GEORGE MUNICIPALITY

DESIGN REPORT

FOR

PROJECT NO. 8 (WORK PACKAGE 7): IMPLEMENTATION OF STORMWATER MASTER PLAN PROJECTS: UPGRADING OF STREET AND STORMWATER, SEWER & WATER: ROSEMOOR: AREA A

REVISION 0

COMPILED FOR:

GEORGE MUNICIPALITY
Contact person: Mr. A van Molendorff
Old Town Hall, Market Street
PO BOX 19
George
6530
Telephone: +27 (0)44 801 9111
email: avmolendorff@george.gov.za

COMPILED BY:

LYNERS
Contact person: Mr. Martyn le Roux
Building No.8, Fairview Office Park
PO Box 757
George
6530
Telephone:+27 (0)44 887 0223
email: martyn@lyners.co.za

Table of Contents

ANNEXURES:

Annexure A: Detail Design Drawings

Annexure B: Water & Sewer Master Plans from GLS Consulting

Annexure C: Nadeson Consulting Services Stormwater Master Plan

Annexure D: George Municipality Civil Engineering Design Standards

Annexure E: Existing Services

Annexure F: Geotechnical Investigation

Annexure G: Cashflow and Program

Annexure H: Sewer and Stormwater Typical Details

Annexure I: Calculations

Table of Acronyms:

HDPE	High Density Polyethylene
NPV	Net Present Value
AADD	Average Annual Daily Demand
UAW	Unaccounted for Water
AC	Asbestos Cement
PRV	Pressure Reducing Valve
SANS	South Africa National Standards
SANTAR	Pitch Fibre Pipes
GIS	Geographic Information System
uPVC	Unplasticized Polyvinyl Chloride
T	Return period (years)

REPORT DETAILS:

Lyners Reference No:	24052CG
George Reference No:	T/ING/010/2020 (PROJECT NO. 8 (WORK PACKAGE 7)
Client	GEORGE MUNICIPALITY
Report prepared by:	M le Roux
Client representative	Adrian van Molendorff
Alternative representative	Raywin Jacobs
Revision record and date	Revision 0, September 2025
Keywords	ROSEMOOR AREA A: STORMWATER, SEWER AND WATER UPGRADES

DISCLAIMER

1. INTRODUCTION

1.1 Appointment

Neil Lyners & Associates (Lyners) was originally appointed in April 2024 by George Municipality to execute and manage the process and procedures for the upgrading of the Rosemore Storm Water Network in line with the Storm Water Masterplan completed for the area (by Nadeson Consulting Services 2019) as part of the approved capital budget. The appointment was however amended in April 2025 to also include sewer and water related network upgrades as the Municipality discovered that the existing water reticulation network still has certain sections consisting of AC lines and the whole sewer reticulation network consisted of Santar pipes.

As a result of this discovery, it was determined that not only the stormwater network in certain streets needed to be upgraded, but also the water and sewer infrastructure, since these services are typically located within the road reserves. This will require sections of some streets to be upgraded multiple times to accommodate the installation of the different civil services, which the Municipality would like to avoid.

This report includes our understanding of the scope of services of the project, outlines the methodology to be followed, preliminary design proposals, and provides an estimated programme, cash flow and provisional fees based on tendered rates

1.2 Locality

Rosemore is a suburb in George almost in the centre of town. Rosemore is situated nearby the suburbs of Conville and Levallia and is nestled between the Meul River in the south and west and a tributary stream of the Meul River to the East. Refer to figure 1 below:

