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.....	.....	.....
A. Makhubo	**D. Govender**	**A. Surendra**
PED Senior Engineer	**Middle Manager: PED Water Operations**	**Middle Manager: PED Water Engineering Manager**
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1. INTRODUCTION

Eskom has three pump stations which are occupied by personnel and the current state of some of the sewage treatment plants is not up to standard. The pump stations in question are Wintershoek, Nooitgedacht, Bosloop and Vygeboom. The Wintershoek and Nooitgedacht pump stations are in the same place, that being Nooitgedacht pump station, and they are divided by a road inside the pump station.

The Nooitgedacht side of the pump station has an existing bio plant that treats the sewage that is generated from the single quarters as well as the ablution facilities on the Nooitgedacht side of the pump station. This bio plant does not have an irrigation system connected to it. The final effluent remains in the final chamber where is it collected by the honeysucker. The Nooitgedacht pumphouse has a septic tank that is located just outside the pumphouse, and this septic tank processes all the sewage that emanates from the toilets inside the pumphouse.

There is also an old defunct bio plant on the Nooitgedacht side of the pump station. This plant is no longer in operation and there is no sewage flowing to this plant at present.

The Wintershoek side of the pump station has a septic tank located just behind the pump house which collects all the sewage from the toilets in the pump house. This sewage flows underground once treated.

The Wintershoek pump station also has a septic tank and French drain system which processes the sewage from the security building located at the entrance of the pump station. Sewage flows into the septic tank and thereafter into French drain system and this is where the sewage is separated from the water. The perforated French drain pipework allows for the cleaner water to flow into topsoil. The sewage is treated by the septic tank, but the quality of the final effluent water does not meet the Department of Water and Sanitation (DWS) standards for disposal.

The Bosloop and Vygeboom pump stations have septic tanks installed near each of their respective pumphouse. These septic tanks treat the sewage the comes from the ablution facilities in the pumphouses.

These pump stations also have existing bio plants which have not been in operation for an extended period. There are existing inflows to these bio plant from the existing sewer lines which come from the ablution facilities on site. The sewage flows via existing pipework to these bio plants whereafter the sewage flows into contact tanks. The contact tanks are rusted and are no longer fit for purpose. The contact tanks have rotating drives which ensure that the sewage is aerated to improve the bio-digestion by the bacteria. The motor, discs, motor drive, short shaft, gear drive, beaming shaft that drive the rotating assemblies are also broken. The outlet chambers of the contact tanks are concrete structures with steel inlet and outlet pipes as well as outlet and inlet valves. The valves in these chambers no longer function and the outlet to these chambers go via their respective chlorination chambers which are also not operational.

Each of the respective bio plants have nearby junction boxes which are the termination points for the incoming power cable. The junction boxes and the power cables to the bio plants and these cables are no longer working.

The sewage plants at Bosloop, Vygeboom and Wintershoek pump stations have become inoperable as detailed above and need to be replaced with newer plants. The plants which are to be installed need to comply to General Authorisations in terms of section 39 of the national water Government Notice 665 for Irrigation of any land with waste or water containing waste generated through any industrial activity or by a waterwork.

2. SUPPORTING CLAUSES

2.1 SCOPE

The *Contractor* is to install a new a packaged sewage plant that has all the necessary equipment contained within the plant. The plant must take in raw sewage from the respective ablution facilities and treat it to produce a sewage effluent water quality that can be used for irrigation.

The plant must treat the raw sewage in the following phases:

Screening: The influent raw sewage must be screened to ensure that only the water component, with minor sewage particles, of the sewage proceeds to the next stage. The screen must be sized to ensure that there are no blockages which will prevent influent from proceeding to the next stage and cause blockages in the feed line. The screen size(s) must be mindful of the final effluent pump downstream which must handle the final effluent and not be damaged in the process.

Anaerobic Digestion: The next phase of the treatment process is anaerobic/anoxic digestion of the sewage. In this phase the biological process takes place, which is the microbes consuming the organic impurities as food, converting them into carbon dioxide, water and into a simpler organic state.

The anaerobic zone must also ensure that it has an intake stream for recycled sewage water that may have gone through the processes described below untreated. The recycle stream also serves as food for the microbes that treat the influent sewage water.

Aerobic Digestion: In this phase there must be the introduction of oxygen which enables the bacteria to grow and digest the simpler state organics. In this phase of the treatment there needs to be a bio media which is the substrate the bacteria will use to digest the organic matter in the presence of the oxygen supplied.

The oxygen must be supplied in a pipe size that will ensure there is enough oxygen for the bacteria to operate. The pipe size must ensure that there are no blockages in the sprinklers/apertures through which the oxygen flows. The pressure of the air supplied must be greater than the pressure in the aerobic digestion zone such that there is a reduced possibility of pipe blockages.

Disinfection: In this step the final effluent is dosed with chlorine ensuring that the treated wastewater is virtually free of bacteria. The chlorination process kills remaining bacteria to levels within the discharge permit.

The final effluent must be pumped from the plant will be used for irrigation purposes at the respective sites.

2.1.1 Applicability

This document applies to Bosloop, Wintershoek, Nooitgedacht and Vygeboom pump stations.

