, three pole, double air break per pole, automatic magnetic type complying with the requirements of BS 775 for "CLASS UR" contactors of the "CLASS II MECHANICAL DUTY CLASS" and "A3 Make and Break Category".

All contactors shall be provided with arc extinguishers, and readily replaceable silver or silver-alloy contacts rated for at least 2-million "on" and "off" switching operations at rated current.

Each contactor shall be provided with an AC, closing coil suitable for continuous operating and at least 15 closing operations per hour at system voltage. The contactor may not hum or chatter in service and the contacts may not bounce on closing.

Contractor

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PMC 6.14 Time switches

The time switches shall be suitable for use on a 231 volt, 50 cycle per second AC supply and shall be of the microprocessor type.

The time switches shall be digital timers suitable for rail or surface mounting and shall be programmable with daily and weekly programs, switching intervals of 1 minute and switching accuracy precise to the second.

The time base shall be of the quartz type with LED display for time, weekday, holiday program, switching position and manual override and shall have a power reserve of 250 hours at full operation. The time switches shall have a switching capacity of 16 A at 231 V.

PMC 6.15 Isolators

All isolators shall be of the "Load-breaking" and "fault making" type and shall comply with the requirements of BS 5419-1977 where applicable. Where relevant, isolators shall be provided with auxiliary contacts for signal purposes.

PMC 6.16 400 Volt air-break contactors

All contactors shall be of the totally enclosed, three pole, double air break per pole, automatic magnetic type complying with the requirements of IEC 158-1 for Class AC 3 contactors of Intermittent Duty Class 0,3.

All contactors shall be provided with arc extinguisher and readily replaceable silver or silver-alloy contacts rated for at least 2-million "on" and "off" switching operations at rated current.

Each contactor shall be provided with a 240 Volt, 50 Hz closing coil suitable for continuous operation and at least 15 closing operations per hour. In rural areas contactor coils must be rated to operate satisfactorily between 75% and 130% of nominal voltage.

An adequate number of auxiliary contacts shall be fitted.

The contactor may not hum or chatter in service and the contacts may not bounce on closing.

PMC 6.17 Earth leakage units

The earth leakage units shall consist of a combination of a earth leakage relay and a moulded case circuit breaker and shall have a sensitivity as specified, it shall conform to SANS 767.

PMC 6.18 Terminals

Terminals may be of the bolted type otherwise they shall be of rail mounted clamp type.

All types of terminals and their insulation shall have a minimum comparative creep index of 500 to BS 3781.

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PMC 6.19 Clamp type terminals

These terminals shall be not less than 8 mm wide.

Screws and connectors shall be electroplated to prevent corrosion. The connectors shall be such that the screws will not loosen due to vibration. Current carrying parts shall be of serrated silver plated copper or brass. Only one connection shall be allowed per connector. For more connections the number of terminals shall be increased and bridge pieces shall be used.

PMC 6.20 Surge Protection

PMC 6.20.1 SURGE ARRESTORS

Surge arrestors shall be supplied and installed under this contract where applicable.

PMC 6.20.2 MAIN SUPPLY PROTECTION

Surge arrestors as specified shall be installed at the main incomer of each distribution board, motor control centre or any type of kiosk.

PMC 6.20.3 POWER FACTOR CORRECTION CAPACITORS FOR 400 VOLT MOTORS

Each of these capacitors shall be of the indoor switchboard mounting 400 Volt 50 cps three-phase self-contained type with a dead casing and shall fully comply with the requirements laid down in BS 1650-1971.

Each capacitor unit shall be of carefully selected rating to correct the power factor of its associated motor to 0,95 at full load and should not exceed a value which compensates for 85% of the no-load magnetizing current.

The dielectric shall consist of plastic film and low-loss paper situated between aluminum foil and impregnated with a synthetic liquid agent with scavenger additive.

The capacitor losses shall not exceed 1 Watt/kV.Ar.

The capacitor units shall have the following admissible overloads at an ambient temperature of 40°C and an altitude 260 m above sea level.

10% excess volts continuously;

50% excess current continuously; and

30% excess kV.Ar continuously.

Each of these capacitor units shall be provided with discharge resistors and a fuse in each winding element that will disconnect the affected element in event of a di-electric breakdown. A time controlled contactor shall connect and disconnect the capacitors to the starter control circuit.

Contractor

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PMC 7 DANGER SIGNS

Danger signs on aluminum plates shall be supplied on each door of an outdoor motor control centre or distribution board and shall be in accordance with the Occupational Health and Safety Act, Act 85 of 1993.

PMC 8 ELECTRONIC LEVEL CONTROL

The micro based electronic controllers which will be mounted in the starter panels shall be easy to calibrate and reliable in service.

The power units for all the pumps in a specific pump station shall be installed in a separate compartment of the starter panel and clearly labeled in accordance with the pumps it controls.

These level controls shall be designed to automatically select the pump sequence to ensure that all the pumps will at random be a duty pump.

Where a controller controls only two pumps and one pump is always a standby pump, the standby pump shall automatically become the next duty pump after each duty cycle, unless one pump is taken down for service. When that occurs, the duty pump shall remain on duty until the normal operation is restored.

When a pump selected for duty fails to respond to the start signal from the control, then the next duty pump shall automatically start-up after five minutes.

The level controller must also stop all the pumps, whether on manual or automatic selection, when the pump has reached a predetermined low level.

The transducers shall be designed to operate in air, been capsulated, of rugged construction and impervious to submergence. The transducer shall not form part of the MCC scope of supply

The coaxial cable between the transducer and power unit shall be of sufficient length to avoid any joints in this cable, as no joints will be permissible.

PMC 9 EMERGENCY STOP PUSH BUTTONS AND WEATHERPROOF ISOLATORS

Each of these units shall consist of a totally enclosed outdoor type heavy duty "push and turn to lock" stop push button station with a cable gland entry at the bottom to accommodate a 4 core 2,5mm² LT PVC SWA PVC cable.

Where installed at motor positions the emergency stop push buttons shall not form part of the MCC scope of supply.

Contractor

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PMC 10 EARTHING

The contractor shall do all the bonding and earthing in accordance with the latest addition of the "Code of Practice for the Wiring of Premises" SABS 10142.

The substation and HT switch room earthing shall consist of a 70mm² bare copper earth wire installed in the same trench as the HT supply cables. Earth resistivity measurements of less than 1 ohm will be acceptable

PMC 11 INFORMATION TO BE SUBMITTED WITH TENDERS IN RESPECT OF THE 400 VOLT DISTRIBUTION BOARDS AND MOTOR CONTROL BOARDS.

The following information shall be submitted with each Tender in respect of all boards offered:

- (a) Full technical details and descriptive literature regarding all equipment and instruments offered;
- (b) Three paper prints of an outline drawing of each board indicating the main overall dimensions and general lay-out of the boards; and
- (c) Three paper prints of an outline drawing of the front end processor cabinet indicating the main overall dimensions, general layout and type of material employed on the face of the panel.

PMC 12 INFORMATION TO BE SUBMITTED BY THE SUCCESSFUL TENDERER

The successful Tenderer shall submit three prints of the under mentioned drawings to the engineer for approval, before manufacturing.

Outline and general layout drawings showing dimension and construction details.

A wiring diagram.

A schematic single line diagram.

After completion of the work, the contractor shall submit three final copies of each of the above-mentioned drawings showing the final layout and wiring diagram of the boards.

PMC 13 INSPECTIONS AND TESTS

All equipment will be inspected by the Engineer and tested in his presence both in the factory during manufacturing and on site during installation. The Engineer will do all inspections accompanied by the Contractor and the Contractor will do all tests with the Engineer as witness.

The Engineer will require seven (7) days notification to avail himself for any test or inspection and the Contractor must arrange for the maximum number of inspections and tests to be done on the

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same day. The Contractor must provide all testing facilities and instruments, all equipment required for a test or inspection.

The instruments must have valid test certificates issued by an accepted testing authority and the results of the test done must be recorded on a test certificate, of which the Engineer must receive two copies. The Engineer reserves the right to call for a calibration test on any instruments used during the test.

The cost of all tests must be included in the tender price.

PMC 14 TESTING OF DISTRIBUTION/MOTOR CONTROL BOARDS AT THE MANUFACTURER'S WORKS

Each distribution/motor control board shall be subjected to the following tests in the manufacturer's works after manufacture:

- (a) A thorough inspection shall be carried out to ensure compliance with the specification and approved drawings and wiring diagrams and to ascertain that all connections are properly made.
- (b) A high voltage test on all primary connections to check the insulation between phases mutually and between each phase and earth.
- (c) The polarities and ratios of all potential and current transformers shall be checked.
- (d) Primary and secondary injection tests shall be carried out on all switching, protection, metering interlocking and indication circuits.

The manufacturer shall submit three copies of test certificates giving details of conditions and results of tests carried out to the Engineer.

PMC 15 CONCRETE PLINTH FOR OUTDOOR STARTER PANELS AND PEDESTALS

The plinth shall be cast 150mm below as well as 150mm above the ground level. It shall have neatly beveled edges and shall be 75mm wider than the panels all round.

An opening of sufficient width to allow for cable entry shall be provided under the starter panels.

The grade 304 stainless steel foundation bolts for mounting of the panels shall be cast or grouted into the plinth. The plinth shall be in Class 20/19 concrete and shall be suitably reinforced if necessary.

It is recommended that the casting of these foundations must be carried out by the Civil Contractor at the cost of the Contractor under this Contract in accordance with his instructions and under his supervision.

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PMC 16 INSTALLATION OF DISTRIBUTION BOARDS AND MOTOR CONTROL BOARDS

Each of the relevant distribution boards and motor control boards shall be built into walls or securely bolted down on the floor or plinth, as may be required, by means of the requisite number of foundation bolts grouted into the floor in the positions indicated on the drawings.

These positions shall be confirmed with the Engineer on site, prior to installation.

PMC 17 TESTING AND COMMISSIONING OF DISTRIBUTION/MOTOR CONTROL BOARDS AFTER INSTALLATION ON SITE

After installation on site but prior to commissioning the following inspections and tests shall be performed on each distribution/motor control board.

- (a) Check all components to ensure that they are free from dust and protective packing material;
- (b) Check the operation of all components liable to damage in transit such as meter and protection measured;
- (c) The insulation of all primary circuits between phases mutually and between each phase and earth shall be measured;
- (d) All fused links shall be checked for electrical continuity; and
- (e) All control supplies shall be checked.
- (f) All adjustable protection devices shall then be set and the boards commissioned all in consultation with and to the instruction of the Engineer.

PMC 18 OPERATING AND MAINTENANCE INSTRUCTIONS

Before completion of the testing of the plant, the Contractor shall provide the Employer with adequate and complete working, operating and maintenance instructions in triplicate, with the necessary drawings and diagrams clarifying the instructions.

Instructions are to be made up in book form and particular reference is to be made to:

Maintenance of equipment;

Precautions to be taken in running the plant;

All instruments and components must be fully described in data sheets supplied by the relevant suppliers;

Wiring diagrams of the complete electrical installation.

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The manual must be specific for the plant supplied and all extraneous material not connected with the relevant plant shall be deleted, leaving the manual as a comprehensive coherent document, bound in a professional way such that this may be used frequently without falling apart. Standard pamphlets may be supplied as addendums, bound separately in a good quality file to serve as reference but will not be allowed as part of the main manual.

PMC 19 MEASUREMENT AND PAYMENT

Measurement and payment will be done in accordance with the methods stated below:

PMC 19.1 Design, Drawings and General

<u>Pay Item</u>	<u>Unit</u>
(a) Provide MCC design drawings and wiring diagrams as specified	Sum
(b) Provide operating and maintenance manuals and "as built" drawings as specified	Sum

PMC 19.2 Supply and Delivery to Site

<u>Pay Item</u>	<u>Unit</u>
(a) Supply and delivery to site of complete MCC	Each

PMC 19.3 Installation

<u>Pay Item</u>	<u>Unit</u>
(a) Site installation of MCC	Each

PMC 19.4 Commissioning

<u>Pay Item</u>	<u>Unit</u>
(a) Commissioning of MCC	Each

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Witness 2

VAAL CENTRAL WATER

CONTRACT NO. BW283/ARWWTW/22

REFURBISHMENT OF THE NYAKALLONG (ALLANRIDGE) WWTW: CIVIL, MECHANICAL AND ELECTRICAL, CONTROL & INSTRUMENTATION

PLC: PROGRAMMABLE LOGIC CONTROLLERS

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PLC PROGRAMMABLE LOGIC CONTROLLERS

PLC-1 SCOPE

This specification includes the manufacturing, delivery, transport, handling, protection, storage, installation, successful commissioning and upholding during the Defects Liability Period.

The applicable scope of the works covered by this section shall be defined in the Variations and Additions to the Standard and Particular Specifications Section C3.4.2 and relevant Tender drawings.

PLC-2 CONDITIONS TO SERVICE

The Programmable logic controllers will be installed inside motor control centres and programmable logic controller cabinets on an industrial plant.

PLC 2.1 ABBREVIATIONS

PLC	-	Programmable logic controller
SFC	-	Sequential function chart
SRS	-	Software requirements specification
CF	-	Control function
CFS	-	Control function section
CSC I	-	Computer software configuration item
CSC	-	Computer software component
CSU	-	Computer software unit

PLC-3 STANDARDS AND TESTS

The programmable logic controllers shall conform to and be in accordance with the latest applicable South African Bureau of Standards Codes and Standards as well as International Electrotechnical Commissioner Standards:

The following Standard Specifications and drawings shall apply:

SANS 10142	-	Code of Practice for the wiring of Premises
SANS 156	-	Moulded Case Circuit Breakers
SANS 1574	-	Electric cables and flexible cords
NRS 002	-	Graphical symbols for electrical power, telecommunications and electronic diagrams

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- SANS 1433-1 - Terminal blocks having screw and screwless terminals
- SANS 1433-2 - Flat push-on connectors
- IEC 68 - Shock and vibration resistance
- IEC 1000 - Electrostatic discharge and electromagnetic interference
- IEC 1131 - Standard software

PLC-4 PROGRAMMABLE LOGIC CONTROLLER HARDWARE

PLC 4.1 HARDWARE CONFIGURATION

Normally the hardware configuration will be a single CPU with I/O modules as required mounted on DIN Rail back plane.

Remote I/O drops are permitted provided the remote I/Os are geographically close.

Programmable logical controllers (PLC).

PLC 4.2 GENERAL

The unit shall comprise of a programmable logical controller with interface modules, a power supply, plant input and output modules all suitable for DIN Rail mounting. All equipment shall be housed in a steel cabinet that will form part of that specific motor control centre unless the application requires a separate cabinet.

Apart from any other modules being necessary to operate and control the system satisfactorily, the following modules shall be made available on the units.

PLC 4.3 POWER SUPPLY

The standalone single slot rack mounted power supplies shall operate from 230 V-AC and shall have sufficient capacity for the application. The power supply shall provide all regulated DC back plane power necessary for the installed modules. The power supply shall have over and under voltage protection for added security.

PLC 4.4 PROCESSOR

The CPU module shall be a back plane slot mounted controller containing on board executive memory, application memory and communication ports. It shall be possible to perform field upgrades through a field bus communications port. The front panel of the CPU shall be equipped with status and fault LED's to facilitate fault diagnostic procedures. The CPU shall have a multipoint interface for an external programming device as well as a field bus port.

For math-intensive applications math-coprocessor hardware shall be included in the CPU.

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Sufficient programming memory shall be made available to ensure at least 50% memory available after completion of application building for future expansion. The controller shall support at least of 32 I/O drops.

Ladder logic instruction performance shall be between 0,3 and 1,4ms per 1000. Clock speed shall be at least 20Mhz. The CPU shall support at least the following IEC 1131-3 programming languages:

- (a) Sequential Function Chart
- (b) Function Block Diagram
- (c) Ladder Diagram
- (d) Structure Text
- (e) Instruction List

The CPU shall be equipped with a lithium battery for battery backed RAM to hold application programs.

PLC 4.5 COMMUNICATIONS PROCESSORS

The communications processor shall provide communication links with other programmable controllers through process Field Bus or Ethernet systems.

The CPU shall have a real time clock for the generation of time related information.

PLC 4.6 INTERFACE MODULES

Interface modules shall connect I/O modules in multi-tier configurations.

LED monitors shall be fitted to this card to aid with fault finding.

PLC 4.7 DIGITAL INPUT/OUTPUT MODULES

The digital I/O modules shall accept inputs from plant controls and auxiliary multiple operations and provide control outputs to plant operations. The modules shall be complete with I/O connectors. 24V DC input and output modules will be preferred.

These modules shall also be capable to accept floating alarms of duration of 20 ms as well as steady alarms from normally closed controls. A typical response time of 1ms for change of state shall be acceptable.

All inputs and outputs shall be 2,5 kV isolated from the logic components.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

PLC 4.8 ANALOG MODULES

These modules shall accept analog inputs from plant transducers and provide control analog outputs to plant operations and shall be capable of converting 0-5 V, 0-10V or 4-20 mA signals as may be required. All analog inputs and outputs shall be galvanic isolated.

The input modules shall have a typical accuracy of at least $\pm 0.05\%$ of full scale while the accuracy of the output modules shall not exceed $\pm 0.2\%$ of full scale.

The input modules shall have broken wire fault detection capabilities.

PLC 4.9 RTD MODULES

These modules shall accept inputs from plant transducers. All inputs shall be galvanic isolated.

The temperature range shall be indicated in degrees Celsius and the modules shall accept RTD units of the American PT, IEC Platinum and Nickel N series.

The modules shall have out of range and broken wire fault detection capabilities.

Typical update times of 640ms for 2 or 4 wire systems and 1.2s for 3 wire systems will be acceptable.

PLC 4.10 ETHERNET NETWORK INTERFACE

These modules shall accept data from an external source. The network speed shall be 10/100Mhz and higher. These modules shall be back plane mounted and shall receive and transmit field bus commands. Fibre optic connection through SP connectors shall be possible.

PLC 4.11 OPTICAL LINK MODULES

The back plane mounted optical link modules for fibre optic cables shall allow networks to be configured in linear, ring and star structures and shall be supplied complete with the necessary cable connectors, interface cards and bus connectors.

PLC 4.12 SWITCHES

The 10/100Mb Switch modules shall have a fibre optic Ethernet port and sufficient UTP connector ports with at least two spare ports for future use.

PLC 4.13 FIBRE OPTIC SPLICING

Fibre optic splicing shall be performed by a specialist contractor. The fibre optic connection between the splicing box and the fibre optic module shall be patch leads and not splicing leads.

PLC 4.14 FIBRE OPTIC TO UTP CONVERTERS

Where specified fibre optic to UTP converters shall be installed. These units shall be secured in an acceptable manner.

Contractor

Witness 1

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Witness 2

PLC 4.1 DISTRIBUTED I/O

The distributed I/O module shall be a standalone unit with an integral 230V AC power supply and equipped with digital and analog I/O as may be required. The module shall have an Ethernet port

PLC 4.2 UNINTERRUPTIBLE POWER SUPPLY (UPS)

ON-LINE transformer based (isolation transformer shall form part of UPS system) UPS system shall provide power to all PLC equipment with standby capacity of at least 2 hours.

RS232 interface shall be provided to relay UPS status (battery voltage, mains voltage, power failure alarm, battery low) to the SCADA system.

Bypass switch shall be provided to enable operating of PLC station in case of UPS failure.

Adequate lightning and surge protection units (on Mains side) shall be installed.

PLC-5 PLC GENERAL

The PLC shall be capable of scanning all inputs and storing data in memory for collection by the SCADA system.

It must also be possible to perform sequence control and interlocking of plant equipment.

Outstations shall be modular PLC packaging system and shall consist of all necessary modules as may be required for the specific application. These PLC's shall be connected to the SCADA system via a Field bus or Ethernet system.

PLC 5.1 INPUT AND OUTPUT CARDS

The allocation of input and outputs shall be in a logical manner. The allocation shall be on the basis of process units or streams or drives such that the failure of a card will cause minimum loss of plant availability.

Specifically for any motor starter the inputs shall be grouped on one card. The number of inputs allocated to a motor starter is such that they can be grouped on a 16 way input card so that at most two motor starters are allocated to one card. The allocation inputs and outputs of motor starters shall be such that a duty and standby motor starter are not together on the same I/O cards.

Rack Capacity

The final rack and input and output card installation shall have at least 10 per cent spare slot capacity over and above any spare inputs or outputs on the installed cards.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

PLC 5.2 PROGRAMMABLE LOGIC SOFTWARE

All PLC software shall be structured in a logical manner representing the key process units and control regimes required for plant control.

PLC 5.3 DOCUMENTATION

All PLC software shall be fully documented and the documentation shall consist of the following as a minimum:-

- (a) Functional specification of the plant to be controlled
- (b) Process control logic diagrams
- (c) Sample report forms
- (d) Sample alarm report details (list and format of reports)
- (e) Fully annotated listing of the full software package
- (f) Full input/output listings
- (g) Full allocated register listing with functional description
- (h) Program software in electronic format
- (i) All documentation is subject to the approval of the Electrical Engineer.

PLC 5.4 Execution of control regimes

Control regimes shall generally be executed at PLC level unless the algorithms are too complex to execute at PLC level. Approval to execute control functions at supervisory level shall be obtained from the Engineer before commencement of the software.

PLC-6 COMMUNICATION

PLC 6.1 GENERAL

PLC to PLC communication shall be field bus or Ethernet and if the communication link is required to go beyond a single room optical fibre modems shall be used. PLC CPU's located within a single building room shall communicate over conventional cabled networks using a suitable cable for the Communication link.

In some cases it may be possible to communicate directly with devices (such as variable speed controllers, etc) in which case master slave communication is permitted, peer to peer communication. If such facility for communication is available it is to be used in preference to hardwired 4-20 mA and contact closures signals for process interfaces.

Contractor

Witness 1

Witness 2

Employer

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Witness 2

PLC 6.2 INTERLOCKING CONTROL USING COMMUNICATION NETWORKS

Where it is necessary to execute process control on a PLC and/or supervisory network the following shall apply:-

Safety interlocks where human or equipment safety is a criterion may be communicated over a PLC to PLC network. The interlocks may not be communicated over a higher level supervisory network. This requirement does not negate the requirement to have hardwired safety stop controls on all drives and switchgear.

Non-essential interlocks, the failure of which will not cause harm to persons or equipment may be communicated with prior permission over a supervisory communications network. Preference, however, is to keep all interlocking at the field bus or Ethernet level unless rate of communication is compromised due to excessive traffic levels.

Data for the purpose of reporting and management information shall be channeled through the supervisory level network. Such data shall preferably not be transmitted on the field bus or Ethernet network level unless a supervisory level channel is not available.

PLC 6.3 ENCLOSURES

PLC equipment shall be mounted in an IP54 enclosure with a suitable viewing window in front of the modules. The enclosure will form part of the motor control centre and in the event of no motor control centre available a separate enclosure will be acceptable.

PLC 6.4 HARDWARE CONFIGURATION UNIT BASIS

Hardware shall be configured on a "unit" basis, which is each pump set shall be configured in a module with equipment dedicated to that pump set only on a unit by unit basis so that the failure of any one item will affect only a single pump set at any instant.

It will however, be necessary to serve a pump set PLC hardware with common services such as uninterruptible power supplies.

For this purpose the pump sets shall be provided with the following:

- (a) A control console located on the operating floor in a position where the operator is able to overlook the pump sets if specified.
- (b) A Human Machine Interface terminal to display process and fault information if specified. The normal start and stop functions shall be executed by way of soft keys on the HMI terminals.
- (c) An "Emergency Stop" push button for each pump set in the pump station mounted on the control console if so specified. The emergency stop push

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Witness 2

button shall have a red mushroom operator and shall be of the latching, twist to release type.

- (d) Stop circuits shall be hardwired in the main circuit breaker control circuit as the primary trip route and shall also be wired into the PLC control circuit.
- (e) Emergency trip push buttons shall activate both the trip coil and no volt release coil of the main circuit breaker or contactor where used.

PLC 6.5 HMI TERMINAL - PROCESS INFORMATION

The monitoring and control functions of each pump set shall be accessible on the human-machine interface.

The device shall be programmed that the control soft keys of each pump set are the same. To ensure that this requirement is maintained, a standard software package shall be applied to each pump set. Variable speed pump sets shall have the facility for speed adjustment added.

The HMI shall have a 10,4 inch colour screen (256 colours) and definition of 640 x 480 pixels. Sufficient application memory shall be available to ensure at least 50% spare memory after application building. The HMI shall be equipped with an Ethernet port for PLC communication.

The HMI shall be equipped with at least 8 dynamic keys with LED indicators 12 static keys with LED indicators and re-usable labels 12 service keys and 15 Alpha numeric keys

The following basic process information shall be displayed for each pump set or pump stage as applicable.

- (a) Operating Parameters
 - Suction pressure
 - Delivery pressure
 - Delivery flow rate
 - Running hours - accumulated total and since last start
 - accumulated kWh
- (b) Valve Parameters
 - Suction valve position indication
 - Delivery valve position indication
- (c) Pump Parameters
 - DE and NDE bearing temperatures

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- Thrust bearing temperature
- Vibration level
- Volute temperature
- (d) Motor Parameters
 - DE and NDE bearing temperatures
 - Phase stator temperatures
 - Motor power
 - Motor current
 - Motor speed (variable speed drives only)
 - Power factor (variable speed drives)
 - Vibration level
- (e) Auxiliary Devices
 - Device run and stop indication
 - Device fault indication
 - Flood alarm
- (f) The following basic information screen shall be provided
 - Process indication of the pump set
 - An Alarm screen
 - Historic alarm screens (if required)
 - Protection settings with adjustment capabilities
 - Status indication of interlocks to facilitate evaluation of the start up sequence
 - Status indication of the interlocks that are in "Bypass" condition
 - Main overview
 - Main 11kV electrical power supply system with status indication of all circuit breakers and associated equipment.

PLC 6.6 SCADA INTERFACE

To facilitate an interface with a SCADA system the PLC shall have a field bus or Ethernet port as may be required.

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The intention is that all main water pump sets be controlled from the relevant local control panel as well as from the SCADA system. However, process data will be collected via the field bus or Ethernet port for reporting and trending on the SCADA system.

Provision shall be made for control of the pump sets via the SCADA system by means of a selector switch on the motor starter panel located in the pump station which shall have the functions Automatic / Manual. Switching off this selector switch while a pump is running shall not trip the relevant motor.

Terminal strips in programmable logic controller panels.

Wiring directly to the PLC I/O cards is not permitted. All wiring shall be by way of two sets of terminals arranged such that one set of terminals are grouped on a cable by cable basis and the second set of terminals reflect the PLC I/O card slots. Patch wiring shall be provided between each of the terminal strips as required.

Terminals used in PLC cubicles shall be of the knife type.

PLC-7 PLC SOFTWARE DEVELOPMENT

PLC 7.1 SOFTWARE

IEC 1131 Standard software with up and download capabilities programmable over the field bus or Ethernet network and complies with a standard Graphical User Interface 32 bit operating system for network applications, shall be used.

The software shall allow the reusability of function blocks as building blocks in future applications and shall have a built-in PLC simulator that will allow the running of the IEC program for debugging purposes.

PLC 7.2 IDENTIFICATION

This specification describes the procedure for the development of PLC software. All PLC software developed shall conform to the conventions and standards described in this procedure. The documents described in this procedure shall be produced as outputs during the software development process, and together they will enable the maintenance and re-use of software, and they will simplify configuration management of software items.

PLC 7.3 SOFTWARE ENGINEERING REQUIREMENTS

PLC software shall be designed for continuous reliable operation.

The software shall be designed for maintainability. This particular requirement enforces the following constraints on the software development:

It shall be possible to change the software in response to changing requirements by modifying only those sections of code that are directly related to the changed requirements.

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The code shall be written on the premise that it shall be possible to make changes to local code sections without affecting the functionality of other code.

The program style shall be direct and simple wherever possible. This will enable future modifications to be performed by programmers that may not have been involved in the development of the original system. Convoluted programming techniques tend to mask the essential design of the program. Such techniques shall only be used when the programmer has no alternative, or when the benefit (efficiency, size, execution time etc.) significantly outweighs the cost.

All PLC programs shall be extensively documented to convey the intended function of the program.

PLC 7.4 COMPUTER SOFTWARE CONFIGURATION ITEMS

High-level plant "classes" identified during the analysis phase shall be mapped to computer software configuration items (CSCI). Child classes shall be mapped to computer software components (CSC) and computer software units (CSU), in accordance with the class hierarchy of the system.

Each CSCI shall be comprehensively documented in a software requirements specification (SRS).

A CSCI, CSC and CSU shall be characterized by one or more control function instances. These instances may be grouped into one or more control function types. Control function types include interlocks, trips, control algorithms and other functional and logical entities that are required for interaction with and control of a specific piece of plant equipment.

PLC 7.5 SOFTWARE REQUIREMENTS SPECIFICATIONS

Each CSCI be specified by means of a software requirements specification. The software requirements specifications shall meet the following requirements:

Each plant component that has been subjected to object-oriented analysis shall be described by a set of overview class hierarchy diagrams that illustrates the inheritance relationships inherent in the system. The class hierarchy diagrams shall illustrate inheritance in:

- (a) The PLC input/output points
- (b) Discrete and batch control functions, e.g. interlocks, trips, start-up sequences
- (c) Continuous process control functions, e.g. PID control
- (d) The analog and digital values that are generated by the PLC software and/or communicated to the SCADA system, e.g. metering information

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The requirements section shall contain an introductory subsection that describes the purpose of the software system, and in particular, the role of the PLC software in the system.

The requirements section shall specify the names and descriptions of all analog and digital plant inputs and outputs that are communicated to or from the PLC.

The requirements section shall incorporate several subsections called control function sections (CFS), each describing a number of instances of a specific control function. For example, a PLC program may implement several PID control loops. The software segment specification would then incorporate a "PID Control Loops" section, in which each PID control loop is described in detail, in keeping with a standard layout.

The requirements section shall list and describe all digital or analog values that are generated by the PLC software (or that are scanned into the PLC) and then transmitted to the SCADA system.

The requirements sections shall include a detailed explanation of how the PLC driven systems operate in conjunction with the hard-wired systems.

PLC 7.6 GENERIC LAYOUT

Each CFS shall conform to the following generic layout:

- (a) Control function (CF) type and instance number - this number shall be unique for each instance in a control function class hierarchy

Name - A short text label that describes the control function.

Description - Textual explanation of the behavior of the control function.

Software algorithm - Explanation of the PLC logic that is used to implement the control function. The names of all the PLC inputs and outputs that are used shall be given in the algorithm description.

- (b) SCADA indication - the SCADA indication details of the control function are given, including the location of the indicator, the colour of the indicator, and the message details.

- (c) Notes and associated conditions - any settings that may be relevant to the CF, or any conditions such as alarms or pre-conditions that relate to the CF shall be documented.

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For example, the requirements section may incorporate a subsection describing the interlocks that pertain to the particular class. Each interlock description shall incorporate the following:

Interlock number	- This number shall be unique for each interlock in a class hierarchy
Name	- A short text label that is normally the same as the interlock message
Description	- Textual explanation of the function of the interlock
Software algorithm	- Explanation of the PLC logic that is used to implement the interlock. The names of all the PLC inputs and outputs that are used shall be given in the algorithm description.
SCADA indication	- The SCADA indication details of the interlock are given, including the location of the indicator, the colour of the indicator, and the message details.
Pre-conditions	- Any pre-conditions that must be satisfied before it can be confirmed that the interlock is unhealthy. In some cases it may be necessary to explain the algorithm and PLC logic of the pre-conditions and any overrides that may be present.

PLC 7.7 NAMING AND DOCUMENTATION OF SOFTWARE

Each PLC program shall be documented in a manner that allows the reader to understand the functionality of the program, and to locate the desired section of ladder logic.

A short "Program description" document shall be produced for each PLC program. The primary functions of the program shall be listed in this document. For example, the program might monitor and control electricity reticulation, provide water quality monitoring functions, and allow for the control of certain pump sets.

Each PLC program shall consist of several segments. Segments are used to divide the program into logical sections. Segments are the basic schedulable entities within the PLC software. Each segment shall be documented by means of an SFC list. The SFC list gives some indication as to the purpose and structure of the program. Segment comments may be up to one page in length.

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PLC segments consist of several SFCs. Each SFC shall be documented by means of a list of networks within the SFC. The list shall identify which of these networks are implemented as macros and which are specific and unique to the SFC. This list is intended to give some indication as to the purpose and structure of the SFC. SFC comments may be up to one page in length.

Each SFC consists of a number of networks. The logic employed in each network shall be described in the network comments that may be up to one page in length. Where a network is implemented by a macro, the macro comments may be copied to the network comments screen, or the network comments screen may simply reference the macro comments. Macro comments and network comments shall describe the PLC logic in terms of "power flow" that is regulated by the opening and closing of coils.

Each coil and register that is used in the PLC program shall be described in the comments field that may be 50 characters long (10+10+10+20).

Print outs of appropriate ladder logic shall be attached to all network comment documents.

PLC 7.8 MACROS

Macros shall be used wherever possible in the implementation of PLC software in order to promote software re-use.

Common software elements shall be identified from the plant class hierarchy.

A set of macros shall be associated with a specific plant class hierarchy, although a direct mapping of macros to entities in the hierarchy may not result in optimal re-usability. In such instances, the macros shall rather be designed for optimal re-usability.

The PLC logic used in macros shall be described in the macro comments screen.

The design of macros shall not be explicitly documented. The software segment specification relating to each software segment identified in the plant class hierarchy shall describe the functional and behavioural aspects of the PLC software. If the software has been implemented in terms of macros, then the reader shall know this from the network comments that are associated with the relevant software.

PLC 7.9 OPERATIONS MANUAL

An "Operations Manual" shall be delivered with the software. This manual shall contain the following information:

- (a) Details of all instruments and devices that shall be connected to the PLC.
- (b) Details of PLC - network connections.

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- (c) A user document that describes how the PLC program shall operate in conjunction with SCADA systems, hard-wired systems and mimic panels. This document shall inform the user of alternative control options, and give some idea of how the PLC system integrates with the plant and its hard-wired systems.

PLC 7.10 QUALIFICATION

PDS 7.10.1 TEST SPECIFICATION

A test plan shall be developed for each software segment whilst the software segment specification is being drawn up.

The test plan shall focus initially on verifying the architectural design of the program that is that the partitioning into segments, SFCs and networks has been performed in an intuitive and logical manner.

Each trip, interlock and data output shall be tested by varying all pre-conditions and overrides. The test scenario for each case shall be comprehensively described. Details of how to model a particular override or pre-condition by modifying the hard-wired configuration shall be given. Explicit criteria shall be given in terms of which the interlock or trip shall be deemed to have passed or failed the test.

PDS 7.10.2 WALK-THROUGHS

Structured walk-throughs and code inspections shall be carried out during the development of each software segment.

Walk-throughs shall initially focus on verifying the architectural design of the program that is that the partitioning into segments, SFCs and networks has been performed in an intuitive and logical manner.

Ladder logic networks shall be tested individually. All possible coil status permutations shall be identified for each network. Factors that may cause coil statuses to change shall be identified and the ramifications of changing coil statuses shall be investigated. Where registers are used in the networks, factors affecting register values shall be identified, and tests shall be devised to investigate the behaviour of the software when register values change to and from critical values.

A checklist shall be used to allow PLC programs to be checked for common PLC programming faults. The checklist shall be maintained on an on-going basis to ensure that the maximum number of common errors can be detected before testing and commissioning.

Walk-through inspections shall be limited in duration to two hours or less.

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Walk-through inspections shall be performed by a team of not less than three (and not more than four) people.

PDS 7.10.3 TEST PROCEDURE

Software testing shall be carried out on site.

Before testing begins, the plant to be used in the on-site tests shall be de-commissioned and configured for testing.

Trips, interlocks and data outputs shall be tested individually. These tests shall follow the test specification that was produced in parallel with the software segment specification.

A test compliance document shall be completed during the test phase, and this document shall be included in the project documentation.

PDS 7.10.4 CHANGE MANAGEMENT

Changes to the functionality of a program may be required if the system fails due to an identifiable fault in the program, if the requirements change such that the change in specification forces a change in the software, or if sub-optimal system behaviour can be improved through software modification.

Faults reports shall be generated by the plant operators, and they shall be passed on to the software configuration manager. Similarly, any change in requirements that leads to a change in specification shall be passed on to the software configuration manager.

Changes shall first be made to the software requirements specification. The ramifications of making the changes shall be investigated, and the software modules (segments, SFCs, networks) that are affected shall be identified and modified.

Before the software changes are effected, a test plan shall be produced that describes how the changes are to be approved. This test plan shall be incorporated in the project documentation in the "Change control" section.

A walk-through inspection shall be held once the changes are complete. The primary goal of this inspection shall be to determine that all possible side effects that may be produced by the changes have been anticipated and explicitly dealt with.

Minutes from this inspection shall be appended to the body of the main project documentation in the "Change control" section.

The modified software shall then be tested according to the test procedure that was produced when the specification was amended.