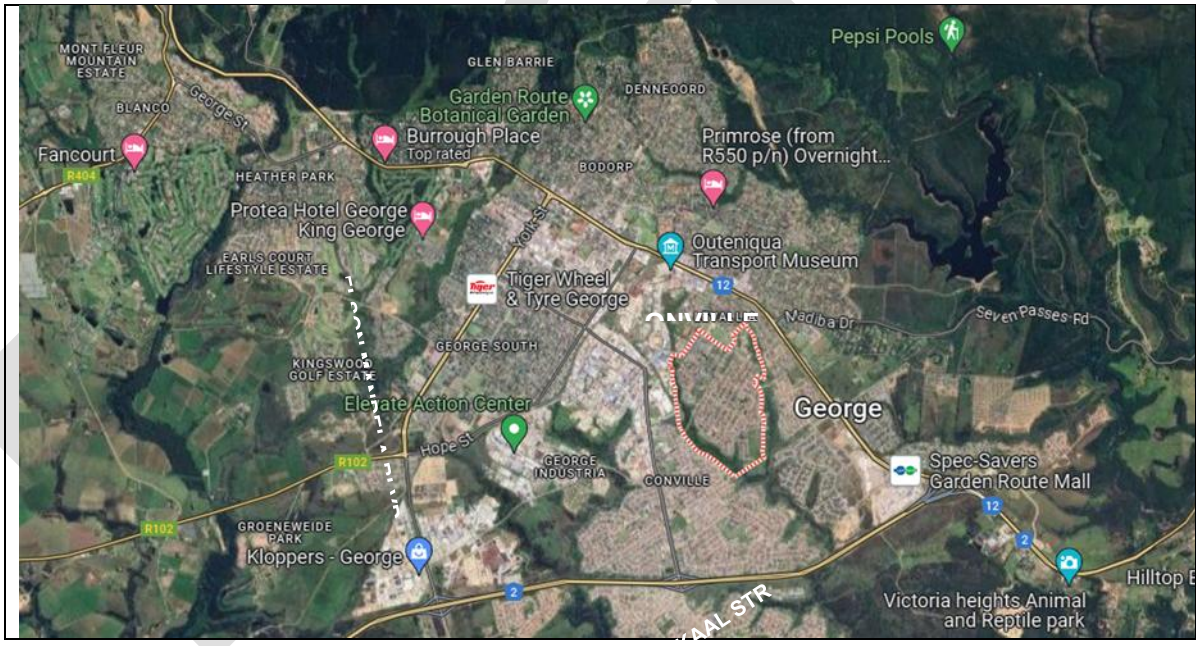

Figure 1: Locality Plan of Rosemore Suburb

1.3 Background

George Municipality originally identified only the need to upgrade the stormwater infrastructure and associated streets in the Municipality after severe flooding in numerous areas following heavy rainfall. A Stormwater Masterplan was developed by Nadeson Consulting Services (Pty) Ltd in 2020 to analyse the catchments, identify problematic areas and proposed upgrades to the stormwater system (both low and high priority).

After initial investigations and discussions with the Directorate's operational teams, it became evident that there are significant challenges within the existing stormwater, water, and sewer reticulation

networks across the entire suburb. While large sections of the water reticulation network have previously been upgraded, pockets of asbestos cement pipes still remain and need to be replaced as the pipes are identified.

The sewer reticulation network consists of SANTAR pipes, which have reached the end of their service life. With the commencement of the GIPTN road upgrades project in the area, it soon became apparent that these sewer pipes are prone to collapse due to their deteriorated condition, with some being over 40 years old.

Initial discussions also revealed that the existing stormwater system has operational issues beyond those identified in the Stormwater Master Plan for the area. Direct input was obtained from various operations managers to gain a better understanding of the extent of the problems.

1.4 Scope of Work

Given the background above Lyners was appointed for the scope of services (stormwater, water & sewer) including the standard consulting engineering services from Inception Stage (Stage 1) to Close-out Stage (Stage 6) as per ECSA Guideline Scope of Services (26 March 2021).

As per instruction from the Municipality Lyners should only focus on the upgrading of the existing streets & stormwater, water and sewer infrastructure for Area A as indicated below in figure 2.

Figure 2: Proposed Scope of Work Roesemoor: Area A

According to available as-built data, George Municipality GIS data, Stormwater Master Plan (by Nadeson Consulting Services), GLS Consulting (master planning for water and sewer) and the problem areas identified by George Municipality user Department Heads the following scope of works were identified for Area A in Rosemoor.

Stormwater: (Refer to figure 3)

- Truter Street: Upgrade from 450mm Ø to 600mm Ø diameter – Approx 130m. Existing pipe to be abandoned and some sections of pipe to be removed. Section of road to be reinstated as some parts of the pipeline cross the road and some sections fall within the road edge. New catchpits, manholes and outlet structure to be completed.