2.2 NORMATIVE/INFORMATIVE REFERENCES

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

2.2.1 Normative

[1] 32-727 - Eskom Safety, Health, Environment and Quality (SHEQ) Policy

[2] Occupational Health and Safety Act No. 85 of 1993,

[3] QM58 - Suppliers contract quality requirements specification

[4] SANS 52566-3: Small wastewater treatment systems for up to 50 PT Part 3: Packaged and/or site assembled domestic wastewater treatment plants

[5] SANS 10400-Part P, Drainage, Plumbing, Sanitation and Water Disposal

[6] SANS 10102-1:2013 The selection of pipes for buried pipelines Part 1: General provisions

[7] SANS 10142-1 The wiring of premises – Part 1: Low-voltage installations (Edition 3: 2020)

[8] SANS 8773: 2007 Plastics piping systems for non-pressure underground drainage and sewerage - Polypropylene (PP)

These documents are indispensable for the application of this document, i.e. documents to be used together with this document.

2.2.2 Informative

[9] 474-58 (Rev1): Document and Records Management

2.3 DEFINITIONS

2.3.1 Disclosure Classification

Controlled disclosure: controlled disclosure to external parties (either enforced by law, or discretionary).

2.4 ABBREVIATIONS

Abbreviation	Description
BOD	Biological Oxygen Demand
COD	Chemical Oxygen Demand
DWS	Department of Water and Sanitation
IP	Ingress Protection
QA	Quality Assurance
QC	Quality Control
QM	Quality Manual
SABS	South African Bureau Standards
SANS	South African National Standards
SE	System Engineer

Abbreviation	Description
SHEQ	Eskom Safety, Health, Environment and Quality
TSS	Total Suspended Solids

2.5 ROLES AND RESPONSIBILITIES

Appointed *Contractor* – Execute the scope of work as per the *Employer's* specification. To ensure quality assurance is done as per QM 58 and Eskom Safety, Health, Environment and Quality (SHEQ) Policy is adhered to.

Engineer – The engineer will review all works which is being executed and ensure that quality assurance is adhered to.

2.6 REQUIRED CRITERIA FOR *CONTRACTOR*

- The *Contractor* must provide a record of having carried out similar works before.
- The *Contractor* must have the necessary qualifications, documentation and technical requirements listed in the technical criteria.

2.7 RELATED/SUPPORTING DOCUMENTS

Not applicable

3. SCOPE OF WORK

3.1 DESCRIPTION OF THE *WORKS*

To design, manufacture and install five (5) packaged modular sewage plant with all the necessary equipment packaged in the plant to meet the requirements of the DWS irrigation water quality as stipulated in table 2 below (see page 18). The design must be inclusive of the irrigation system, pipework and nozzles required to irrigate the final effluent from the plant. The operational bio plant at Nooitgedacht currently does not have an irrigation system and the *Employer* requires that an irrigation system be designed, manufactured and installed for this plant.

The design must encompass all the electrical, mechanical, and civil requirements for the plant. The plant must be capable of treating up to a maximum of 2.5m^3/day of sewage.

Table 1: Location where the sewage treatment plants are to be installed at the respective pump stations.

Site	Location of new sewage plant
Wintershoek Pump Station	Behind the Wintershoek pumphouse. 2 metres away from the existing septic tank.
	Security building at the entrance of the pump station
Nooitgedacht Pump Station	Nooitgedacht pumphouse. 2 metres away from the existing septic tank.
	Installation of irrigation system for the existing bio plant.*

Vygeboom Pump Station	Behind the pumphouse. 20 metres away from the existing septic tank.
Bosloop Pump Station	Next to the pump station. 2 metres away from the existing septic tank.

*Note: Nooitgedacht's existing bio plant only requires the installation of an irrigation system.

3.2 *EMPLOYER'S* DESIGN REQUIREMENTS

The *Contractor* must use the existing pipework as the feed stream to the newly installed plant as well as the existing electrical power cables to run the plant. Where the *Contractor* finds that the pipework or electric cables are not adequate for the plant, the *Contractor* is to inform the *Employer* in a written proposal of the changes that need to be made to accommodate the plant. The *Contractor* can only proceed with these changes once he has received written confirmation from the *Employer*.

The *Contractor* is to design the plants taking into consideration the number of personnel working at the respective sites and makes informed assumptions on the amount of sewage that is likely to be treated by the plant. The plant is to be designed for gravity feed as per the existing bio plant. The *Contractor* is to provide an installation procedure to the *Employer* showing how the plant will be installed and this procedure details how the existing pipework will be connected to the plant. The installation procedure also details how the irrigation system will be installed to the plant.

The *Contractor* must submit the design to the *Employer* for acceptance before commencing with the construction or installation of the plant.

3.2.1 Civil Requirements

The *Contractor* must ensure that the civil design meets all the requirements for the plant. The design of the plant must cater for the installation of the plant by ensuring that there is a solid foundation designed for the plant and also ensure that the foundation can handle the load from the plant. The *Contractor* must adhere to the civil specifications as stated by the original equipment manufacturer.

3.2.2 Mechanical Requirements

The plant is designed with all the necessary mechanical equipment to ensure safe and reliable operation of the plant. That is to say that the *Contractor* designs plant with all the necessary valves, pipes, sprinklers, chlorinator and pumps which are required for the plant to operate. The mechanical design of the plant is inclusive of an irrigation system that will discharge the final effluent into the surrounding vegetation.

The plant design must also cater for mechanical flow meters at the inlet and outlets of the plants to account for the quantity of sewage that is treated. The plant must also be designed with sample points at the inlet and outlet of the plant.

3.2.3 Electrical Requirements

The *Contractor's* design is to cater for all the electrical requirements of the plant from cabling, junction boxes, control panels, circuit breakers, relays and the relevant protections.

The *Contractor* designs the plant to use renewable power supply as far as reasonably possible but there must be a backup power supply which will draw power from the existing board.