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PLC-8 MEASUREMENT AND PAYMENT

Measurement and payment will be done in accordance with the methods stated below:

PDS 8.1.1 SUPPLY AND DELIVERY TO SITE

<u>Pay Item</u>	<u>Unit</u>
(a) Supply and delivery to site of PLC and peripheral equipment installed in MCC or other specified enclosures, all as specified.	Sum
(b) Supply and delivery to site of UPS as specified.	Sum
(c) Supply and delivery to site of HMI as specified.	Sum

PLC 8.2 INSTALLATION

<u>Pay Item</u>	<u>Unit</u>
(a) Installation of PLC and peripheral equipment in MCC or other specified enclosures, all as specified.	Sum
(b) Installation of UPS in MCC or other specified enclosures, all as specified.	Sum
(c) Installation of HMI in MCC or other specified enclosures, all as specified.	Sum
(d) Site cable connections and programming of PLC and peripheral equipment	Sum

PLC 8.3 COMMISSIONING

<u>Pay Item</u>	<u>Unit</u>
(a) Commissioning of PLC and peripheral equipment.	Sum
(b) Commissioning of UPS.	Sum
(c) Commissioning of HMI.	Sum

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VAAL CENTRAL WATER

CONTRACT NO. BW283/ARWWTW/22

REFURBISHMENT OF THE NYAKALLONG (ALLANRIDGE) WWTW: CIVIL, MECHANICAL AND ELECTRICAL, CONTROL & INSTRUMENTATION

PSC: THE SUPERVISORY CONTROL AND DATA ACQUISITION SOFTWARE PACKAGE (SCADA)

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PSC THE SUPERVISORY CONTROL AND DATA ACQUISITION SOFTWARE PACKAGE (SCADA)

PSC 1 SCOPE

This specification includes the supply, development, delivery, handling, protection, storage, installation, successful commissioning and upholding during the Defects Liability Period.

The applicable scope of the works covered by this section shall be defined in the Variations and Additions to the Standard and Particular Specifications Section C3.4.2 and relevant Tender drawings.

PSC 2 CONDITIONS TO SERVICE

The SCADA System and peripheral equipment will be installed inside a control room on an industrial plant.

PSC 3 SCADA SOFTWARE REQUIREMENTS

PSC 3.1 General

The Supervisory Control and Data Acquisition software package (SCADA) chosen for this application shall be a standard package and shall have a wide and well-established user base in the South African telemetry environment. Custom written software will not be considered for this project. The package shall be able to scan up to a required number of scan points initially and shall be scalable and upgradeable to expand the database to any size to include additional scan points by merely upgrading the license agreement. The number of scan points required is indicated in the Variations and Additions to the Standard and Particular Specifications.

The software shall be a native 64-bit application and must run on the Windows 10 operating system or an operating system of similar capability. Preference will be given to systems built on Distributed Internet Application Architecture standard (DNA).

A software support service with optional updates shall be available. The location and level of software support available shall be indicated. Preference shall be given to a locally supported SCADA package.

The SCADA software shall be supplied as a complete package and shall include an integrated development package. No additional software should be required to configure or run all the features of the SCADA system. Systems comprising a collection of software from various manufacturers (other than the computer operating system, the network operating software and the reporting package) will not be considered.

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PSC 3.2 Standard software requirements

The SCADA software shall serve as Human Machine Interface (HMI), collect data from various field devices, perform process control and monitoring, alarm handling/monitoring, historical data logging, historical and real time trending and report generation. The software shall enable the running of all these tasks simultaneously and one task shall not inhibit another (e.g. printing of reports shall not inhibit the telemetry task or require it to go off-line). The same applies to the editing of mimic displays and database tag configuration, which shall be possible concurrently with the main scanning task running.

PSC 4 NETWORKING CAPABILITY

The package shall be capable of transparently supporting distributed multi-client, multi-server configurations. In this configuration, the database shall be distributed among the server stations with each one scanning its front-end device(s) and updating its own database.

The SCADA system must allow client stations (i.e. supervisory stations) to connect to server stations (nodes) via a remote link. The system shall provide the capability of supporting Local Area Network (LAN - Ethernet) and Wide Area Network (WAN - radio, telephone modem).

PSC 5 DATA LOGGING

All logged data shall be stored in Microsoft's SQL Server standard compatible format. Database with proprietary formats will not be acceptable for this project. The system shall implement the data-logging scheme to permit configuration without users being required to write SQL-type commands.

System shall support data collected from field devices by polling and exception reporting.

PSC 6 DATABASE CONNECTIVITY

All database items shall be transparently available on all operator stations (nodes) via a dedicated network. This includes mimic displays, trending, reporting and alarms. There shall be no appreciable degradation in response time between subscriptions to local database items, and subscriptions to database items in another server station (node)

The system architecture shall support native database interfaces to popular relational database management systems such as Oracle, Sybase, dBase IV with connectivity to ODBC-compliant systems as well. It is the intent to provide an open system based upon the ANSI SQL standard. Enterprise connectivity through the native database interfaces as listed above shall be supported.

PSC 7 CONFIGURATION

On-line monitoring, control, configuration and engineering functions must be provided on all client and server stations (nodes) on the SCADA network. Built in tools must exist to do bulk

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configuration of the database. SCADA packages that require off-line compilation of configuration changes will not be considered.

The system must provide the ability to add tags on the fly from within the graphics editor, trend viewer, or anywhere in the system that calls for a tag.

The software shall provide the user with the ability to monitor, fault find and configure a server from a remote LAN or WAN based workstation.

It must be possible to configure the server software application to execute as a Windows NT Service, allowing the configuration of a robust control system.

It shall be possible to configure a node as View Only or Full Control.

PSC 8 FRONT-END DEVICES

The SCADA package offered should interface to a vendor's Front End Processor (FEP) via a serial communications port.

The SCADA package shall come complete with a comprehensive library of drivers for all standard industrial applications, including the drivers required to provide the communications mechanism between the SCADA and the telemetry Central Interface Unit equipment. One critical feature that the driver shall support is the time-and-date stamping of data as detailed below. It will be preferred to use OPC (Object Linking and Embedding for Process Control) drivers to interface telemetry, PLC's and other intelligent devices (OPS servers) to the SCADA system (OPC client).

PSC 9 OPEN INTERFACES

The system shall support the current industry standards for open system interfaces: OLE, DDE, CSV etc.

The software shall easily and seamlessly connect up to other third party applications such as Excel, Lotus, Microsoft Office, SQL Server, Oracle, Delphi, Power Builder, Visual Basic etc. SCADA systems that 'lock' the user into one programming language / environment will not be considered for this project.

PSC 10 OBJECT ORIENTED GRAPHICS

Mimic screens shall be graphically based on dynamic and static objects. The system shall support true vector based graphics and allow unlimited panning and zooming without any degradation in mimic resolution and sharpness. There shall be no limitation to the screen resolution and / or number of colours supported.

A comprehensive standard graphics symbol library must be provided and must allow modification and / or adding of custom symbols to the library easily without purchasing additional software. All library symbols must support unlimited panning, zooming and sizing.

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It shall be possible to dynamically move, size and rotate all graphic objects, linked to changes of state in the on-line database.

The package shall have conventional CAD type editing facilities to ensure that the mimics are easy to build and modify.

It shall be possible to launch third party applications from within a graphic page, by operator action or on process event, as well as configure user-specified, process triggered, hypertext help pages for display.

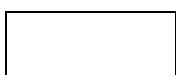
The SCADA system must allow mimics to be 'replayed' from historically logged data as well as live real-time data.

PSC 11 MIMIC SCREENS

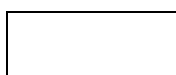
Information about the system status shall be gradually graphically displayed on the various screens (starting with major components and then going to ever more detail sub components).

The following graphic animated pictures shall be available to the operator at the master station:

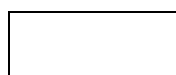
- (a) A system diagram showing all major water system components with their statuses (e.g. Raw Water Pump Station, Water Treatment Works, High Lift Pump Station and all reservoirs and radio communication status and wired networks).
- (b) The Water Treatment Works showing all major components (chemical dosing system, filters, electrical panels, motorised valves, pumps, and communication statuses).
- (c) Pump Stations diagrams (raw and high lift) showing all major components (pumps, motorised valves, pump consoles, electrical panel and communication statuses).
- (d) Chemical dosing plant diagram (with all its components and parameters).
- (e) Filter plant diagram (with all its components and parameters). Filter back wash processes shall be continuously monitored and displayed and the cause of a back wash sequence failure shall be indicated.
- (f) Pump diagrams showing all pump parameters (for each pump). A pop-up window with remote control (SCADA control functions) shall be provided that will allow remote starting and stopping of a pump set.
- (g) Electrical diagrams showing all electrical parameters (for each sub system and general).
- (h) Telemetry diagrams showing all outstation telemetry parameters.
- (i) Graphs showing water level, flow and total flow trends (30 days, 7 days, 24 hours).
- (j) Graphs showing Motor electrical parameters (30 days, 7 days, 24 hours)
- (k) Graphs showing general electrical power quality parameters (30 days, 7 days, 24 hours)



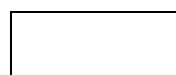
Contractor



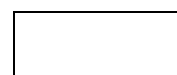
Witness 1



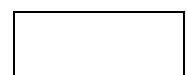
Witness 2



Employer



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Witness 2

- (l) Graphs showing battery voltage for each station (30 days, 7 days, 24 hours)
- (m) List of all station inputs, outputs and software delivered alarms with their status and measured values - for each station
- (n) Alarm log
- (o) Event log

It shall be possible to group up to six analog values on one graph and to zoom on the graph by entering starting - ending day / time and minimum / maximum value to be displayed.

To ensure fast trend window performance trend sample times must be matched with data log sample (dead band) times so that trends are forced to use matching data log sets that log to the proprietary logging files instead of the SQL tables.

The system shall be capable of handling a minimum of 200 graphic pictures.

PSC 12 TIME AND DATE STAMPED PROTOCOL SUPPORT

The system offered shall be able to handle time and date stamped digital events and analog values IN THE INTRINSIC DESIGN OF THE PACKAGE, and not by writing special code, scripts or other instructions. This feature shall NOT be achieved via a custom add-on. The time and date stamping shall occur at the source of the data (reflecting time-of-occurrence, NOT time-of-arrival at the master station) and these records shall be correctly incorporated in the historical data files of the computer and automatically form part of the trends and reports. This shall occur correctly even if the records do not arrive in chronological order. It shall occur automatically without any special operator intervention.

The events shall be stored in chronological order into the alarm and event files for accurate viewing and report generation. The Tenderer shall clearly describe how this requirement shall be met.

PSC 13 SECURITY

The software shall provide a comprehensive security system. The security system must integrate smoothly with the operating system's security system. It must be possible to completely disable all Windows controls like Title Bar, Sizing Border, Menu, Status Bar etc., and thereby create a totally tamper-proof operator interface.

Operator access to software facilities shall be via keyboard / mouse and shall be password protected. At least five levels shall be required. It shall be possible to assign a minimum of five different passwords to the same level (to accommodate different operators).

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The following five levels has been identified and shall serve as a guideline:

- Level 1: Basic functions - selecting graphic pictures and graphs, acknowledging alarms, requesting printouts of graphs, alarm, event and maintenance logs.
- Level 2: Control functions (remote starting and stopping)
- Level 3: Software control function (auto, remote control function)
- Level 4: Software facilities - generation of mimics, selection of report types and frequency of printing.
- Level 5: Software changes (system level).

The level of password to be assigned to various operator functions shall be discussed and finalised with the successful Tenderer.

All attempts made by an operator to access a password-protected level shall be logged on the printer and in the historical file.

PSC 14 REPORT GENERATION

It should be possible for an operator to select the automatic printing (to disc and / or printer) of the daily / weekly / monthly reports required.

The operator (who would have attended the SCADA software training sessions provided for in this specification) shall be able to create his own report forms. Building a report shall be menu-driven. Each menu shall allow the operator to specify what information shall be printed and where it shall placed on the page. Basic mathematical functions and graphs shall be supported. A report scheduler shall enable the operator to specify when the report should be printed based on the time of day, day of the week, month or event. The data for the report shall come from either the current database or from historical trending files.

The contractor shall set up a number of standard reports (at least three) that can be used on this system during the training sessions. These shall be specified before the advent of such a training course and shall, amongst others, include the generation of a summary sheet of the total volumes of water that has past specific points (where flow meters have been installed) in the water supply network, for billing purposes.

It shall be possible for the operator to request the printing of graphic pictures, historical and real time trends.

To aid the generation of professional reports, a package such as Microsoft Office (MS Access, Excel) or an equivalent shall be included in the master station software to be supplied.

If report generating software is specified then report information must be drawn directly from the SCADA data logs and not through the SQL server.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

PSC 15 DATA STORAGE AND RETRIEVAL

The master station hard disk shall be of sufficient capacity to accommodate a record of at least 365 preceding days of all the analog and digital values obtained from the various outstations.

History files shall be automatically backed-up to a compact disk (DVD) upon software-specified day of the month or as the hard disk approaches 2/3 filled. An appropriate message shall alarm the operator that such action is about to take place and shall prompt the operator to load a DVD into the disk drive, before commencing with the procedure of saving the data to the disk. The whole process shall otherwise be software-driven. The software shall determine the date of the last data downloaded onto the disk (from the time/date stamp) and shall only download that portion of data not yet saved to disk. No data already saved to disk shall be destroyed in the process.

PSC 16 POWER FAILURE

In case of power failure (battery low signal from UPS) the SCADA application and operating system shall shut down gracefully (all programs and files closed, memory flushed, buffers written to disk). On power restoration system shall restart automatically.

PSC 17 SCADA HARDWARE REQUIREMENTS

PSC 17.1 Operator station

- (a) Latest Intel i7 processor or equivalent complete with Cache memory: (level 2)
- (b) RAM:64 GIG 667MHz DDRAM, expandable
- (c) Hard drive: IDE / EIDE 1GIG
- (d) RS232 card with four ports (telemetry FEP, modem, UPS, spare) and external lightning and surge protection units.
- (e) Graphic card: 64 Bit hardware – accelerated 3D graphics.
- (f) Mouse: Internet Scroll Mouse (optical) and mouse pad
- (g) Keyboard 104, windows keys
- (h) LED Colour display monitor with at least 21" screen
- (i) Printer: Colour Ink Jet
- (j) 10/100/1000 MB Network card
- (k) Printer port

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

PSC 17.2 Uninterruptible Power Supply (UPS)

ON-LINE transformer based (isolation transformer shall form part of UPS system) UPS system shall provide power to all SCADA equipment (PC, Telemetry FEP, radio, printer, VDU and modem) with standby capacity of at least 2 hours.

Bypass switch shall be provided to enable operating of SCADA station in case of UPS failure.

Adequate lightning and surge protection units (on Mains side) shall be installed.

PSC 18 CONFIGURATION OF SCADA SOFTWARE

Tenderers shall make sufficient provision in their Tenders for the following:

- (a) To create mimic screens for all plant processes under this contract.
- (b) To provide trend screens for all flow meters, levels and pumps under this contract.
- (c) At least the following dynamic trend screens shall be provided for:
 - On and off cycle of pumps
 - Flow indications
 - Level indications
- (d) Pump speed indications
- (e) Alarm reports
- (f) At least the following alarm reports shall be required:
 - Motor trip
 - High levels
 - Outstation fails
 - Power failures and low battery power
- (g) The following standard control features shall be offered:
 - Plant animated mimics-graphic display of mimics and plant status with simultaneous selectable displays of different plant sections on the monitor.
 - Security levels of access to control functions shall be allowed for. Tenderers shall submit full details of security access to control functions.
 - On the initiation of the system the mother station with its peripherals shall scan the plant and determine the number of points it monitors. It shall then create relevant data tables from the above.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

- The monitoring system shall scan the plant continually and compare the information received with that in data tables and any changes shall be stored.

(h) Reporting

- The software shall be so assembled to allow for the transfer of data into spreadsheet to allow reporting and analysis of results.
- The ability to change windows and constraints on line; and changing time scaling on line.

(i) Alarms

- The system shall accept alarm signals in abnormal conditions and attract the operator's attention with an audible alarm and visible change on the VDU.
- Until acknowledgement of alarms which require operator's action the alarm shall continue to signal.
- Alarms shall be divided into categories viz:
 - i) Urgent
 - ii) Caution
 - iii) Attention; and Event

(j) General

- The outstations shall be interrogated sequentially by the mother station.
- On initiation the outstation shall scan the plant and determine the number of points it controls and monitors. It shall then create relevant data tables from this;
- The outstation shall scan the plant continually and compare the information received with that in the data tables and any change shall be stored;
- When the outstation is interrogated by the mother station the stored information shall be sent from the mother station where it shall be read into a parallel buffer.
- On initialisation the mother station shall obtain from the outstation all the information in their data tables and set up its own data tables; and

(k) To execute a control:

- An outstation shall be selected;
- The plant shall be selected;

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

- The desired command shall be fed in; and
- The command is then sent to the outstation which selects the plant and sends as a check the re-compiled word back. When this is received at the master station the "execute command" is given which operates the plant at the outstation.
- If the command is not executed, an error message shall be sent by the outstation indicating whether:
 - i) The plant failed to operate; and
 - ii) It was not possible to select the plant.
 - iii) The control signals shall feature, in addition, interlocks that will prevent plant equipment operating if it can cause a dangerous condition.

(I) Front End Processor

The front end processor shall scan all outstations to collect data for processing. The front end processor shall generate the following scan routines which are:

- Alarm, status scan;
- Analog, pulses scan;
- Controls;
- Communications fail scan;
- Suppressed scan; and
- Data correlation;

PSC 19 REPORTING SOFTWARE

Web-based reporting and analytical software shall be compatible with the SCADA software. The reporting software shall be capable of creating meaningful and relevant reports from multiple data sources including the SCADA system database, OPC, Industrial Historians and spreadsheets.

The software shall be so assembled to allow for the transfer of data into spreadsheet to allow reporting and analysis of results.

The ability to change windows and constraints on line; and changing time scaling on line.

PSC 20 MEASUREMENT AND PAYMENT

Measurement and payment will be done in accordance with the methods stated below:

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

PSC 20.1 Supply and Delivery to Site

<u>Pay Item</u>	<u>Unit</u>
(a) Supply and delivery of SCADA Package software	Sum
(b) Supply and delivery of supplementary software	Sum
(c) Supply and delivery of SCADA PC hardware	Sum
(d) Supply and delivery of SCADA UPS	Sum

PSC 20.2 Installation

<u>Pay Item</u>	<u>Unit</u>
(a) Configuration of SCADA and supplementary software	Sum
(b) Installation of SCADA PC hardware	Sum
(c) Installation of SCADA UPS	Sum
(d) Generating reports as specified	Sum

PSC 20.3 Commissioning

<u>Pay Item</u>	<u>Unit</u>
(a) Commissioning of SCADA System and testing interface with new plant	Sum
(b) Commissioning of SCADA PC hardware	Sum
(c) Commissioning of SCADA UPS	Sum
(d) Commissioning of reporting system	Sum

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2

VAAL CENTRAL WATER

CONTRACT NO. BW283/ARWWTW/22

**REFURBISHMENT OF THE NYAKALLONG (ALLANRIDGE) WWTW:
CIVIL, MECHANICAL AND ELECTRICAL, CONTROL & INSTRUMENTATION**

**PERIMETER FENCING, ELECTRIC FENCING AND CCTV SPECIFICATION –
WWTW REMOTE SITE MONITORING**

Contractor	Witness 1	Witness 2		Employer	Witness 1	Witness 2

1. CCTV SYSTEM SPECIFICATION

The remote site shall be equipped with 24hr site and perimeter fence surveillance through a combination of strategically located PTZ thermal day/night IP cameras and DUAL thermal day/night IP bullet cameras. The CCTV system networking equipment shall be centralised in the CCTV Control Room. The system shall be administered from a dedicated workstation in the O&M building and the camera surveillance visuals shall be accessible on a workstation installed at the guard house/control room and/or remotely monitored at the SAIDSA approved offsite Control Room.

The Following general requirements are applicable:

- The equipment specified in this document shall include all necessary components for a fully functional CCTV surveillance installation, whether specifically listed or not.
- The Contractor shall ensure that all offered equipment and software can be integrated into a fully functional CCTV surveillance installation.
- All equipment shall be rated for continuous operation under the environmental conditions.
- Where computer hardware is specified, it remains the Contractors' responsibility to ensure that the actual hardware offered and installed is adequate to support all software offered, Software licenses and the specified software functionality, including future expandability is provided for the duration of 5 years after COD.

1.1 General Surveillance Specifications

The CCTV shall be designed to meet certain degree of functionality. The main functionality that the CCTV system shall achieve is:

Fixed dual thermal day/night IP cameras

- Human detection (1.8 x 0.5m) at 60m
- Vehicle detection (1.4 x 4.0m) at 150m PTZ dual thermal day/night IP cameras
- Human Recognition (1.8 x 0.5m) at 368m
- Vehicle Recognition (1.4 x 4.0m) at 1127m

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

1.2 CCTV Equipment Specification

The CCTV System shall consist of the following equipment:

- CCTV Network Video Recorder
- Central CCTV Network Switch and field switches
- Field fixed Bullet dual thermal day/night IP cameras
- Field PTZ dual thermal day/night IP cameras complete with networking equipment
- CCTV workstations
- Video Management Software (VMS)

1.2.1 CCTV NVR

A single Network Video Recorder (NVR) shall be supplied and shall be installed in the allocated space within the Control Room/Server cabinet. The NVR shall have enough channels to support all the cameras installed in and around the plant and shall have 20% space channel capacity.

The NVR shall allow for no less than four (4) weeks of video footage storage. The Client shall be able to export all stored footage and the NVR shall be support and be configured for secure remote access.

The NVR shall be supplied from the UPS installed in the CCTV Control Room/Server Cabinet. The NVR shall interface with all cameras through the Central CCTV network switch and this shall be done over an ethernet and fibre optic connection that is no less than gigabit speed.

1.2.2 Main CCTV Switch

The main CCTV switches shall be installed inside the CCTV Control Room Cabinet. The switch will be the central connection devices for the CCTV backbone network which shall operate at no less than 1 Gbps.

The switch shall offer at least link layer 2 support and shall be equipped with both copper ethernet and fibre optic ports.

Network management and monitoring software shall be provided for setup, configuration and monitoring of the network.

The switch shall be equipped with PoE ports that are sufficient to supply the offered fixed bullet dual thermal day/night IP camera to be installed at the CCTV Control Room.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

1.2.3 Field PTZ Dual Thermal Day/Night IP Camera

Pan-tilt-zoom (PTZ) dual thermal day/night IP cameras shall be installed at strategic locations within the Remote site. The PTZs shall be supplied and installed to meet the minimum performance.

The PTZ cameras shall be installed on concrete poles and shall be supplied with all the necessary mounting brackets and accessories for a neat and secure installation.

The PTZ cameras shall be programmed for route tracking as per the Client's requirements. They shall also be integrated with the fixed cameras and the perimeter electric.

The PTZ cameras shall be bispectral, complete with optical and thermal modules and shall provide dual image streaming. The PTZ shall be programmed to do advanced fire detection, both within the plant and outside the perimeter.

The PTZ cameras shall be PoE enabled and/or power supply. They shall be supplied from a CCTV utility box. The ethernet cable shall supply the PTZ through a suitable RJ-45 surge arrestor.

1.2.4 CCTV Utility Box

Each PTZ shall be supplied with an IP65 Utility Box which shall be used to house the equipment required to power the PTZ camera and connect it back to the main fibre ring terminated in the nearest manhole. The utility box shall be supplied with mounting brackets and all accessories required for fixed mounting. The equipment to be housed by the utility box includes:

- CCTV PoE Switch
- UPS
- Fibre Splice Box
- Circuit breakers
- Surge arrestors

All equipment is to be din rail mounted and trunking shall be provided for neat cable management. Where din rail mountable equipment is unavailable, equipment is to be fastened securely using appropriate mounting equipment.

Utility boxes shall have 10% spare mechanical space.

The PTZ camera and utility box shall be fixed to concrete poles. All CCTV mounting poles shall be supplied with lightning protection.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

1.2.5 Fixed Bullet Thermal Day/Night Cameras

There shall be a high-resolution fixed dual thermal day/night IP bullet camera installed “head to tail” along the perimeter. The camera is to be supplied with required mounting accessories for pole mounting and shall have an IP rating for outdoor use. An anti-theft vandal resistant bracket must be supplied and mounted over each fixed dual thermal day /night camera.

A camera shall also be installed such that it has uninterrupted line-of-sight to of the main access point to the building. The camera shall provide full view of the access door at an angle acceptable to the client.

There shall also be a high-resolution fixed bullet camera installed at the Guard House. The camera is to be supplied with required mounting accessories for wall mounting at the Guard House and shall have an IP rating for outdoor use. The camera shall be installed such that it has uninterrupted line- ofsite to of the main access gate to the site. The camera shall provide full view of the access gate and shall be configured to achieve license plate recognition with an image of at least 250 px/m at a distance of 30 meters from the camera. The camera shall also provide full view of the access gate under zero (0) lux conditions.

The bullet cameras shall be supplied by PoE. The contractor shall ensure that the PoE of all switches which supply cameras are sufficient for the respective camera operations.

1.2.6 CCTV Workstations and Management Software

Video management software (VMS) shall be provided as part of the CCTV surveillance solution. The CCTV VMS shall include technical support from the software vendor for a period of no less than three (3) years.

A dedicated CCTV workstation in the CCTV Control Room building shall be used to interface with the CCTV NVR. The VMS shall be installed on the dedicated workstation, setup and configuration and shall allow for viewing of footage on the workstation.

Included with the supply of the VMS shall be the configuration of the software, which includes but is not limited to the configuration of users, user rights and user view ports. Training on how to use the software shall be provided. The VMS shall include all software and camera licensing as required for full operation of the system as well as license plate recognition and logging tools. The software shall allow for secure remote access to CCTV footage and configuration of motion detection and alarming.

THE VMS shall be programmed to manage the virtual perimeter identification and virtual perimeter intruder detection capabilities of the PTZ cameras. The VMS shall also allow for alarming and alarm management.

The VMS shall be access controlled via username and password and shall allow for different user profile configurations with various access rights.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

The Service Provider will be responsible to configure the software as per the Clients requirements.

All PTZ cameras shall be installed on mounting poles. Concrete poles shall have below-ground cable entry points. All cables that are routed external to the pole shall be done in metal Sprague conduit.

1.2.7 Earthing and Bonding

All CCTV utility boxes and metal conduit shall be adequately earthed and bonded

1.2.8 Smart Artificial Intelligence

CCTV artificial intelligence and analytic software and hardware to be provided by the Service provider to detect perimeter movement. Alarm triggers to be communicated to offsite or onsite control room and also via telegram. Applicable for Optical or Thermal Cameras. The device must be setup on the same Network as the NVR and IP cameras. Detection & Analysis is done at the edge. The device shall be configurable on-site or remotely via the Graphical User Interface (GUI).

1.3 Cabling

The networking cables required for the communication system include:

- Fibre Optic Cable – single mode Copper Ethernet Cable

1.3.1 Fibre Optic Cable

Single Mode fibre optic cable shall be used for

- CCTV backbone network
- Connection to remote CCTV cameras
- Connection between Field Communication cabinet and CCTV Control Room

The CCTV backbone network shall be configured in ring topology connecting the CCTV Communication cabinet to all the Field Communication Boxes.

The fibre optic cable shall be directly buried in a trench with the MV and LV cables around the site. Where the fibre cable crosses the road, the cable shall be installed in suitable conduit.

All cable lengths shall be installed in a single run without spliced joints.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

Where splicing cannot be avoided, the installation of fusion splices shall be compliant with the following:

- All splicing shall be of the fusion splice type and no mechanical splices are to be used.
- A maximum splice insertion loss of 0.10 dB per splice shall be allowed.
- All fusion splices shall be done in splice enclosures of the correct type and size suitable for the environment and specific installation and shall have a warning label affixed unto the outside cover.
- All splice joints shall have a splice protector over them.
- All splice enclosures shall have a record sheet/label inside denoting the planning and use of the fibre according to colour coding and/or numbering. Furthermore, this shall be dated and labelled according to areas and/or signals in use. A detailed plan of all splice enclosure locations, and their detail, shall be submitted.

Fibre connectors shall be used according to the following order of preference:

- LC
- SC
- ST

All SFP connector types, where option is available, shall be chosen according to the order of preference. SFP connectors shall be chosen in accordance with fibre link loss budgets determined by offered equipment.

All connectors shall be supplied with end caps protecting the connector against moisture and dust or damage. All pigtail connecting cables shall be supplied in a minimum length of 3 meter. A maximum insertion loss of 0.5 dB per connector shall be allowed.

It shall be ensured that the minimum bending radius - as prescribed by the cable manufacturer – is never exceeded during handling and installation.

All links are to be tested and verified upon completion of installation. Suitable patch leads are to be provided based on proposed fibre connectors.

1.3.2 Ethernet Cable

Copper Ethernet CAT6 F/UTP cable shall be used to interface various network equipment where required. It shall be ensured that the minimum bending radius - as prescribed by the cable manufacturer – is never exceeded during handling and installation. All cable screens and shields shall be bonded and earthed. Ethernet cable runs shall not exceed 90 meters.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

1. FENCING SPECIFICATION

Project Specification:

The contractor shall provide a fencing system based on the following parameters.

Specification: Permanent High Security Fence. 2400mm high with 800mm outrigged electrical fence and 24 strand internal fence. Overall fence height is 3m.

This specification is based on the system which provides difficult to cut and climb type fence with an integrated electric fence system with camera response capabilities.

Poles:

Post are to be Hollow tube section rolled to an H profile to provide edge protection, design and wind loadings to be demonstrated with the bid submission as part of your pre-qualification QA / QC presentations.

Posts have a wall thickness of 2mm steel from the rolling/ slitting mills.(mill certificates provided with the QA / QC packs) The profile is to be 80x60mmx2mm . An extended post is to be allowed for so that the 8 strand wall top electric fence is allowed for . (No TEK screwing on site)

A post cap that is not able to be removed is to be allowed for . The post cap is to have a drop in feature that interlocks with the top bolt system ,cap to match the profile of the fence post.

Post are to be all predrilled including the electric fence holes prior to HDG (hot dipped galvanizing) , certified SABS and ISO certifications required at the dipping plants . Galvanizing certificates are to be supplied as part of the QA/ QC handover packs to the client .

Posts are to be 3800mm long and incased with 15 MPA foundation 600x400x400mm deep.

Post are also Pre and post heated to be PVC coated . QA/ QC document to demonstrate the coating process . Powder coating is not permitted. Posts are to allow for 16 flush fixtures and M80x60mm Stainless steel 304 graded bolts when securing the panels to the poles.

Under dig and concrete protection:

A 76x25 mm mesh panels 400mm is to be buried in the trench 500mm deep on the Fenceline below the fence as an anti under dig prevention above the mesh anti burrow protection is a 100mm thick concrete slab the is 600mm wide (200mm on the outside 400mm inside) this concrete is to incase the bottom 50mm of the mesh panel that sites above ground.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

Panel:

The panels is a 76mm horizontal x 12mm vertical aperture mesh panels made from 4mm on 4mm core wire thickness (mill certifications to be supplied) The core wire is a Galfan finish and is to be PVC dipped coated with a pre and post heating process . Powder coating is not permitted . QA/QC submission packs to clearly show that the coating process allows the dipping of the panels.

Panels - to be 3050mm wide x 2400mm high . an 800mm high Electric fence is to sit above the fence line .

The full LV electric fence is sit behind the mesh fence for alarmed response .

Above the panels is to sit a continuous Z profile 100mmx2mm spike that is HDG and PVC in keeping with the full fence design system.

The fence is to carry a 15 year Guarantee against corrosion . Certificates and guarantees to be submitted with the tender.



Figure 1: This figure shows the fence /under dig/ electric system picture is just an illustration tendered to submit their drawings with the tender :

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	



Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

Where water crossings are encountered then the contractor is to engage the engineers and client to resolve the low lying watered areas to find a suitable solution to keep the fence high and dry.

The contractor is to ensure that the installation allows for gradient adjustments and stepping of the fence lines.

2. ELECTRIC FENCE : FENCE TOP AND BACK OF FENCE 32 STRANDS

Supply and install of a 32 strand Wires are 1.6mm class A wire @100mm centers. The electric fence is 8 strands on top of the fencing and 24"back of Wall " detection electric fence , with 2 x energizers and 6 zones. Energizer 1 is a HV energizer / Energizer 2 is an LV energizer. Each zone to be set independently to be on/off or in high/low voltage modes. This will be installed on top of and behind the new High security mesh fencing. The system shall be networkable, ethernet interface and integrated to the CCTV system. PC based visual interaction with the electric fence system functionality with visual map images of the electric fence and its zones to be displayed on the computer screen. Software to enable the site to be controlled from a remote location as well as displayed on Cell phone, I pads or similar. The LCD display to read the status and performance of the energizer. Adaptive Power Technology (APT) for the energizers to detect how much power the fence can accept and handle before it starts to arc and waste energy in order to maximise the power on the fence and minimise false alarms. Synchronisation between energizers to be done using synchronisation modules. Energizer power consumption (normal operating conditions): 18VA, Electrical supply voltage: 240V, Internal battery 7AH Standby time (fully charged battery): 24hrs, High-voltage output Energy (500 Ohms load): 3.7 Joule per zone, Open circuit voltage: 9 000V, Operating temperatures: -10°C to 50°C.

Field node boxes are to be placed @ 400m intervals with Solar back up and battery back. Lightening and surge protection is to be allowed for in this set up with fibre redundancy and capacity to be stored at the IP 65 enclosures . The stands and kits are to be supplied by accredited installers and COC on completion .

The electric fence is to be zoned and a site map depicting the zones and alarmed areas are to have google map image overlays.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	



Figure 2: This is a typical example of a full perimeter system set up. When alarms are triggered then the system alarms in red and has a live voltage reading . Alarms are to have a full reporting system to allow for QA/ QC interfacing .

3. OFFSITE CONTROL ROOM, SURVEILLANCE ANALYTICS AND ARMED RESPONSE ISMS (INTEGRATED SECURITY MANAGEMENT SYSTEMS)

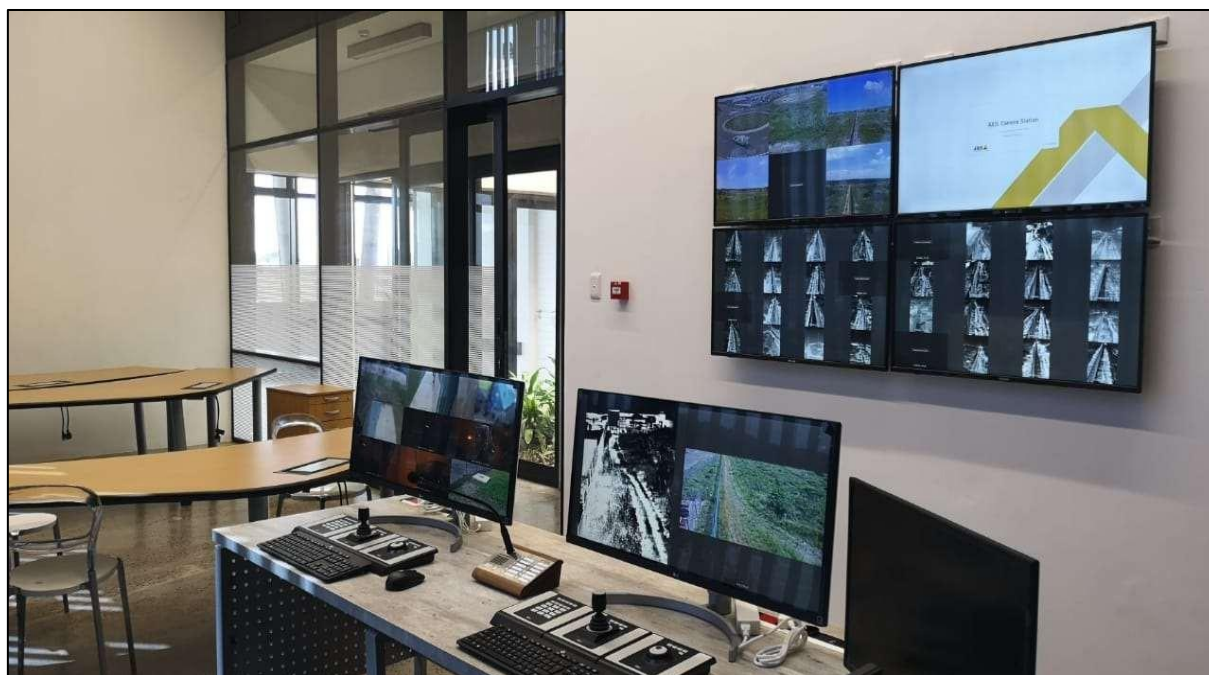
The CCTV cameras and electric fence will be linked to an offsite control room that is South African Intruder Detection Services Association (SAIDSA) certified for:

- Alarm installations
- CCTV installations
- Alarm monitoring
- CCTV monitoring
- Armed reaction

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

The following services are to be included for a 12-month period after installation. Monthly Off-Site Monitoring/Command Centre CCTV, 24-hour Event-Based Monitoring of Site Cameras above in the off-site control room.

- 24- hour Technical Support Services to all sites, and live Analytic software.
- Immediate Alarm Call Out Armed Responses dispatched from Control Room.
- Management Report Generation of incidents (monthly).
- All products installed must be operational and functional to full capacity.
- Monthly maintenance on installed CCTV System – cameras, bracket. Cleaning of lenses, ensuring brackets are secured to mountings or wall.



MINIMUM REQUIREMENTS

- Company and staff to be PSIRA registered.
- Proof of certification for CCTV trained staff.
- Offsite control room used to be SAIDSA-approved for CCTV monitoring & armed response.
- Rotakin certification required as per SANS 10222-5-1-4 specifications.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

- Fibre optic technical accreditation.
- Staff accreditation in Hikvision CCTV, Access Control, Alarm, VMS operators and Video intercom.
- The Service Provider Compensation for Occupational Injuries and Diseases Letter of Good Standing from the Department of Labour.
- Confirmation of CCTV control room operations and observational skills certification.
- Confirmation of CCTV surveillance skills and body language certification
- The Service Provider shall provide proof of certification for Project Management – accredited academic institution certification
- Confirmation of Business Partnership Status with the supplier of the camera, access control, radar and electric fence equipment. Letter required
- The Service Provider shall provide proof of training and certification on thermal imaging CCTV surveillance and installation.
- The Service Provider shall provide proof of license with the Independent Communications Authority of South Africa for Electronic Communications Network Services and Electronic Communications Services

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

HAPHU Units: “Specialized Hot Asset Protection Housing Units “

These units are cage like protection units that protect high value assets within the client’s property . These are constructed from double sheet protection mesh with a double layer of 358 mesh (4mm on 4mm) aperture size of the mesh is 8,7mmx8,7mm .