- Niewoudt Outlet: Upgrade from 600mm Ø to 1050mm Ø diameter – Approx 77m. Existing pipe sections need to be removed. New manholes and outlet structure to be completed. Some parts of the road will need to be reinstated.

- Nuwe Street: Re-route 450mm Ø diameter – Approx 95m. Existing pipe to be abandoned and some sections of pipe to be removed. New catchpits and manholes to be completed. Section of road to be reinstated as some parts of the pipe fall within the road edge.

- Marsh Street: Upgrade from Ø 375mm to Ø 450mm – Approx 22m. Construct new side kerb inlet and outlet structure.

- Corner of Deur and Truter Street: Construct new side kerb inlet structures, increase road slope and install MK10 mountable kerbs

- Corner of Kondor and Truter Street: Upgrade from 450mm Ø to 600mm Ø diameter – Approx 24m. Construct new side kerb inlet structure, increase road slope and install MK10 mountable kerbs

- Thwait Street: New stormwater outlet structure from catchpit in Thwait and Van Till street

- Corner of O'Connell and Fotheringham Street: Upgrade from 450mm Ø to 600mm Ø diameter – Approx 11m. New catchpit, manhole and outlet structure to be completed.

- Corner of O'Connell and Fotheringham Street: Upgrade from 600mm Ø to 750mm Ø diameter – Approx 12m. New catchpit, manhole to be completed.

- Corner of O'Connell and Fotheringham Street: Install 1050mmØ diameter – Approx 36.33m. New headwall outlet structure and manhole to be completed. Section of road to be reinstated as the pipe crosses the road.

Figure 3: Proposed Stormwater Scope of Work

Sewer (Internal): (Refer to figure 4, blue highlighted)

- Truter Street: Upgrade to 160mm Ø diameter PVC-U Class 34 – Approx 585m

- Nuwe Street: Upgrade to 160mm Ø diameter PVC-U Class 34 – Approx 120m

- Kondor Street: Upgrade to 200mm Ø diameter PVC-U Class 34 – Approx 110m
- Deur Street: Upgrade to 160mm Ø diameter PVC-U Class 34 – Approx 50m
- Thwait Street: Upgrade to 160mm Ø diameter PVC-U Class 34 – Approx 305m
- Van Til Street: Upgrade to 160mm Ø diameter PVC-U Class 34 – Approx 405m
- Van Til Street: Upgrade to 400m Ø diameter PVC-U Class 34 – Approx 20m
- O'Connell Street: Upgrade to 315mm Ø diameter PVC-U Class 34 – Approx 256m
- Meester Street: Upgrade to 160mm Ø diameter PVC-U Class 34 – Approx 87m
- Mitchell Baker Street: Upgrade to 160mm Ø diameter PVC-U Class 34 – Approx 212m
- Rowe Street: Upgrade to 160mm Ø diameter PVC-U Class 34 – Approx 165m
- Marsh: Upgrade to 160mm Ø diameter PVC-U Class 34 – Approx 117m
- WH Christian Street: Upgrade to 160mm Ø diameter PVC-U Class 34 – Approx 70m
- Aansluit Street: Upgrade to 160mm Ø diameter PVC-U Class 34 – Approx 32m
- House Connections – 191
- All existing sewer lines will be abandoned and manholes will be backfilled.

Sewer (<u>External):</u> (Refer to figure 4, yellow highlighted)

- Southern Side of Site: Upgrade to 250mm Ø diameter PVC-U Class 34 – Approx 228m
  Upgrade to 400m Ø diameter PVC-U Class 34 – Approx m

Figure 4: Proposed Sewer Scope of Work

Water:

- Allowance made for 200m, 160mm diameter AC pipes to be replaced with uPVC pipes. Specific locations not identified yet.
- Smart Water Meters – 247 erven.

Additional Services:

The following additional services are anticipated as defined in the Guideline Scope of Services:

- Upgrading/reinstatement of associated streets/roads and sidewalks;
- Environmental Assessment Practitioner;
- Geotechnical Services;
- Surveyor.

1.5 Objective

The objective of this project is to discuss the proposed detail civil service infrastructure upgrades of the existing stormwater, water, sewer and reinstatement of associated roads/sidewalks infrastructure in Area A of Rosemoor, in line with the relevant master plans.