3.2.3.1 Cabling

The *Contractor* must assess the existing electrical local control panel power supply and determine if it is still in a good state and that it can handle the power requirements for the plant. Furthermore, the electrical design for the plant cabling must be specified to meet the electrical loads from the respective plant equipment.

3.2.3.2 Control Panel

The *Contractor* designs the plant with a local control panel which will have start and stop buttons to allow for the site personnel to stop and start the plant when required. The control panel is designed to have local light indications which will indicate the status of the plant. A green light indicates that the plant is in operation and a red light to indicate the plant is off.

The control panel is designed to have a display of all the electrical equipment that is drawing power from the plant. The display must show the equipment's name and have local indications of the status of the equipment. Similarly, to the overall plant status there must be green and red indications to show that the equipment is in operation or not. This will aid in resolving plant problems.

3.2.4 Protections

The control panel is designed to cater for the necessary electrical protections such as current overload, thermal overload and earth fault etc, to ensure that all the individual equipment and the plant is protected accordingly. The equipment must trip individually and there must be a local indication which shows which equipment has tripped.

3.2.5 Plant Operation

The plant is to be designed such that it does not require any operational intervention from the personnel at the respective sites. This is to say that the plant is designed with the necessary equipment to ensure that the plant can self-diagnose the operations that are required at any given stage in the process. The final effluent must be fitted with a float valve which will detect the level and respond accordingly. There must also be an inline chlorinator which doses chlorine automatically.

3.2.6 Plant Material

The *Contractor* designs the plant with material that can be sourced locally, and which does not have long lead times. The *Employer* requires that the plant is designed to be manufactured of plastic material (PVC, LDPE, LLDPE) because the plant will be installed underground and may be affected by the soil.
The pipe connections and electrical cables must be designed knowing that the plant is to buried underground and furthermore the material selection must take into consideration that if there are to be any leaks in the area, the material must be able to withstand the damp conditions.
The local control panel must be designed of material that can handle the elements. This is to say that the material of construction as well as the protective coating must withstand the elements. The electrical switchgear in the control panel must be ingress protection (IP) 65 or greater.

3.2.7 Maintainability

The plant is to be designed and installed in a manner that allows for easy maintenance. All the plant equipment is to easily accessible to any personnel that must conduct maintenance.

3.2.8 Quality Control

All work is carried out under the supervision of an experienced supervisor. The *Contractor* complies with the *Employer's* Quality Requirements as specified in Eskom Generation Standard GGS 0462.

The *Contractor* to provide a Quality Control Plan to Eskom PED for approval prior to commencement with the works. The *Contractor* shall also ensure that the quality control documentation is available during the work and are submitted to ESKOM on completion.

3.3 *CONTRACTOR'S* SCOPE OF WORK

The *Contractor* designs, procures, supplies, manufactures, delivers to site, installs, and commissions and tests the sewage plants to ensure they are fully functional. The plants are to be located at Wintershoek, Nooitgedacht, Vygeboom and Bosloop pump stations respectively. The *Contractor* also notes that he is to design, procure, supply, manufacture, deliver to site and install the irrigation systems for all 5 plants as well as the irrigation system for the Nooitgedacht bio plant that is in operation.

The *Contractor* is to design the plant to operate effectively and shall allow for continuous operation.

It is the responsibility of the *Contractor* to ensure that all the activities are carried out and all equipment, plant and material is supplied to complete the *works* in every respect. The *Contractor* is responsible for but not limited to:

a) Detailed Design of the *works*
b) Manufacture and procurement of plant, material and equipment necessary to complete the *works.*
c) Delivery to and offloading at site.
d) Decommissioning of the old plant.
e) Installation.
f) Commissioning, testing and optimisation.
g) Documentation as specified.
h) Quality management for all activities

The *Contractor* supplies the following information to the *Employer* for approval prior to installation:

- Detailed design for the *works*
- A general arrangement drawing indicating the relevant components included in the design of the *works.*
- Equipment list
- Design calculations of the different components and process parameters where applicable.

- QCP for the design, installation, testing and commissioning of the works.
- Process flow diagrams and P&IDs of the total *works* to be installed by the *Contractor.*
- Site route drawing / general arrangement for the wiring from instrumentation to junction box.
- Description, technical schedules and specifications of all piping and system components that form part of the works.
- Operating and Control Manuals and Philosophies for the *works*
- Project schedule for the design, procurement and installation of the *works*
- Utility requirements for the *works*
- Loading requirements for the *works*
- Logic and electric single line diagrams for the *works*

3.3.1 Wintershoek and Nooitgedacht Pump Station

The *Contractor's* scope of work is to decommission the existing septic tanks located behind the Wintershoek and Nooitgedacht pumphouses respectively, and the septic tank and the French drains system located near the security building. The *Contractor* is also to decommission the defunct bio plant located on the Nooitgedacht side of the pump station.

The *Contractor* is to also design, procure, install and commissioning packaged sewage plants that meet the *Employer's* design requirements for the three locations described above, that being the Wintershoek pumphouse, Nooitgedacht pumphouse and the security building. The scope of work is also inclusive of the design, installation and commissioning of an irrigation system that is to be used in conjunction with these packaged sewage plants.

The *Contractor* must also take note that he is to design, procure, install and commission a new irrigation system for the existing operational bio plant that is on the Nooitgedacht side of the pump station.

The *Contractor* is responsible for all the works that are required to complete the installation of the sewage treatment plant at Wintershoek and Nooitgedacht pump station. This means that the contractor ensures that there is adequate personnel and material required to complete the *Works*.