The frames are 70/70x6mm angle iron and built with all fixings to be house internally .

A solid access gate is built to the specialist supplier details and mounted on a concrete plinth / beam 500mm wide x 300mm deep.



Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

4. GATES AUTOMATION

- The entrance gates and access control will be determined on site . Contractors will price the gates based on a 6m slider gate.
- 5m double swing gate.
- 1.5m pedestrian gate.

All gates are to be manufactured to match the fence mesh specification with frames that have a 40x40x2mm angle iron skirt so that the mesh can bolt in behind the angle iron frame.

Gate posts / frames and portals for the sliders will be suitable for industrial applications. Contractors shop drawings of their gates are to be submitted with their tenders .

Gate posts for the swing gates are a minimum of 100x100x3mm tube

Slider gates bottom member is no less than a 120x60 rectangular tube 2mm wall. Pedestrian gates have a tubular frame of no less than 50x50x2 mm with the angle iron skirt .

5. LOCAL UPLIFTMENT AND MAINTENANCE PERIOD PROPOSALS

As part of the tender submission tenderers are to demonstrate how they will actively create employment during the installation program and demonstrate how the teams that are trained during construction are then gainfully employed for a period of no less than 2 years after the project handover as part of the maintenance schedule of 24 months .

Opportunities that are to be considered:

- Guarding;
- Gardening / grass and brush maintenance;
- Electric fence maintenance;
- Response vehicle operators;
- Electrical maintenance; and
- Fence repairs and maintenance.

Contractor	Witness 1	Witness 2	Employer	Witness 1	Witness 2	

VAAL CENTRAL WATER

CONTRACT NO. BW283/ARWWTW/22

**REFURBISHMENT OF THE NYAKALLONG (ALLANRIDGE) WWTW:
CIVIL, MECHANICAL AND ELECTRICAL, CONTROL & INSTRUMENTATION**

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HEALTH AND SAFETY SPECIFICATIONS BY THE EMPLOYER

Contractor

Witness 1

Witness 2

Employer

Witness 1

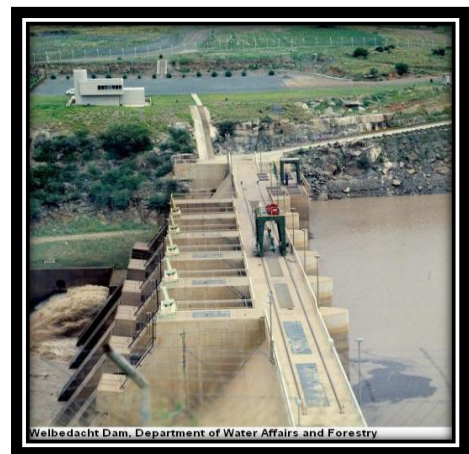
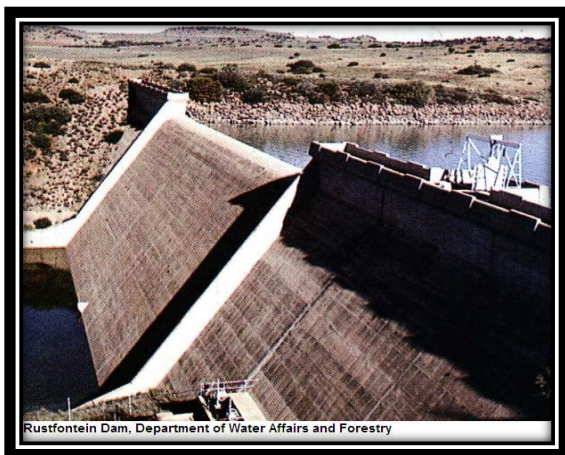
Witness 2

OCCUPATIONAL HEALTH AND SAFETY SPECIFICATION FOR VAAL CENTRAL WATER

Document Number: VCW/SHEQ/003
Issue 1



**Assuring sustainable provision of
quality water services, for life!**



Contractor

Witness 1

Witness 2

Employer

Witness 1

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Annexures

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1. Issue Control and Distribution

1.1 Distribution of Manual

Distribution of the Management System documentation is by controlled master soft copy over the **Vaal Central Water** Intranet.

1.2 Revision Status of Manual

Rev. No	Sect. No	Page No	Detail Of Change	Date	Authorized By
1	All	All	First Issue	02/10/2014	

 Contractor

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1.3 Revision Status of Procedures

Rev. No	Sect. No	Page No	Detail Of Change	Date	Authorized By
1	All	All	First Issue	02/10/2014	
2	All	All	Second Issue	02/10/2022	
3	All	All	Third Issue	18/09/2024	

2. Scope

This health and safety specification in respect of an engineering and construction works contract:

- Provides the overarching framework within which the Contractor is required to demonstrate compliance with certain requirements for occupational health and safety established by the **Occupational Health and Safety Act (Act no. 85 of 1993;**
- Establishes the manner in which the Contractor shall manage the risk of health and safety incidents in the execution of the contract; and
- Establishes the manner in which Vaal Central Water's SHEQ Officer will interact with the Contractor.

3. Preamble

Every effort has been made to ensure that this specification is accurate in all respects, however, should it contain any errors or omissions they may not be considered as grounds for claims under the contract for additional reimbursement or extension of time.

 Contractor

 Witness 1

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 Employer

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4. Purpose

The purpose of this Specification is to brief the contractors on the significant safety aspects of the project. It provides information and requirements on *inter alia*:

- a) Safety considerations affecting the site and its environment;
- b) Health and safety aspects of the associated structures and equipment;
- c) Submissions on health and safety matters; and
- d) The contractor's health and safety plan.

NOTE

This specification establishes general requirements and specific requirements to enable Vaal Central Water and the Contractor to satisfy the Occupational Health and Safety Act (Act No.85 of 1993) and the Construction Regulations.

The Construction Regulations, 2014, require Vaal Central Water to stop any Contractor from executing construction work which is not in accordance with the health and safety of persons. This specification establishes genetic health and safety requirements. Site specific requirements for health and safety are stated in the scope of work associated with a contract.

5. Definitions

Act

The Occupational Health and Safety Act (Act no. 85 of 1993).

Competent Person

Any person having the knowledge, training and experience specific to the work or task being performed.

Vaal Central Water's Assistant Manager SHEQ/ SHEQ Officer

The person appointed as an agent by Vaal Central Water in terms of Regulation 4(5) of the Construction Regulations and named in the contract data as being Vaal Central Water's agent responsible for health and safety matters.

Ergonomics

The application of scientific information concerning humans to the design of objects, systems and the environment for human use in order to optimise human wellbeing and overall system performance.

Hazard

A source of or exposure to danger.

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Hazard Identification

The identification and documenting of existing or expected hazards to the health and safety of persons, which are normally associated with the type of construction work being executed or to be executed.

Healthy

Free from illness or injury attributable to occupational causes.

Incident

an event or occurrence occurring at work or arising out of or in connection with the activities of persons at work, or in connection with the use of plant or machinery, in which, or in consequence of which:

a) Any person dies, becomes unconscious, suffers the loss of a limb or part of a limb or is otherwise injured or becomes ill to such a degree that he/she is likely either to die or to suffer a permanent physical defect or likely to be unable for a period of at least 14 days either to work or to continue with the activity for which he/she was employed or is usually employed;

b) major incident occurred; or

The health or safety of any person was endangered and where:

a) A dangerous substance were spilled;

b) The uncontrolled release of any substance under pressure took place;

c) Machinery or any part thereof fractured or failed resulting in flying, falling or uncontrolled moving objects, or machinery ran out of control.

Inspector

a person designated as such under section 28 of the Act.

Major Incident

an occurrence of catastrophic proportions, resulting from the use of plant or machinery, or from activities at a workplace.

Reasonably Practicable

practice having regard to:

a) The severity and scope of the hazard or risk concerned;

b) The state of knowledge reasonably available concerning that hazard or risk and of any means of removing or mitigating that hazard or risk;

c) The availability and suitability of means to remove or mitigate that hazard or risk; and

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d) The cost of removing or mitigating that hazard or risk in relation to the benefits deriving there from.

Registered Person

a Person registered in terms of the Electrical Installation Regulations.

Risk

The probability that injury or damage will occur.

Safe

Free from any hazard.

Scaffold

any temporary elevated platform and supporting structure used for providing access to and supporting workmen or materials.

Structure

- a) Any building, steel or reinforced concrete structure (not being a building), railway line or siding, bridge, waterworks, reservoir, pipe or pipeline, cable, sewer, sewage works, fixed vessels, road, drainage works, earthworks, dam, wall, mast, tower, tower crane, batching plants, pylon, surface and underground tanks, earth retaining structure or any structure designed to preserve or alter any natural feature, and any other similar structure;
- b) Any formwork, false work, scaffold or other structure designed or used to provide support or means of access during construction work; or
- c) Any fixed plant in respect of work which includes the installation, commissioning, decommissioning or dismantling and where any such work involves a risk of a person

Substance

any premises or place where a person performs work in the course of his/her employment.

Workplace

any premises or place where a person performs work in the course of his employment.

6. Interpretations

The Act and its associated regulations shall have precedence in the interpretation of any ambiguity or inconsistency between it and this specification. Compliance with requirements of this specification does not necessarily result in compliance with the provisions of the Act.

Contractor

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7. Application for construction work permit

A client who intends to have construction work carried out, must at least 30 days before that work is to be carried out apply to the provincial director in writing for a construction work permit to perform construction work if the intended construction work starts from the 7th August 2018 and will -

- a) exceed 365 days and will involve more than 3600 person days of construction work; or the works contract is of a value exceeding thirteen million rand or Construction Industry Development Board (CIDB) grading level 7.
 - b) the tender value limit is grade 7, 8 or 9 of the Construction Industry Development Board (CIDB) grading.
- 1) An application contemplated in sub-regulation (1) must be done in a form similar to Annexure 1.
 - 2) The provincial director must issue a construction work permit in writing to perform construction work contemplated in sub-regulation (1) within 30 days of receiving the construction work permit application and must assign a site-specific number for each construction site.
 - 3) A site-specific number contemplated in Sub-regulation (3) must be conspicuously displayed at the main entrance to the site for which that number is assigned.
 - 4) A construction work permit contemplated in this regulation may be granted only if-
 - a) the fully completed documents contemplated in regulation 5 (1) (a) and (b) have been submitted; and
 - b) (b) proof in writing has been submitted-
 - i. that the client complies with regulation 5 (5)
 - ii. with regard to the registration and good standing of the principal contractor as contemplated in regulation 5 (1) (j); and
 - iii. that regulation 5 (1) (c), (d), (e), (g) and (h) has been complied with.
 - 5) A client must ensure that the principal contractor keeps a copy of the construction work permit contemplated in subregulation (1) in the occupational health and safety file for inspection by an inspector, the client, the client's authorised agent, or an employee.
 - 6) No construction work contemplated in subregulation (1) may be commenced or carried out before the construction work permit and number contemplated in subregulation (3) have been issued and assigned.
 - 7) A site specific number contemplated in subregulation (3) is not transferrable.

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8. Duties and Responsibilities

8.1 Client's Responsibilities (Construction Regulations 5):

1. In terms of Construction regulation 5 a Client must-
 - a) prepare a baseline risk assessment for an intended construction work project;
 - b) prepare a suitable, sufficiently documented and coherent site-specific health and safety specification for the intended construction work based on the baseline risk assessment contemplated in paragraph (a);
 - c) provide the designer with the health and safety specification contemplated in paragraph (b);
 - d) ensure that the designer takes the prepared health and safety specification into consideration during the design stage;
 - e) ensure that the designer carries out all responsibilities contemplated in regulation 6;
 - f) include the health and safety specification in the tender documents;
 - g) ensure that potential Service Providers / Principal Contractor submitting tenders have made adequate provision for the cost of health and safety measures;
 - h) ensure that the Service Provider / Principal Contractor to be appointed has the necessary competencies and resources to carry out the construction work safely;
 - i) take reasonable steps to ensure co-operation between all contractors appointed by the client to enable each of those contractors to comply with these Regulations;
 - j) ensure before any work commences on a site that every Service Provider / Principal Contractor is registered and in good standing with the compensation fund or with a licensed compensation insurer as contemplated in the Compensation for Occupational Injuries and Diseases Act, 1993 (Act No. 130 of 1993).
 - k) appoint every Service Provider / Principal Contractor in writing for the project or part thereof on the construction site;
 - l) discuss and negotiate with the Service Provider / Principal Contractor the contents of the Service Provider/Principal Contractor health and safety plan contemplated in regulation 7(1), and must thereafter finally approve that plan for implementation;
 - m) ensure that a copy of the Service Provider / Principal Contractor health and safety plan is available on request to an employee, inspector or contractor;
 - n) take reasonable steps to ensure that each contractor's health and safety plan contemplated in regulation 7(1)(a) is implemented and maintained;

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- o) ensure that periodic health and safety audits and document verification are conducted at intervals mutually agreed upon between the Service Provider / Principal Contractor and any contractor, but at least once every 30 days;
 - p) ensure that a copy of the health and safety audit report contemplated in paragraph (o) is provided to the Service Provider / Principal Contractor within seven days after the audit;
 - q) stop any contractor from executing a construction activity which poses a threat to the health and safety of persons which is not in accordance with the client's health and safety specifications and the Service Provider's / Principal Contractor health and safety plan for the site;
 - r) where changes are brought about to the design or construction work, make sufficient health and safety information and appropriate resources available to the Service Provider / Principal Contractor to execute the work safely; and
 - s) ensure that the health and safety file contemplated in regulation 7(1)(b) is kept and maintained by the Service Provider / Principal Contractor.
2. Where a client requires additional work to be performed as a result of a design change or an error in construction due to the actions of the client, the client must ensure that sufficient safety information and appropriate additional resources are available to execute the required work safely.
 3. Where a fatality or permanent disabling injury occurs on a construction site, the client must ensure that the contractor provides the provincial director with a report contemplated in section 24 of the Act, in accordance with regulations 8 and 9 of the General Administrative Regulations, 2013, and that the report includes the measures that the contractor intends to implement to ensure a safe construction site as far as is reasonably practicable.
 4. Where more than one Service Provider / Principal Contractor is appointed as contemplated in sub-regulation (1) (k), the client must take reasonable steps to ensure co-operation between all principal contractors and contractors in order to ensure compliance with these Regulations.
 5. Where a construction work permit is required as contemplated in regulation 3(1), the client
 6. must, without derogating from his or her health and safety responsibilities or liabilities, appoint a competent person in writing as an agent to act as his or her representative, and where such an appointment is made the duties that are imposed by these Regulations upon a client, apply as far as reasonably practicable to the agent so appointed.
 7. Where notification of construction work is required as contemplated in regulation 4(1), the client may, without derogating from his or her health and safety responsibilities or liabilities, appoint a competent person in writing as an agent to act as his or her representative, and where such an appointment is made

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the duties that are imposed by these Regulations upon a client, apply as far as reasonably practicable to the agent so appointed: Provided that, where the question arises as to whether an agent is necessary, the decision of an inspector is decisive.

8. An agent contemplated in sub-regulations (5) and (6) must—
 - a) manage the health and safety on a construction project for the client; and
 - b) be registered with a statutory body approved by the Chief Inspector as qualified to perform the required functions;
9. When the chief inspector has approved a statutory body as contemplated in sub regulation (7)(b), he or she must give notice of that approval in the Gazette.

Notes 1:

- a) **Regulation 5(1)d must be read with regulation 6, the duties of the designer and a written report must be submitted to the Client by the Designer as proof of compliance with the afore said regulation.**
- b) **Regulation 5(1)(i) Where there are multiple principal contractors (or contractors) non site appointed by the client , the client shall coordinate cooperation between contractors to ensure health and safety control, read with regulation 7(4). Regulation 5 (5); (6) and (7) .**
- c) **Where a client specifies which contractors a principal contractor must appoint the duties as specified in 7(1)(c)(iii) shall be applicable to the said client.**
- d) **A client may appoint a Construction Health and Safety Agent or Construction Health and Safety Manager based on the scope and risk profile of construction work to represent him/her on matters of health and safety. Provided that, where the question arises as to whether a Construction Health Safety Agent or a Construction Health and Safety Manager is necessary, the decision of an inspector is decisive.**

Notes 2:

- a) **Refer to exemption issued by the Chief Inspector.**
- b) **The 30 days required to issue a Construction Work Permit is on condition that all correct and fully completed documents are submitted as per the attached 'list of items (not limited to) to be submitted with the construction work permit application'.**
- c) **Where any person aggrieved by any decision taken by an inspector in relation to the application of a Construction Work Permit under a provision of this regulation may appeal against such decision to the chief inspector in terms of Section 35.**

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- d) The Construction Work Permit shall be issued to the Client for whom the Construction work is conducted.**

8.2 Designer's Duties (CR 6):

1. The designer of a structure must—

- a) ensure that the applicable safety standards incorporated into these Regulations under section 44 of the Act are complied with in the design;
- b) take into consideration the health and safety specification submitted by the client;
- c) before the contract is put out to tender, make available in a report to the client—
- all relevant health and safety information about the design of the relevant structure that may affect the pricing of the construction work;
 - the geotechnical-science aspects, where appropriate; and
 - the loading that the structure is designed to withstand;
- d) inform the client in writing of any known or anticipated dangers or hazards relating to the construction work, and make available all relevant information required for the safe execution of the work upon being designed or when the design is subsequently altered;
- e) refrain from including anything in the design of the structure necessitating the use of dangerous procedures or materials hazardous to the health and safety of persons, which can be avoided by modifying the design or by substituting materials; take into account the hazards relating to any subsequent maintenance of the relevant structure and must make provision in the design for that work to be performed to minimize the risk;
- f) when mandated by the client to do so, carry out the necessary inspections at appropriate stages to verify that the construction of the relevant structure is carried out in accordance with his design: Provided that if the designer is not so mandated, the client's appointed agent in this regard is responsible to carry out such inspections;
- g) when mandated as contemplated in paragraph (g), stop any contractor from executing any construction work which is not in accordance with the relevant design's health and safety aspects: Provided that if the designer is not so mandated, the client's appointed agent in that regard must stop that contractor from executing that construction work;
- h) when mandated as contemplated in paragraph (g), in his or her final inspection the completed structure in accordance with the National Building Regulations, include the health and safety aspects of the structure as far as reasonably practicable, declare the structure safe for use, and issue a completion certificate to the client and a copy thereof to the contractor; and

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- i) (j) during the design stage, take cognisance of ergonomic design principles in order to minimize ergonomic related hazards in all phases of the life cycle of a structure.
- 2. The designer of temporary works must ensure that—
 - a) all temporary works are adequately designed so that it will be capable of supporting all anticipated vertical and lateral loads that may be applied;
 - b) the designs of temporary works are done with close reference to the structural design drawings issued by the contractor, and in the event of any uncertainty consult the contractor;
 - c) all drawings and calculations pertaining to the design of temporary works are kept at the office of the temporary works designer and are made available on request by an inspector; and (d) the loads caused by the temporary works and any imposed loads are clearly indicated in the design.

Notes:

Regulation 6 (1) (c) - Designers must ensure that designs are accompanied by a report as required in terms of this regulation.

8.3 Principal Contractor Responsibilities

- a) The Principal Contractor shall accept the appointment under the terms and Conditions of Contract. The Service Provider / Principal Contractor shall sign and agree to those terms and conditions and shall, before commencing work, notify the Department of Labour of the intended construction work in terms of Regulation 4 of the Construction Regulations 2014. The Principal Contractor shall submit the notification in writing prior to commencement of work and inform the Client or his Agent accordingly;
- b) The Principal Contractor shall ensure that he is fully conversant with the requirements of this Specification and all relevant health and safety legislation. This Specification is not intended to supersede the Act nor the Construction Regulations 2014 or any part of either. Those sections of the Act and the Construction Regulations 2014 which apply to the scope of work to be performed by the Principal Contractor in terms of this contract (entirely or in part) will continue to be legally required of the Principal Contractor to comply with. The Principal Contractor will in no manner or means be absolved from the responsibility to comply with all applicable sections of the Act, the Construction Regulations 2014 or any Regulations proclaimed under the Act or which may perceivable be applicable to this contract;
- c) (1) The Principal Contractor must further —
 - i. provide and demonstrate to the client a suitable, sufficiently documented and coherent site specific health and safety plan, based on the client's documented health and safety specifications contemplated in regulation 5(1)(b), which plan must be applied from the date of commencement of

Contractor

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- and for the duration of the construction work and which must be reviewed and updated by the Principal Contractor as work progresses;
- ii. open and keep on site a health and safety file, which must include all documentation required in terms of the Act and these Regulations, which must be made available on request to an inspector, the client, the client's agent or a contractor; and on appointing any other contractor, in order to ensure compliance with the provisions of the Act—
- provide contractors who are tendering to perform construction work for the Principal Contractor, with the relevant sections of the health and safety specifications contemplated in regulation 5(1)(b) pertaining to the construction work which has to be performed; ensure that potential contractors submitting tenders have made sufficient provision for health and safety measures during the construction process;
 - ensure that potential contractors submitting tenders have made sufficient provision for health and safety measures during the construction process;
 - ensure that no contractor is appointed to perform construction work unless the Principal Contractor is reasonably satisfied that the contractor that he or she intends to appoint, has the necessary competencies and resources to perform the construction work safely;
 - ensure prior to work commencing on the site that every contractor is registered and in good standing with the compensation fund or with a licensed compensation insurer as contemplated in the Compensation for Occupational Injuries and Diseases Act, 1993;
 - appoint each contractor in writing for the part of the project on the construction site;
 - take reasonable steps to ensure that each contractor's health and safety plan contemplated in sub-regulation (2)(a) is implemented and maintained on the construction site;
 - ensure that the periodic site audits and document verification are conducted at intervals mutually agreed upon between the Principal Contractor and any contractor, but at least once every 30 days;
 - stop any contractor from executing construction work which is not in accordance with the client's health and safety specifications and the Principal Contractor health and safety plan for the site or which poses a threat to the health and safety of persons;
 - where changes are brought about to the design and construction, make available sufficient health and safety information and appropriate resources to the contractor to execute the work safely; and

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- discuss and negotiate with the contractor the contents of the health and safety plan contemplated in sub-regulation (2)(a), and must thereafter finally approve that plan for implementation;
- d) ensure that a copy of his or her health and safety plan contemplated in paragraph (a), as well as the contractor's health and safety plan contemplated in sub-regulation (2)(a), is available on request to an employee, an inspector, a contractor, the client or the client's agent;
- e) hand over a consolidated health and safety file to the client upon completion of the construction work and must, in addition to the documentation referred to in sub-regulation (2)(b), include a record of all drawings, designs, materials used and other similar information concerning the completed structure;
- f) in addition to the documentation required in the health and safety file in terms of paragraph(c)(v) and sub-regulation (2)(b), include and make available a comprehensive and updated list of all the contractors on site accountable to the Service Provider / Principal Contractor, the agreements between the parties and the type of work being done; and
- g) ensure that all his or her employees have a valid medical certificate of fitness specific to the construction work to be performed and issued by an occupational health practitioner in the form of Annexure 3.

9. Requirements

9.1 General Requirements

- a) Create and maintain a safe and healthy work environment,
- b) Execute the works in a manner that complies with all the requirements of the Act and all its associated regulations, and in so doing, minimize the risk of incidents occurring; and
- c) Respond to notices issued by **Vaal Central Water's Assistant Manager SHEQ/ SHEQ Officer** as follows:
 - i. Improvement Notice: improve health and safety performance over time so that repeat notices are not issued.
 - ii. Contravention Notice: rectify contravention as soon as possible.
 - iii. Prohibition Notice: terminate affected activities with immediate effect and only recommence activities when it is safe to do so.

Contractor

Witness 1

Witness 2

Employer

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9.2 Project/Site Specific Requirements

The following is a list of specific activities and considerations that have been identified for the project and site for which Risk Assessment, Standard Work Procedures (SWP), Management and Control Measures and Method Statements (where necessary) have to be developed by the Principal Contractor:

- Clearing and grubbing of the area/site.
- Site establishment including:
 - Offices
 - Secure/safe storage areas for materials, plant and equipment
 - Ablution facilities
 - Sheltered dining area
 - Vehicle access to the site.
- Dealing with existing structures.
- Location of existing services.
- Installation and maintenance of temporary construction electrical supply, lighting and equipment
- Adjacent land uses/surrounding property exposures
- Boundary and access control/public liability exposures (Remember: the employer is also responsible for the OHS of non-employees affected by his/her activities).
- Health risks arising from neighbouring as well as own activities and from the environment, e.g. threats by dogs, bees, snakes, lightning, allergies, etc.
- Exposure to noise.
- Exposure to vibration.
- Protection against dehydration and heat exhaustion.
- Protection from wet and cold conditions.
- Dealing with HIV/Aids and other diseases as per specific programme provided by the client or its agents.
- Use of portable electrical equipment, including;
 - Angle grinder
 - Electrical drilling machine
 - Skill saw

Contractor

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Employer

Witness 1

- Excavations including;
 - Ground/soil conditions
 - Trenching
 - Shoring
 - Drainage
 - Daily inspections
- Welding including;
 - Arc welding
 - Gas welding
 - Flame cutting
 - Us of LP gas torches and appliances
- Loading and offloading of trucks
- Aggregate/sand and other materials delivery
- Manual and mechanical handling
- Lifting and lowering operations
- Driving and operation of construction vehicles and mobile plant including;
 - Trench machine
 - Excavator
 - Bomag roller
 - Plate compactor
 - Front end loader
 - Mobile crane and the ancillary lifting tackle
 - Parking of vehicles and mobile plant
 - Towing of vehicle and mobile plant
- Use and storage of flammable chemical substances-the client and/or its agent on its behalf to be informed of this prior to commencement of the project.
- Temporary works and traffic accommodation.

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Witness 1

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Witness 1

- Exposure to sewer plants, pipeline and excavations
- Hygiene effects as a result of exposure to sewer
- Environmental pollution
- Protection against flooding
- Gabion work.
- Protection of overhead power lines.
- As discovered by the principal contractor's hazards identification exercise.
- As discovered from any inspections and audits conducted by the client and/or its agent on its behalf or by the principal contractor or any other contractor on site.
- As discovered from any accident/incident investigation

9.3 Scope of Work Requirements

The following in particular requirements depending on scope of works and will form a basis for compliance audits:

- A. Administrative 7 Legal Requirements
- B. Education, Training & Promotion
- C. Public Safety & Emergency Preparedness
- D. Personal Protective Equipment
- E. Housekeeping
- F. Scaffolding, Formwork and Support work
- G. Ladders
- H. Electrical Safeguarding
- I. Emergency/Fire Prevention & Protection
- J. Excavation and Demolition
- K. Formwork
- L. Tools
- M. Cranes
- N. Personnel and Materials Hoists

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Witness 1

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O. Transport & Materials Handling

P. Site Plant and Machinery

Q. Plant & Storage Yard/Site Workshops Specifics

R. Health & Hygiene

Contractor

Witness 1

Witness 2

Employer

Witness 1

9.4 OUTLINED DATA, REFERENCES AND INFORMATION ON CERTAIN AND/OR SPECIFIC OBLIGATORY REQUIREMENTS TO ENSURE COMPLIANCE

A) Administrative & Legal Requirements

Subject	OHS Act Section/Regulation	Requirements
Notice Of Construction Work	CR 4 Annexure 4	- Department of Labour notified - Copy of Notice available
Copy of the OHS Act (Act 85 of 1993)	GAR 4	Updated Copy of the Act and Regulations
Health and Safety Specifications and Plan/Programme	CR 5 & 7(1)(a)	- H&S specifications from the Client/Agent. - OHS Plan/Programme developed and reviewed regularly.
Hazard Identification & Risk Assessment	Section 8(2)(d) CR 9	- HIRA carried out/Recorded. - Risk Assessment and OHS Plan drawn. - RA Plan available on site. - Employees/Subcontractors informed/trained.
Registration with the Compensation	COID Act Section 80	Written proof of registration-Letter of good standing.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Subject	OHS Act Section/Regulation	Requirements
Commissioner/Insurer		
Assigned duties (Managers)	Section 16(2)	Responsibility of complying with the OHS Act assigned to other persons by the CEO.
Designation of person responsible on site	CR 8(1)	Competent person appointed in writing as Construction Supervisor with job description.
Designation of Assistant for above	CR 8(2)	Competent person appointed in writing as Assistant Construction Supervisor with job description.
Designation of Health and Safety Representatives	Section 17 & 18 GAR 6	- More than 20 employees-One H&S Rep for each 50 employees or part thereof. - Designation of writing, period and area of responsibility specified in terms of GAR 6 & 7 - Meetings held monthly, minutes kept - Actioned by management
Health and Safety Committee	Section 19 & 20 GAR 5	- H&S Committee established. - All H & S Reps shall be members of the H & S Committee

 Contractor

 Witness 1

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 Employer

 Witness 1

 Witness 2

Subject	OHS Act Section/Regulation	Requirements
Agreement with Mandatories/Contractors & Subcontractors	Section 37(1)&(2)	• Written Agreement with Contractors and Subcontractors • List of Contractors and Subcontractors displayed • Proof of registration with the Compensation Commissioner/Insurer Letter of good standing. • Construction Manager/Supervisor designated. • Written arrangements. • H&S Reps and Committee. • First Aider.
Reporting of incidents (Department Of Labour)	Section 24 & GAR 8 COID Act Section 38, 39 & 41	• Incident Reporting Procedure displayed. • All incidents in terms of Section 24 reported to the Provincial Director of the DoL within 3 days. (Annexure 1-WCL 1/2). • Cases of occupational diseases reported. • Copies of reports available on site. • Record of first aid injuries kept.

 Contractor

 Witness 1

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 Witness 1

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Subject	OHS Act Section/Regulation	Requirements
Investigation of incidents	GAR 9	• All injuries which resulted in the person receiving medical treatment other than first aid, recorded and investigated by investigator designated in writing. • Copies of reports available on site. • Tabled at H&S meetings. • Action taken by management.
Fall Prevention & Protection Plan	CR 10	• Competent persons to draw up and supervise the Fall Protection Plan. • Proof of appointees' competence available on site. • Risk Assessment carried out for working at heights. • Fall Protection Plan drawn up/updated available on site.
Roof Work	CR 10(5)	• Competent person appointed to draw up and supervise the Roof Work Plan. • Proof of appointees' competence available on site. • Risk Assessment carried out for roof work. • Roof Work Plan drawn up/updated. • Roof work inspected before each shift. Inspection Register kept.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Subject	OHS Act Section/Regulation	Requirements
		Employees medical examined for physical & psychological fitness. Written proof on site.
Structures	CR 11	- Information regarding the structure being erected received from the Designer including: - Geo-science technical report where relevant. - Design loading of the structure. - Anticipated dangers/hazards/special measures to construct safely. - Method statements and sequence of construction. - Risk Assessment carried out. - Structures inspected before shift. Inspections register kept. - All above information available on site.
Temporary Works	CR 12	- Competent person appointed in writing to supervise erection, maintenance, use and dismantling of Support & Form Work. - Design drawings available on site. - Risk Assessment carried out.

 Contractor

 Witness 1

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 Witness 1

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Subject	OHS Act Section/Regulation	Requirements
		• Support & Formwork inspected: • Before use/inspection • Before pouring of concrete • Weekly whilst in place • Before stripping/dismantling • Inspection register kept
Scaffolding	CR 16	• Competent person appointed in writing to: • Erect scaffolding (Scaffolding Erectors) • Act as scaffolding team leaders. • Inspect scaffolding weekly and after inclement weather (Scaffold Inspectors). • Written proof of competency of above appointees' available on site. • Copy of SABS 085 available on site. • Risk Assessment carried out • Inspected weekly/after bad weather. Inspection registers kept.

 Contractor

 Witness 1

 Witness 2

 Employer

 Witness 1

 Witness 2

Subject	OHS Act Section/Regulation	Requirements
Suspended Platforms	CR 17	• Competent persons appointed in writing to: • Control the erection of suspended platforms • Act as Suspended Platforms Team Leaders • Inspect suspended scaffolding weekly and after inclement weather • Risk Assessment conducted. • Certificate of Authorization issued by a Registered Engineer available on site/Copy forwarded to the Department of Labour • The following inspections of the whole installation carried out by a competent person: • After erection and before use • Daily prior to use. Daily inspections recorded. • The following tests to be conducted by a competent person: • Load test of whole installation and working parts every three months. • Hoisting ropes/hooks/load attaching devices quarterly. Tests logbook kept. • Employees working on Suspended Platform medically examined for physical &

 Contractor

 Witness 1

 Witness 2

 Employer

 Witness 1

 Witness 2

Subject	OHS Act Section/Regulation	Requirements
		psychological fitness. Written proof available.
Excavation	CR 13	- Competent person/s appointed in writing to supervise and inspect excavation work. - Written proof of competence available on site. - Risk Assessment carried out. - Inspected: - Before every shift. - After any blasting. - After any unexpected fall of ground. - After any substantial damage to the shoring. - After rain. Inspections register kept. - Method Statement developed where explosives will be used/are used.
Demolition Work	CR 14	- Competent person/s appointed in writing to supervise and control Demolition Work. - Written proof of competence available on site.

 Contractor

 Witness 1

 Witness 2

 Employer

 Witness 1

 Witness 2

Subject	OHS Act Section/Regulation	Requirements
		• Risk Assessment carried out. • Engineering survey and Method Statements available on site. • Inspections to prevent premature collapse carried out by a competent person before each shift. Inspections register kept.
Materials Hoist	CR 19	• Competent person appointed in writing to inspect Material Hoist. • Written proof of competence available on site. • Risk Assessment carried out. • Material hoist to be inspected weekly by a competent person. Inspections records kept.
Bulk Mixing Plants	CR 20	• Competent person appointed in writing to control the operation of the Batch Plant and the service, maintenance and cleaning. Register kept. • Written proof of competence available on site. • Risk Assessment carried out. • Bulk Plant to be inspected weekly and record kept.
Cranes & Lifting Machines	CR 22	• Competent person appointed in writing to inspect Cranes, Lifting Machines and

 Contractor

 Witness 1

 Witness 2

 Employer

 Witness 1

 Witness 2

Subject	OHS Act Section/Regulation	Requirements
Equipment	DMR 18 & 19	Lifting Equipment. • Written proof of competence available on site. • Inspection: • -All cranes-daily by the operator • -Tower cranes-after erection/6 monthly • -Other cranes-annually by competent person • -Lifting tackle (slings/ropes/chain slings etc.)-daily or before every new application
Inspection & Maintenance of Electrical Installation & Equipment (Including portable electrical tools)	CR 24 Electrical Machinery 9 & 10 Electrical Installation Regulations	• Competent person appointed in writing to inspect/test the installation and equipment. • Written proof of competence available on site. • Electrical Installation & Equipment inspected after installation, after alterations and quarterly. Inspection register kept. • Portable electric tools, electric lights and extension leads must be uniquely identified/numbered.

 Contractor

 Witness 1

 Witness 2

 Employer

 Witness 1

 Witness 2

Subject	OHS Act Section/Regulation	Requirements
		Weekly visual inspection by User/Store man. Register kept.
Designation of Stacking & Storage Supervisor	CR 28 GSR 8(1)(a)	- Competent person/s with specific knowledge and experience designated to supervise all stacking and storage. - Written proof of competence available on site.
Designation of a person to coordinate emergency planning and fire protection	CR 29 ER 9	- Person/s with specific knowledge and experience designated to co-ordinate emergency contingency planning, execution and fire prevention measures. - Emergency evacuation plan developed: - Drilled/practiced - Plan & records of drills/practices available on site - Fire risk assessment carried out. - All fire extinguishing equipment identified and on register - Inspected weekly and record kept. - Serviced annually.
First Aid	GSR 3	Every workplace shall be provided with sufficient number of first aid boxes.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Subject	OHS Act Section/Regulation	Requirements
		• First aid freely available. • Equipment as per the list in the OHS Act. • One qualified First Aider appointed for every 50 employees. (Required where more than 10 persons are employed). • List of First Aid Officials and Certificates. • Name of person/s in charge of the first aid box displayed. • Location/s of first aid boxes clearly indicated. • Signs instructing employees to report all injuries/illness including first aid injuries.
Personal Protective Equipment (PPE)	GSR 2	• PPE risk assessment carried out • Items of PPE prescribed/use enforced. • Records of issue kept • Undertaking by employee to wear/use PPE • PPE remain property of the employer, not to be removed from the premises GRS 2(4).

 Contractor

 Witness 1

 Witness 2

 Employer

 Witness 1

 Witness 2

Subject	OHS Act Section/Regulation	Requirements
Inspection & Use of welding/flame cutting equipment	GSR 9	• Competent person/s with specific knowledge and experience designated to inspect electrical arc, gas welding and flame cutting equipment. • Written proof of competence available on site. • All new vessels checked for leaks, leaking vessels NOT taken into stock but returned to supplier immediately. • Equipment identified/numbered and entered into register. • Equipment inspected weekly and record kept. • Separate, purpose made storage available for full and empty vessels.
Control of storage & usage of Hazardous Chemical Substances (HCS) and Flammables	HCS Regulations CR 25	• Competent person/s with specific knowledge and experience designated to control the storage and usage of HCS (including flammables). • Written proof of competence available on site. • Risk Assessment carries out. • Register of HCS kept on site. • MSDS available on site. • Separate, purpose made storage available for full and empty containers.