2. DESIGN STANDARDS AND PARAMETERS

2.1 Design Standards

The following documents form the basis of the technical parameters used in the detail design:

- SANS 1200: Code of Practice for the Design of Civil Engineering Services.
- The Neighbourhood Planning and Design Guide (2019).
- George Municipality Civil Engineering Services: Civil Engineering Standards & Requirements for Services (Updated January 2009), included in Annexure D.

2.2 Design Considerations

The following design considerations were addressed during the detail design of this project within the existing area A:

2.2.1 Pipeline Layouts

Water:

The water mains were positioned within the road reserves. Allowance was made for possible sections to be upgraded as during previous similar projects AC pipes were discovered on site although the GIS system of the Municipality indicated uPVC pipes.

Design specifications:

- Minimum cover to main pipes: 1400mm under roads.
- Minimum cover to pipes on road verge: 0,8m below NGL.
- Minimum house connection size: 20mm diameter HDPE.
- Minimum pipe size: 75mm diameter uPVC.
- Velocity: 1 - 1.5 m/s

- Smart Water meters: In accordance with the George Municipal Standard, Smart Water Meter Specification and installed to the Standard Quality Control Methodology, Smart Water Meter Installation.

Sewer:

The sewer mains were positioned within the road reserves. Refer to Annexure A for detail sewer layout. The proposed new pipelines and manholes will be constructed within the road surface itself, as space on the sidewalks is limited due to existing services (water, electrical, Telkom etc.) and the narrow width of the road reserves.

Design specifications:

- Minimum Velocity: 0.7 m/s (Full-bore)
- Maximum Velocity: 3.0 m/s
- Minimum Cover: 1000mm servitudes / 1200mm sidewalks / 1300mm - 1400mm roads
- Grades > 1:5: Transverse anchor blocks
- Bedding: SABS 1200 LB (Flexible Pipes)
- Manhole Spacing:80 meters
- Benching Grade: < 1:5 and > 1:25
- Junctions: 45 degrees, crown to crown
- N-Value (UPVC): 0.015 for old pipes (future conditions)
- Benching Manhole Drops: 50mm
- Spare Capacity: 25% Infiltration

Stormwater:

The existing storm water pipelines are positioned within the road reserves within sidewalks as indicated on the standard road cross section below (refer to Annexure A for detail stormwater layout):

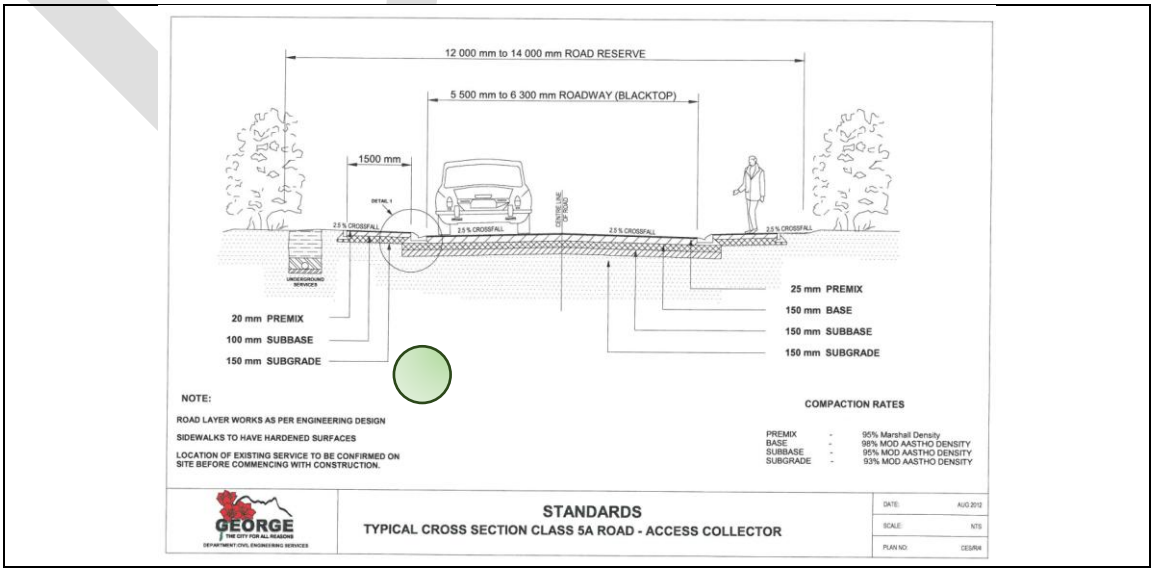

Figure 5 : Position of existing Storm Water pipes (green) in Road Cross Sections

Design specifications:

- Minimum cover to main pipes: 800mm or 1000mm in roads.