Figure 1: Wintershoek Pump Station image

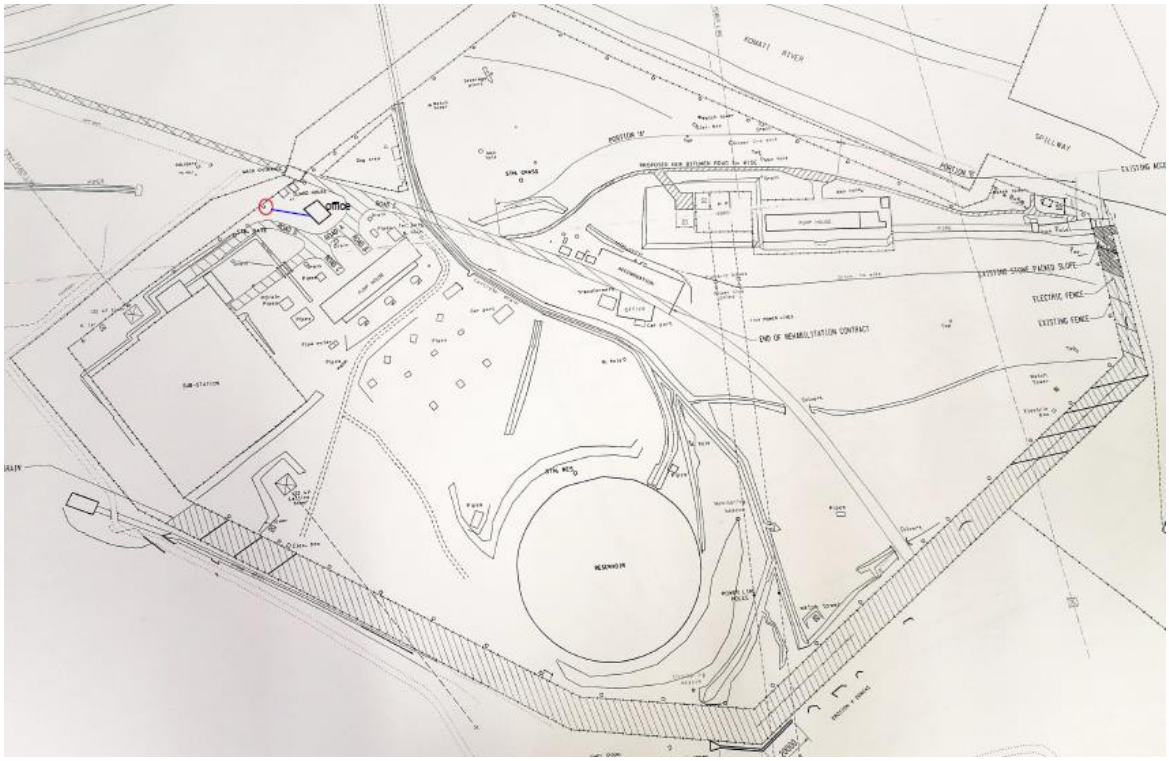

Figure 2: Wintershoek plant layout showing the flow of sewage from the ablution facilities to the French drain system.

Figure 3: Wintershoek image showing elevations of flow from the ablution facilities to the existing sewage plant.

3.3.1.1 Decommission the Wintershoek pumphouse and security building septic tanks and French drain system at the security building.

The *Contractor* is to ensure that the septic tanks located at the Wintershoek pumphouse and security building respectively are emptied, and the inlet and outlet pipework is disconnected from the septic tanks. The septic tanks are not to be removed but merely disconnected and left in-situ.

The Contractor is also to dig up the existing French drain system located at the security building and removes it from site.

The inlet pipework to the septic tank is not to be decommissioned as it may be used as the inlet to the new sewage treatment plant. The *Contractor* is to assess the pipework together with the *Employer* to confirm if it is fit for purpose.

3.3.1.2 Decommission the Nooitgedacht pumphouse septic tank and the defunct bio plant.

The *Contractor* is to ensure that the septic tank located at the Nooigedacht pumphouse is emptied, and the inlet and outlet pipework is disconnected from the septic tank. The septic tank is not to be removed but merely disconnected and left in-situ.

The *Contractor* is to decommission the defunct bio plant located on the Nooitgedacht side of the pump station. The inlet and outlet pipework for the bio plant is to be completely removed.

The inlet pipework to the septic tank is not to be decommissioned as it will be used as the inlet to the new sewage treatment plant.

3.3.1.3 Disposal of the French drain system and defunct bio plant

The French drain system and bio plant that have been decommissioned are to be removed from site by the *Contractor*. The *Contractor* classifies the waste that will be generated in the process of removing these plants and ensures that it is disposed of at the appropriate waste disposal site and supplies the *Employer* with the waste disposal certificate.

3.3.2 Bosloop and Vygeboom Pump Station

The *Contractor's* scope of work is the decommissioning, design, installation and commissioning of the sewage plants to meet the *Employer's* design requirements for the Bosloop and Vygeboom pump stations.

The *Employer* will ensure that the inlet pipework will be routed to the plant as well as the electrical power supply cabling. The *Contractor* will be responsible for the installation of the plants and the required panels, outlet pipework, flow meters and irrigation systems.