 Contractor

 Witness 1

 Witness 2

 Employer

 Witness 1

 Witness 2

Subject	OHS Act Section/Regulation	Requirements
Vessels Under Pressure (VUP)	Pressure Equipment Regulations	- Competent person/s with specific knowledge and experience designated to supervise the use, storage, maintenance, statutory inspections & testing of VUP's. - Written proof of competence available on site. - Certificate of manufacture available on site. - Register of VUP on site. - Inspections & testing by Approved Inspection Authority (AIA): - After installation/re-erection or repairs. - Every 36 months. - Register/Logbook of inspections, tests, modifications and repairs kept.
Construction Vehicles & Earth Moving Equipment	CR 23	- Operators/Drivers appointed to: - Carry out a daily inspection prior to use - Drive the vehicle/plant that he/she is competent to operate/drive. - Written proof of competence available on site.

 Contractor

 Witness 1

 Witness 2

 Employer

 Witness 1

 Witness 2

Subject	OHS Act Section/Regulation	Requirements
		Record of daily inspections kept.
Inspection of ladders	GSR 13A	- Competent person/s appointed in writing to inspect ladders. - Ladders inspected at arrival on site and weekly thereafter. - Inspection records kept. - Application of the type of ladders (wooden, aluminium, etc.) regulated by training and inspections and noted in register.
Ramps	GSR 13B	- Competent person appointed in writing to supervise the erection & inspection of ramps. - Inspection register kept. - Daily inspected and noted in register.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

B) Education and Training

Subject	Requirement
Company OHS Policy Section 7(1)	- Policy signed by the CEO and published/Circulated to the employees. - Policy Displayed on Construction/Employees Notice Board. - Management and employees committed.
Company OHS Rules Section 13(a)	- Construction site rules published and displayed. - Follow-up to ensure employees understand/adhere to the policy and rules.
Induction and Task Safety Training Section 13(a)	- All new employees receive OHS Induction Training. - Training includes Daily Safety Task Instructions (DSTI). - Employees acknowledge receipt of training. - Follow-up to ensure employees understand/adhere to instructions.
General OHS Training Section 13(a)	- All current employees receive specified OHS training: written proof - Operators of Plant & Equipment receive specified training - Follow-up to ensure employees understand/adhere to instructions.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Occupational Health and Safety Promotion	Incident Experience Board indicating: • Number of hours worked without injured. • Number of days worked without an injury. • Vision, Mission and Goal, Star Grading-Board kept up to date. • Safety Posters displayed & changed regularly. • Employee Notice Board for OHS Notice. • Site OHS Competition (Company OHS Competition). • Participation in projects OHS competition

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

C) Public Safety & Security Measures & Emergency Preparedness

Subject	Requirement
Notices & Signs.	• Notices and signs at entrances/along perimeters indicating “No Unauthorised Entry” • Notices and signs at entrance instructing visitors and non-visitors what to do, where to go and where to report when entering the site/yard with directional signs. E.g. “Visitors to report to Office”. • Notice and signs posted to warn of overhead work and other hazardous activities. E.g. General Warning Signs
Site Safeguarding (Security Measures)	• Nets, canopies, platforms, fans etc. to protect members of the public/visitors/client/employees passing/entering the site. • Access control measures/register in operation. • Security patrols after hours, during weekends and holidays. • Sufficient lighting after dark. • Guard has access to telephone/mobile/other means of emergency communication.
Emergency Preparedness	• Emergency contact numbers displayed and made available and accessible to employees and security. • Emergency evacuation instructions posted up on all Notice Boards. • Emergency contingency plan available on site.

 Contractor

 Witness 1

 Witness 2

 Employer

 Witness 1

 Witness 2

Subject	Requirement
	- Emergency doors open outwards/unobstructed. - Emergency alarm audible all over the premises.
Emergency Drill & Evacuation	- Adequate number of employees trained to use firefighting equipment. - Emergency evacuation plan available displayed and practiced.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

D) Personal Protective Clothing/Equipment

Subject	Requirement
PPE Needs Analysis	• Determine the needs for PPE identified and prescribed training • PPE remain the property of the employer, not to be removed from premises GSR 2(4).
Head protection	• All persons on site shall wear safety helmets including subcontractors and visitors • Visitors to wear same.
Foot protection	• All employees on site shall wear safety footwear including gumboots for concrete/wet work and non-slip shoes for roof work.
Eye and face protection	• Eye and face(Also Hand and Body) Protection (Goggles, face shields, welding helmets etc.) used when operating the following: • Jack/Kango Hammers • Angle/bench grinder • Electric drills (Overhead work into concrete/cement/bricks) • Explosive powered tools • Concrete vibrators/pokers • Hammers and chisels

 Contractor

 Witness 1

 Witness 2

 Employer

 Witness 1

 Witness 2

Subject	Requirement
	• Shears • Cutting tools and equipment • Sanders and sanding machines • Cutting/welding tools • CO2 and arc welding equipment • Skill/bench saws • Spray painting equipment.
Hearing protection	• Hearing protectors (Muffs, plugs, etc.) used when operating the following: • Hammers & Chisels • Jack/Kango Hammers, etc. • Explosive power tools • Wood/Aluminium working machines e.g. saws, planers, routers. • Angle grinders • Drilling machine
Hand protection	• Protective gloves worn by employees when handling/using:

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Subject	Requirement
	• Cement/bricks/steel/chemicals • Welding equipment • Hammers & Chisels • Jack/Kango Hammers, etc.
Respiratory protection	• Suitable/efficient prescribed Respirators worn correctly by employees handling/using : • Dry cement • Dusty areas • Hazardous chemicals • Angle grinders • Spray painting etc.
Fall Protection Equipment	• Suitable safety belts/fall arrest equipment correctly used by persons working on/in unguarded, elevated

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Subject	Requirement
	positions, e.g.: ○ Scaffolding ○ Riggers ○ Lift shafts ○ Edge work ○ Ring beam edges etc. Other methods of fall prevention applied e.g. catch nets.
Protective Clothing	• All jobs requiring protective clothing (Overalls, Rain Wear, Welding Aprons, etc.) Identified and clothing worn.
PPE Issue & Control	• Identified equipment issued free of charge • All PPE maintained in good condition. (Regular checks). • Worker instructed in the proper use and maintenance of PPE. • Commitment obtained from the user accepting conditions and to wear the PPE. • Record of PPE issued kept on H&S file. • PPE remain the property of the employer, not to be removed from the premises.

 Contractor

 Witness 1

 Witness 2

 Employer

 Witness 1

 Witness 2

E) Housekeeping

Subject	Requirement
Scrap Removal System	• All items of scrap/unusable off-cuts/rubble and redundant material removed on regular basis. (Daily) • Scrap/waste removal from heights by chute/hoist/crane. • Nothing thrown/swept over sides. • Scrap disposed of in designated containers/areas. • Removal from site/yard on a regular basis.
Stacking and Stacking (Section 1 for Designation & Register)	• Stacking: • Stable, on firm level surface/base. • Prevent leaning/collapsing • Irregular shapes bonded • Not exceeding 3x the base • Stacks accessible • Removal from top only. • Storage: • Adequate storage areas

 Contractor

 Witness 1

 Witness 2

 Employer

 Witness 1

 Witness 2

Subject	Requirement
	• Functional-e.g. demarcated storage areas/racks/bin etc. • Special areas identified and demarcated e.g. flammable gas, cement, etc. • Neat, safe, stable and square. • Store/storage areas clear of superfluous material. • Storage behind sheds etc. neat/under controls. • Storage areas free from weeds, litter.
Waste Control/Reclamation	• Re-usable off-cuts or other re-usable material removed daily and kept to a minimum in the work areas. • All re-usable materials neatly stacked/stored in designated areas. (Nails removed/bent over in re-usable timber). • Issue of hardware/nails/screws/cartridges etc. controlled and return of unused items monitored.
Sub-Contractors	• Sub-contractors required to comply with Housekeeping requirements.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

F) Working At Heights (Including Roof Work)

Subject	Requirements
Openings	Unprotected openings adequately guarded/fenced/barricaded/catch nets installed.
	- Roof work discontinued when bad/hazardous weather. - Fall protection measures (including warning notices) when working close to edges or on fragile roofing material.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

G) Scaffolding

Subject	Requirement
Access/System Scaffolding	• Foundation firm/Stable. • Sufficient bracing. • Tied to structure/prevented from side or cross movement. • Platform boards in good. condition/sufficient/secured. • Handrails and toe boards provided. • Access ladders/stairs provided. • Areas under scaffolding tidy. • Safe/unsafe for use signs. • Complying with OHS Act and SANS 085
Mobile Scaffolding	• Foundation firm / stable • Sufficient bracing. • Platform boards in good condition/sufficient/secured. • Handrails and toe boards provided. • Access ladders / stairs provided.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Subject	Requirement
	• Area/s under scaffolding tidy. • Safe/unsafe for use signs
Mobile Scaffolding	• Wheels / swivels in good condition • Brakes working and applied. • Height to base ratio correct. • Outriggers used where necessary • Complying with OH&S Act/SABS 085
Suspended Scaffolding	• Outriggers securely supported and anchored. • Correct No. of steel wire ropes used. • Platform as close as possible to the structure. • Handrails on all sides • All winches / ropes / cables / brakes inspected regularly and replaced as prescribed • Scaffolding complies with OHS Act (Act 85/93) • Winch(es) maintained by competent person(s)
Formwork / Support Work	• All components in good condition.

 Contractor

 Witness 1

 Witness 2

 Employer

 Witness 1

 Witness 2

Subject	Requirement
	• Foundation firm / stable. • Adequate bracing / stability ensured. • Good workmanship / uprights straight and plumb. • Good cantilever construction. • Safe access provided. • Areas under support work tidy. • Same standards as for system scaffolding.
Special Scaffolding	• Special Scaffolding e.g. Cantilever, Jib and Truss-out scaffolds erected to an acceptable standard and inspected by specialists.
Edges & Openings	• Edges barricaded to acceptable standards. • Manhole openings covered / barricaded. • Openings in floor / other openings covered, barricaded/fenced. • Stairs provided with handrails. • Lift shafts barricaded / fenced off.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

H) Ladders

Subject	Requirement
Physical Condition / Use & Storage	• Stepladders - hinges/stays/braces/stiles in order. • Extension ladders - ropes/rungs/stiles/safety latch/hook in order. • Extension / Straight ladders secured or tied at the bottom / top. • No joined ladders used • Wooden ladders are never painted except with varnish • Aluminium ladders NOT to be used with electrical work • All ladders stored on hooks / racks and not on ground. • Ladders protrude 900 mm above landings / platforms / roof. • Fixed ladders higher than 5 m have cages/Fall arrest system

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

I) Electricity (As Part Of, Or Additional To The Manual “Safety & Switch Procedure For Electrical Installations”)

Subject	Requirement
Electrical Distribution Boards & Earth Leakage	• Colour coded / numbered / symbolic sign displayed. • Area in front kept clear and unobstructed. • Fitted with inside cover plate / openings blanked off / no exposed “live” conductors / terminals/Door kept close • Switches / circuit breakers identified. • Earth leakage protection unit fitted and operating. • Tested with instrument: Test results within 15 – 30 milliamps • Aperture/Opening/s provided for the plugging in and removal of extension leads without the need to open the door • Apertures and openings used for extension leads to be protected against the elements and especially rain
Electrical Installations & Wiring	• Temporary wiring / extension leads in good condition / no bare or exposed wires. • Earthing continuity / polarity correct: • Looking at the open connectors to connect the wiring, the word “Brown” has the letter ‘R’ in it, so the b’R’own • wire connects to the ‘R’ight hand connector. “Blue” has the letter ‘L’ in it, so the b’L’ue wire connects to the • ‘L’eft hand connector.

 Contractor

 Witness 1

 Witness 2

 Employer

 Witness 1

 Witness 2

Subject	Requirement
	• Cables protected from mechanical damage and moisture. • Correct loading observed e.g. no heating appliance used from lighting circuit etc. • Light fittings/lamps protected from mechanical damage/moisture. • Cable arrestors in place and used inside plugs
Physical condition of Electrical Appliances & Tools	• Electrical Equipment and Tools: (includes all items plugging in to a 16 Amp supply socket) • Insulation / casing in good condition. • Earth wire connected/intact where not of double insulated design • Double insulation mark indicates that no earth wire is to be connected. • Cord in good condition/no bare wires/secured to machine & plug. • Plug in good condition, connected correctly and correct polarity.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

J) Emergency And Fire Prevention And Protection

Subject	Requirement
Fire Extinguishing Equipment	• Fire Risks Identified and on record • The correct and adequate Fire Extinguishing Equipment available for: ○ Offices ○ General Stores ○ Flammable Store ○ Fuel Storage Tank/s and catchment well ○ Gas Welding / Cutting operations ○ Where flammable substances are being used / applied. ○ Equipment Easily Accessible
Maintenance	• Fire equipment checked minimum monthly, serviced yearly
Location & Signs	• Fire Extinguishing Equipment: • Clearly visible • Unobstructed • Signs posted including “No Smoking” / “No Naked Lights” where required. (Flammable store, Gas store, Fuel

 Contractor

 Witness 1

 Witness 2

 Employer

 Witness 1

 Witness 2

Subject	Requirement
	tanks etc.)
Storage Issue & Control of Flammables (incl. Gas cylinders)	- Storage Area provided for flammables with suitable doors, ventilation, bund etc. - Flammable store neat / tidy and no Class A combustibles. Decanting of flammable substances carried out in ignition free - and adequately ventilated area. Container bonding principles applied - Only sufficient quantities issued for one task or one day's usage - Separate, special gas cylinder store/storage area. - Gas Cylinders stored / used / transported upright and secured in trolley/cradle/structure and ventilated. - Types of Gas Cylinders clearly identified as well as the storage area and stored separately. - Full cylinders stored separately from empty cylinders. - All valves, gauges, connections, threads of all vessels to be checked regularly for leaks. - Leaking acetylene vessels to be returned to the supplier IMMEDIATELY.
Storage, Issue & Control of Hazardous Chemical	- HCS storage principles applied: products segregated - Only approved, non-expired HCS to be used

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Subject	Requirement
Substances (HCS)	• Only the prescribed PPE shall be used as the minimum protection • Provision made for leakage/spillage containment and ventilation • Emergency showers/eye wash facilities provided • HCS under lock & key controlled by designated person • Decanted/issued in containers as prescribed with information/warning labels • Disposal of unwanted HCS by accredited disposal agent • No dumping or disposal of any HCS on or inside the storage area or anywhere else on the project site • All vessels or containers to be regularly checked for leaks

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

K) Excavation and trenching

Subject	Requirement
Excavations	• Shored / Braced to prevent caving / falling in. • Provided with an access ladder. • Excavations guarded/barricaded/lighted after dark in public areas • Soil dumped at least 1 m away from edge of excavation • On sloping ground soil dumped on lower side of excavation • All excavations are subject to daily inspections

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

L) Tools

Subject	Requirement
Hand Tools	Shovels / Spades / Picks: * Handles free from cracks and splinters * Handles fit securely * Working end sharp and true Hammers: * Good quality handles, no pipe or reinforcing steel handles. * Handles free from cracks and splinters Handles fit securely Chisels: * No mushroomed heads / heads chamfered * Not hardened * Cutting edge sharp and square Saws: * Teeth sharp and set correctly

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Subject	Requirement
	* Correct saw used for the job
Explosive Powered Tools	• Only used by trained / authorised personnel. • Prescribed warning signs placed / displayed where tool is in use. • Work area must be properly isolated/demarcated during use of tool. • Inspected at least monthly by competent person and results recorded. • Issue and return recorded including cartridges / nails and unused cartridges / nails / empty shells recorded. • Cleaned daily after use.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

M) Cranes

Subject	Requirement
Tower Crane	• Only operated by trained authorised operator with valid certificate of training • Structure - no visible defects • Electrical installation good/safe • Crane hook: Throat pop marked/safety latch fitted/functional • SWL/MML displayed • Limit switches with backup switches fitted/operational • Access Ladder fitted with backrests/Fall arrest system installed • Lifting tackle in good condition/inspection colour coding • Lifting tackle checked daily
Mobile Crane	• Only operated by trained authorised operator with valid certificate of training • Rear view mirrors • Windscreen visibility good • Windscreen wipers operating effectively • Indicators operational

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Subject	Requirement
	• Hooter working • Tyres safe/sufficient tread/pressure visibly sufficient • No missing Wheel nuts Headlights, taillights operational • Reverse alarm working and audible and known by all employees
Mobile Crane continued	• Grease nipples and grease on all joints • No Oil leaks • Hydraulic pipes visibly sound/no leaks • No corrosion on Battery terminals • Boom visibly in good condition/no apparent damage • Cable/sheaves greased/no visible damage/split wires/corrosion and checked daily • Brakes working properly • Crane hook: Throat pop marked/safety latch fitted/functional • SWL/MML displayed • By-pass valves operational • Deflection chart displayed/visible to operator/driver

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Subject	Requirement
	• Outriggers functional used
Gantry Crane	• Only operated by trained authorised persons • Correct slinging techniques used • Recognised/displayed on chart signals used • Log book kept/up to date • Prescribed inspections conducted on crane & lifting tackle and checked daily • “Crane overhead” signage, where applicable • Crane hook: Throat pop marked/safety latch fitted/functional • SWL/MML displayed/load limiting switches fitted/operational

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

N) Builder's Hoist

Subject	Requirement
Builder's Hoist	• "Hoist In Operation" - sign displayed. • General construction strong and free from patent defects. • Tower: * Adequately secured / braced. • At least 900 mm available for over travel. • Barricaded at least 2 100 mm high at ground level and floors. • Landing place provided with gate at least 1 800 high. • Platform: * No persons conveyed on platform • Steel wire ropes with breaking strength of six times max. load. • Signal systems used which may include two way radio connection. • Goods prevented from moving / falling off. • Effective brake capable of stopping and holding max. load.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

O) Transport & Material Handling Equipment

Subject	Requirement
Site Vehicles	• All Site Vehicles, Dumpers, Bobcats, Loaders etc; checked daily before use by driver / operator. • Inventory of vehicles used/operated on site • Inspection by means of a checklist / results recorded. • No persons riding on equipment not designed or designated for passengers. • Site speed limit posted, enforced and not exceeded. • Drivers / Operators trained / licensed and carrying proof. • No unauthorised persons allowed to drive/operate equipment.
Conveyors	• Conveyor belt nip points and drive gear guarded. • Emergency stop/lever/brake fitted, clearly marked & accessible and tested to be functional under full load.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

P) Site Plant & Machinery

Subject	Requirement
Brick Cutting Machine	• Operator Trained. • Only authorised persons use the machine. • Emergency stop switch clearly marked and accessible. • Area around the machine dry and slip/trip free/clear of off-cuts • All moving drive parts guarded/electrical supply cable protected • Operator using correct PPE - eye/face/hearing/foot/hands/body.
Electric Arc Welder	• Welder Trained. • Only authorised / trained persons use welder. • Earth cable adequately earthed to work. • Electrode holder in good condition/safe • Cables, clamps & lugs/connectors in good condition. • Area in which welding machine is used is dry/protected from wet. • Welder using correct PPE - eye/ face/foot/body/respirator. • Correct transparent screens & warning signs placed

 Contractor

 Witness 1

 Witness 2

 Employer

 Witness 1

 Witness 2

Subject	Requirement
Woodworking Machines	• Operators Trained. • Only authorised persons use machines. • Provided with guards. • Guards used. • Operators using correct PPE - eye/face/feet/hearing • Circular saws strictly operated according to prescribed methods and settings • Only prescribed saw blades (cross-cut, ripping blade, smooth cut, aluminium) shall be used for various applications
Compressors	• Relief valves correctly set and locked / sealed. • Maximum Safe Working Pressure (MSWP) indicated on face of pressure gauge: not on glass cover. • All drives adequately guarded. • Receiver/lines drained daily • Hoses good condition/clamped, not wired • Compressed air NEITHER used to dust off clothing/PPE/ and work areas NOR on bare skin
Concrete Mixer / Batch	• Top platform provided with guardrails.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Subject	Requirement
Plant	• Dust abatement methods in use. • Operators using correct PPE - eye / hands / respirators. • All moving drive parts guarded. • Emergency stops identified / indicated and accessible. • Area kept clean/dry/and free from tripping and slipping hazards. • Operator's overseer identified and crane signals displayed and used.
Gas Welding / Flame Cutting Equipment	• Only authorised/trained persons use the equipment. • Torches and gauges in good condition. • Flashback arrestors fitted at cylinders and gauges. • Hoses in good condition/correct type/all connections with clamps • Cylinders stored, used and transported in upright position, secured in trolley / cradle / to structure. • All cylinders regularly checked for leaks, leaking cylinders returned immediately • Fire prevention/control methods applied/hot work permits

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Q) Plant & Storage Yards/Site Workshops Specifics

Subject	Requirement
Section 8(2)(1) General Machinery Regulation 2(1): Supervision of the Use & Maintenance of Machinery	• Person/s with specific knowledge and experience designated in writing to Supervise the Use & • Maintenance of Machinery • Critical items of Machinery identified/numbered/placed on register/inventory • Inspection/maintenance schedules for abovementioned • Inspections/maintenance carried out to above schedules • Results recorded
General Machinery Regulation 9(2): Notices re. Operation of Machinery	• Schedule D Notice posted in Work areas
Pressure Vessels Regulation 13(1)(b): Supervision of the Use & Maintenance of Vessels under Pressure (VuP)	• Person/s with specific knowledge and experience designated in writing to Supervise the Use & Maintenance of VuP's • VuP's identified/numbered/placed on register/Manufacturers plate intact • Inspection/maintenance schedules for abovementioned • Inspections/maintenance carried out to above schedules • Results recorded/Test certificates available

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Subject	Requirement
Lock-out Procedure	• Lock-out procedure in operation
Ergonomics	• Ergonomics survey conducted – results on record • Survey results applied
Demarcation & Colour Coding	• Demarcation principles applied • All services, pipes, electrical installation, stop-start controls, emergency controls etc. colour coded to own • published or SABS standard • Employees trained to identify colour coding
Portable & Bench Grinders	• Area around grinder clear/trip/slip free • Bench grinders mounted securely/grinder generally in good condition/No excessive vibration • On/Off switch/button clearly demarcated/accessible • Adequate guards in place • Tool rest – secure/square/max. 2 mm gap, perpendicular to drive shaft • Stone/disk - correct type and size/mounted correctly/dressed • Use of Eye protection enforced

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Subject	Requirement
Battery Storage & Charging	• Adequately ventilated, ignition free room/area/no smoking signs • Batteries placed on rubber/wooden surface • Emergency shower/eye wash provided • No acid storage in area • Prescribed methods in place and adhered to when charging batteries
	• Chain Blocks/Tirfors/jacks/mobile gantries etc. identified/ • numbered on register • Chains in good condition/links no excessive wear/checked daily • Lifting hooks – throat pop marked/safety latch fitted • SWL/MML marked/displayed
Presses/Guillotines/ Shears	• Only operated by trained/authorised persons • Interlocks/lock-outs fitted/PPE worn or used at all times

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

R) Workplace Environment, Health & Hygiene

Subject	Requirement
Lighting	• Adequate lighting in places where work is being executed e.g. stairwells and basements. • Light fittings placed / installed causing no irritating/blinding glare. • Stroboscopic effect eliminated (not only reduced) where moving objects or machinery is used
Ventilation	• Adequate ventilation/extraction/ exhausting in hazardous areas e.g. chemicals/adhesives/welding/petrol or diesel/motors running and in confined spaces/basements.
Noise	• Tasks identified where noise levels exceeds 85 dB at any one time. • All reasonable steps taken to reduce noise levels at the source. • Hearing protection used where noise levels could not be reduced to below 85 dB.
Heat Stress	• Measures in place to prevent heat exhaustion in heat stress problem areas e.g. steel decks, when the WBGT index reaches 30. (See Environmental Regulation 4) • Cold drinking water readily available at all times.
Ablutions	• Sufficient hygiene facilities provided - 1 toilet per 30 employees (National Building Regulations prescribe chemical toilets • for Construction sites)

 Contractor

 Witness 1

 Witness 2

 Employer

 Witness 1

 Witness 2

Subject	Requirement
	• Toilet paper available. • Sufficient showers provided. • Facilities for washing hands provided • Soap/cleaning agent available for washing hands • Means of drying hands available • Lock-up changing facilities / area provided. • Ablution facilities kept hygienic and clean.
Eating / Cooking Facilities	• Adequate storage facilities provided. • Weather protected eating area provided, separate from changing area • Refuse bins with lids provided. • Facilities kept clean and hygienic.
Pollution of Environment	• Measures in place to minimize dust generation. • Accumulation or littering of empty cement pockets, plastic wrapping / bags, packing materials etc. prevented. • Spillage / discarding of oil, chemicals and dieseling into storm water and other drains or into existing or newly dug holes/cavities on site expressly prohibited.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Subject	Requirement
Hazardous Chemical Substances	• All substances identified and list available e.g. acids, flammables, poisons etc. • Material Safety Data Sheets (MSDS) indicating hazardous properties and emergency procedures in case of incident on • file and readily available. • Substances stored safely. • Expiry dates meticulously checked where applicable

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

10. THE PRINCIPAL CONTRACTOR'S GENERAL DUTIES

The Principal Contractor shall at all times ensure his status of an "employer" as referred to in the Act, and will abide by his/her responsibilities, duties and functions as per the requirements of the Act and Regulations with specific reference to Section 8 of the Act.

The Principal Contractor shall keep, and on demand make available, a copy of the Act on site at all times and in addition to that he/she will introduce and maintain a file titled "Health and Safety File", or other record in permanent form, which shall contain all relevant aspects and information as contemplated in the Construction Regulations. He/she will make this file available to the client or his representative whenever necessary or on request to an interested party.

11. THE PRINCIPAL CONTRACTOR'S SPECIFIC DUTIES

The Principal Contractor's specific duties in terms of these specifications are detailed in the Construction Regulations 2014. The Principal Contractor shall ensure compliance to the Act and its Regulations and specifically to the above regulations, and document each record in the Health and Safety File.

The Contractor shall ensure that no work commences on an electrical installation which requires a new supply or an increase in electricity supply before the person who supplies or contracts or agrees to supply electricity to that electrical installation has been notified of such work. The contractor shall ensure that no asbestos work is carried out before the Provincial Director of the Department of Labour has been notified in writing.

12. THE GENERAL NOTES TO THE PRINCIPAL CONTRACTOR

Legal Framework

Part of legal obligations

The more important Acts and relevant subordinate/secondary legislation as well as other (inter alia Local Government) legislation that also apply to the State as well as to State owned buildings and premises: -

- (i) The latest issue of SABS 0142: "Code of Practice for the Wiring of Premises"
- (ii) The Local Government Ordinance 1939 (Ordinance 17 of 1939) as amended and the municipal by-laws and any special requirements of the local supply authority
- (iii) The Fire Brigade Services Act 1987, Act 99 of 1987 as amended
- (iv) The National Building Regulations and Building Standards Act 1977 (Act 103 of 1977) as amended and relevant proclaimed

Regulations (SABS 0400)

- (v) The Post Office Act 1958 (Act 44 of 1958) as amended

- (vi) The Electricity Act 1984, Act 41 of 1984

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(vii) The Regulations of Local Gas Board(s), including Publications of the SABS Standards and Codes of Practice, with specific

reference to GNR 17468 dated 4th October 1997

(viii) Legislation pertaining to water usage and the environment

(ix) Legislation governing the use of equipment, which may emit radiation (e.g. X-Rays etc.)

(x) Common Law

Legal Liabilities

Common Law and Legislation

Based on two main criteria –

- Would the reasonable person have foreseen the hazard?

That is a reasonable person in that specific position, taking experience, qualifications, authority, position in the organization etc. into consideration

- Would the reasonable person have taken precautionary measures (action) to prevent or limit the hazard?

Negligence can be proven on failure on any or both of the above criteria (There may not necessarily be a relationship between criminal and civil liability!)

Lockout Systems - Electrical

A system of control shall be established in order that no unauthorized person can energize a circuit, open a valve, or activate a machine on which people are working or doing maintenance, even if equipment, plant or machinery is out of commission for any period, thus eliminating injuries and damage to people and equipment as far as is reasonably practicable.

Physical/mechanical lock-out systems shall be part of the safety system and included in training. Lockouts shall be tagged and the system tested before commencing with any work or repairs.

Incident Investigation

Inspection and reporting is the best way in which a responsible contractor can control his area of responsibility. All incidents therefore, irrespective of whether it gave rise to loss, injury, damage or not, shall be investigated and the results recorded in the Health and Safety File. (attached GAR 9)

13. GENERAL

The project under control of the Principal Contractor shall be subject to periodic health and safety audits that will be conducted by the client at intervals agreed upon between the Principal Contractor and the client,

Contractor

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provided such intervals will not exceed periods of one month. The Principal Contractor is to ensure that he/she and all persons under his control on the construction site shall adhere to the above specifications, as non-conformance will lead to the client taking action as directed by Construction Regulation 5(1)(q). The Principal Contractor should note that he/she shall be held liable for any anomalies including costs and resulting deficiencies due to delays caused by non-conformance and/or non-compliance to the above Health and Safety Specifications and the Health and Safety Plan based on these specifications.

13.1 Emergency Procedures

The contractor shall submit for acceptance of the **Vaal Central Water's Assistant Manager: SHEQ/Construction SHE Officer** an Emergency Procedure which include but are not limited to the fire, spills, accidents to employees, exposure to hazardous substances, which:

- Identifies the key personnel who are to be notified of any emergency
- Sets out details including contact numbers of available emergency services; and
- The actions or steps which are to be taken during an emergency.

The Contractor shall within 24 hours of an emergency taking place notify **Vaal Central Water's Assistant Manager SHEQ/ SHEQ Officer** in writing of the emergency and briefly outline what happened and how it was dealt with.

13.2 Health and Safety File

Contents of the OHS plan.

The OHS plan shall include but not limited to the following:

• Principal contractor OHS Policy

• Legal and other requirements: Principal contractor must specify what legal and other requirements will be applicable to the construction process:

• **Hazard Identification and Risk Assessment:** The principal contractor must in detail demonstrate how, when, where and what type of risk assessments and by whom risk assessments will be conducted?

• **Objectives and targets:** Objectives and targets must be set and detailed description to be given how objectives and targets will be reached.

• **Resources, Roles, and responsibilities:** Appointments, who will be appointed for what.

• **Competency training and awareness:** Detailed description of what training will take place, including induction, job specific training and external training.

• **Communication:** Types of communication that will take place. Meetings and frequency of meetings (OHS committee meetings / site meetings. Monthly reports.

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- **Performance monitoring:** What types of monitoring would be done: Inspections/ PTO's etc.
- **Inspections:** Inspections, frequency of inspections the people responsible for inspections.
- **Incident Management and Investigation:** Who, when, why, where, and how incidents will be managed.
- **Audits:** Types of audits and frequency of audits
- **Signage:** Signage that will be used
- Access control / Security
- Public Health and Safety
- Traffic Management and accommodation
- PPE Management
- First Aid arrangements
- Emergencies
- Management of subcontractors.
- Control of Documents
- Occupational Health and Safety budget
- **Operational control:** This refers to the material, equipment and activities that will take place on site based on the scope of work and will be as follows:
 - ✓ Signage
 - ✓ Equipment transport to site. Delivery and offloading.
 - ✓ Construction employee facilities
 - ✓ Stacking and Storage
 - ✓ Housekeeping
 - ✓ Waste management
 - ✓ Construction vehicles and mobile plant
 - ✓ Hand tools
 - ✓ Temporary electrical installations
 - ✓ Electrical work

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- ✓ Use of portable electrical tools
- ✓ Ladders
- ✓ Clearing and grubbing. Vegetation clearance
- ✓ Excavations
- ✓ Bedding and Backfilling
- ✓ Lifting machines and lifting equipment
- ✓ Lifting operations
- ✓ Welding and flame cutting activities.
- ✓ Grinding / Using circular saws.
- ✓ Tie into existing services
- ✓ Confined spaces
- ✓ Electrical and mechanical works.
- ✓ Adverse weather conditions
- ✓ Use and storage of flammable liquids.
- ✓ Hazardous chemical substances
- ✓ Dangerous animals.
- ✓ Working close to water environments
- ✓ Lighting
- ✓ Ventilation
- ✓ Noise
- ✓ Working in or with sewage / effluent
- ✓ Removing asbestos material.

The OH&S file / files opened in terms of Construction Regulation 5(1)(s) and CR 7(1)(b) shall be always kept on site. This shall be a file or permanent record containing information on aspects of the contract regarding OHS of any person who may be affected by the construction work.

Contractor

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The principal contractor shall appoint a suitably qualified person to prepare the file / files and to keep it up to date for the duration of the contract. The file shall include the following information but not limited to:

- Appointment – Principal contractor
- 37(2) Mandatory agreement between client and principal contractor
- Appointment – OHS Agent
- Client OHS specifications.
- Client Baseline Risk assessment
- Principal contractor OHS plan and approval.
- Construction Work Permit
- Letter of Good Standing
- Public liability insurance
- Copy of the Occupational Health and Safety Act
- Copy of Construction Regulations
- Copy of the COID Act
- Legal Register
- OHS Policy
- Organogram & Appointments & Competencies of appointed persons
- Employee management: Personal profiles / ID's / Medicals with annexure 3 attached.
- Risk Management: Risk assessment review register / method statements / risk assessments / safe operating procedures / planned task observations / daily safety task instructions.
- Training and communication. (Induction / toolbox talks)
- Minutes of meetings
- Monthly reports
- Inspections
- Incident management: Incident registers / Incident investigations forms & templates
- Emergency Management
- PPE management
- Management of Contractors

Contractor

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- Fall protection.
- HCS
- Construction vehicles and mobile plant
- Lifting machines
- Traffic management
- Waste management
- COC's (Certificate of compliance)
- Confined spaces
- Excavation inspections

The Contractor shall maintain on site a health and safety file which contains copies of the following, as relevant:

Documents required prior to commencing with physical construction activities

- a) The Contractor's health and safety policy signed by the Chief Executive Officer, which outlines the Contractor's objectives concerning the protection of the health and safety of his employees at work, and how they will be achieved and implemented by the Contractor;
- b) The notification made to the Provincial Director of Labour, and if relevant, the notification of the person who supplies or contracts or agrees to supply electricity to the electrical installation;
- c) The letters of appointment, as relevant, of the construction supervisor for the site in respect of construction works covered by the Construction Regulations and the registered person responsible for the electrical installation covered by the Electrical Installations Regulations;
- d) A copy of the certificate of registration of the registered person responsible for the electrical installation covered by the Electrical Installations Regulations;
- e) The approval of the design of the part of an electrical installation which has a voltage in excess of 1 kV by a person deemed competent in terms of the Electrical Installations Regulations;
- f) The preliminary hazard identification undertaken by the competent person;
- g) Proof of registration of the electrical contractor who undertakes the electrical installation in terms of the Electrical Installations Regulations;
- h) The organogram which outlines the roles and responsibilities of the construction supervisor's assistants and safety officers; and
- i) The contractor's health and safety plan;

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- j) The emergency procedure;
- k) The procedure for the replacement of lost, stolen, worn or damaged personal protective clothing; and
- l) Proof that the contractor is registered and in good standing with the compensation fund or with a licensed compensation insurer;

Any revisions to the organogram which outlines the roles and responsibilities of the construction supervisor's assistants and safety officers;

- a) Each and every subcontract agreement;
- b) Proof that every subcontractor is registered and in good standing with compensation fund or with a licensed compensation insurer;
- c) Proof of all subcontractor's induction training whenever it is conducted;
- d) Copies of the minutes of the subcontractors health and safety meetings;
- e) Copies each of the Contractor's subcontractors' health and safety policy, signed by the Chief Executive Officer, which outlines the Contractor's objectives and how they will be achieved and implemented by the Contractor;
- f) The health and safety plans of all the Contractor's subcontractors who are required to provide such plans;
- g) A comprehensive and updated list of all subcontractors employed on site by the contractor, indicating the type of work being performed by such subcontractors;
- h) The outcomes of the monthly audits for compliance with the approved health and safety plan of each and every subcontractor working on the site;
- i) Any report made to an inspector by the health and safety committee;
- j) The minutes of all health and safety meetings and every recommendation made to the Contractor by the health and safety committee;

13.3 Identification Of Hazards And Development Of Risk Assessments, Standard Working Procedures (SWP) And Method Statements

The Principal Contractor is required to develop Risk Assessments, Standard Working Procedures (SWP) and Method Statements for each activity executed in the contract or project. The identification of hazards is over and above the hazards identification programme and those hazards identified during the drafting of the Health and Safety Plan. The Contractor shall before the commencement of any work on the site and during

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construction work, cause a risk assessment to be performed by a competent person appointed in writing. Such an assessment shall as a minimum:

- i. Identify the risks and hazards to which persons may be exposed to;
- ii. Analyse and evaluate the identified risks and hazards;
- iii. Document a plan of safe work procedures, including the use of any personal protective equipment or clothing and the undertaking of periodic toolbox talks or inductions before undertaking hazardous work, to mitigate, reduce or control the risks and hazards that have been identified;
- iv. Provide a monitoring plan

Note: A risk assessment is a crucial step in protecting workers as well as complying with the law. It helps to focus on the risks that really matter in a particular workplace – the ones with the potential to cause harm. Workers and others have a right to be protected from harm caused by a failure to take reasonable control measures. The following four steps are recommended:

- a) Identify the Hazards:** By looking at what could reasonably be expected to cause harm, ask employees or their representatives what they think, obtain advice from trade associations or publications on health and safety, check manufacturer's instructions or data sheets for chemicals and equipment as they can be very helpful in spelling out the hazards and putting them in their true perspective, review accident and ill health records, think about long term hazards to health (e.g. high levels of noise or exposure to harmful substances) as well as safety hazards etc.
- b) Identify who May be Harmed and how** by identifying how groups of people might be harmed i.e. what type of injury or ill health might occur?
- c) Evaluate the Risks and Decide on Precautions** by doing everything reasonably practicable to protect people from harm i.e. by looking at how things are done, what controls are in place and how the work is organised and comparing this against good practice to see if more can be done to bring practices up to standard. Consider if the hazard can be got rid of all together, and if not, how can the risk be controlled so that harm is unlikely e.g. try a less risky option (e.g. switch to using a less hazardous chemical); prevent access to the hazard (e.g. by guarding); organize work to reduce exposure to the hazard (e.g. put barriers between pedestrians and traffic); issue personal protective equipment (e.g. clothing, footwear, goggles etc.); and provide welfare facilities (e.g. first aid and washing facilities for removal of contamination)
- d) Record the Findings** by writing down the findings of the risk assessment

The Contractor shall ensure that as far as is reasonably practicable, ergonomic related hazards are analysed, evaluated and addressed in the risk assessment.