2.2.2 Pipe Material

Water:

uPVC was chosen due to its durability, resistance to corrosion, and flexibility. The pipe material do conform to applicable industry standards and local regulations.

George Municipality's Civil Engineering Standards specify the following pipe materials and classes to be used:

- uPVC Class 16 pipe heavy duty complying to SABS 966 for the water reticulation network.
- HDPE Class 16 type 5, Complying to SABS 553 for erf connections.

However, due to the existing pressure reducing valves and static pressures less than 10 bar, Class 12 pipes should be utilized for Rosemoor.

Sewer:

In line with George Municipality's requirements and standard pipe material, uPVC Class 34 pipes are proposed.

Stormwater:

George Municipality's Civil Engineering Standards specify the following pipe materials and classes to be used:

- Reinforced Concrete Spigot and Socket pipes
  - 100D class for pipe diameters between 375 to 450mm
  - 50D class for pipe diameters between 600 to 900mm

The specification does state that loading class must be determined by loadings on the pipe and trench conditions. Discussions with the Client confirmed that 100D pipes as a minimum is required.

2.2.3 Hydraulic Capacity

2.2.3.1 Water:

GLS Consulting (Pty) Ltd was appointed by George Municipality to prepare a Water Master Plan (2024-12) for the area. According to their hydraulic analysis of the network, the existing water pipe sizes are adequate for the water reticulation demands. The reticulation network pipes will therefore be replaced size for size where required, except for 75mm diameter pipes that will be replaced with 90mm diameter pipes. Refer to Annexure B.

2.2.3.2 Sewer:

GLS Consulting (Pty) Ltd was appointed by George Municipality to prepare a Sewer Master Plan (2024-12) for the area. According to their hydraulic analysis of the network, most of the existing sewer pipe sizes are adequate for the sewer reticulation demands. The sewer pipelines will be replaced size for size as required. Some pipeline sizes will however require increases as indicated on the GLS sewer master plan. Refer to Annexure B.

Lyners also calculated the proposed design flows from first principles. The following parameters were used for the calculations which translates to the requirements of *The neighbourhood planning & Design Guide "Red Book"* 2019.

Persons/Low income dwelling unit:	4 Persons/ Dwelling unit
PDDWF:	430 l/unit/day
Infiltration:	25% (**GM** Requirement)

160mm diameter pipes

Total existing unit dwellings:	271
Total AADD (l/day):	115 175 l/day
Peak factor:	3.3
Total Peak Sewer Flow (l/sec):	5.42 l/sec

315mm diameter pipes:

Total existing unit dwellings:	1250
Total AADD (l/day):	531 250 l/day
Peak factor:	2.5
Total Peak Sewer Flow (l/sec):	19.31 l/sec

250mm diameter pipes:

Total existing unit dwellings:	1500
Total AADD (l/day):	637 500 l/day
Peak factor:	2.5
Total Peak Sewer Flow (l/sec):	22.66 l/sec

The analysis of sewer pipe performance was conducted using the Manning equation to evaluate whether the proposed pipe diameters and slopes can adequately convey the projected peak flows. For the 160mm diameter pipe, with a minimum slope of 1:200 m/m and a Manning's roughness coefficient (n) of 0.012, the calculated flow capacity at 80% full is 11.53 l/s. this exceeds the required flow rate of 5.42 l/s, this confirms that the pipe is adequately sized for the anticipated flow demand.

For the 315mm diameter pipe, with a minimum slope of 1:500 m/m and a Manning's roughness coefficient (n) of 0.012, the calculated flow capacity at 80% full is 44.42 l/s which also exceeds the required flow rate of 19.31 l/s, this confirms that the pipe is adequately sized for the anticipated flow demand.