Figure 4: Bosloop Pump Station image

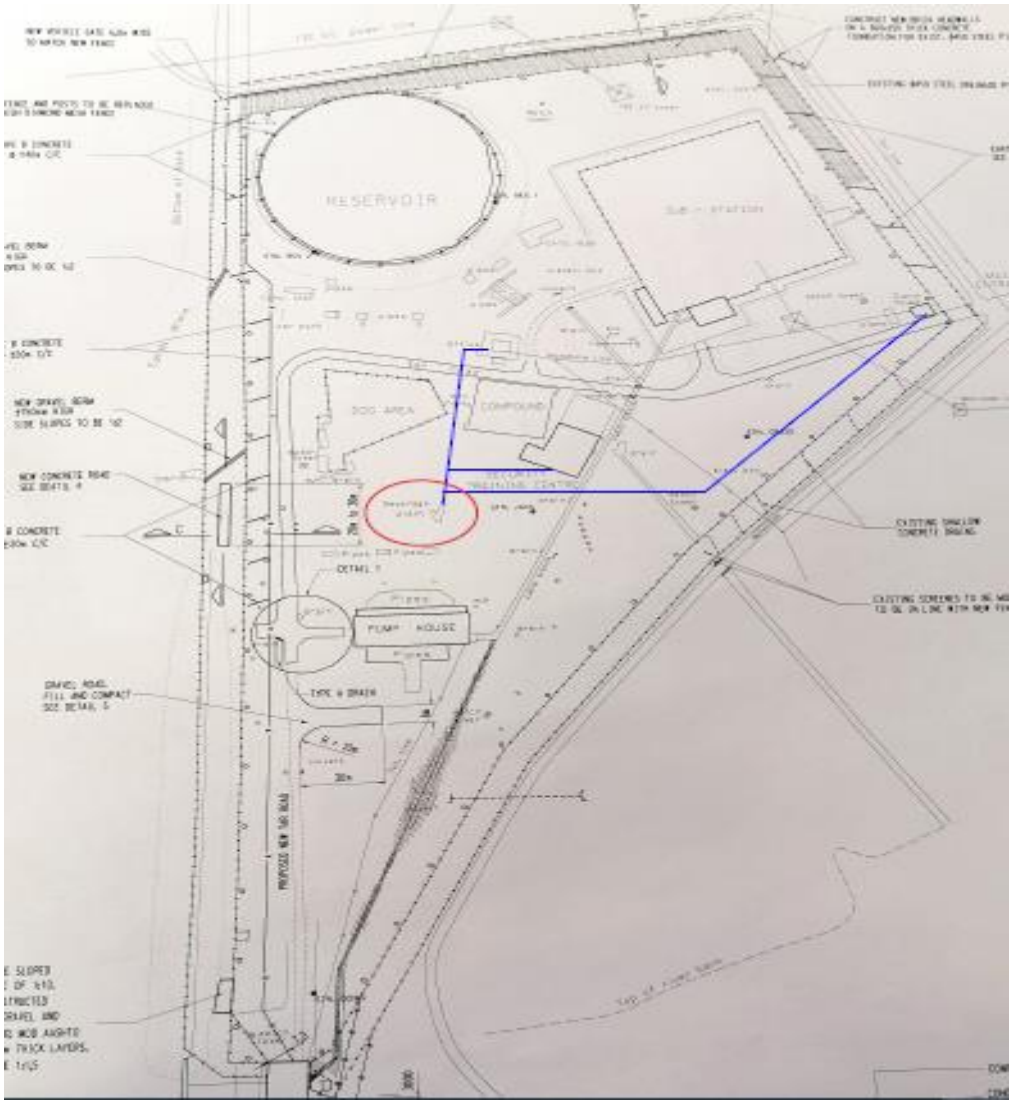

Figure 5: Bosloop plant layout showing the flow of sewage from the ablution facilities to the sewage plant.