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13.4 Arrangements for Monitoring and Review

Monthly Audit by Client and/or its Agent on its behalf. The Client and/or its Agent on its behalf will be conducting Periodic Audits at times agreed with the Principal Contractor Audit to comply with Construction Regulation 5(1)(o) to ensure that the principal Contractor has implemented, is adhering to and is maintaining the agreed and approved OH&S Plan.

Other audits and inspections by client and/or its agent on its behalf

The Client and/or its Agent on its behalf reserves the right to conduct any other ad hoc audits and inspections as it and/or its Agent on its behalf deem necessary.

A representative of the Principal Contractor and the relevant Health and Safety Representative(s) (SHE-Reps) must accompany the Client and/or its Agent on its behalf on all Audits and Inspections and may conduct their own audit/inspection at the same time. Each party will, however, take responsibility for the results of his/her own audit/inspection results. The Client and/or its Agent on its behalf may require to be handed a copy of the minutes of the previous Health and Safety Committee meeting reflecting possible recommendations made by that committee to the Employer for reference purposes.

The findings of all audit reports made regarding the implementation of the Contractor's or subcontractor's health and safety plan;

The inputs of the health and safety officer, if any, into the health and safety plan;

Details of induction training conducted whenever it is conducted including the list of attendees;

13.5 Reports

The Principal Contractor shall report all incidents where an employee is injured on duty to the extent that he/she:

- Dies
- becomes unconscious
- loses a limb or part of a limb
- is injured or becomes ill to such a degree that he/she is likely either to die or to suffer a permanent physical defect or likely to be unable for a period of at least 14 days either to work or continue with the activity for which he/she was usually employed

OR where:

- a major incident occurred
- the health or safety of any person was endangered

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- where a dangerous substance was spilled
- the uncontrolled release of any substance under pressure took place
- machinery or any part of machinery fractured or failed resulting in flying, falling or uncontrolled moving objects
- machinery ran out of control,

to the Provincial Director of the Department of Labour within seven days and at the same time to the Client and/or its Agent on its behalf.

Refer in this regard to Section 24 of the Act & General Administrative Regulation 8.

The Principal Contractor is required to provide the Client and/or its Agent on its behalf with copies of all statutory reports required in terms of the Act and the Regulations.

The Principal Contractor is required to provide the Client and/or its Agent on its behalf with a monthly “SHE Risk Management Report”.

The Principal Contractor is required to provide a.s.a.p. the Client and/or its Agent on its behalf with copies of all internal and external accident/incident investigation reports including the reports contemplated in 12.7, 12.8.2, 15, 16, 17, 21 and 22 below. As soon as the occurrence of any accident/incident of whatever nature comes to the notice of the Principal Contractor, it shall be reported immediately.

13.6 Review

The Principal Contractor is to review the Hazard Identification, Risk Assessments and Standard Work Processes at each Production Planning and Progress Report meeting as the construction work develops and progresses and each time changes are made to the designs, plans and construction methods and processes.

The Principal Contractor must provide the Client and/or its Agent on its behalf, other Contractors and all other concerned parties with copies of any changes, alterations or amendments as contemplated in the above paragraph.

13.7 Site Rules and other Restrictions

Site OH&S Rules

The Principal Contractor must develop a set of site-specific OH&S rules that will be applied to regulate the Health and Safety Plan and associated aspects of the construction.

When required for a site by law, visitors and non-employees upon entering the site shall be issued with the proper Personal Protective Equipment (PPE) as and when necessary.

13.8 Security Arrangements

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The Principal Contractor must establish site access rules and implement and maintain these throughout the construction period. Access control must include the rule that non-employees shall at all times be provided with fulltime supervision while on site.

The Principal Contractor must develop a set of Security rules and procedures and maintain these throughout the construction period.

If not already tasked to the H&S Officer appointed in terms of Construction Regulation 8(8), the Principal Contractor must appoint a competent Emergency Controller who must develop contingency plans for any emergency that may arise on site as indicated by the risk assessments. These must include a monthly practice/testing programme for the plans e.g. January: trench collapse, February: flooding etc. and practiced/tested with all persons on site at the time, participating.

13.8 Training

The contents and syllabi of all training required by the Act and Regulations including any other related or relevant training as required must be included in the Principal Contractor's Health and Safety Plan and Health and Safety File.

13.9 General Induction Training

All employees of the Principal and other Contractors must be in possession of proof of General Induction training

13.10 Site Specific Induction Training

All employees of the Principal and other Contractors must be in possession of Site Specific Occupational Health and Safety Induction or other qualifying training

13.11 Other Training

All operators, drivers and users of construction vehicles, mobile plant and other equipment must be in possession of valid proof of training. All employees in jobs requiring training in terms of the Act and Regulations must be in possession of valid proof of training as follows:

Occupational Health and Safety Training Requirements: (as required by the Construction Regulations and as indicated by the Health and Safety Specification Document & the Risk Assessment/s and recommendations by the Health and Safety Committee):

- General Induction (Section 8 of the Act)
- Site/Job Specific Induction (also visitors) (Sections 8 & 9 of the Act)
- Site/Project Manager
- Construction Supervisor

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- OH&S Representatives (Section 18 (3) of the Act)
- Training of the Appointees indicated in 12.6.1 & 12.6.2 above
- Operation of Cranes (Driven Machinery Regulations 18 (11))
- Operators & Drivers of Construction Vehicles & Mobile Plant (Construction Regulation 23)
- Basic Fire Prevention & Protection (Environmental Regulations 9 and Construction Regulation 29)
- As a minimum basic First Aid to be upgraded when necessary (General Safety Regulations 3)
- Storekeeping Methods & Safe Stacking (Construction Regulation 28)
- Emergency, Security and Fire Co-ordinator

The health and safety file shall be made available for inspection by any inspector, subcontractor, the Project Manager, **Vaal Central Water's Assistant Manager SHEQ/SHEQ Officer** or employee of the contractor upon the request of such persons. The Contractor shall hand over the health and safety file to Vaal Central Water's Assistant Manager SHEQ/ SHEQ Officer upon completion of the contract and if relevant, a certificate of compliance accompanied by a test report for the electrical installation in accordance with the provisions of the Electrical Installations Regulations.

13.12 Health and Safety Committee

The Contractor shall convene health and safety meetings whenever more than two (2) health and safety representatives have been appointed for the site. These meetings shall be attended by all health and safety representatives and persons nominated by the Contractor. Such meetings shall be convened at least once every month to:

- Make recommendations to the Contractor regarding any matter affecting the health or safety of persons on the site; and
- Discuss any incident on the site in which or in consequence of which any person was injured, became ill or died.

The Contractor shall consult with the health and safety committee on the development, monitoring and review of the risk assessment. The Contractor shall ensure that minutes of the health and safety committee are kept.

13.13 Inspectors, Formal Enquiries and Incidents

The Contractor shall inform the relevant safety representative:

- Beforehand of inspections, investigations or formal inquiries of which he/she has been notified by an inspector; and

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- b) As soon as reasonably practicable of the occurrence of an incident on the site.

The Contractor shall record all incidents and notify **Vaal Central Water's Assistant Manager SHEQ/ SHEQ Officer** of any incident, except in the case of a traffic accident on a public road, as soon as possible after it has occurred and report such incidents to an inspector. The Contractor shall investigate all incidents and issue **Vaal Central Water's Assistant Manager SHEQ/ SHEQ Officer** with copies of such investigations.

13.14 Health and Safety Representatives

The Contractor shall appoint in writing one health and safety representative for every 50 employees working on the site, whenever there are more than 20 employees on the site, to:

- a) Review the effectiveness of health and safety measures;
- b) Identify potential hazards and potential major incidents;
- c) In collaboration with Vaal Central Water, examine the causes of incidents;
- d) Investigate complaints by any employee of the Contractor relating to that employee's health and safety on the site;
- e) Make recommendations to the Contractor on matters arising from a), b), c) or d) on general matters affecting the health or safety of employees at the workplace;
- f) Inspect the site with a view to, the health and safety of employees, at regular intervals;
- g) Participate in consultations with inspectors at the workplace and accompany inspectors on inspections at the workplace; and
- h) Participate in any internal health and safety audit

The Contractor shall provide the health and safety representative with the necessary assistance, facilities and training to carry out the functions.

13.15 Construction Supervisor

The Contractor shall, prior to commencing the work, appoint a full time competent employee in writing as the Construction Supervisor for the site, with the duty of supervising the performance of the work falling within the scope of the contract and may appoint one or more competent employees to assist the appointed construction supervisor.

The Contractor may, having considered the size of the project, the degree of dangers likely to be encountered or the accumulation of hazards or risks on the site appoint a full time or part time construction safety officer in writing, who has in the Contractor's opinion the necessary competencies and resources, to assist the Contractor in the control of all safety related aspects on the site.

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13.16 Occupational Health and Safety Staff

The Contractor shall appoint in writing a full-time Occupational Health and Safety Manager for the project. The Occupational Health and Safety Manager shall have the necessary competence and resources to perform his duties diligently and shall be professionally registered with the SACPCMP as a Pr CHSM. The contractor shall furthermore ensure that one Occupational Health and Safety Officer is employed for every 100 employees, and shall be equipped with the following:

- Computer
- Camera
- Access to telephone
- Printing/ scanning/ copying facilities

The Contractor shall compile and maintain an organogram which outlines the roles and responsibilities of the construction supervisor's assistants and safety officers.

The appointed SAFETY MANAGER/OFFICER must comply with the following competencies;

- **NADSAM / SAMTRAC / NEBOSH / Equivalent**
- **Registered as Construction health and safety manager/officer at SACPCMP.**
- **Hazard Identification and risk assessment (HIRA)**
- **Legal Liability**
- **Excavation inspection course (*Safety officer will not be allowed be appointed as excavation supervisors/inspectors. The course will assist them to identify hazards better regarding excavation works.*)**
- **Confined space training**

No health and safety officer or health and safety manager will be allowed on site if not registered with the SACPCMP. Conformation letters shall not be accepted.

13.17 Vaal Central Water's Health and Safety Manager/Officer

Vaal Central Water Health and Safety Manager/Officer shall:

- Audit the Contractor's compliance with the requirements of this specification prior to the commencement of any physical construction activities on the site;
- Accept or reject all safety plans, giving reasons for rejecting such plans;
- Monitor the effective implementation of all safety plans;

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- Conduct periodic and random audits on the health and safety file to establish compliance with the requirements of this specification;
- Visit the site at regular intervals to conduct site inspections, and based upon such visits issue, wherever necessary, Improvement Notices, Contravention Notices and Prohibition Notices to the Contractor or any of the Contractor's subcontractors with a copy to the Project Manager and, where relevant, to the Contractor.

The Contractor shall invite **Vaal Central Water's Health and Safety Manager/Officer** to audit compliance with the requirements of this specification before commencing with any physical construction activity on the site.

Documents required after construction activities have commenced

The letters of appointments, if relevant, of

- a) Persons who are required to assist the construction supervisor;
- b) Safety Officers
- c) Health and Safety Representatives;
- d) Replacement of construction supervisor; and
- e) Assistants of construction supervisor

The Contractor shall with respect to the site and construction works that are contemplated:

- i. Cause a preliminary hazard identification to be performed by a competent person before commencing any physical construction activity;
- ii. Evaluate the risks associated with such work constituting a hazard to the health and safety of such employees and steps that need to be taken to comply with the Act; and
- iii. As far as is reasonably practicable, prevent the exposure of such employees to hazards concerned or; where prevention is not reasonably practicable, minimize such exposures;

Note: the information provided by the designer shall outline known or anticipated dangers or hazards relating to the works and make available all information required for the safe execution of the work. It shall provide as relevant, geotechnical information (or refer to reports provided in the site information), the loading of the structure is designed to withstand, the methods and sequence of construction.

The Contractor shall carry out regular inspections and audits to ensure that the works are being performed in accordance with the requirements of this specification.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

13.18 Health and Safety Plans

The Contractor shall prior to commencing the works to which specification applies, submit to **Vaal Central Water's Assistant Manager SHEQ/ SHEQ Officer** for approval a suitable and sufficiently documented health and safety plan, based on this specification and the risk assessment that is conducted. The health and safety plan shall as a minimum provide:

- The information contained in Table 1 in respect of each of the hazards associated with work falling within the scope of the contract.

Table 1: Example of the Format of a Health and Safety Plan

What are the hazards relating to work tasks?	Who might be harmed and how?	What are the safe work procedures for the site?	What further action is necessary (monitoring and review)?	Action by Whom	Action by When

An outline of the manner in which the Contractor intends complying with the requirements of this specification:

- The Contractor shall discuss the submitted health and safety with **Vaal Central Water's Assistant Manager SHEQ/ SHEQ Officer**, modify such plan in the light of the discussions and resubmit the modified plan for approval.
- The Contractor shall apply the approved health and safety plan from the date of its commencement and for the duration of the works to which this specification applies.
- The Contractor shall conduct periodic audits for compliance with the approved health and safety plan at intervals agreed upon with **Vaal Central Water's Assistant Manager SHEQ/ SHEQ Officer**, but at least once every month.
- The Contractor shall update the health and safety plan whenever changes to the works are brought about.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

Responsibilities towards employees and visitors

The Contractor shall as far as is reasonably practicable, cause every employee to be made conversant with the hazards to his health and safety attached to any work which he has to perform, any article or substance which he/she has to produce, process, use, handle, store or transport and any plant or machinery which is required or permitted to use, as well as with the precautionary measures which should be taken and observed with respect to those hazards or safe work procedures.

The Contractor shall ensure that all employees under his or her control are:

- Informed, instructed and trained by a competent person regarding any hazard and the related work procedures before any work commences , and thereafter at such times as may be determined in the risk assessment; and
- Issued with proof of health and safety induction training issued by a competent and carry proof of such induction when working on site.

The Contractor shall cause a record of training to be kept which indicates the names, identity numbers and job description of all those who attended such training.

The Contractor shall not allow or permit any employee to enter the site, unless such person has undergone health and safety induction training pertaining to the hazards prevalent on the site at the time of entry.

The Contractor shall ensure that each visitor to a construction site, save where such visitor only visits the site office and is not in direct contact with the construction work activities. Undergoes health and safety instruction pertaining to the hazards prevalent on the site; and Is provided with necessary personal protective equipment.

The Contractor shall provide suitable on-site signage to alert workers and visitors to health and safety requirements. Such signage shall include but not be limited to:

- Unauthorized entrance prohibited;
- Signage to indicate what personal protective equipment is to be worn; and
- Activity related signs.

The Contractor shall not permit any person who is or who appears to be under the influence of intoxicating liquor or drugs, to enter or remain at workplace.

Subcontractors

The Contractor may only subcontract work in terms of a written subcontract and shall only appoint a subcontractor should he/she be reasonably satisfied that such a subcontractor has the necessary competencies and resources to safely perform the work falling within the scope of the contract.

Such a subcontractor shall require that the subcontractor to:

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

- Co-operate with the Contractor as far as is necessary to enable both the Contractor and subcontractor to comply with the provisions of the Act; and
- As far as is reasonably practicable, promptly provide the Contractor with any information which might affect the health and safety of any person at work or which might justify a review of the health and safety plan.

The Contractor shall provide any subcontractor who is submitting a tender or appointed to perform a subcontract falling within the scope of the contract, with the relevant sections of this specification and any work specific information which might be pertinent to the subcontract.

The Contractor shall take reasonable steps as are necessary to ensure:

- Co-operation between all subcontractors to enable each of those subcontractors to comply with the requirements of the Act and associated regulations; and
- That each subcontractor's health and safety plan is implemented.
- The Contractor shall conduct periodic audits for compliance with the approved health and safety plan of each subcontractor working on the site at intervals agreed upon with subcontractors, but at least once per month.
- The Contractor shall stop any subcontractor from executing construction work which is not in accordance with the Contractor's or subcontractor's health and safety plan for the site or which poses a threat to the health and safety of person.
- The Contractor shall ensure that where changes to the works occur, sufficient health and safety information and appropriate resources are made available to the subcontractor to execute the work safely.

The Contractor shall ensure that:

- Every subcontractor is registered and in good with the compensation fund or with a licensed compensation insurer prior to work commencing on site;
- Potential subcontractors submitting tenders have made provision for the cost of health and safety measures during the construction process; and
- Every subcontractor has in place a documented health and safety plan prior to commencing any work on site which falls within the scope of the contract.
- The Contractor shall receive, discuss and approve health and safety plans submitted by the subcontractor.
- The Contractor shall ensure that all subcontractors are informed regarding any hazard as stipulated in the risk assessment before any work commences, and thereafter at such times as may be determined in the risk assessment.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

- The Contractor shall reasonably satisfy him/herself that all employees of subcontractors are informed, instructed and trained by a competent person regarding any hazard and the related work procedures before any work commences, and thereafter at such times as may be determined in the risk assessment.
- The Contractor shall satisfy himself that all subcontractor employees deployed in the site are:
 - Informed, instructed and trained by a competent person regarding any hazard and the related work procedures before any work commences, and thereafter at such times as may be determined in the risk assessment; and
 - Issued with proof of health and safety induction training issued by a competent person and carry proof such induction when working on site.

First Aid, Emergency Equipment and Procedure

The Contractor shall where more than five employees are employed at a workplace provide a first aid box or boxes at or near the workplace which shall be available and accessible for the treatment of injured persons at that workplace. Such first aid boxes shall contain suitable first aid equipment.

The Contractor shall ensure that where are more than 10 employees employed on the site that for every group of up to 50 employees at that workplace, at least one person is readily available during normal working hours, who is in possession of a valid certificate of competency in first aid.

Facilities for Workers

The Contractor shall provide and keep clean and fit for use at or within reasonable access on the site:

- a) At least one shower facility for every 15 workers;
- b) At least one sanitary facility for every 30 workers;
- c) Changing facilities for each sex; and
- d) Sheltered eating areas.

A Contractor shall provide reasonable and suitable living accommodation for the workers at construction sites which are remote from their homes and where adequate transportation between the site and homes, or other suitable living accommodation if not available.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

ANNEXURE 1

SHE FILE CHECKLIST

CONSTRUCTION REGULATIONS CHECKLIST

Y=Yes N=No N/A=Not Applicable

Vaal Central Water SHEQ Officer		
Name of Company		Principal Contractor: Sub-Contractor:
Manager		
Cell #		
Date		

1.	Act	Principal Contractor & Sub-Contractor	Y	N	N/A	Remarks
		Contractor's Organogram				
		Contractor's OHS Policy				
	CR 3	Application for construction work permit				
	CR 4	Notification of construction work to DOL				
	CR 5(1)(j)	Letter of Good Standing (Workman's Compensation)				

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

	*	Registration Number				
		Health and Safety Specification				
	CR 7	Health and Safety Plan				
	Sec37(1)&(2)	Mandatory Agreement				
2.	Act	Appointments (Competent Person)	Y	N	N/A	Remarks
	Sec 16(2)	Designated Employer				
	Sec 17(1)	SHE REP (More than 20 employees)				
	Sec 19(1)	Chairperson (SHE Committee)				
	GAR 8/9 Sec 24	Competent Person to do Investigations kept on SHE file				
	GMR 2(1)	Competent Person (Machinery)				
	CR 8(1)	Construction Manager				
	CR 8(7)	Construction Supervisor				
	CR 8(8)	Assistant Construction Supervisor				
	GSR 3(4)	First Aider				
	CR 8(5)	Construction Safety Officer				

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

	*	Full Time				
	*	Part Time				
	*	If part time what is the frequency of visits to site				
	CR 9(1)	Competent Person to do Risk Assessment				
	*	Monitoring Plan				
	*	Review Plan				
	CR 10(1)(a)	Competent Person (Fall Protection Plan)				
	CR 10(a)	Competent Person (Form Work & Support Work)				
	CR 13(1&2)	Competent Person (Excavation Work)				
	CR 14(1)	Competent Person (Demolition Work)				
	CR 16(1)	Competent Person (Scaffolding)				
	CR 19	Competent Person (Material Hoist Operator)				
	CR 19(8)(a)	Competent Person (Material Hoist Inspector)				
	CR 18(1)	Competent Person (Batch Plant Operation)				

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

	CR 19(2)(b)	Competent Person (Inspection of explosive powered tools)				
	CR 19(2)(g)	Competent Person (Issuing & collection of cartridges & nails)				
	CR 22(e)	Competent Person (Crane and Certified)				
	CR 23(1)(j)	Construction Vehicle & Mobile Plants Inspector				
	CR 24 (c & d)	Temporary Electrical Installation Inspector				
	CR 28(a)	Competent Person (Stacking and Storage)				
	CR 29 (h)	Competent Person (Fire Equipment Inspector)				
3.	Act CR 9(1)	Risk Assessment shall include:	Y	N	N/A	Remarks
	CR 9(1)(a)	Risk Identification				
	CR 9(1)(b)	Risk Analysis				
	CR 9(1)(c)	Risk Controls				
		Matrix and Rating				
	CR 9(1)(d)	Monitoring Plan				
	CR 9(1)(e)	Review Plan				

 Contractor

 Witness 1

 Witness 2

 Employer

 Witness 1

 Witness 2

		Training Attendance Register				
4.	Act CR 7(7)	Induction Training	Y	N	N/A	Remarks
	CR 7(4)	Company Training Syllabus				
	CR 7(9)(a)	Training Attendance Register				
	CR 7(9)(b)	Proof of Induction on Person				
	*	Was induction done by Client				
	*	Was Induction done Company				
5.	Act CR 8(1)(a)	Fall Protection Plan				
	CR 8(2)(A)	A Risk Assessment				
		Where people are working on elevated position (				
	CR (2)(c)	Training Program				
		Training Attendance Register				
	CR 8(2)(d)	Planned Inspections (Fall Protection Equipment)				

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

	CR 8(3)	Is the Supervisor in possession of Fall Protection Plan)				
6.		Certificate of Medical Fitness				
		Evaluation of physical fitness of persons by a registered Medical Practitioner (ORIGINALS)				
7.	Various	Planned Maintenance Inspection. Registered Records (Checklists and Signature)				
	Sec 44	Scaffolds				
	CR 8(2)(d)	Inspection, testing and maintenance of fall protection equipment (Checklists and signature)				
	DMR 18(5)	Lifting machines and lifting tackle				
	GSR 3(3) GSR 3(4)	First aid box Valid Certificate in First Aid				
	EMR 9	Portable Electric Equipment				
	EMR 10	Portable Electric Lights				
	GSR 2	Personal Protective Equipment				

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

	*	PPE/Risk Analysis				
	*	Do you have Checklists				
	*	Are all equipment permanently and clearly numbered				
8.		Records to be kept				
	CR 4(1)	Notification to the Regional Director				
	CR 5(6)	Copy of every contractor available on site.				
	CR 5(7)	Contractor's SHE File including all required documentation available on site				
	CR 5(8)	Consolidated SHE File to be handed to Vaal Central Water after completion of work.				
	CR 5(9)	Comprehensive and updated list of all contractors, agreements, the work being done included in SHE File available onsite.				
	CR 7(2)	Risk Assessments Available onsite				
		Risk Assessments addressing all the hazards				

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

		on site, dated and signed by the Risk Assessor.				
		All hazards identified communicated to the employees. (Provide proof).				
	CR 7(9)	Proof of induction training available on site.				
	CR 8(3)	Construction Supervisor has latest available version of Fall Protection Plan.				
	CR 9(2)(b)	Designer's information in writing to contractor of dangers and hazards relating to construction work.				
	CR 11(1)(c)	Drawings pertaining to the design of/support work structure kept on site and available.				
	CR 11(3)(h)	Record of excavation inspections on site and available				
	CR 12(2)	Method statement for demolition a structure				
	CR 12(11)	Method statement for demolishing a structure				

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

	CR 15(2)(b)	Certificates of system design for suspended platform				
	CR 15(2)(c)	Operational Compliance Plan				
	CR 15(10)	Competence of Erectors, Operators and Inspectors				
	Permit System	Daily Inspection Record				
	CR 15(11)	Suspended platform design drawings, inspections and performance test records on site and available				
	CR 15(12)(c)	Training Records Signature				
	CR 17(8)(c)	Materials Hoist Inspection records on site and available				
	CR 18(9)	Maintenance and Repair Records on site and available				
	CR 19(2)(9)	Register of nails and studs (explosive powered tool)				
	CR 21(1)(j)	Construction Vehicle and mobile plant inspection register				

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

	CR 22(d)	Temporary Electrical Installation Inspection Register				
	Permit System	Workers Register Daily				
	HCS.REGS	Chemical substances and Data Sheets				
		Toolbox Talks Daily				
	GSR 2	Issuing of PPE and Facilities (Proof and Signed)				
		Treatment Register (First Aid Box)				
	GAR 9	Reportable Incidents				
	File	Accident and Incident reports (first aid-medical cases-lost time cases)				

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

REMARKS:

Construction Safety Officer		Contractor	

Manager SHEQ		Approved	Yes	No

Date	

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

ANNEXURE 2

APPLICATION FOR A PERMIT TO DO CONSTRUCTION WORK

In terms of Regulation 3(2) of Construction Regulations 2014

This application shall be submitted with the following documents:

- 1. Health and Safety Specification**
- 2. Health and Safety Plan**
- 3. Baseline Risk Assessment**

1. Name and Postal address and telephone numbers of the client:

2. Details of the Agent:

- e) Title, Surname and Initials: _____
- f) Identity number/Passport Number: _____
- g) Registration number with SACPCMP: _____
- h) Office Tel. Number and/or Mobile Number: _____
- i) Postal Address: _____

3. Name, postal address and telephone numbers of the appointed principal contractor:

4. Name, postal address and telephone numbers of designers:

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

5. Name, postal address and telephone numbers of the following persons:

a. Construction Manager: _____

b. Construction Safety and Health Manager: _____

c. Construction Health and Safety Officer: _____

6. Exact physical address of the construction and site office:

7. Nature of construction work:

8. Expected commencement date:

9. Expected completion date:

10. Estimated maximum number of persons on the construction site:

Planned number of contractors on site accountable to principal contractor:

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

11. Name(s) of contractors appointed:

12.

Signature of Client/Client's Agent**Date****13.**

Signature of Principal Contractor**Date****14. Date of Application:**

FOR OFFICE USE ONLY

Authorization	Labour Centre	Official Approval Stamp

15. Submitted documents prescribed in Construction Regulation 5(4) (Please Tick ✓)

CR 5(1) (a)		CR 5(1)(b)		CR 51); (C-S)	

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

16.	Result of the application (Please Tick ✓)	Approved		Denied	

17. Reason for declining application:

18. _____
Signature of the Supervisor

19. _____
Signature of revoking Officer/Inspector

 Contractor

 Witness 1

 Witness 2

 Employer

 Witness 1

 Witness 2

ANNEXURE 3

**Occupational Health and Safety Act' 1993
(Regulation 4 of the Construction Regulations, 2014)**

Notification of Construction Work

1. (a) Name and postal address of principal contractor:

(b) Name and Tel. no. of Principal Contractor's contact person:

2. Principal Contractor's Compensation Registration number:

3. (a) Name and postal address of client:

(b) Name and Tel no. of Client's contact person or agent:

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

4. (a) Name and postal address designer(s) of the project:

(b) Name and Tel. no. of designer(s) contact person:

5. Name and telephone number of principal contractor's construction supervisor on site appointed in terms of regulation 8(2):

6. Name/s of principal contractor's sub-ordinate supervisor(s) on site appointed in terms of 8(2):

7. Nature of construction work:

8. Expected commencement date: _____

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

9. Expected completion date: _____

10. Estimated maximum number of persons on construction site:

Total: _____ Male: _____ Female: _____

11. Planned number of contractors on the construction site accountable to principal contractor:

12. Name(s) of contractors already selected:

Principal Contractor

Date

Client's Agent (where applicable)

Date

Client

Date

This document shall be forwarded to the office of the Department of Labour PRIOR TO COMMENCEMENT of work on site.

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

ANNEXURE 4

Occupational Health and Safety Act (Act 85 of 1993) Construction Regulations 2014

Medical Certificate of Fitness

Name of Employee: _____ ID Number: _____

Co. Number: _____

	*Possible Exposure e.g. noise, heat, fall, risk, confined space etc.	*Job Specific Requirements e.g. operating mobile crane, digging trenches, erecting form work & support work etc.	*Protective Equipment E.g. Dust respirator (Light Duty, Welding Gloves etc.)																																													
*Occupation E.g. General Worker, Welder, Bricklayer, Steel Fixer, Mobile Crane Operator etc.	<table border="1"> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> </table>																<table border="1"> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> </table>																<table border="1"> <tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> </table>															
*The Employer to complete the information in the space marked with an * before sending the Employee for a medical examination.																																																

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

	Declaration by the Medical Examiner: I certify that I have, by examination and testing using the above criteria specified by employer, satisfied myself that the above mentioned employee is fit to perform the duties as described by the employer in the matrix above. Occupational Medicine Practitioner/Occupational Health Nursing Practitioner (Please Print Name): _____ Signature: _____ Practice Number: _____ Date: _____ Address: _____ _____

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

ANNEXURE 5

Tender OHS Management System Questionnaire

This questionnaire forms part of the tender evaluation process. The questionnaire is to be completed by the Contractor tendering and submitted with their tender offer. The objective of the questionnaire is to provide an overview of the status of the contractor's OHS management system. Contractors will be required to verify their responses noted in their questionnaire by providing evidence of their ability and capacity in relevant matters.

Please note that all questions may not be relevant to the contract. The SHEQ Representative shall highlight questions that are mandatory.

- Be advised that if your tender is successful you will be re required to provide:
- A Risk Assessment for the Project
- A Site Safety Plan
- Budget Breakdown
- Job Safety Assessments of Safe Work Method Statements for individual activities that have a medium to high hazard level.

Certification: The information provided in this questionnaire is an accurate summary of the company's occupational health and safety management.	
Company Name:	
Signed:	Name:
Position:	Date:
Contract Details:	
Contract Name:	Contract Number:
Please complete Insurance details in Section 8:	
Name and Contact Details of Vaal Central Water's Representative:	

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

N/A=Not applicable or relevant to this contract

	Questionnaire	Yes	No	N/A
1	OHS Policy Management			
1.1	Is there a written company health and safety policy? If yes, provide a copy of the policy	☐ Yes	☐ No	☐ N/A
1.2	Does the company have an OHS Management System certified by a recognised independent authority? e.g. ISO If yes, provide a copy of contents page(s)	☐ Yes	☐ No	☐ N/A
1.3	Is there a company OHS Management System manual or plan? If yes provide a copy of contents page(s)	☐ Yes	☐ No	☐ N/A
1.4	Are health and safety responsibilities clearly identified for all levels of staff? If yes, provide a sample(s)	☐ Yes	☐ No	☐ N/A
	Other Comments:			
2	Safe Work Practices and Procedures			
2.1	Has the company prepared Safe Work Method Statements, Safe Operating Procedures or specific safety instructions relevant to the contract? If yes, provide a summary listing procedures or instructions>	☐ Yes	☐ No	☐ N/A

 Contractor

 Witness 1

 Witness 2

 Employer

 Witness 1

 Witness 2

2.2	If the work requires use of Permits and Isolation Procedures: Is the company familiar with Permits and Isolation Procedures? If yes, provide evidence such as training, operating instructions etc.	☐ Yes	☐ No	☐ N/A
2.3	Is there a documented incident investigation procedure? If yes, provide a copy of a standard incident report form.	☐ Yes	☐ No	☐ N/A
2.4	Are there procedures for maintaining, inspecting and assessing the hazards of plant operated/owned by the company? If yes, provide details and samples (evidence of completed maintenance logs, pre-start daily safety inspections, job safety assessments, safe working method statements.	☐ Yes	☐ No	☐ N/A
2.5	Are the procedures for storing and handling hazardous substances? If yes, provide details.	☐ Yes	☐ No	☐ N/A
2.6	Are there procedures for identifying, assessing and controlling risks associated with manual handling? If yes, provide details.	☐ Yes	☐ No	☐ N/A
2.7	Are there procedures covering the use of computers and minimising the risk from overuse or related injuries? If yes, provide details.	☐ Yes	☐ No	☐ N/A
	Other Comments:			

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

3	OHS Training			
3.1	Describe how employees are inducted in your company. Provide copy of induction program.	☐ Yes	☐ No	☐ N/A
3.2	Describe how health and safety training is conducted in your company. Provide copy of training program relevant to the contract.	☐ Yes	☐ No	☐ N/A
3.3	Is a record maintained of all training and induction programs undertaken for employees in your company? If yes, provide examples of safety training records.	☐ Yes	☐ No	☐ N/A
3.4	Percent of managers and supervisors trained in OHS in last 3 years. Percent of managers and supervisors trained in preparation of risk assessments. Percent of managers and supervisors trained in preparation of job safety analysis. Percent of workers trained in OHS in last 3 years?	☐ Yes	☐ No	☐ N/A
3.5	Do your employees all applicable licenses/certificates and are appropriately experienced for this work? If yes, please complete Section 9.	☐ Yes	☐ No	☐ N/A

 Contractor

 Witness 1

 Witness 2

 Employer

 Witness 1

 Witness 2

4	Health and Safe Workplace Inspections			
4.1	Are there regular health and safety inspections at worksites undertaken? If yes, provide details and their frequency.	Yes	No	N/A
4.2	Are the health and safety inspections at worksites documented? If yes, provide examples of forms and completed inspection reports.	Yes	No	N/A
4.3	Is there a procedure by which hazards are reported by employees and followed up? If yes, provide copy of procedure or similar evidence.	Yes	No	N/A
	Other Comments:			
5	Health and Safety Consultation			
5.1	Are employees consulted on OHS matters including amenities? If yes, provide details and samples (toolbox meetings, team briefings, meeting schedules and consultation procedures.	Yes	No	N/A
5.2	For larger companies: Is there a workplace health and safety committee?	Yes	No	N/A

 Contractor

 Witness 1

 Witness 2

 Employer

 Witness 1

 Witness 2

	If yes, provide a copy of meeting agenda/minutes.			
5.3	For larger companies: Are there elected OHS representatives? If yes, how often does refresher training occur?	Yes	No	N/A
	Other Comments :			
6	OHS Performance			
6.1	Has the company ever been convicted of any occupational health and safety or environmental offences in the last five years, or have any proceedings underway or pending? If yes, provide details.	Yes	No	N/A
6.2	Has the company had any government or environmental inspector notices issued in the last 12 months? E.g. prohibition or prohibition notices? If yes, provide details.	Yes	No	N/A
6.3	For larger companies: Is there a system for recording and analysing health and safety performance statistics? If yes, provide details and samples (e.g. performance reports, performance statistics over the last 12 months)	Yes	No	N/A

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

	Other Comments:			
7	References			
Most Recent Contracts:		Contract 1	Contract 2	
Contract Description				
Client				
Contact				
Phone Number				

8	Insurances: Please provide copy of certificate of Currency				
Insurance	Insurer/Not Applicable	Policy Name	Policy Number	Expiry Date	Coverage
Workers Compensation					
Public Liability					
Professional					
Professional Indemnity					
Other					

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

9	Certificates/Licenses/Industry Training: Please provide copies or samples				
	Licence/Certificate	Licensee	License no.	Expiry Date	Notes

NB. After the contractor has met all the requirements of this specification and the relevant legislative requirements a permit to set site shall be issued by the SHEQ Department.

Prepared By	Signature:	Date:
Reviewed By	Signature:	Date:
Reviewed By	Signature:	Date:
Reviewed By	Signature:	Date:
Approved By	Signature:	Date:

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 Contractor

 Witness 1

 Witness 2

 Employer

 Witness 1

 Witness 2

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Vaal Central Water

SHEQ Department

051 4030800

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

AREA:		BASELINE HAZARD IDENTIFICATION AND RISK ASSESSMENT	
COMPILED BY :	Labijs Mmusi		
DATE OF ASSESSMENT :	18 September 2024		
SCOPE OF WORK :			
REVIEW DATE :	(a) Every 6 months; (b) after reportable incidents; or (c) change in scope of work		

Probability Index	5	Almost certain to inevitable	Severity Index - Injury/ Disease (I)	5	Fatal	Severity Index - Production (P)	5	No production	Severity Index - Environment (E)	5	Permanent effects	Severity Index - Cost (C)	5	> R 500,000	Frequency Index	5	Hazard permanently present
	4	Probable		4	Permanent to slight disability		4	Loss of ≥ 1 month's production		4	Long term ≥ 2 years		4	R 100,000 – R 499,999		4	Weekly occurrence
	3	Improbable		3	≥ 14 days with complete recovery		3	Loss of ≥ 1 week's production		3	Medium term : 6 – 12 months		3	R 10,000 – R 99,999		3	Monthly occurrence
	2	Less than even chance		2	Medical attention: ≤ 14 days with complete recovery		2	Loss of ≥ 1 day's production		2	Short term : < 6 months		2	R 1,000 – R 9,999		2	Annual occurrence
	1	Highly improbable		1	First aid only		1	Loss of ≥ 1 man shift		1	Insignificant effect		1	R 0 – R 999		1	Every 5 years
	0	Not probable		0	Near miss		0	No loss time		0	No aspect or impact		0	No cost involved		0	No hazard exists

PROBERBILITY + HIGHEST SEVERITY INDEX + FREQUENCY = RISK VALUE (P + S + F = RV)	Risk Classification	Risk Value	Action to be taken / Controls	Priority of Action
	Very High Risk	10 and above	Training, SWP, Detailed Action Plan	Immediate
	High Risk	7 - 9	Training, SWP, Detailed Action Plan	Within 1 week
	Medium Risk	5 - 6	Training, SWP, Registers	Within 1 Month
	Low Risk	3 - 4	Training	Within 6 Months
	Tolerable Risk	1 - 2	Tolerate and monitor	As reasonably practicable

Item	Task/ General Activities/ Equipment	Hazards Identification (Conditions complimenting the total effect without mitigating)	Associated Risk Related to Hazards (The total effect without mitigation)	Legal Reference	Probability Index	Severity Index				Frequency Index	Risk Score	Risk Value	Controls to be Implemented to Eliminate/ Reduce/ Control Risks/ Hazards	Mark applicability on site (✓)
						I	P	E	C		P + S + F = RV			
1.	Designs	Inadequate/unsafe designs	- Fatalities - Property Damage - Reputational Harm	Construction Regulation 5 & 6 OHSACT Section 8 & 37	4	5	5	0	5	5	14	14	- A Design of contract to be awarded to an appointed Designer by the Client- Vaal Central) (Bloemfontein). - Designers to be either an qualified Architect or a registered and appointed Engineer. - Health and Safety Specifications to be provided to the designer. - Designer to take Health and Safety into consideration when designing.	✓
		Contractor incompetent in interpreting designs			4	5	5	0	5	5	14	14	Contractor to be evaluated prior to awarding the tender. Contractor to be appointed in terms of CR 5(1)(k) of Construction Regulations 2014 and in terms of Section 37(2) of the OHS Act 85 of 1993.	✓
2.	Procurement	Inadequate provision made for Health and Safety	- Fatality - Injuries - Property Damage - Reputational Harm	Construction Regulation 5 OHS Act Sect 16	4	5	5	0	5	5	14	14	- Provision has to be made for Health and Safety in the tender documents. - When a prospective contractor tenders for the project, his tender submission is to be evaluated to ensure that he has made provision for adequate Health and Safety resources. - The project specification is to be taken into account when preparing a tender submission.	✓
		Incompetent employees appointed in statutory positions	- Fatality - Injuries - Property Damage - Reputational Harm	Construction Regulation 5 OHS Act Sect 16	4	5	5	0	5	5	14	14	- All prospective employees that will be appointed in statutory positions must be evaluated by the prospective contractor as part of their selection process. - The CV's and qualifications of these employees are to be submitted as part of the OHS File to the Clients Representative to evaluate and approve.	✓

Item	Task/ General Activities/ Equipment	Hazards Identification (Conditions complimenting the total effect without mitigating)	Associated Risk Related to Hazards (The total effect without mitigation)	Legal Reference	Probability Index	Severity Index				Frequency Index	Risk Score	Risk Value	Controls to be Implemented to Eliminate/ Reduce/ Control Risks/ Hazards	Mark applicability on site (✓)
						I	P	E	C		P + S + F = RV			
		Inadequate/ Unsafe plant, materials and equipment procured	Delays in the project		4	5	5	0	5	5	14	14	- All plant, material and equipment schedules to be included into the OHS File when submitting to the Agent for review and approval. - Maintenance records/ service history of plant to be evaluated. - It will be the sole responsibility of the Contractor to ensure that they procure the correct resources for the project e.g. the correct lifting machines that could handle the load of the pipes without overriding Safety systems.	✓
3.	Site Access	Unauthorized access granted to contractor	Civil Unrest Property Damage Reputational Harm	OHS Act Section 8	4	4	3	0	3	3	11	11	- Client to grant access in writing to the contractor. - Public Participation and consultation meetings to be held with the community informing them about the intended works.	✓
4.	Site Establishment	Poor planning	Injury Property Damage Civil Unrest Reputational Harm	GSR GAR OHS Act Section 8 CR 5 & 7									- A Client to grant access in writing to the contractor. - Public participation and consultation meetings to be held with the community informing them about the intended works. - Activity to be planned properly and instructions to be given to a delegated person nominated by the Contractor and the Client's Representative.	✓
		Poor Communication		OHS Act Client Spec									- Formal communication to be evident between the contractor and the Client. . .	✓
		Damaging existing services e.g. sewerage	Property Damage	OHS Act Client Spec									- Where possible existing service provider to be used to ensure knowledge of existing services. If not, an alternative service provider to be used and to be monitored. - All existing services to be identified prior to any activity commencing in the HIRAC process and to be communicated to employees involved in the task.	✓
		Clearing & grubbing	Damage to services and electrocution.	OHS Act 8/ CR 5									Land owner to provide permission in the form of lease agreement prior to clear the site	✓
		Digging holes to plant fencing posts.	Exposure to flying debris	OHS Act 8/ CR 5									Employees to wear full required PPE while working continually.	✓
5.	Transporting employees and equipment.	- Personnel falling from vehicles - Personnel/public/ animals being struck by or run by vehicles - Vehicles overturning and/or colliding - People/Animals and other vehicles being struck by something falling from vehicles - Wet/Slippery and bad road conditions (Gravel Roads) - Overloading	- Vehicle accident - Fatalities and injuries - Property and asset damage	National Road Traffic Act, Act 93 of 1996 & Regulations	4	5	5	0	5	5	14	14	- Vehicle to be inspected every time before coming onto site. - Pre use inspection to be done. - Vehicle to be fitted with an amber and reverse alarm.	✓
		Incompetent driver	- Vehicle accident - Fatalities and injuries - Property and asset damage	National Road Traffic Act, Act 93 of 1996 & Regulations	4	2	3	0	2	5	12	12	- Driver to be licensed, authorized and appointed. - Induction to be done.	✓
		Vehicle not roadworthy	- Vehicle accident - Fatalities and injuries - Property and asset damage	National Road Traffic Act, Act 93 of 1996 & Regulations	4	2	3	0	2	5	12	12	- Vehicle to be inspected every time before coming onto site. - Pre use inspection to be done. Vehicle to be fitted with amber light and reverse alarm.	✓
		Material/equipment/containers not secured properly	Property and asset damage		4	2	1	0	1	3	10	10	- Material/equipment to be properly secured. No "satan" type levers. - Load to be inspected before coming onto site.	✓
6.	Excavating on public roads including densely populated areas	- Personnel/public being run over by vehicles - Personnel/Public/ animals and /or vehicles falling into the excavations - Weight of equipment too close to the edge of a trench. - Unstable ground	Fatalities and injuries	OHS Act, Act 85 of 1993 & Regulations	4	5	5	0	5	5	14	14		✓
7.	Excavating and trenching using machinery, plant and tools.	- Walls collapsing /unstable ground - Ingress of water	- Fatalities and injuries - Drowning	OHS Act, Act 85 of 1993 & Regulations	4	5	5	0	5	5	14	14	- Design, develop and Implement an Excavation and Trenching Standard Operating Procedure and include Excavation and Trenching in Densely Populated areas and also include sloping. - Use only maintained equipment fitted with yellow flashing lights and reversing alarms. - Maintain a safe distance from working plant.	✓

Item	Task/ General Activities/ Equipment	Hazards Identification (Conditions complimenting the total effect without mitigating)	Associated Risk Related to Hazards (The total effect without mitigation)	Legal Reference	Probability Index	Severity Index				Frequency Index	Risk Score	Risk Value	Controls to be Implemented to Eliminate/ Reduce/ Control Risks/ Hazards	Mark applicability on site (✓)
						I	P	E	C		P + S + F = RV			
													- Wear appropriate PPE including high visibility clothing and hard hat etc. - Perimeter fencing where appropriate Place trained personnel on look-out. - Competent person appointed as an Excavation Supervisor.	
8.	Breaking hard rocks using a jack hammer.	- Dust - Exposure to noise - Prolonged exposure to vibration - Revolving parts - Flying objects	- Related Respiratory illnesses - Noise Induced Hearing Loss - Accumulate Trauma Disorder - Body injuries - Eye injuries	OHS Act, Act 85 of 1993 & Regulations	4	4	3	0	3	3	11	11	- Wear proper PPE: Eye protection, steel-toed boots, hearing protection and safety gloves - Rotate workers whenever possible, when jack-hammering for extended periods of time - Inspect the jackhammer and associated equipment for defect or damage - Design and develop Safe Work Procedures.	✓
9.	Use of ladders to access/egress the trench	- Tripping and falling - Slippery conditions - Unsafe distance positioning of ladders	Fatality, Multiple body injuries	OHS Act, Act 85 of 1993 & Regulations	4	5	4	0	4	5	14	14	Design, develop and implement the Use of Ladders Standard Operating Procedure.	✓
10.	Use of hand tools i.e. picks, shovels and rakes	- Head of a tool flying off and striking the user or nearby employees - Mushroomed heads shattering on impact flying towards the user or other employees.	Fatality, Multiple body injuries	OHS Act, Act 85 of 1993 & Regulations	4	5	4	0	4	5	14	14	- Make and take time before you pick up a tool and begin working to think about the requirements of the job. - Select tools designed for the intended and specific use purpose. - Assess your work space to determine which tool will work efficiently and safely in that space. - Design, develop and implement Safe Work Procedures.	✓
	Mixing and pouring of concrete to anchor fencing posts.	Exposure to concrete splash	Skin irritation and eye infection	OHS Act 8	4	4	3	0	4	5	11	11	Proper PPE must be worn when pouring concrete to prevent skin irritation.	✓
11.	Off-loading from the delivery trucks, laying and removal of pipes from the trenches	- Pipes moving or falling off the trucks when tampered with - Slings can slip or break - Improper slinging	Fatality, Multiple body injuries	National Road Traffic Act, Act 93 of 1996 & Regulations	4	5	4	0	4	5	14	14	- Correct manual handling - Use mechanical aids where possible - Apply appropriate signage and pedestrian control. - Maintain control of loads when lifting and moving - Carry pipes close to the ground while moving.	✓
12.	Tipping, back-filling and blanketing	- Dust - Vibration from compacting - Noise - Personnel engulfment	- Related Respiratory illnesses - Accumulative Trauma Disorder - Noise Induced Hearing Loss - Fatality, Multiple body injuries and or fractures	OHS Act, Act 85 of 1993 & Regulations	4	5	5	0	4	5	14	14	Engineering revision of the processes and equipment used to be conducted.	✓
13.	Impact with overhead and underground	- Overhead and under-ground power cables - Under-ground water and sewer pipes services	- Electrocution / explosion - Pipe breaking / drowning - Fatality	OHS Act, Act 85 of 1993 & Regulations OHS Act, Act 85 of 1993 & Regulation	4	5	5	0	4	5	14	14	- Determine location of underground and overhead service. - If underground and overhead services are located in the vicinity, exercise extreme care while excavating. - Consider any restriction on kinds of tools and equipment that maybe required. - Consult with Local Authority. - Locate and keep clear of overhead services (3m up to 132Kv. If distances cannot be maintained, plant operator and observer shall be trained and assessed as competent.	✓
14.	Manual Handling	Improper lifting	- Back injuries - Body strains	OHS Act, Act 85 of 1993 & Regulations	4	2	3	0	2	5	12	12	- Manual handling awareness - Adequate rest periods allowed, job rotation, minimize repetitious twisting and shoveling	✓
15.	Grinding and cutting	- Electrical - Heat, Flames, Fire - Sparks - Noise - Disintegration of grinding stones	- Electrocution /shock - Burns - Respiratory illnesses - Eye injuries - Fire - Noise Induced Hearing Loss	OHS Act, Act 85 of 1993 & Regulations	4	2	1	0	1	3	10	10	- Design, develop and Implement a Control Plan for Grinding and cutting that will include Silica Dust Control. - Design, develop and Implement a Safe Work Procedure.	✓
16.	Working in difficult conditions	- Extreme hot - Extreme cold - Rainy Conditions - Extended hours	- Heat stress - Cold stress - Slippery conditions, trench collapsing & ingress of water inside the trench - Fatigue, stress &	OHS Act, Act 85 of 1993 & Regulations	4	1	1	0	1	3	8	8	- Supply adequate drinking water in the work area. - Provide protection from UV rays - PPE	✓

Item	Task/ General Activities/ Equipment	Hazards Identification (Conditions complimenting the total effect without mitigating)	Associated Risk Related to Hazards (The total effect without mitigation)	Legal Reference	Probability Index	Severity Index				Frequency Index	Risk Score	Risk Value	Controls to be Implemented to Eliminate/ Reduce/ Control Risks/ Hazards	Mark applicability on site (✓)
						I	P	E	C		P + S + F = RV			
			- Anxiety - Dehydration and dizziness											
17.	Stacking/storage of materials in a densely populated area and storage of tools	- Public safety - Inadequate access and egress	Injuries or fatality to employees and/or a member of the public (members)	OHS Act, Act 85 of 1993 & Regulations	4	5	4	2	4	3	12	12	- Provide secure stockpile area for pipes and fittings. - Unload and stack pipes strictly in accordance with the manufactures' recommendations. - Provide the appropriate fencing and/or barricades as per the site risk assessment. - Apply appropriate signage and pedestrian control. - Design, develop and implement a Standard Working Procedure and Safe Work Procedure.	✓
18.	Working in a confined space	- Limited ventilation - Restricted movement - Toxic atmosphere - Excessive Heat	- Fatality - Injuries - Suffocation and/or fatality - Heat stress	OHS Act, Act 85 of 1993 & Regulations	4	5	4	0	4	5	13	13	- A trained person to identify and evaluate all the existing potential hazards - Evaluate activities both outside and inside the confined space. - Air to be tested from outside before entry. - A Working in the Confined Space Permit design developed and implemented. - Safe Work Procedure for working in a confined space designed, developed and implemented.	✓
19.	General activities	- Incorrect use of Personal Protective Equipment (PPE). - In adequate training, consultation, planning and improvisation	- Personal injuries - Occupational diseases	OHS Act, Act 85 of 1993 & Regulations	3	2	2	0	3	3	8	8	- All personnel onsite to be appropriately inducted. - Competent supervision to be provided on site.	✓
20.	Storage and use of flammable liquids	Spillage of flammable liquids	- Environmental pollution - Fire and explosions - Property damage	OHS Act, Act 85 of 1993 & Regulations, NEMA	4	0	3	2	5	5	12	12	- The primary safeguard to prevent the release of flammable liquids is provided by the container. It is therefore critical to ensure that it is of appropriate design for the duty. The materials of construction should be compatible with the chemical and physical properties of the flammable liquid to ensure that no interaction occurs which might cause leakage. All the container openings should be equipped with a secure and well-fitting cap or lid to resist the escape of flammable liquid or vapours, including if the container falls or rolls over. - Individual containers must be clearly marked to indicate their contents and the degree of flammability. - Material Data Safety Sheets (MSDS) to be obtained and filed accordingly and awareness training conducted.	✓
21.	Access to site and trenches	Delivery and other vehicles Improper storing and stacking of materials Sakes and insect bites	- Personnel/public/ animals being struck by or run by vehicles - Injuries and /or fatality to employees - Snakes and insects bites	OHS Act, Act 85 of 1993 & Regulations	3	2	2	0	3	3	8	8	- Conduct site inspection to ensure access/egress is adequate for the task activities. - Keeping safe distance from edge of trench. - No load to be placed or moved near the edge of trench where it likely to cause collapse of the trench. - All trenches to have safety barricades when left open for a period of time. - Provide submersible pump to dewater trenches where ground is water-charged. - No personnel movement across the trench.	✓
22.	Pressure testing	Failure of pipe fitting under excessive pressure Failure to identify if the installation is under a pressure test	Fatality/ major injuries	CR13	4	5	5	0	4	5	14	14	- When testing with compressed air, never exceed a maximum pressure above 50 kPa - Provision for a pressure gauge, stop valve and bleed valve is compulsory	✓
23.	Sub-structure: Trestle Piers	Exposure to flying debris while cleaning. Exposure to corrosion debris	- Eye injuries - Skin irritation	OHS Act 8 CR 5	4	5	5	0	4	5	14	14	Full PPE must be worn while cleaning concrete surfaces	✓
24.	Environment	Poor housekeeping, spillages, not using toilet facilities on site	- Can lead to environmental pollution and contamination and animal poisoning. - Urinating on site		4	0	3	2	5	5	12	12	- Waste containers to be put on site for any domestic waste. - Ref to waste management plan for disposal. Toilets to be put on site and clearly identified for people on site. - No urinating on site, make use of toilet on site.	✓

No.	Name of Risk Assessors and Risk Assessment Team	Signatures	Date of Risk Assessment Approval	Comments by Risk Assessor and Risk Assessment Team
1.	Labius Mmusi		2024/09/18	
2.	Samson Madonsela		2024/09/18	

VAAL CENTRAL WATER

CONTRACT NO. BW283/ARWWTW/22

**REFURBISHMENT OF THE NYAKALLONG (ALLANRIDGE) WWTW:
CIVIL, MECHANICAL AND ELECTRICAL, CONTROL & INSTRUMENTATION**

PART C4: SITE INFORMATION

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

SITE INFORMATION

DESCRIPTION OF SITE AND ACCESS

Allanridge/Nyakallong is a small gold mining town situated approximately 36km north of Welkom in the Free State. The town falls under the Matjhabeng Local Municipality, which forms part of the Lejweleputswa District Municipality.

The Nyakallong (Allanridge) WWTW is situated on the northern border of Nyakallong, with the exact coordinates of 27°46'7.82"S and 26°39'46.88"E. Access to the WWTW can be gained through Nyakallong via gravel roads.

The works receives sewage from Allanridge and Nyakallong through several raw wastewater pump stations and discharges the treated effluent into the Voëlpan. The site reflects what is typically expected from an existing treatment works, comprising various structures, interconnecting pipework, and electrical and mechanical equipment.

The geotechnical investigation report (Annexure B) provides insight into the subsurface conditions of the site. In general, the upper soil horizon comprises of transported material (potentially collapsible in nature) which is underlain by residual mudstone that grades to very soft rock mudstone at depth. Both horizons have undergone calcretization to varying degrees ranging from honeycomb to hardpan calcrete.

The laboratory test results show that materials encountered on site show poor engineering characteristics and are therefore deemed unsuitable for use as structural fill or layerworks.

END OF SECTION

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

VAAL CENTRAL WATER

CONTRACT NO. BW283/ARWWTW/22

**REFURBISHMENT OF THE NYAKALLONG (ALLANRIDGE) WWTW:
CIVIL, MECHANICAL AND ELECTRICAL, CONTROL & INSTRUMENTATION**

ANNEXURE A:

TENDER DRAWINGS

(Issued separately – Refer to Volume 3)

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

VAAL CENTRAL WATER

CONTRACT NO. BW283/ARWWTW/22

**REFURBISHMENT OF THE NYAKALLONG (ALLANRIDGE) WWTW:
CIVIL, MECHANICAL AND ELECTRICAL, CONTROL & INSTRUMENTATION**

ANNEXURE B:

GEOTECHNICAL INVESTIGATION REPORT

Contractor

Witness 1

Witness 2

Employer

Witness 1

Witness 2

NYAKALLONG WWTW

Geotechnical Investigation Report

Report No: 9687/19633

PREPARED FOR:

ixengineers
Infrastructure Excellence

Contact Details:

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TITLE: **NYAKALLONG WWTW
GEOTECHNICAL INVESTIGATION REPORT**

CLIENT: **iX Engineers**
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Transmittal Note to Client:
Please return signed copy of
this page to ARQ.

Signature:_____

Name:_____

Date:_____

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DATE: 4 March 2024

REFERENCE NUMBER: 9687/19633

PROJECT TEAM: Yokazi Mkalali
Engineering Geologist

Brendon Blok
Geotechnical Engineer

Coert van Dyk PrEng
Geotechnical Engineer



Rev No	Date	Created/ Revised by	Approved by	Remarks
00	04 March 2024	Y. Mkalali/B. Blok	C. van Dyk	Final Report

EXECUTIVE SUMMARY

ARQ (Pty) Ltd was appointed by iX Engineers on behalf of their Client, Bloem Water, to conduct a level geotechnical investigation for the proposed upgrades of the Nyakallong WWTW in Allenridge, Free State.

The aim of the investigation was to assess the geotechnical conditions on site, identify geotechnical risks and problem soils if present, and allow for the development of appropriate founding solutions for the proposed infrastructure and recommendations on the suitability of in-situ material for use as fill and general layerworks.

The investigation comprised the excavation and profiling of nine (9) test pits on the 18th and 19th January 2024, in accordance with SAICE's Site Investigation Code of Practise (SICOP, 2010). Representative material samples were collected and submitted for testing at a SANAS accredited soil laboratory in Pretoria.

The material profile on site is generally characterised by transported material underlain by residual soils that have developed from the weathering of the mudstone bedrock. Both horizons have undergone calcretization to varying degrees ranging from honeycomb to hardpan calcrete

A geotechnical evaluation of the site conditions is provided in Section 3. The foundation recommendations presented in Section 3.5 have been refined for the geotechnical conditions encountered on site. It is recommended that structures are founded on spread or strip footings at an allowable bearing pressure of 200kPa on the medium dense to dense / stiff to very stiff honeycomb calcrete. The new chlorine disinfection tank, assuming plan dimensions of 4m x 10m, can be founded on a raft with an allowable bearing pressure of 50kPa..

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LIST OF ABBREVIATIONS AND ACRONYMS

ARQ	ARQ Geotech (Pty) Ltd
BEL	Bulk Earthwork Level
CBR	California Bearing Ratio
COTO	Committee Of Transport Officials
DCP	Dynamic Cone Penetrometer
GIR	Geotechnical Investigation Report
HR	Hard Rock
MHR	Medium Hard Rock
NGL	Natural Ground Level
OMC	Optimum Moisture Content
SR	Soft Rock
TP	Test Pit
VSR	Very Soft Rock

1. INTRODUCTION

1.1. TERMS OF REFERENCE

ARQ was appointed by iX Engineers, acting on behalf of their client Bloem Water, to conduct a geotechnical investigation for proposed upgrades to the existing Nyakallong Waste Water Treatment Works (WWTW) near Allanridge, Free State.

The Client indicated that the upgrades would include, but not limited to, concrete water retaining structures, valve chambers, typical single storey buildings and general site works on a ± 4.0 Ha site. The site is currently an operational WWTW.

1.2. PURPOSE AND SCOPE

The aim of the investigation is to assess the overall geotechnical conditions on site, allowing insight into appropriate founding solutions for the proposed structures and establishing the availability and quality of construction materials on the site.

ARQ's investigation aims to provide information on the following geotechnical aspects as requested by the Client:

- Geotechnical conditions of site,
- Engineering properties and classification of excavated material,
- Potential problem soils,
- Soil corrosivity,
- Excavatability of material,
- Groundwater level (if encountered),
- Suitability of in-situ material for use in general fill, bulk earthworks and layer works,
- Basic recommendations on temporary cut slope stability (if required), and
- Founding recommendations, including bearing capacity and settlement.

2. FACTUAL INFORMATION

2.1. SITE DESCRIPTION

a) Location

The site is located in Nyakallong near Allanridge which is ± 35 km north of Welkom, Free State. The approximate coordinates of the site are $27^{\circ}46'7.82''\text{S}$ and $26^{\circ}39'46.88''\text{E}$. Refer to Figure 2-1 for a locality plan as seen in Google Earth™.

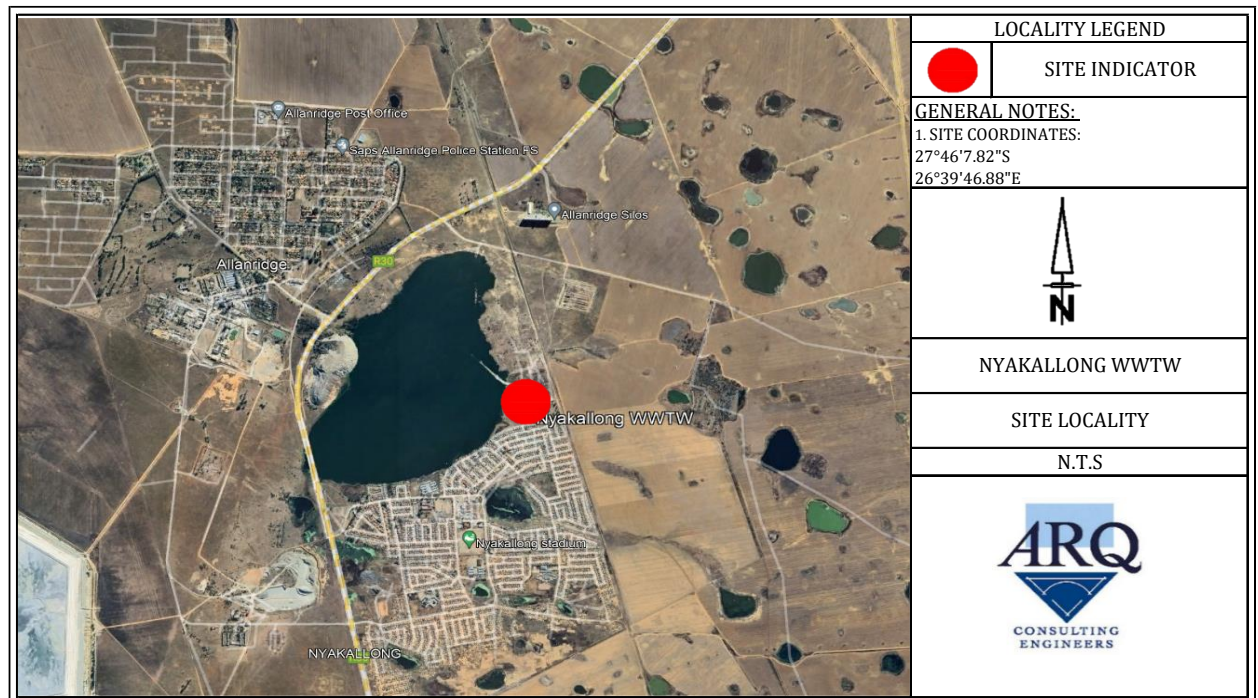


Figure 2-1: Locality plan as seen in Google Earth™.

b) Current land use and known services.

The site is currently an operational waste water treatment works (WWTW) managed by Bloem Water.

The layout of underground services was not available at the time of the investigation which necessitated the use of Ground Penetrating Radar (GPR) for service detection. The GPR services were provided by the Client to clear investigation test positions.

c) Climate

According to Climate-Data.org (2024) the average annual temperature in Allanridge is 18°C and the rainfall is 584 mm per annum, mostly concentrated in January to December with the driest month being July.

Climatic conditions are indicative of the rate and type of weathering present. According to the Weinert N-value (1980), which is used to determine the type of weathering likely to occur in an area based on climatic conditions (evaporation and rainfall), mechanical weathering is likely to occur in locations where $N > 5$, while chemical weathering occurs in regions where $N < 5$.

The site is in a dry region where $N > 5$ as shown in Figure 2-2. The weathering mechanisms on site are thus expected to be predominantly mechanical weathering but this can be influenced by localised topographic, hydrological, and geological conditions.

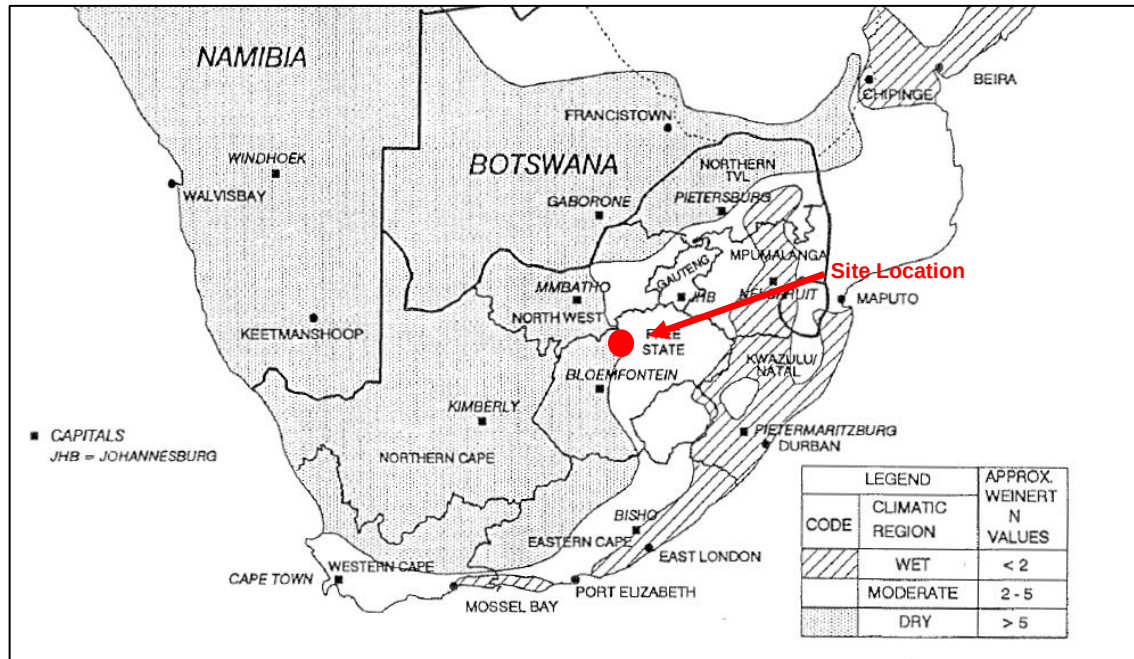


Figure 2-2: Weinert N-value map of South Africa (TRH 4, 1996).

2.2. REGIONAL GEOLOGY

The 1:250 000 geological map 2726 KROONSTAD was overlain on Google Earth™ to determine the expected geology of the site. The geological map shows the site is situated on the border of two stratigraphic units namely, aeolian sand (**Qs**) from the Quaternary Era, and mudstone, siltstone, and shale (**Pvo**) of the Volkrust formation, Eccca Group, Karoo Supergroup. Refer to Figure 2-3 for the geology overlay as seen in Google Earth™.

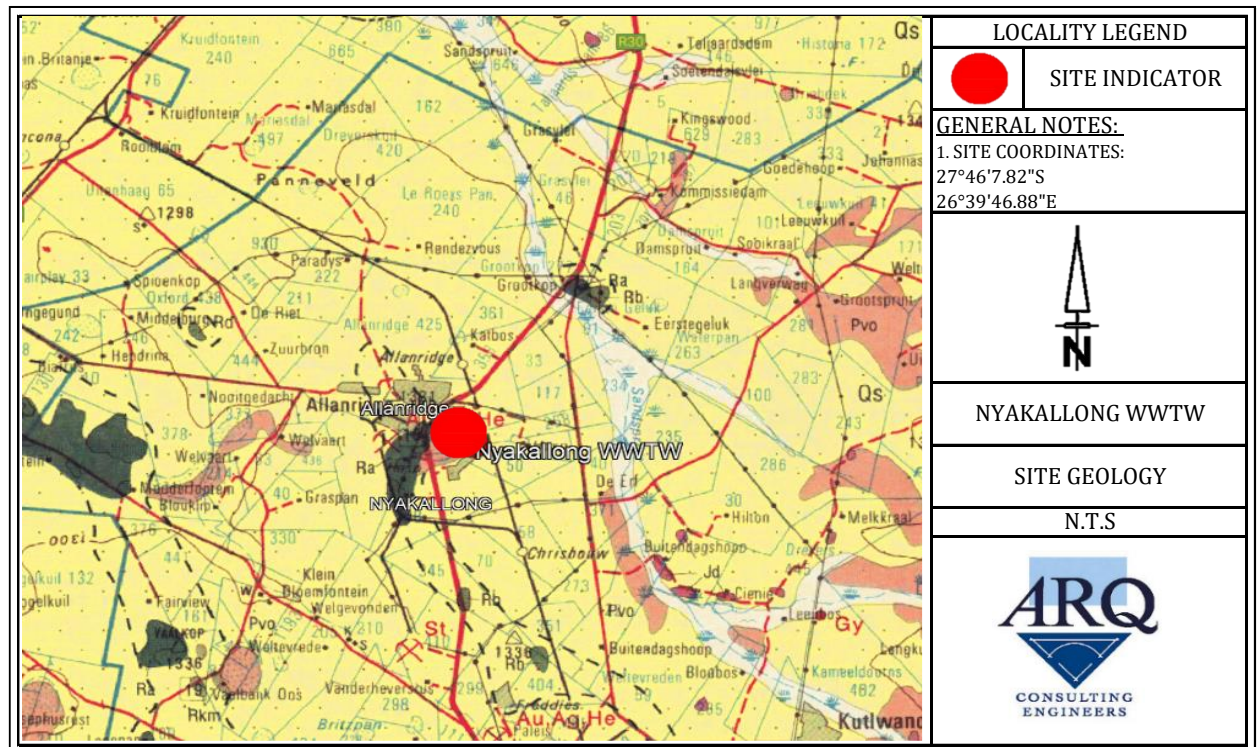


Figure 2-3: Underlying geology as seen in Google Earth™.

2.3. ENGINEERING GEOLOGY

The term mudrock is used to include all sedimentary rocks which are composed predominantly of silt-sized or smaller particles. In practice, stratigraphy and laminations present within the rock should be used to distinguish between shale and mudrock, i.e. shale is laminated and mudrock is massive.

a) Rocks

The engineering geology of the Karoo mudrock is documented by Brink in Volume 3 of his Engineering Geology of Southern Africa series.

Brink (1983) states that one of the more troublesome properties of the Karoo mudrocks is their tendency to break down rapidly after exposure. Karoo mudrock has the tendency to either break down into smaller rock fragments or into clay and silt sized particles.

Karoo mudrock is mainly used as subbase with a stabiliser, in selected layer and in compacted fill. However, mudrock is believed to be not suitable in rockfill and as concrete aggregate. Lime is generally considered to be the most suitable chemical agent for stabilizing mudrock and it is used extensively for stabilizing subbase material in National roads and Natal road work.

b) Soils

According to Brink (1983), residual soils derived from the weathering of Karoo mudrocks frequently contain active clay minerals of the smectite group. The potential expansiveness generally falls into the medium and occasionally high expansive category of the Van der Merwe expansiveness chart.

In consideration of the site being classified as a dry zone ($N > 5$) and anticipating mechanical weathering as the primary weathering mechanism, it is expected that shallow soils will be encountered on the site. Brink also indicates that the expected pedocetes are most likely to be calcretes.

2.4. DESCRIPTION OF INVESTIGATION

The geotechnical investigation was planned and conducted according to the Client's requirements and SAICE'S Site Investigation Code of Practice (SICOP, 2010).

2.4.1. NEAR SURFACE INVESTIGATION

The near surface investigation comprised the excavation of nine (9) test pits at predetermined locations (where access would allow) over the development area as per the requirements stipulated above. The test pits were excavated on the 18th and 19th January 2024 using a hired CAT 320CL (30 ton) excavator with a 1.0m wide bucket.

The test pits were excavated to the maximum reach of the excavator (5m below surface) or until effective refusal conditions were encountered. The test pits were profiled in-situ by an engineering geologist in accordance with current standards (Brink and Bruin, 2002). All the test positions were recorded using a hand-held GPS (± 5 m accuracy).

The location of the test positions, as overlain in Google Earth™ satellite imagery, are presented in Figure 2-4. The coordinates of the test pits are provided in Table 2-1 below.



Figure 2-4: Test pit position layout as seen in Google Earth™.

Table 2-1: Coordinates of test pit positions

Test Position	Latitude	Longitude
TP01	26° 8'49.19"S	28°20'48.04"E
TP02	26° 8'47.91"S	28°20'49.21"E
TP03	26° 8'46.56"S	28°20'50.35"E
TP04	26° 8'45.43"S	28°20'51.40"E
TP05	26° 8'44.49"S	28°20'52.19"E
TP06	26° 8'47.91"S	28°20'49.21"E
TP07	26° 8'46.56"S	28°20'50.35"E
TP08	26° 8'45.43"S	28°20'51.40"E
TP09	26° 8'44.49"S	28°20'52.19"E

Dynamic Cone Penetrometer (DCP) tests were initially planned to be conducted at each test pit position, either adjacent to the test pit position or at the bottom of the test pit excavation.

However, the DCP malfunctioned on site and therefore no DCPs were successfully conducted. The Client is requested to advise whether these results are required at this stage (in which case ARQ will discuss arrangements with the Client), or whether DCPs can be conducted by others at a later stage (e.g. during construction). Laboratory test results

Representative soil samples were collected during the investigation and the following laboratory tests were performed at an independent SANAS-accredited soil laboratory.

- Foundation indicators (Sieve analysis, Hydrometer and Atterberg limits),
- Moisture-density relationship (Mod. AASHTO),
- California Bearing Ratio (CBR), and
- pH and Conductivity.

A summary of the test results is presented in Table 2-2. The detailed laboratory test results are included in **Appendix C**. Further interpretation of the results is contained in Section 3 of this report.