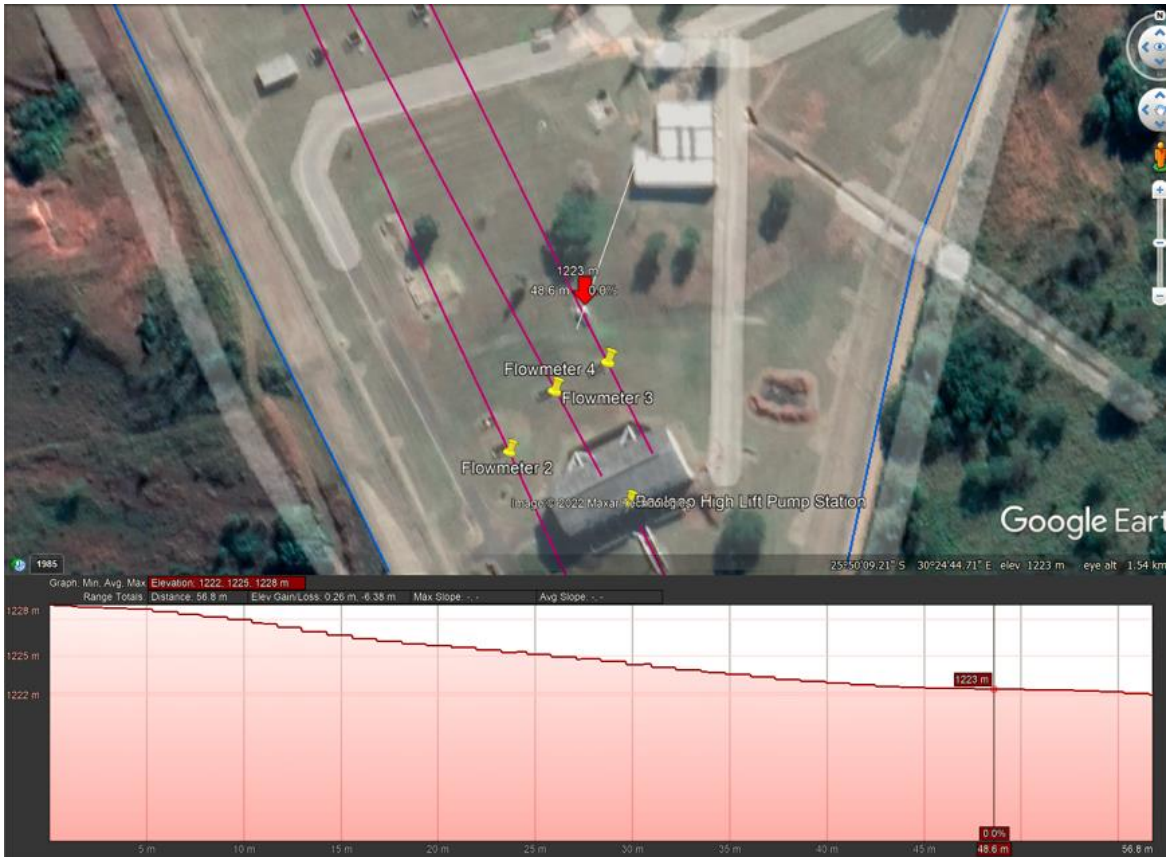

Figure 6: Bosloop image showing elevations of flow from the ablution facilities to the existing sewage plant.

Figure 7: Vygeboom Pump Station

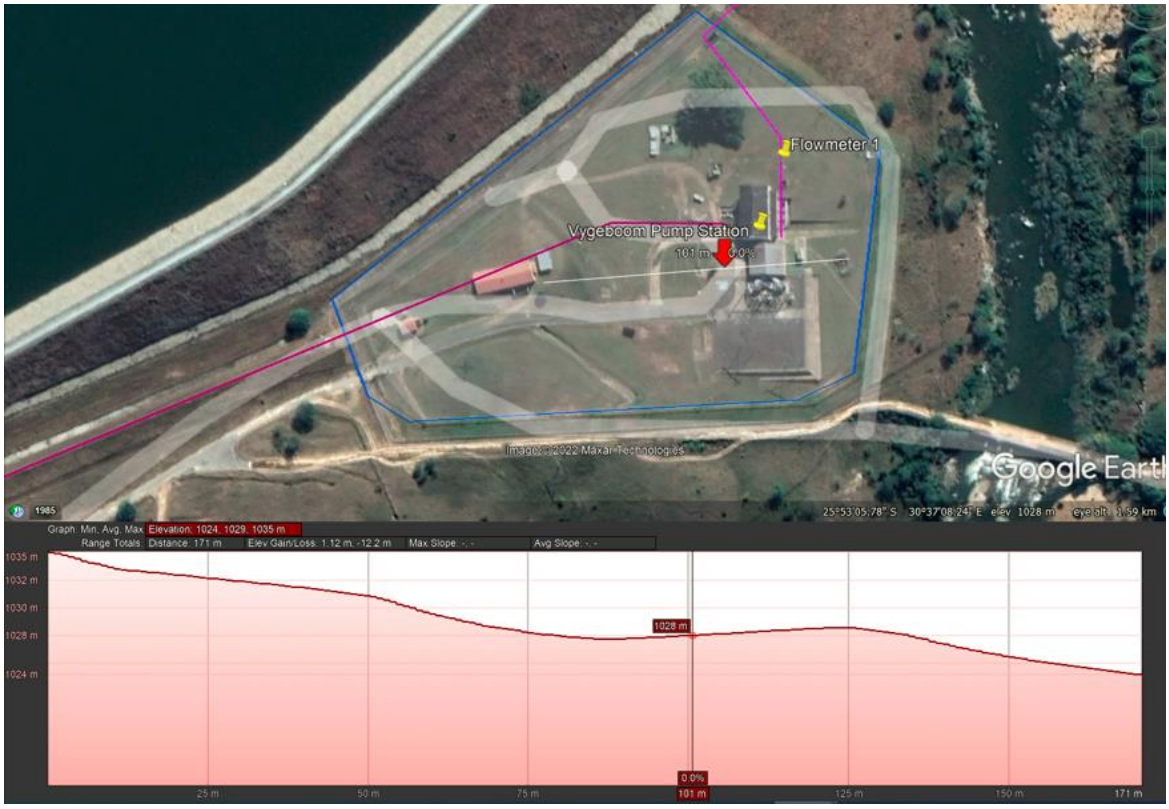

Figure 8: Schematic showing elevations of flow from the ablution facilities to the existing sewage plant.

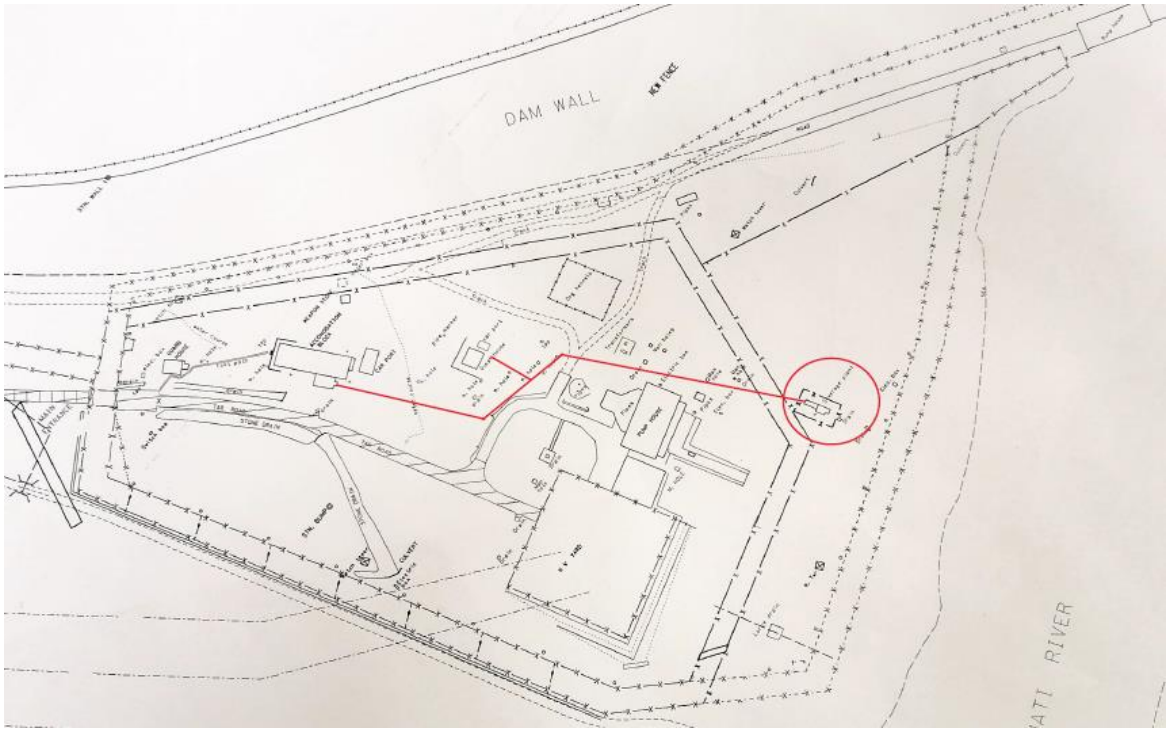

Figure 9: Vygeboom plant layout showing the flow of sewage from the ablution facilities to the sewage plant.

3.3.2.1 Draining of the existing bio plants at Bosloop and Vygeboom pump station

The bio plants at Bosloop and Vygeboom pump station are currently in a derelict state and there is stagnant algae water in the concrete chambers of these plants. The *Contractor* drains the water from the plants into a vacuum truck and must dispose of this water at an appropriate location.

3.3.2.2 Decommission the bio plants at Bosloop and Vygeboom pump station.

The *Contractor* is then to decommission the existing bio plants and removes them from site. The *Contractor* excavates around the existing concrete structures of the plants and disconnects all the existing plant equipment such as the motor, rotating assembly, chamber valves, chlorinator and removes them from site. The inlet pipework is not to be removed by the *Contractor* as it will still be used by the *Employer*.

The *Contractor* must perform pipe detection to assess the layout of the underground pipework that feeds the existing bio plant and ensures that in the process of decommissioning the plant that the feed pipework is not to be damaged.

The panel and power cables which are in existence must also be decommissioned by the *Contractor*. The cable which feeds the panel is to be removed as well as the cables which were used to power the drive motor of the contact must be removed by the *Contractor*.

3.3.2.3 Disposal of the bio plants at Bosloop and Vygeboom pump station.

The bio plants that have been decommissioned are to be removed from site by the *Contractor*. The *Contractor* classifies the waste that will be generated in the process of removing these bio plants and ensures that the waste is disposed of at the appropriate waste disposal site and supplies the *Employer* with a waste disposal certificate.

3.3.3 Design, Install and Commission Packaged Sewage Plants

The *Contractor* is to design, install and commission a total of five (5) packaged sewage plants for Wintershoek, Nooitgedacht, Bosloop and Vygeboom pump stations respectively, that will treat the current inflow from the sites' ablution facilities and produce a final effluent that can be used for irrigation purposes. The *Contractor's* design must cater for all the necessary sewage treatment steps which will be required to achieve the results stated above in the *Employer's* design requirements.

The *Contractor* designs the plants to cater for a capacity of 2.5 m^3/day and it must treat the sewage inflows to produce a final effluent that meets (if not exceed) the chemical parameters in the DWS specification for irrigation purposes listed in Table 2 below.

Table 2: DWS irrigation limits values applicable to the irrigation of any land or property up to 2000 cubic metres

Variables	Limits
pH	not less than 5,5 or more than 9,5 pH units
Electrical Conductivity	does not exceed 70 milliSiemens above intake to a maximum of 150 milliSiemens per metre (mS/m)
Suspended Solids	does not exceed 25 mg/l
Chloride as Free Chlorine	does not exceed 0,25 mg/l
Fluoride	does not exceed 1 mg/l
Soap, Oil and Grease	does not exceed 2,5 mg/l
Chemical Oxygen Demand	does not exceed 75 mg/l
Faecal coliforms	do not exceed 1000 per 100 ml
Ammonia (ionised and un-ionised) as Nitrogen	does not exceed 3mg/l
Nitrate/Nitrite as Nitrogen	does not exceed 15 mg/l
Ortho-Phosphate as phosphorous	does not exceed 10 mg/l

3.3.3.1.1 Civil Scope of Work

The *Contractor's* design must cater for the civil requirement such as the excavation, ground preparation and foundation that is required for the plant.

The *Contractor* is responsible for the installation of the sewage plant and the irrigation system that will be used to irrigate the nearby ground. The *Contractor* prepares the ground which the plant will be installed on by performing the necessary excavations and remedial work upon completion of the installation. The *Contractor* builds the foundation which the plant will be erected on and ensures that the foundation is able to handle the load of the plant when the plant is in operation. The *Contractor* also lays down the irrigation pipework and buries it at a depth of 30cm and also installs the sprinklers that are above ground.