Table 2-2: Summary of general laboratory test results

Sample No.	TP03	TP05	TP07	TP08
Depth (m)	0.9-1.8	1.50-2.10	0.0-1.0	1.0-1.7
Material Origin	Pedogenic	Hardpan Calcrete	Transported	Pedogenic
Material Description	Clayey Sand	-	Silty Sand	Sandy Clay
Liquid Limit	22	41	NP	28
Plasticity Index	4	15	NP	5
Linear shrinkage	2	5	0	2.5
Grading modulus	0.61	0.67	0.67	0.59
Clay %	17	35	11	39
Silt %	10	16	6	9
Sand %	72	39	83	48
Gravel %	1	10	0	4
Heave Classification	Low	Low	Low	Low
AASHTO Classification	A-4	A-7-6	A-2-4	A-4
USC Classification	ML	ML	SM	ML
pH values	8.12	8.11	8.16	8.56
Electrical Conductivity (S/m)	0.0076	0.0087	0.0087	0.0076
Corrosivity	Generally not	Generally not	Generally not	Generally not
Optimum moisture content (%)	13.8	11.8	8.2	7.9
Max Dry Density (kg/m ³)	1754	1914	1913	1957
CBR @ 100% Mod AASHTO (%)	7	3	46	20
CBR @ 98% Mod AASHTO (%)	6	2	31	14
CBR @ 95% Mod AASHTO (%)	5	2	17	8
CBR @ 93% Mod AASHTO (%)	4	2	12	6
Max swell @ 100% Mod AASHTO (%)	1	1	0.7	0.7
TRH Classification	G10	*NC	G8	G10
Classification (COTO)	*NC	*NC	*NC	*NC

*NC = non-classifiable according to COTO, (2020), i.e., the material quality is worse than G9 quality

3. INTERPRETIVE INFORMATION

3.1. SITE STRATIGRAPHY

The material profile encountered on site confirms that the site is underlain (at depth) by mudstone and residual soils that have developed from the weathering of the mudstone bedrock associated with the Volkrust formation, Eccca Group.

3.1.1. MATERIAL PROFILE

In general, the upper soil horizon comprises of a transported material which may be described as silty sand with a pinholed structure and loose consistency.

A pedogenic horizon was encountered across the site underlying the transported material and may be subdivided into two material types namely (1) dense clayey sand interpreted as transported material that underwent calcretization, and (2) stiff to very stiff sandy clay interpreted as residual mudstone that underwent calcretization. Each material is calcretized to varying degrees (honeycomb to hardpan), with abundant calcrete nodules in a moderately to well cemented matrix. Locally, the pedogenic horizon exists as soft to medium hard rock, hardpan calcrete.

The pedogenic horizon is underlain by the residual mudstone described as firm sandy clay which grades to very soft rock mudstone at depth.

Shallow refusal was encountered in test pits, TP03 to TP07, on soft to medium hard rock hardpan calcrete at depths of between 2.0m and 3.1m below current ground level. Refusal conditions were not encountered within the very soft rock mudstone.

A summary of the test pit profiles is presented graphically in Figure 3-1. The detailed test pit profiles are included in **Appendix A** and the test pit photographs are presented in **Appendix B**.

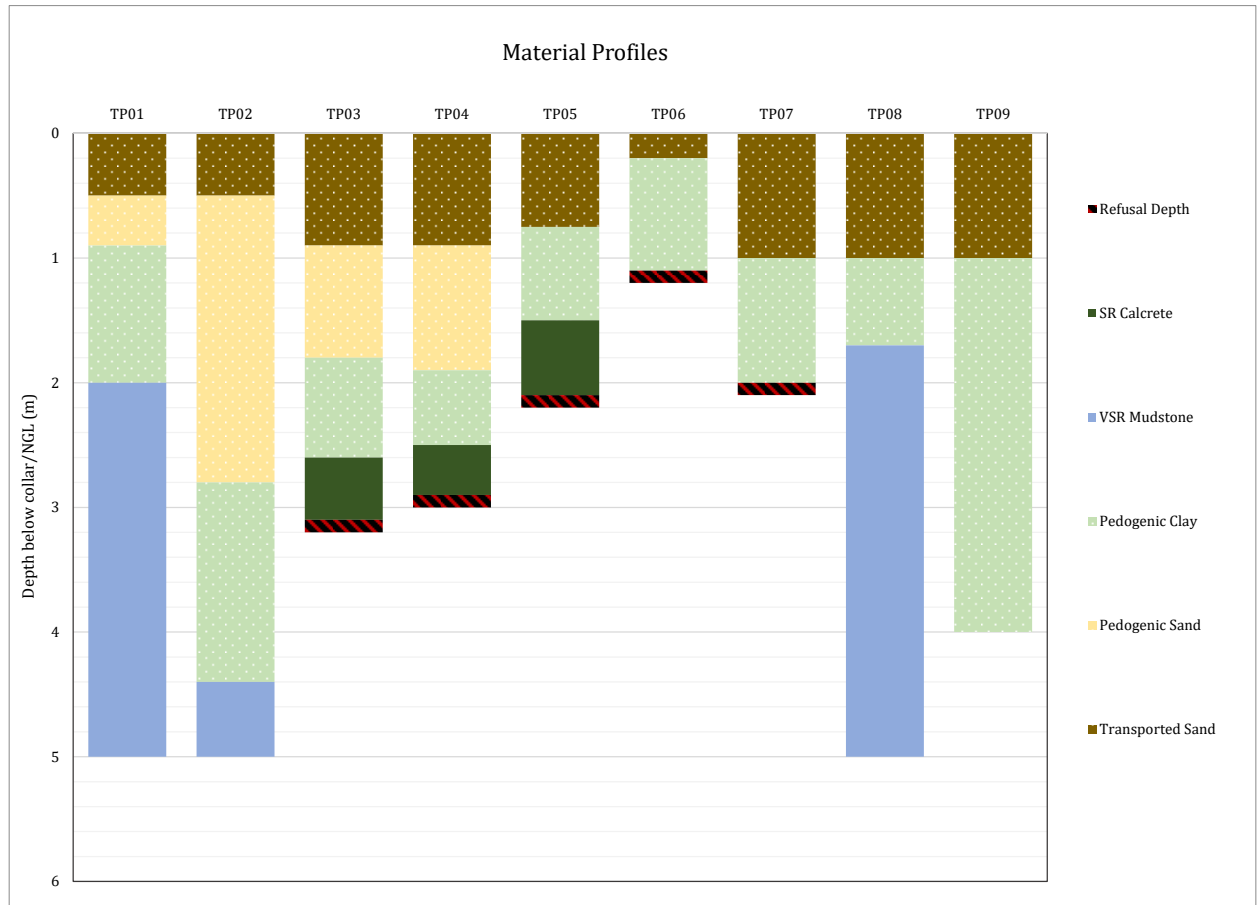


Figure 3-1: Graphic representation of the test pit profiles.

3.2. MATERIAL USAGE

a) Transported Material

The transported stratum is granular in nature (silty sand) generally classifying as SM according to Unified Soil Classification (USCS). The tested fill material shows a low plasticity index, low strength properties classifying as sub-G9 material according to COTO (2020), i.e. the material quality is worse than G9 due to poor grading modulus which is less than the required 0.75. This material is not recommended for re-use in any structural or engineered fill. It can however be used for non-structural purposes.

b) Pedogenic Material

The pedogenic material is cohesive and classifies as ML, according to Unified Soil Classification (USCS). Even though the material shows a low expansiveness rating, the

material possesses low strength properties which have led to the material being non-classifiable according to COTO (2020), i.e. the material quality is worse than G9. Therefore, the material is not recommended for use as structural fill or engineered fill. It can however be used for non-structural purposes.

c) Mudstone Material

As with most fine-grained sedimentary rocks, mudstone is prone to rapid weathering once excavated and exposed to moisture and the atmosphere. Therefore, both the residual and excavated very soft rock material encountered on site is expected to classify as a cohesive material ML/CL, according to Unified Soil Classification (USCS). Both materials are expected to show low plasticity index, poor density when compacted, low CBR strengths and are non-classifiable according to COTO (2020), i.e. the material quality is worse than G9. The mudstone material is not suitable for use in structural fill or engineered fill. It can however be used for non-structural purposes.

Note: Limited material usage testing was conducted during the investigation. Further site-specific testing is required to verify material usage prior to construction.

3.3. IDENTIFICATION OF GEOTECHNICAL CONSTRAINTS

a) Expansive soils

Expansive or active soils are defined as soils in which a variation in moisture content results in significant or detrimental volumetric changes.

The material encountered on site presents no visible signs of an expansive structure such as slickensides and fissures. This is further confirmed by the laboratory testing, which classified these materials as having a “low” expansiveness rating and is therefore not expected to be problematic in this regard.

b) Collapse Potential

Collapse settlement occurs under constant total stress triggered by an increase in the moisture content within the soil volume. This may either be due to surface water infiltration or re-establishment of the groundwater table. The increased moisture content dissolves inter-grain cementation and lubricates the soil skeleton reducing shear strength. The grains fall into a denser state of packing, and this may lead to sudden foundation settlement of significant magnitude.

Collapse settlement is irreversible and occurs on first wetting after application of load (including self-weight in the case of fills). The magnitude of the settlement is dependent on the degree of voiding/pinholing in the soil structure and the extent to which particle re-arrangement occurs.

The transported material encountered on site showed slight visible signs of collapse structure in places in the form of pinholes. Meaningful voids or visible porosity were not observed on site.

This potential for collapsible fabric should be carefully considered and as such the proposed founding recommendations outlined in Section 3.4 aims to mitigate the risk.

c) Groundwater and seepage

A definitive groundwater table was not encountered within the maximum depth of excavation, 5.0m below current ground level.

Given the presence of shallow pedogenic material and very soft rock mudstone, it is likely that a perched and seasonally fluctuating water table may form during periods of intense or prolonged rainfall. Therefore, depending on the season during construction, appropriate measure for water redirection or dewatering may be required to keep excavations dry and safe.

d) Corrosivity of soils

The laboratory test results show that the tested material is “generally not corrosive” according to CSIR (1997).

e) Excavation stability

Notwithstanding any other requirements in the Construction Regulations (2014), the Contractor may not require or permit any person to work in or near an excavation/trench which has not been adequately shored/stabilised, unless the side slopes of the excavation have been cut back to a safe batter slope angle. The following batter slopes are recommended provided the excavation depth is limited to 3.0m:

Temporary slopes: an average batter of 1:1 (vertical:horizontal) is recommended.

Permanent slopes: an average batter of 1:1.5 (vertical:horizontal) is recommended for dry slopes and 1:2 (vertical:horizontal) wet slopes.

Rock slopes: an average batter of 2:1 (vertical:horizontal) is recommended for temporary slopes provided that kinematic/structurally controlled failures do not govern that a flatter slope should be employed.

Should excavations be required steeper than the batter slopes recommended, then (a) the Contractor is required to appoint a competent person for the inspection and certification of trench walls/excavations, which shall be declared safe in writing before any person may enter, or (b) bracing/shoring/lateral support of adequate strength shall be designed and installed to ensure trench wall stability.

If uncertainty relating to stability exists, the contractor should source the services of a suitably qualified and experienced geotechnical engineer or engineering geologist to undertake an inspection or stability analysis as may be required.

f) Excavatability

Excavations conditions in South African construction works are routinely specified in terms of SABS 1200 D. This document defines three primary excavation categories, namely, “soft”, “intermediate” and “hard” excavation as well as two classes of boulder excavation.

Each of the primary excavation categories are classified/determined based on in-situ material response to excavation efforts imparted by various excavation techniques/machines. As the test pits excavated in the geotechnical investigation were

excavated making use of the 30 Ton Excavator, classification according to efficient excavation (restricted excavation) based on kW engine power per mm of tined-bucket width is deemed most representative and used as the basis for determination (see SABS 1200D 3.1.2(a),2 and (b),2).

According to SABS 1200D, and making specific reference the excavation means referenced above, the distinction between “soft” and “intermediate” excavation occurs at the point where a bucket powered by 0.1kW per mm of tined bucket width can no longer efficiently excavate in-situ material, and either pneumatic tools or a more powerful machine is required. The excavator used for this investigation possesses approximately 103kW of engine power and was equipped with a tined bucket of approximately 1000mm width (i.e. 0.103 kW/mm). This implies that the excavation ability is fairly close to that of the benchmark used as distinction between “soft” and “intermediate” excavation classes and will be used as such for the purposes of this evaluation. Therefore, materials efficiently excavated by the excavator in the investigation are taken to be soft, while materials in which excavation was inefficient or on which refusal conditions were reached is taken to be “intermediate” or “hard”. It will be appreciated that the means of investigation employed here terminates in “intermediate” conditions and thus a distinction between “intermediate” and “hard” excavation is not possible.

Refusal, i.e. intermediate to hard excavation, was encountered in five (5) of the nine (9) excavated test pits refusing on soft to medium hard rock hardpan calcrete at between 2.0m and 3.1m below current ground level.

Soft excavation conditions are expected above the test pit refusal depths. Should earthworks levels intersect refusal level, then an allowance of an excavation class other than soft should be made.

When considering specific or localised areas of the site, the reader is requested to refer to test pits in the specific areas of interest to gain insight into the excavation conditions with depth. Given the limited investigation points, conditions at variance with those identified above should not be overlooked.

3.4. BASIC DESIGN RECOMMENDATIONS

Considering the nature of the proposed development and the geotechnical conditions encountered, the following basic design recommendations are specified below.

3.4.1. FOUNDATION RECOMMENDATIONS

The upper soil horizon (transported), described as loose sands, is potentially compressible & collapsible in nature and is deemed unsuitable as a founding horizon.

a) Lightly loaded structures

Structural loads can be placed via spread and strip footings on the underlying medium dense to dense / stiff to very stiff honeycomb calcrete (clayey sand/sandy clay). The founding horizon occurs at depths of between 0.5m and 1.3m below current ground level, average 0.9m. Strip footings of up to 1.0m width and pad footings of up to 2.0m maximum dimension, may be loaded to an allowable bearing capacity of 200kPa. Differential

settlement can be taken as 50% of total. Settlement under this load is estimated to be between 10mm and 15mm. The footing soffit must be founded at least 0.5m deep below final platform level and the base of the foundation excavation must be ripped and recompacted to 93% Mod AASHTO density prior to placement of the concrete.

The allowable bearing pressures have been provided on the premise that both strip and pad footings will not exceed the maximum dimensions specified.

b) Special structures (Tanks)

Liquid containing tanks/reservoirs have a large foundation depth of influence due to their large loaded area (in plan). These structures therefore require a separate foundation evaluation and recommendations. As no loading details have been provided at this stage, we have estimated a foundation load for a 4m high water retaining structure. We have assumed a 50kPa load will be distributed by a suitably designed raft/plinth tank foundation.

The new chlorine disinfection tank (10m x 4m plan dimension) may be founded on the underlying medium dense / firm residual mudstone / calcrete, approximately 1.0m below current ground level, at an allowable bearing pressure of 50kPa. Settlement under this load will be between 15mm and 20mm. Differential settlement can be taken as 50% of total.

It is recommended that the proposed foundations be inspected by a geotechnical engineer with site knowledge in order to confirm adequate capacity or otherwise provide alternative recommendations.

3.4.2. SURFACE BEDS, ROADS AND PARKING AREAS

The following points are made regarding the surface beds, access roads and parking areas:

- Once the cut and fill operations are conducted, the upper 300mm should be ripped and recompacted to 93% Mod AASHTO density at 0 to +2% of OMC.
- The in-situ material is expected to reach CBR values of between 2% to 12% when compacted to 93% Mod AASHTO density. The pavements/surface beds (layerworks and surfacing) should be designed accordingly.

In areas where the collapsible upper transported material (i.e. pinholed material) is exposed at final platform/roadbed level i.e. underlying the proposed slabs, roads, and parking layerworks. The required degree of compaction is as follows:

- 90% Mod AASHTO from 0m to 0.35m below final bulk earthworks/roadbed level, and
- 85% Mod AASHTO from 0.35m to 0.70m below final bulk earthworks/roadbed level.

The material should be compacted at a moisture content above optimum moisture content. The densification of the collapsible material can be achieved as follows:

1. In-situ densification via surface rolling. It is envisaged that high energy impact rolling will be required to compact to the required depths. Verification of the effectiveness of the soil improvement technique can be conducted through large-scale trials in sections of the site prior to implementation.
OR

2. Removal and compaction. Remove the collapsible material to the required depth (700mm) and then reintroduce the same material in compacted layers.

4. CONCLUSION

The geotechnical investigation report provides insight into the subsurface conditions of the site. In general, the upper soil horizon comprises of transported material (potentially collapsible in nature) which is underlain by residual mudstone that grades to very soft rock mudstone at depth. Both horizons have undergone calcretization to varying degrees ranging from honeycomb to hardpan calcrete.

The laboratory test results show that materials encountered on site show poor engineering characteristics and are therefore deemed unsuitable for use as structural fill or layerworks.

It is recommended that structures are found on spread or strip footings at an allowable bearing pressure of 200kPa on the medium dense to dense / stiff to very stiff honeycomb calcrete. The new chlorine disinfection tank, assuming plan dimensions of 4m x 10m, can be founded on a raft with an allowable bearing pressure of 50kPa.

ARQ's recommendations are based on a limited number of data points collected during the investigation. Therefore, the occurrence of conditions at variance with those presented here should not be overlooked.

5. REFERENCES

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APPENDIX A

TEST PIT PROFILES

Scale
1:25



0.00

LOOSE, SILTY SAND

Slightly moist to moist, orange brown, loose, pinholed, silty SAND.
Transported.

Notes:

- With abundant grass and plant roots.

0.50

DENSE, CLAYEY SAND

Slightly moist to moist, orange brown, dense, clayey SAND.
Honeycomb calcrete.

Notes:

- With abundant poorly to well developed calcretions of gravel to cobble size in moderately to well cemented matrix (transported).

0.90

STIFF TO VERY STIFF, SANDY CLAY / CLAYEY SAND

Slightly moist, greenish grey mottled white, stiff to very stiff, intact, sandy CLAY / clayey SAND.
Honeycomb calcrete.

Notes:

- With abundant poorly to well developed calcretions of gravel and cobble size in matrix of moderately to well cemented sandy clay (residual mudstone).

2.00

VERY SOFT ROCK, MUDSTONE

Greenish grey, highly weathered, fine grained, highly fractured, very soft rock, MUDSTONE.

4.50

NOTES

- 1) Unstable Sides: No
- 2) Refusal: No
- 3) Water Table: None

CONTRACTOR :
MACHINE : CAT 320CL Excavator
DRILLED BY :
PROFILED BY : Yokazi Mkalali

TYPESET BY : Yolandie Verster
SETUP FILE : ARQ-STD.SET

INCLINATION : Vertical

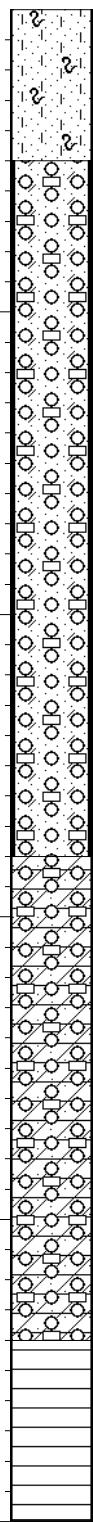
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DATE :
DATE : 2024-01-18

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ELEVATION :
Latitude : 27°46'6.81"S
Longitude : 26°39'48.56"E

HOLE No: TP01
Nyakallong WWTW

Scale
1:25



LOOSE, SILTY SAND

Slightly moist to moist, orange brown, loose, pinholed, silty SAND.
Transported.

Notes:

- With abundant grass and plant roots.

DENSE, CLAYEY SAND

Slightly moist to moist, orange brown, dense, intact, clayey SAND.
Honeycomb calcrete.

Notes:

- With abundant poorly developed calcretions of gravel to cobble size in moderately to well cemented matrix (transported).

STIFF, SANDY CLAY

Slightly moist to moist, greenish and orange brown mottled white, stiff, intact, sandy CLAY.
Honeycomb calcrete.

Notes:

- With abundant poorly to moderately developed calcretions of gravel to cobble size in well to moderately cemented sandy clay (residual mudstone).

VERY SOFT ROCK, MUDSTONE

Greenish grey, highly to completely weathered, fine grained, highly fractured, very soft rock, MUDSTONE.

NOTES

- 1) Unstable Sides: No
- 2) Refusal: No
- 3) Water Table: None

CONTRACTOR :
MACHINE : CAT 320CL Excavator
DRILLED BY :
PROFIED BY : Yokazi Mkalali

TYPESET BY : Yolandie Verster
SETUP FILE : ARQ-STD.SET

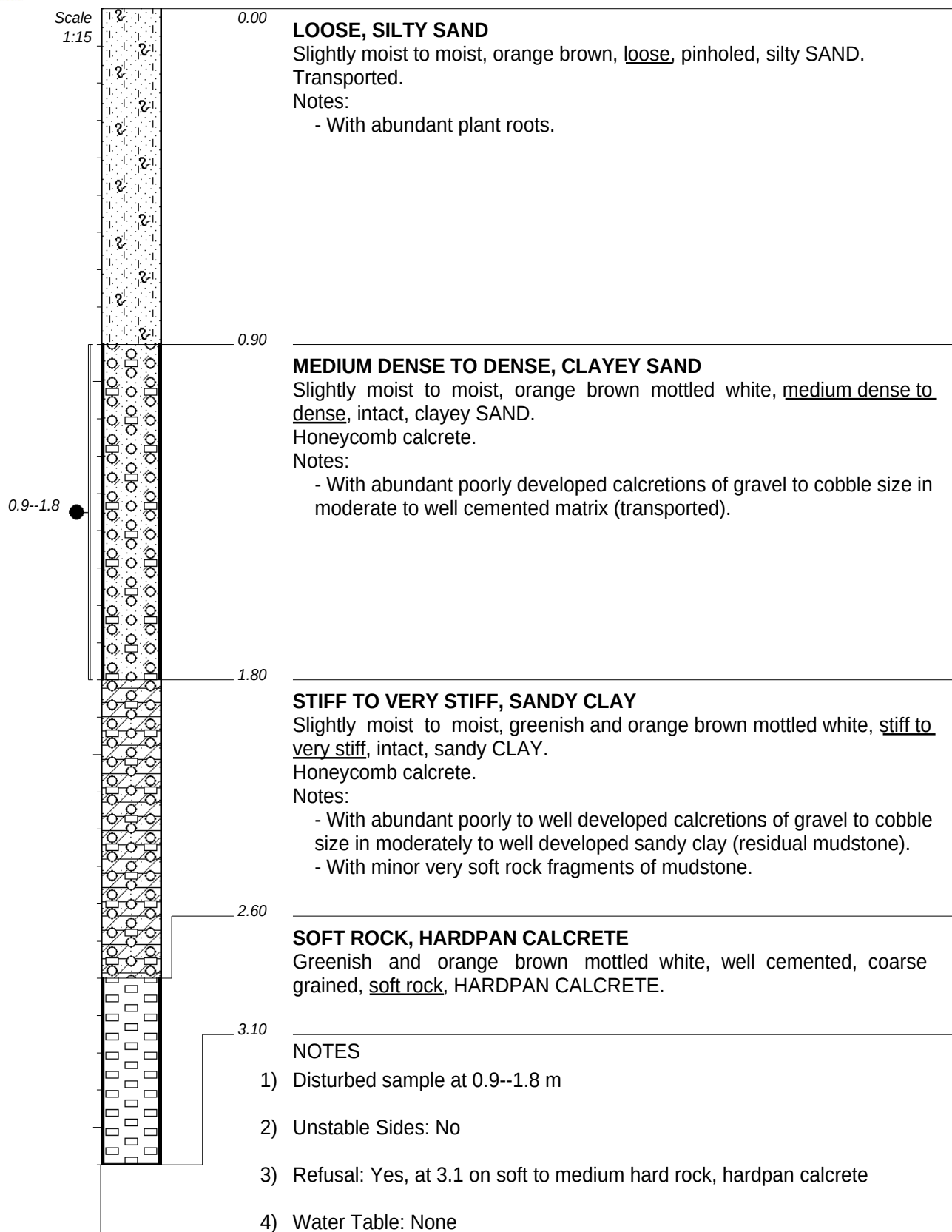
INCLINATION : Vertical

DIAM :
DATE :
DATE : 2024-01-18

DATE : 22/02/2024 10:55
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ELEVATION :
Latitude : 27°46'7.29"S
Longitude : 26°39'46.14"E

HOLE No: TP02
Nyakallong WWTW



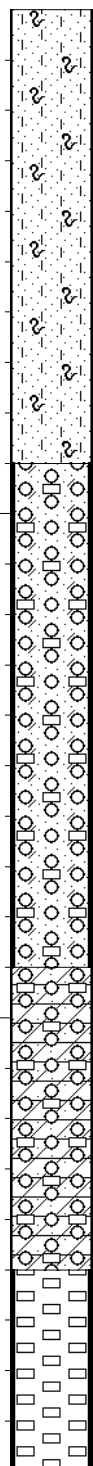
CONTRACTOR :
MACHINE : CAT 320CL Excavator
DRILLED BY :
PROFIED BY : Yokazi Mkalali
TYPESET BY : Yolandie Verster
SETUP FILE : ARQ-STD.SET

INCLINATION : Vertical
DIAM :
DATE :
DATE : 2024-01-18
DATE : 22/02/2024 10:55
TEXT : ..rofiles\9687TestPits.TXT

ELEVATION :
Latitude : 27°46'8.42"S
Longitude : 26°39'46.66"E

HOLE No: TP03
Nyakallong WWTW

Scale
1:15



0.00

LOOSE, SILTY SAND

Slightly moist to moist, brown, loose, pinholed, silty SAND.
Transported.

Notes:

- With minor grass roots.

0.90

MEDIUM DENSE TO DENSE, CLAYEY SAND

Slightly moist to moist, orange brown mottled white, medium dense to dense, intact, clayey SAND.
Honeycomb calcrete.

Notes:

- With abundant poorly developed calcretions of gravel to cobble size in moderate to well cemented matrix (transported).

1.90

STIFF TO VERY STIFF, SANDY CLAY

Slightly moist to moist, greenish and orange brown mottled white, stiff to very stiff, intact, sandy CLAY.
Honeycomb calcrete.

Notes:

- With abundant poorly to well developed calcretions of gravel to cobble size in moderated to well developed sandy clay (residual mudstone).
- With minor very soft rock fragments of mudstone.

2.50

SOFT ROCK, HARDPAN CALCRETE

Green and orange brown mottled white, well cemented, coarse grained, soft rock, HARDPAN CALCRETE.

2.90

NOTES

- 1) Unstable Sides: No
- 2) Refusal: Yes, at 2.9 on soft to medium hard rock, hardpan calcrete
- 3) Water Table: None

CONTRACTOR :
MACHINE : CAT 320CL Excavator
DRILLED BY :
PROFIED BY : Yokazi Mkalali

TYPESET BY : Yolandie Verster
SETUP FILE : ARQ-STD.SET

INCLINATION : Vertical

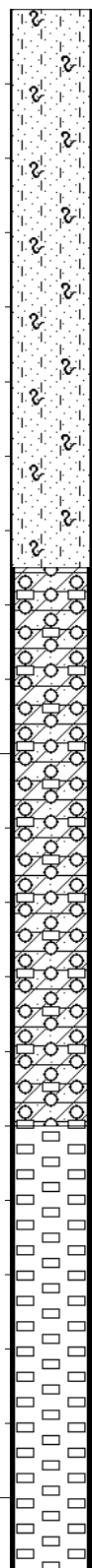
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DATE :
DATE : 2024-01-18

DATE : 22/02/2024 10:55
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ELEVATION :
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Longitude : 26°39'46.48"E

HOLE No: TP04
Nyakallong WWTW

Scale
1:10



0.00

LOOSE, SILTY SAND

Slightly moist to moist, brown, loose, pinholed, silty SAND.
Transported.

Notes:

- With abundant plant and grass roots.

0.75

STIFF TO VERY STIFF, SANDY CLAY

Slightly moist to moist, greenish brown mottled white, stiff to very stiff, intact, sandy CLAY.

Honeycomb calcrete.

Notes:

- With abundant poorly to well developed calcretions of gravel to cobble size in moderately to well cemented sandy (residual mudstone).
- With minor very soft rock fragments of mudstone.

1.50

SOFT ROCK, HARDPAN CALCRETE

Greenish and orange brown mottled white, well cemented, coarse grained, soft rock, HARDPAN CALCRETE.

2.10

NOTES

- 1) Unstable Sides: No
- 2) Refusal: Yes, at 2.1 on soft to medium hard rock, hardpan calcrete
- 3) Water Table: None

CONTRACTOR :
MACHINE : CAT 320CL Excavator
DRILLED BY :
PROFIED BY : Yokazi Mkalali

TYPESSET BY : Yolandie Verster
SETUP FILE : ARQ-STD.SET

INCLINATION : Vertical

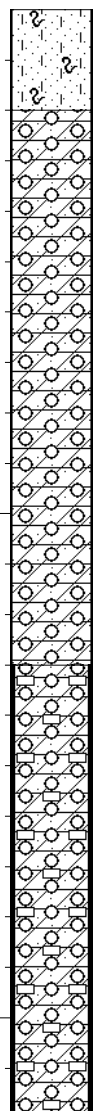
DIAM :
DATE :
DATE : 2024-01-18

DATE : 22/02/2024 10:55
TEXT : ..rofiles\9687TestPits.TXT

ELEVATION :
Latitude : 27°46'10.98"S
Longitude : 26°39'46.95"E

HOLE No: TP05
Nyakallong WWTW

Scale
1:15



0.00

LOOSE, SILTY SAND

Slightly moist to moist, dark brown, loose, pinholed, silty SAND.
Transported.

Notes:

- With abundant grass roots.

0.20

FIRM, SANDY CLAY

Slightly moist to moist, greenish brown mottled orange and grey, firm, intact, sandy CLAY.
Residual mudstone.

Notes:

- With abundant poorly developed calcretions of gravel to cobble size.

1.30

VERY STIFF, SANDY CLAY

Slightly moist to moist, greenish grey mottled white, very stiff, intact, sandy CLAY.

Honeycomb calcrete.

Notes:

- With abundant poorly to well developed calcretions of gravel to cobble size in moderately to well cemented sandy clay (residual mudstone).
- With abundant very soft rock, mudstone fragments.

2.20

NOTES

- 1) Unstable Sides: No
- 2) Refusal: Yes, at 2.2 on soft rock, hardpan calcrete
- 3) Water Table: None

CONTRACTOR :
MACHINE : CAT 320CL Excavator
DRILLED BY :
PROFIED BY : Yokazi Mkalali

TYPESET BY : Yolandie Verster
SETUP FILE : ARQ-STD.SET

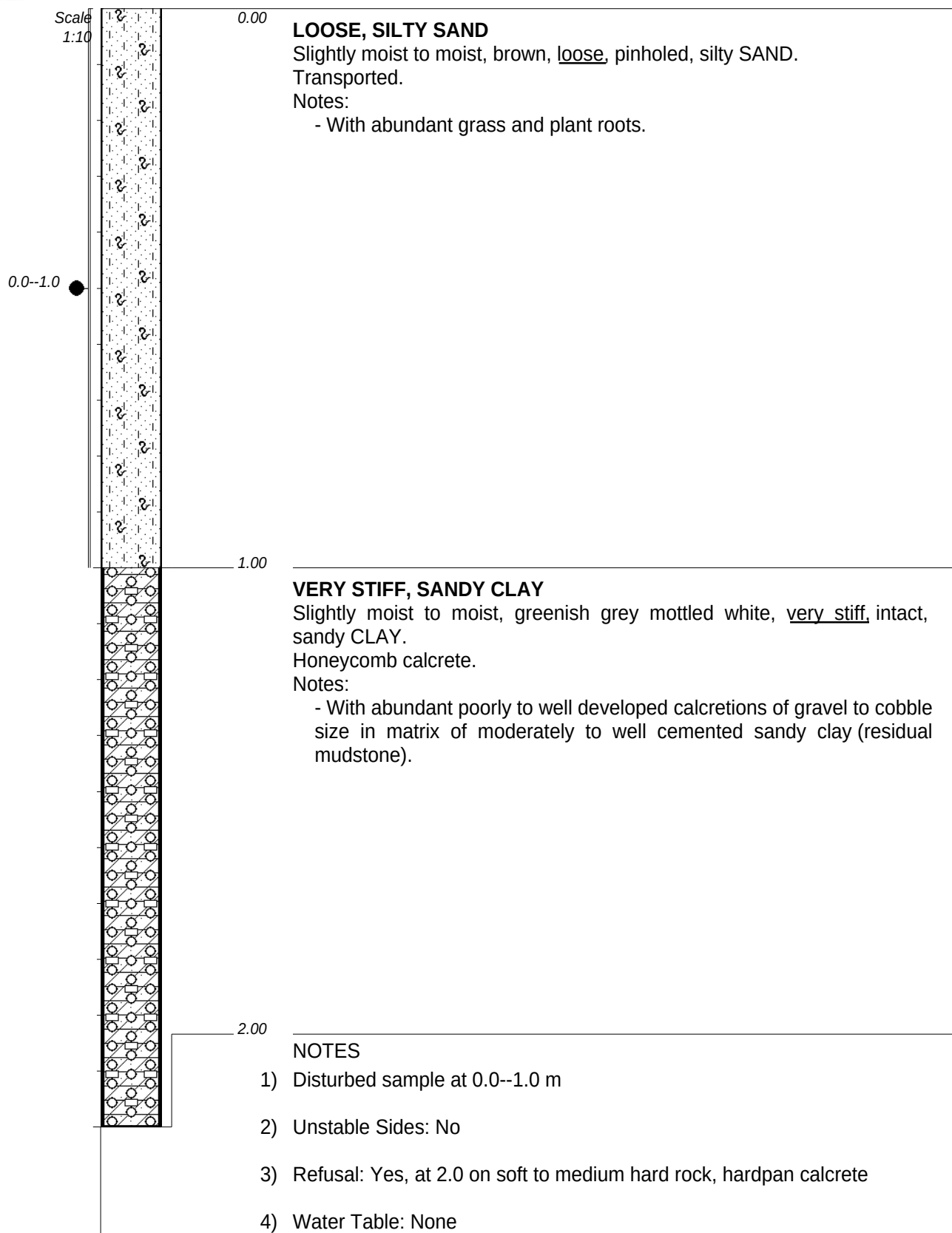
INCLINATION : Vertical

DIAM :
DATE :
DATE : 2024-01-19

DATE : 22/02/2024 10:55
TEXT : ..rofiles\9687TestPits.TXT

ELEVATION :
Latitude : 27°46'10.46"S
Longitude : 26°39'47.60"E

HOLE No: TP06
Nyakallong WWTW

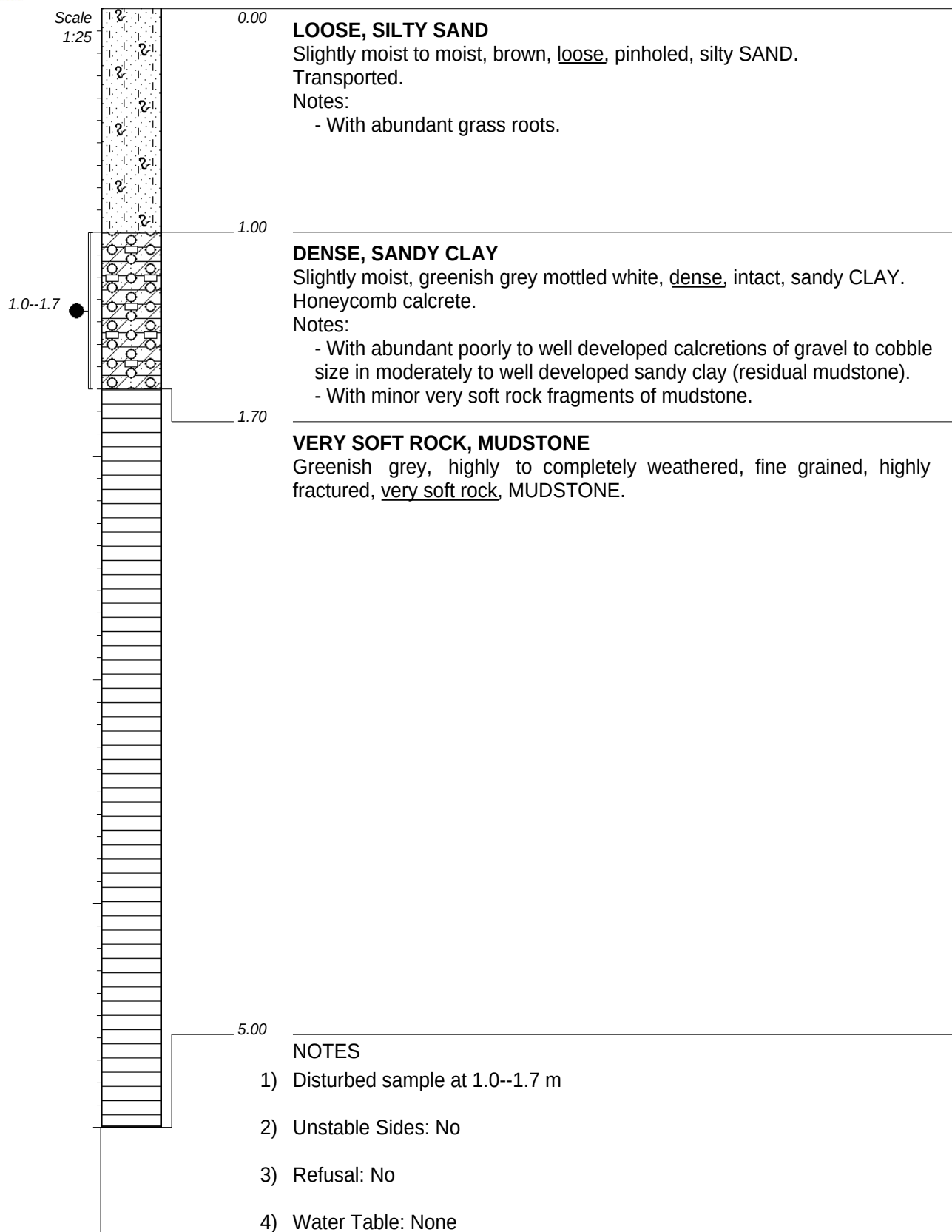


CONTRACTOR :
MACHINE : CAT 320CL Excavator
DRILLED BY :
PROFIED BY : Yokazi Mkalali
TYPESET BY : Yolandie Verster
SETUP FILE : ARQ-STD.SET

INCLINATION : Vertical
DIAM :
DATE :
DATE : 2024-01-18
DATE : 22/02/2024 10:55
TEXT : ..rofiles\9687TestPits.TXT

ELEVATION :
Latitude : 27°46'9.32"S
Longitude : 26°39'49.61"E

HOLE No: TP07
Nyakallong WWTW



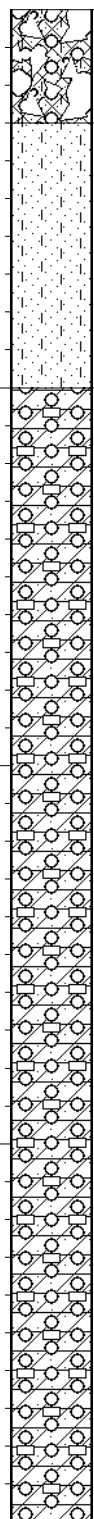
CONTRACTOR :
MACHINE : CAT 320CL Excavator
DRILLED BY :
PROFILED BY : Yokazi Mkalali
TYPESET BY : Yolandie Verster
SETUP FILE : ARQ-STD.SET

INCLINATION : Vertical
DIAM :
DATE :
DATE : 2024-01-18
DATE : 22/02/2024 10:55
TEXT : ..rofiles\9687TestPits.TXT

ELEVATION :
Latitude : 27°46'8.15"S
Longitude : 26°39'48.69"E

HOLE No: TP08
Nyakallong WWTW

Scale
1:20



0.00

MEDIUM DENSE, SILTY SAND WITH GRAVEL AND COBBLES

Slightly moist, dark brown, medium dense, intact, silty SAND with gravel and cobbles.