3.3.3.1.2 Mechanical Scope of Work

The design must also be inclusive of the mechanical aspects of the plant such as the pipework, valves, pumps, chlorinator and sprinklers. The design must be such that the mechanical equipment operates automatically especially the final effluent pump which must use a float valve to start and stop the pump to manage the level in the final chamber to prevent spillages or leaks into the environment. The plant design must be inclusive of the irrigation system that will be used after the final step in the treatment. The irrigation system design must be able to handle the flow from the final effluent pump and not introduce a flow restriction which will affect the operation of the plant. The irrigation system must operate automatically and ensure that the level in the final chamber is maintained between 20% and 80%. The design of the pipework from which the sprinklers are fed must ensure that the length does not exceed 5 metres must also cater for 5 drip type irrigation sprinklers connected to this feed pipework.

The *Contractor* installs the valves, pipework, chlorinator and pump to affect the mechanical operation of the plant. The existing pipework which fed the bio plant will be used as the feed to the new plant, thereafter the *Contractor* installs any other equipment and pipework which is required for the plant to operate. The *Contractor* installs the pipework and sprinklers which will distribute the final effluent for irrigation purposes in the nearby surrounding area. The sprinkler pipework must be 25mm LDPE pipe. The sprinkler system pipework is to be buried to a depth of 30cm and is thereafter covered after it is installed. The only protrusion will be the drip type sprinkler heads. The sprinklers must be thread connected to the main feed pipework. Any connectors or adaptors that are required for the pipework to complete the works are to be made of LDPE. The *Contractor* ensures that at the termination of the irrigation system feedpipe work there is a draining port which will be closed with an end cap. This draining port is to allow for cleaning of the irrigation pipework when necessary.

The plant design must also cater for the installation of mechanical flow meters at the inlet and outlets of the plants to account for the quantity of sewage that is treated by the plant. The installation must also include sampling points at the inlet and outlet to the sewage plants.

3.3.3.1.3 Electrical Scope of Work

The *Contractor* also designs for the electrical infrastructure that is required for the plant. The design is inclusive of the junction box and local control panel which will enable plant personnel to start and stop the plant. The design must be inclusive of the power supply cable from the nearby supply board to a junction box as well as the cables that supply power to the plant's equipment.

The *Contractor's* design must be such that the plant operates automatically and continuously with little to no intervention from the site personnel. This is inclusive of the control system that is required to ensure that the plant automatically irrigates the nearby area when the level in the final chamber is 80% and stops the pump when the level is 20%.

3.3.3.1.4 Drawings and manuals

The *Contractor* must provide the *Employer* with as built drawings of the plant which depicts the details of the plant. The *Contractor* also provides the *Employer* with process flow diagrams which show the flows into and out of the plant as well the plant operations.

The *Contractor* also provides the *Employer* with the operation and maintenance manuals for the plants. These manuals must also include the technical specification of all the equipment installed in the plant.

3.3.3.1.5 Commissioning

The *Contractor* will then be responsible for the commissioning of the plant upon completion of the installation. The *Contractor* must develop a commissioning procedure which will be used to commission the plant and hand this over to the *Employer*.

The *Contractor* and the *Employer* must sign and accept the quality control plan once all the plant equipment has been installed. Once the quality control plan has been accepted by both parties the *Contractor* and *Employer* commission the plant together and ensure that the plant operates as per the design.

3.3.3.1.6 Training

The *Contractor* is to train the personnel on site on how to operate and maintain the sewage plants. The training must be inclusive of troubleshooting and problem solving so that the personnel may be equipped with the knowledge to resolve plant issues. The *Contractor* is to provide the *Employer* with proof of training in the form of an attendance register confirming that the staff has been trained.

4. PROCEDURE FOR SUBMISSION AND ACCEPTANCE OF *CONTRACTOR'S* DESIGN

The *Contractor* establishes a document tracking system to record the dates for the supply and receipt of all design drawings, calculations, requests for information and design documentation.
The *Contractor* is to supply the following documentation as the minimum requirements of this specification in the basic and detailed design packages to the *Project Manager* for the *Employers* review and acceptance before any manufacturing, construction or commissioning commences:

- Document submittal schedule indicating when all documents will be submitted.
- Drawing Register indicating when drawings will be submitted.
- Complete detailed design file
- Functional Specifications
- Material Selection
- General Arrangement Drawing of System
- Component material datasheets
- Quality Control Procedures
- Quality Control Plan and Inspection and Test Plan
- Method Statements
- Commissioning procedures
- Assembly procedures
- Operating and Control Philosophies
- Maintenance Philosophy
- Pump curves and datasheet
- Loop Diagrams

- Field termination drawings
- Pipeline Schedule
- Instrument schedule
- Mechanical Hook-up diagrams
- Electrical Hook-up diagrams
- I/O block diagrams
- Alarm list
- Cubicle Internal Equipment Schedule
- Functional Distribution (Allocation of field devices to I/O)
- Detailed I/O List and Channel Assignments
- Electrical cable schedules
- C&I cable schedules
- Electrical termination schedules
- C&I termination schedules
- Instrument datasheets
- Instrument calibration certificates
- Valve datasheet
- Schematics for the electrical design
- Critical Spares List
- PLC operating and maintenance manual.
- Operating, Maintenance and Engineering Training Manuals

5. AUTHORISATION

This document has been seen and accepted by:

Name & Surname	Designation
Lerato Mokonopi	Primary Energy: Operations Manager (Acting)
Anesh Surendra	Primary Energy: Engineering Manager

6. REVISIONS

Date	Rev.	Compiler	Remarks
12 June 2023	0	A. Makhubo	Final Document