Fill.

Notes:

- With abundant grass roots and minor rubble.

0.30

LOOSE TO MEDIUM DENSE, SILTY SAND

Slightly moist to moist, brown, loose to medium dense, pinholed, silty SAND.

Transported.

1.00

VERY STIFF, SANDY CLAY

Slightly moist to moist, greenish to orange brown mottled white, very stiff, intact, sandy CLAY.

Honeycomb calcrete.

Notes:

- With abundant poorly to well developed calcretions of gravel to cobble size in moderately to well developed sandy clay (residual mudstone).
- With minor very soft rock fragments of mudstone.

4.00

NOTES

- 1) Unstable Sides: No
- 2) Refusal: No, near refusal, with increased difficulty to excavate from 3.8 m
- 3) Water Table: None

CONTRACTOR :
MACHINE : CAT 320CL Excavator
DRILLED BY :
PROFILED BY : Yokazi Mkalali

TYPESET BY : Yolandie Verster
SETUP FILE : ARQ-STD.SET

INCLINATION : Vertical

DIAM :
DATE :
DATE : 2024-01-19

DATE : 22/02/2024 10:55
TEXT : ..rofiles\9687TestPits.TXT

ELEVATION :
Latitude : 27°46'9.36"S
Longitude : 26°39'41.50"E

HOLE No: TP09
Nyakallong WWTW

	GRAVEL	{SA02}
	SAND	{SA04}
	SANDY	{SA05}
	SILTY	{SA07}
	CLAY	{SA08}
	CLAYEY	{SA09}
	MUDSTONE	{SA12}
	HARDPAN CALCRETE	{SA26}{SA29}
	HONEYCOMB CALCRETE	{SA27}
	WELL CEMENTED	{SA29}
	RUBBLE	{SA31}
	FILL	{SA32}
	ROOTS	{SA40}
	DISTURBED SAMPLE	{SA38}
	COBBLES	{SA58}

Name ●

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFIED BY :

TYPESET BY : Yolandie Verster
SETUP FILE : ARQ-STD.SET

INCLINATION :
DIAM :
DATE :
DATE :

DATE : 22/02/2024 10:55
TEXT : ..rofiles\9687TestPits.TXT

ELEVATION :
Latitude :
Longitude :

LEGEND
SUMMARY OF SYMBOLS

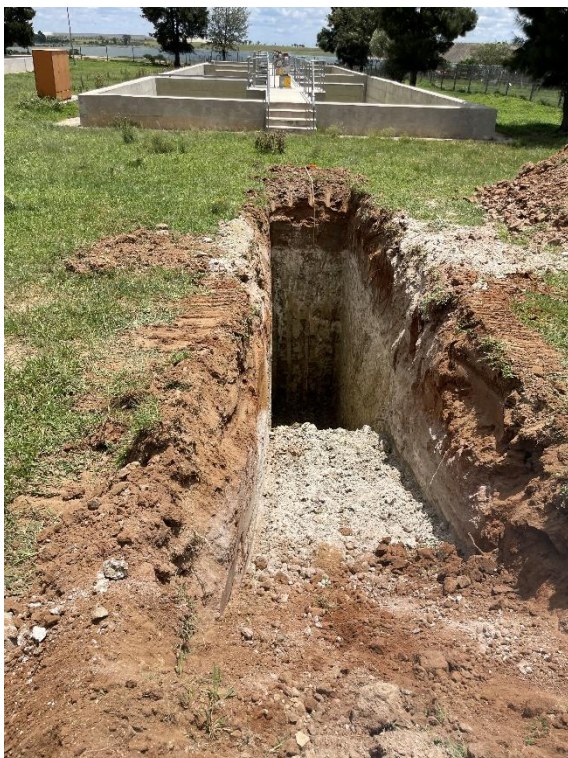
APPENDIX B

TEST PIT PHOTOS

PROJECT: NYAKALLONG WWTW
PROJECT NO.: 9687
CLIENT: iX ENGINEERS (PTY) LTD



SITE: NYAKALLONG WWTW
TEST PIT NUMBER: TP01



PROJECT: NYAKALLONG WWTW
PROJECT NO.: 9687
CLIENT: iX ENGINEERS (PTY) LTD



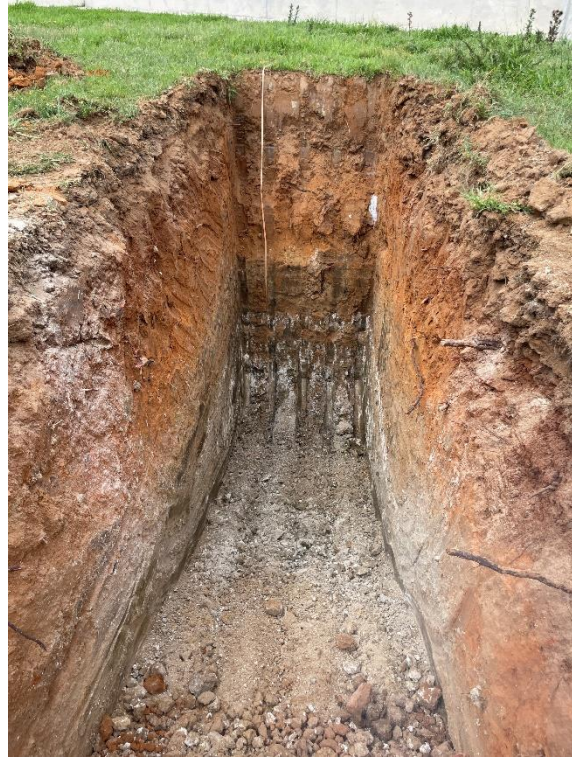
SITE: NYAKALLONG WWTW
TEST PIT NUMBER: TP02



PROJECT: NYAKALLONG WWTW
PROJECT NO.: 9687
CLIENT: iX ENGINEERS (PTY) LTD



SITE: NYAKALLONG WWTW
TEST PIT NUMBER: TP03



PROJECT: NYAKALLONG WWTW
PROJECT NO.: 9687
CLIENT: iX ENGINEERS (PTY) LTD



SITE: NYAKALLONG WWTW
TEST PIT NUMBER: TP04



PROJECT: NYAKALLONG WWTW
PROJECT NO.: 9687
CLIENT: iX ENGINEERS (PTY) LTD



SITE: NYAKALLONG WWTW
TEST PIT NUMBER: TP05



PROJECT: NYAKALLONG WWTW
PROJECT NO.: 9687
CLIENT: iX ENGINEERS (PTY) LTD



SITE: NYAKALLONG WWTW
TEST PIT NUMBER: TP06



PROJECT: NYAKALLONG WWTW
PROJECT NO.: 9687
CLIENT: iX ENGINEERS (PTY) LTD



SITE: NYAKALLONG WWTW
TEST PIT NUMBER: TP07



PROJECT: NYAKALLONG WWTW
PROJECT NO.: 9687
CLIENT: iX ENGINEERS (PTY) LTD



SITE: NYAKALLONG WWTW
TEST PIT NUMBER: TP08



PROJECT: NYAKALLONG WWTW
PROJECT NO.: 9687
CLIENT: iX ENGINEERS (PTY) LTD



SITE: NYAKALLONG WWTW
TEST PIT NUMBER: TP09



APPENDIX C

LABORATORY TEST RESULTS

TEST REPORT**S24/0022**

For

ARQ GEOTECH (PTY)LTD

Date

2 Lynnwood Galleries
354 Rosemary Road

Attention

2024-02-06

Your Reference

YOKAZI MKALALI

NYAKALLONG WWTW - 9867

Sample(s)	Test(s) Conducted	Date requested	Test Method(s) used	Sampling method & Date	Test(s) done at	Test(s) dates
S24/0022/1	- Foundation Indicator (rel. density, sieve analysis to 0.002mm & Atterberg limits) - Untreated Material - Mod. AASHTO Effort - CBR Compaction and Penetration @ Mod. AASHTO, NRB & Proctor Efforts(excl. M/D determination)***** - pH Value - Electrical Conductivity	2024-01-22	- SANS 3001-GR1, GR3, GR10, TMH1 A12T - SANS 3001 GR30 - SANS 3001 GR40 - TMH1 A20 - TMH1 A21T	Sampling by client	PRETORIA	2024-01-24 2024-02-06
S24/0022/2	- Foundation Indicator (rel. density, sieve analysis to 0.002mm & Atterberg limits) - Untreated Material - Mod. AASHTO Effort - CBR Compaction and Penetration @ Mod. AASHTO, NRB & Proctor Efforts(excl. M/D determination)***** - pH Value - Electrical Conductivity	2024-01-22	- SANS 3001-GR1, GR3, GR10, TMH1 A12T - SANS 3001 GR30 - SANS 3001 GR40 - TMH1 A20 - TMH1 A21T			
S24/0022/3	- Foundation Indicator (rel. density, sieve analysis to 0.002mm & Atterberg limits) - Untreated Material - Mod. AASHTO Effort - CBR Compaction and Penetration @ Mod. AASHTO, NRB & Proctor Efforts(excl. M/D determination)***** - pH Value - Electrical Conductivity	2024-01-22	- SANS 3001-GR1, GR3, GR10, TMH1 A12T - SANS 3001 GR30 - SANS 3001 GR40 - TMH1 A20 - TMH1 A21T			

Sample(s)	Test(s) Conducted	Date requested	Test Method(s) used	Sampling method & Date	Test(s) done at	Test(s) dates
S24/0022/4	• Foundation Indicator (rel. density, sieve analysis to 0.002mm & Atterberg limits) • Untreated Material - Mod. AASHTO Effort • CBR Compaction and Penetration @ Mod. AASHTO, NRB & Proctor Efforts(excl. M/D determination)**** • pH Value • Electrical Conductivity	2024-01-22	• SANS 3001-GR1, GR3, GR10, TMH1 A12T • SANS 3001 GR30 • SANS 3001 GR40 • TMH1 A20 • TMH1 A21T	Sampling by client	PRETORIA	2024-01-24 2024-02-06

Note: **** Decision rule not be applied to the Colto Classification, please enquire if required.
*** Non-standard aggregate sizes used in test. Generally smaller aggregates will produce lower values and the larger sizes higher values.
** Used tap water to wash and not distilled water.
* Not SANAS Accredited:
Results marked "Not SANAS Accredited" in this report are not included in the SANAS Schedule of Accreditation for this laboratory / certification body / inspection body.
Sample and sampling environmental conditions will only be noted if it is abnormal, not according to test method specification or can have an influence on the final result.
The test results are only applicable to the samples tested.

I accept this document
Ms M Choeru
Technical Signatory (Soils)

The results relate only to the items tested.
Opinions and interpretations expressed herein are outside the scope of SANAS accreditation.
Refer to the Scope of Accreditation for details regarding the technical signatories.
This test report shall not be reproduced except in full, without written approval of the laboratory.



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T +27 12 813 4900 E info@soillab.co.za
Soillab Pretoria
Cor Albertus & Analeesq Street, La Montagne, 0184
www.soillab.co.za

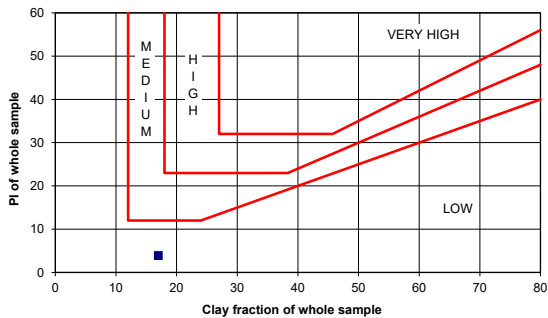
R54 revision 1

PARTICLE SIZE ANALYSIS

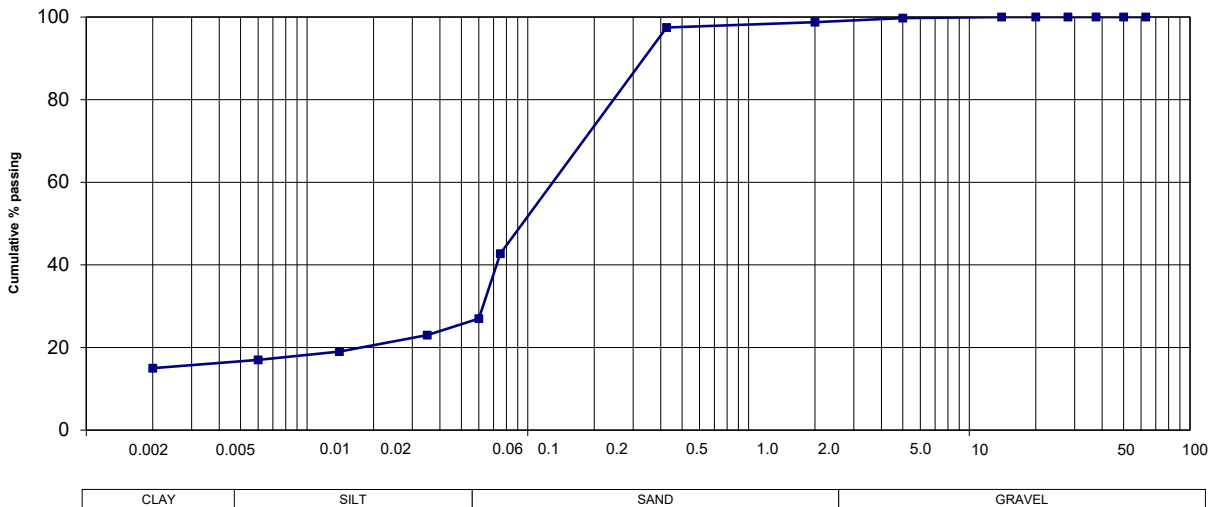
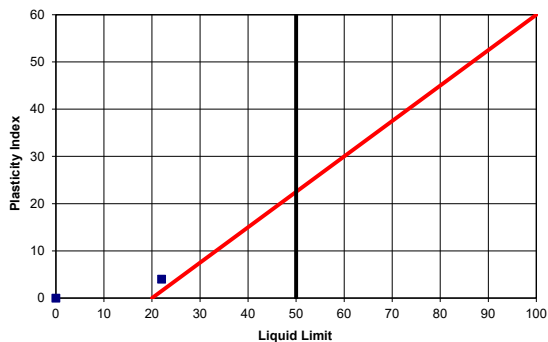
Sample No.	01
Soillab Sample No.	S24-0022-01
Depth (mM)	0.9 - 1.8 (0 - 1.8)
Position	TP03
Material Description	DARK BROWN CLAYEY SAND
Relative density on < 2 mm (TMH1 A12T)	2.665
Organic Material	
Moisture (%)	
SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)	
63.0 mm	100
50.0 mm	100
37.5 mm	100
28.0 mm	100
20.0 mm	100
14.0 mm	100
5.0 mm	100
2.00 mm	99
0.425 mm	97
0.075 mm	43
HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)	
60 µm	27
35 µm	23
14 µm	19
6 µm	17
2 µm	15
% Clay	17
% Silt	10
% Sand	72
% Gravel	1
ATTERBERG LIMITS (SANS 3001:GR10)	
Liquid Limit	22
Plasticity Index	4
Linear Shrinkage (%)	2.0
Grading Modulus	0.61
Classification	A-4 (0)
Unified Classification	SM & SC
Chart Reference	

PROJECT : NYAKALLONG WWTW - 9867
 JOB No. : S24-0022
 DATE : 2024-01-22

POTENTIAL EXPANSIVENESS



PLASTICITY CHART

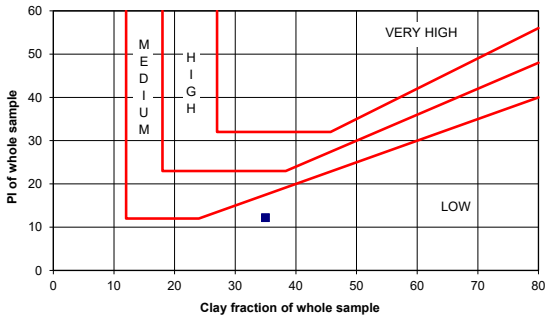


PARTICLE SIZE ANALYSIS

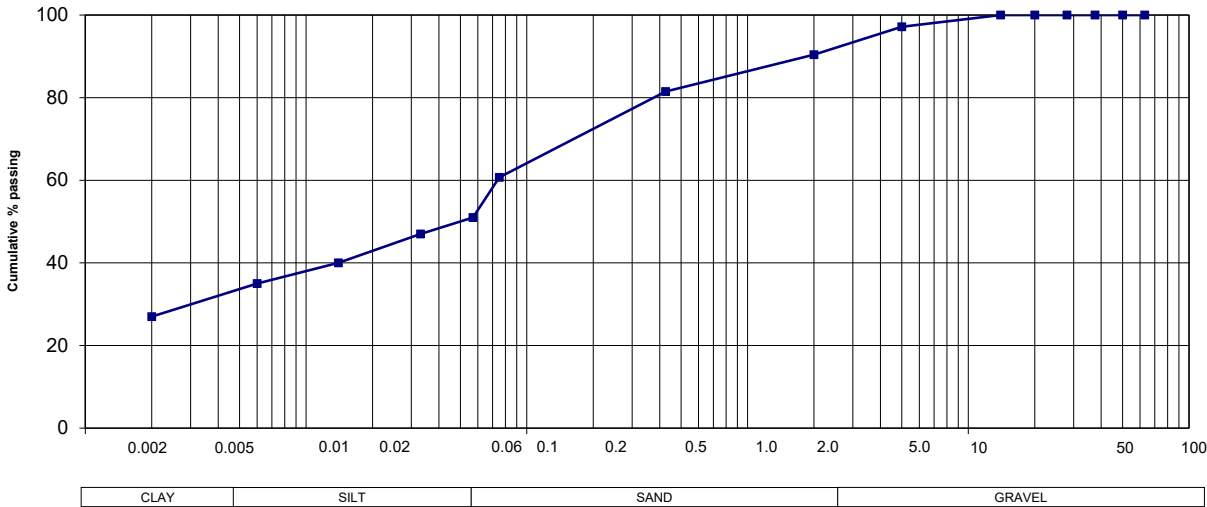
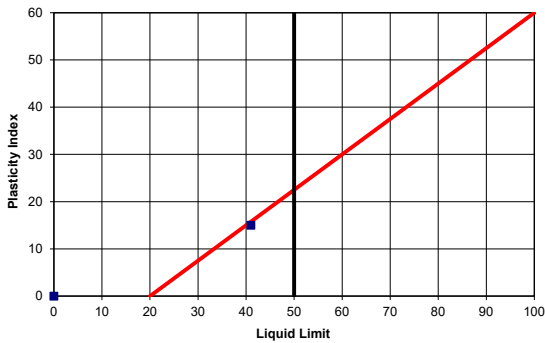
Sample No.	02
Soillab Sample No.	S24-0022-02
Depth (mM)	1.5 - 2.1
Position	TP05
Material Description	DARK OLIVE CLAYEY SAND
Relative density on < 2 mm (TMH1 A12T)	2.450
Organic Material	
Moisture (%)	
SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)	
63.0 mm	100
50.0 mm	100
37.5 mm	100
28.0 mm	100
20.0 mm	100
14.0 mm	100
5.0 mm	97
2.00 mm	90
0.425 mm	81
0.075 mm	61
HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)	
57 µm	51
33 µm	47
14 µm	40
6 µm	35
2 µm	27
% Clay	35
% Silt	16
% Sand	39
% Gravel	10
ATTERBERG LIMITS (SANS 3001:GR10)	
Liquid Limit	41
Plasticity Index	15
Linear Shrinkage (%)	5.0
Grading Modulus	0.67
Classification	A-7-6 (8)
Unified Classification	ML
Chart Reference	

PROJECT : NYAKALLONG WWTW - 9867
 JOB No. : S24-0022
 DATE : 2024-01-22

POTENTIAL EXPANSIVENESS



PLASTICITY CHART



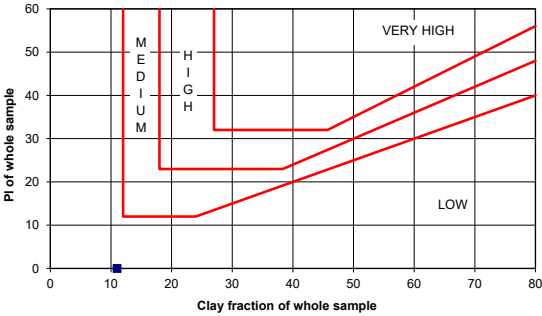
R54 revision 1

PARTICLE SIZE ANALYSIS

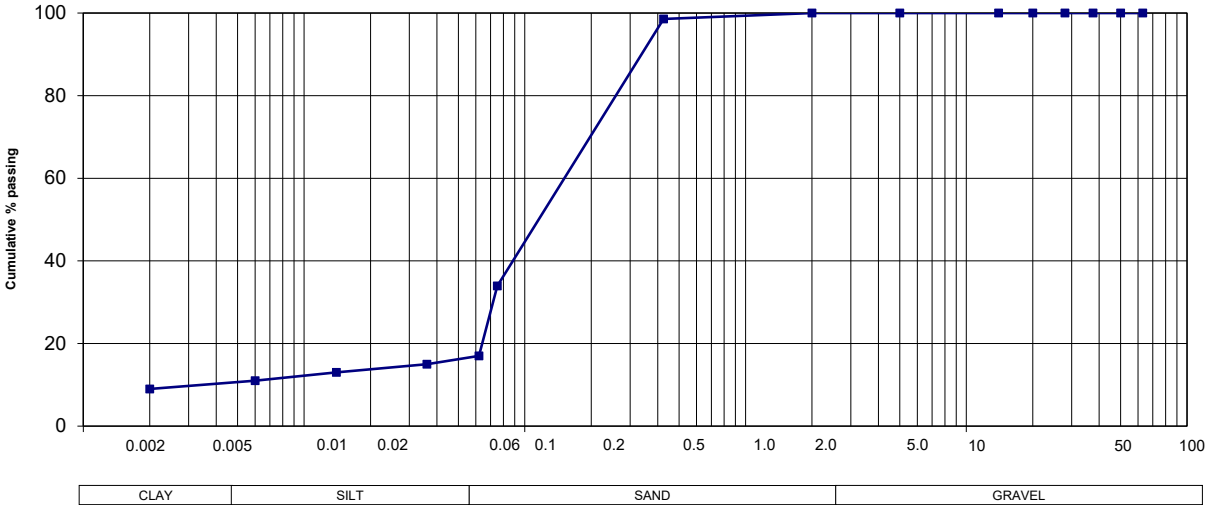
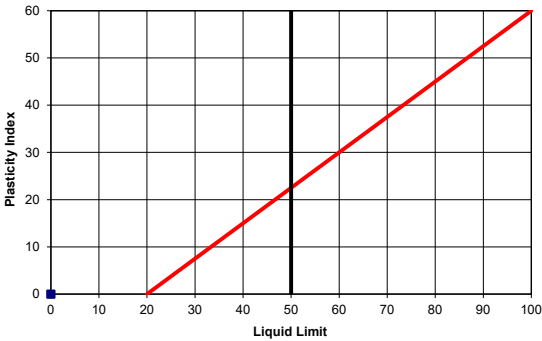
Sample No.	03
Soillab Sample No.	S24-0022-03
Depth (mM)	0.0 - 1.0
Position	TP07
Material Description	LIGHT GREY CLAYEY SAND
Relative density on < 2 mm (TMH1 A12T)	2.686
Organic Material	
Moisture (%)	
SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)	
63.0 mm	100
50.0 mm	100
37.5 mm	100
28.0 mm	100
20.0 mm	100
14.0 mm	100
5.0 mm	100
2.00 mm	100
0.425 mm	99
0.075 mm	34
HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)	
62 µm	17
36 µm	15
14 µm	13
6 µm	11
2 µm	9
% Clay	11
% Silt	6
% Sand	83
% Gravel	0
ATTERBERG LIMITS (SANS 3001:GR10)	
Liquid Limit	
Plasticity Index	NP
Linear Shrinkage (%)	0.0
Grading Modulus	0.67
Classification	A-2-4 (0)
Unified Classification	SM
Chart Reference	

PROJECT : NYAKALLONG WWTW - 9867
 JOB No. : S24-0022
 DATE : 2024-01-22

POTENTIAL EXPANSIVENESS



PLASTICITY CHART

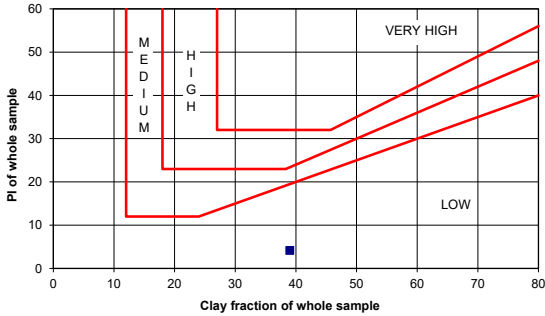


PARTICLE SIZE ANALYSIS

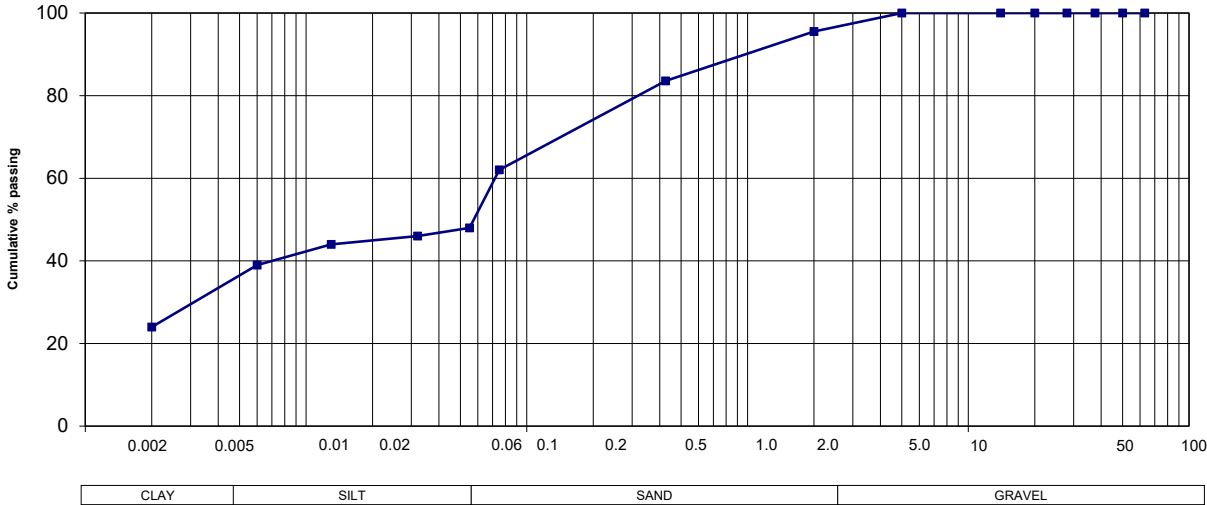
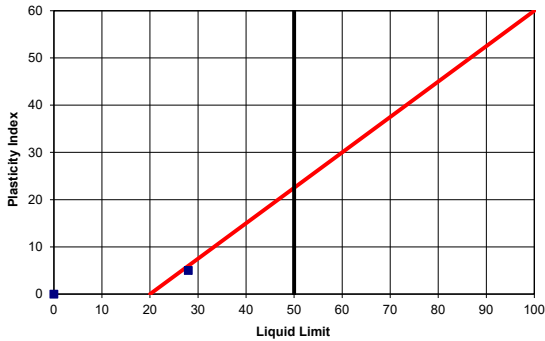
Sample No.	04
Soillab Sample No.	S24-0022-04
Depth (mM)	1.0 - 1.7
Position	TP08
Material Description	DARK OLIVE CLAYEY SAND
Relative density on < 2 mm (TMH1 A12T)	2.646
Organic Material	
Moisture (%)	
SCREEN ANALYSIS (% PASSING) (SANS 3001:GR1)	
63.0 mm	100
50.0 mm	100
37.5 mm	100
28.0 mm	100
20.0 mm	100
14.0 mm	100
5.0 mm	100
2.00 mm	96
0.425 mm	84
0.075 mm	62
HYDROMETER ANALYSIS (% PASSING) (SANS 3001:GR3)	
55 µm	48
32 µm	46
13 µm	44
6 µm	39
2 µm	24
% Clay	39
% Silt	9
% Sand	48
% Gravel	4
ATTERBERG LIMITS (SANS 3001:GR10)	
Liquid Limit	28
Plasticity Index	5
Linear Shrinkage (%)	2.5
Grading Modulus	0.59
Classification	A-4 (1)
Unified Classification	ML
Chart Reference	

PROJECT : NYAKALLONG WWTW - 9867
 JOB No. : S24-0022
 DATE : 2024-01-22

POTENTIAL EXPANSIVENESS



PLASTICITY CHART



Project Description

Client:	ARQ GEOTECH (PTY) LTD	Soillab Job No.:	S24-0022
Job Description:	NYAKALLONG WWTW - 9867	Contract Number:	
Date:	2024/01/22	Reference Number:	

Sample Description

Soillab Sample No.:	S24-0022-01	S24-0022-02	S24-0022-03	S24-0022-04
Sample Description:	TP03	TP05	TP07	TP08
Sample Depth:	0.9 - 1.8 (0 - 1.8)	1.5 - 2.1	0.0 - 1.0	1.0 - 1.7
Material Description:	DARK BROWN	DARK OLIVE	LIGHT GREY	DARK OLIVE

Screen Analysis (% Passing) - SANS 3001-GR1

75,00 mm	100	100	100	100
63,00 mm	100	100	100	100
50,00 mm	100	100	100	100
37,50 mm	100	100	100	100
28,00 mm	100	100	100	100
20,00 mm	100	100	100	100
14,00 mm	100	100	100	100
5,00 mm	100	97	100	100
2,000 mm	99	90	100	96
0,425 mm	97	81	99	84
0,075 mm	43	61	34	62

Soil-mortar percentages - SANS 3001-PR5

Coarse Sand	2.000-0.425mm	1	10	1	13
Coarse Fine Sand	0.425-0.250mm	9	5	14	7
Medium Fine Sand	0.250-0.150mm	23	9	29	7
Fine Fine Sand	0.150-0.075mm	24	9	22	8
Silt and clay	<0.075mm	43	67	34	65

Constants

Grading Modulus	SANS 3001-PR5	0.61	0.67	0.67	0.59
Liquid Limit		22	41		28
Plasticity Index	SANS 3001-GR10	4	15	NP	5
Linear Shrinkage		2.0	5.0	0.0	2.5

MOD AASHTO - SANS 3001-GR30

Max Dry Density (kg/m ³)	1754	1912	1913	1981
Optimum Moisture Content (%)	13.8	11.8	8.2	10.4

CBR - SANS 3001-GR40

MOULD A				
Moulding Moisture Content (%)	13.7	11.8	8.1	10.4
Dry Density (kg/m ³)	1765	1914	1922	1995
Relative Compaction	100.0	100.0	100.0	100.0
CBR (%)	7	3	46	7
% Swell	0.6	0.3	0.3	0.2
MOULD B				
Dry Density (kg/m ³)	1667	1816	1819	1883
Relative Compaction	94.5	94.9	94.7	94.4
CBR (%)	5	2	16	3
% Swell	0.8	0.5	0.4	0.3
MOULD C				
Dry Density (kg/m ³)	1579	1718	1720	1781
Relative Compaction	89.5	89.8	89.5	89.3
CBR (%)	3	2	6	1
% Swell	1.0	1.0	0.7	0.7
CBR (%)				
100% Mod AASHTO	7	3	46	7
98% Mod AASHTO	6	2	31	5
97% Mod AASHTO	6	2	26	4
95% Mod AASHTO	5	2	17	3
93% Mod AASHTO	4	2	12	2
90% Mod AASHTO	3	2	7	1
COLTO Classification:	>G9	>G9	>G9	>G9

W.I. 7.8.1 (a)



CIVIL ENGINEERING LABORATORY



T0345

SNA CIVIL AND STRUCTURAL ENGINEERS (PTY) LTD

191 VONKPROP ROAD SAMCORPARK PRETORIA

PO Box 72727 Lynnwood Ridge '0040

Tel : (012) 751-9388

E-MAIL : snalab@sna.co.za

REG. NO. 2005/006128/07

SANAS accredited facility since 2007

TEST REPORT**REPORT NUMBER****Client :**

SOILLAB

30764**Address:**P.O.BOX 72928
LYNNWOOD RIDGE
PRETORIA
0040**Cell :**

071 610 3443

Tel:

012 813 4900

E-Mail:mahlangut@soillab.co.za**ATTENTION:**

THULISILE

Project/Order:

NYAKALLONG WWTW - 9867 / PTA09146

Brief :

PH AND COND

Date requested

23/01/2024

Date sampled

SAMPLED BY CLIENT

Date received

23/01/2024

Date Tested

Start date : 23/01/2024

End date : 29/01/2024

Location of sampling

SAMPLED BY CLIENT

Sampling method/methods

SAMPLED BY CLIENT

Sampling plan

SAMPLED BY CLIENT

Sampled by

SAMPLED BY CLIENT

Sample number

REFER TO TEST REPORT

Sample Condition/Description

REFER TO TEST REPORT

Sample classification

N/A

Sampling Environmental condition

SAMPLED BY CLIENT

Test Method/Methods used

REFER TO TEST REPORT

Test done at

SNALAB(PTA)

Deviation to test methods : Deviations, exclusions or additions will be noted on test result sheets**Test/Tests marked # Not SANAS Accredited in this report are not included in the SANAS Schedule of Accreditation for this laboratory.**

The results relate only to the items tested. Any opinions ,classifications , comments and interpretations do not fall within the scope of our SANAS accreditation.

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Test report/reports shall not be reproduced except in full, without written approval of the Laboratory.

This test report relates only to samples received.

If the report is referred to as an INTERIM REPORT it is not fit for publication.

The only information that will be made publicly accessible will be to Accreditation Body Assessors or Managers who are equally bounded by confidentiality undertakings.

Information above noted as " **Supplied by Client/Sampled by Client**" may effect the validity of the test results.

Hendrik Diederiks, Pr Tech Eng

Laboratory Manager

Technical Signatory

2024/01/30

DATE ISSUED:

	Project	NYAKALLONG WWTW - 9867		Lab No :	30764
	Rd/Sect/Bp			Client No :	2300
	Layer/ Test pit	S24-0022		Date :	23/01/02024
					W.I.7.8.1(g)i
HOLE & / SAMPLE No.		TP03	TP05	TP07	TP08
MATERIALS DESCRIPTION		DARK YELLOWISH ORANGE	LIGHT GREY SOIL	DARK YELLOW	LIGHT GREY
DEPTH (mm)		0.-1.8	1.5-2.1	0.0-1.0	1.0-1.7
INDICATORS					
METHODS:	SIEVE mm	% PASSING			
SANS 3001-GR 1 + GR2 + GR5	100.0				
	90.0				
	75.0				
	63.0				
	50.0				
	37.5				
	28.0				
	20.0				
	14.0				
	5.0				
	2.00				
	0.425				
	0.075				
	GM				
	SOIL MORTAR ANALYSIS (% vs # mm)				
	2.0 - 0.425				
	0.425 -0.250				
	0.250 - 0.150				
	0.150 - 0.075				
	<0.075				
ATTERBERG LIMITS (%)					
SANS 3001 GR 10	LL				
	PI				
	LS				
CHEMICAL ANALYSES					
TMH 1: A20	Ph	8.12	8.11	8.16	8.56
TMH 1: A21T	CONDUCTIVITY (S/m)	0.0076	0.0087	0.0087	0.0076
MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT					
SANS 3001 GR 30	MDD kg/m ³				
	OMC %				
CALIFORNIA BEARING RATIO					
SANS 3001 GR 40	100 % Comp				
	98 % Comp				
	97 % Comp				
	95 % Comp				
	93 % Comp				
	90 % Comp				
	Swell at 100 %				
CLASSIFICATIONS					
AASHTO Classification #		A-4 (8)	A-4 (8)	A-4 (8.0)	A-4 ()
G- Classification #					
Remarks:	The results relate only to the items tested. Any opinions ,classifications , comments and interpretations do not fall within the scope of our SANAS accreditation.			Date:	2024/01/30
				Technician:	



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