In the case of the bulk pipeline, the pipe diameters of 250mm and 400mm respectively, satisfies the recommended flow demands, the 250mm diameter pipe, with a minimum slope of 1:350 and a Manning's roughness coefficient (n) of 0.012, the calculated flow capacity at 80% full is 28.60 l/s. This exceeds the required flow rate of 22.66 l/s and confirms that the pipe is adequately sized for the anticipated flow demand.

Refer to Annexure I for calculations of pipe sizes.

Proposed Sewer – Pipe Analysis Report

The proposed sewer route was modelled and analysed using the design flows as calculated, the drawings for the horizontal and vertical alignments based on the design flows are included in Annexure A.

From	To	Length (m)	Inlet Elevation (m)	Outlet Elevation (m)	Drop (m)	Gradient 1:XXX	Internal Diameter (mm)	Manning	Max Flow Velocity (m/s)
FSMH1	FSMH2	4.22	211.400	211.300	0.05	42.2	188.2	0.012	1.76
FSMH2	FSMH3	44.68	211.250	210.360	1.06	50.2	188.2	0.012	1.62
FSMH3	FSMH4	13.78	211.090	210.880	0.05	65.6	150.6	0.012	1.22
FSMH4	FSMH5	26.84	210.830	210.400	0.05	62.4	150.6	0.012	1.25
FSMH5	FSMH6	14.66	210.350	210.150	0.05	73.3	150.6	0.012	1.15
FSMH6	FSMH7	77.00	210.100	209.350	0.05	102.7	150.6	0.012	0.97
FSMH7	FSMH8	53.08	209.300	208.160	0.80	46.6	188.2	0.012	1.68
FSMH8	FSMH9	5.58	207.260	207.020	0.77	23.3	188.2	0.012	2.37
FSMH10	FSMH11	66.28	208.700	207.830	0.05	76.2	150.6	0.012	1.13
FSMH11	FSMH12	71.20	207.780	206.390	1.80	51.2	150.6	0.012	1.38
FSMH13	FSMH14	27.92	204.780	204.000	0.05	35.8	150.6	0.012	1.65
FSMH14	FSMH15	67.10	203.950	202.240	0.05	39.2	150.6	0.012	1.57
FSMH15	FSMH16	37.68	202.190	201.060	0.05	33.3	150.6	0.012	1.71
FSMH16	FSMH70	10.58	201.010	200.090	1.58	11.5	150.6	0.012	2.91
FSMH17	FSMH19	49.90	211.580	209.150	0.05	20.5	150.6	0.012	2.18
FSMH18	FSMH19	43.63	209.850	209.150	0.05	62.3	150.6	0.012	1.25
FSMH19	FSMH20	38.58	209.100	208.550	0.05	70.1	150.6	0.012	1.18
FSMH20	FSMH8	49.10	208.500	207.310	0.05	41.3	150.6	0.012	1.54
FSMH21	FSMH22	57.06	211.290	210.560	0.05	78.2	150.6	0.012	1.12
FSMH22	FSMH23	73.32	210.510	207.170	1.27	22.0	150.6	0.012	2.11
FSMH23	FSMH24	79.99	205.900	201.650	0.05	18.8	150.6	0.012	2.27
FSMH24	FSMH25	23.05	201.600	200.250	0.05	17.1	150.6	0.012	2.39
FSMH25	FSMH26	53.31	200.200	197.350	0.57	18.7	150.6	0.012	2.28
FSMH26	FSMH80	13.36	196.780	195.910	1.94	15.4	150.6	0.012	2.52
FSMH27	FSMH28	48.32	209.300	207.470	1.05	26.4	150.6	0.012	1.92
FSMH28	FSMH29	64.44	206.420	202.600	1.05	16.9	150.6	0.012	2.40
FSMH29	FSMH30	32.46	201.550	199.550	1.30	16.2	150.6	0.012	2.45
FSMH30	FSMH79	25.92	198.250	196.730	2.34	17.1	150.6	0.012	2.39
FSMH31	FSMH32	44.22	205.100	204.100	0.05	44.2	150.6	0.012	1.48
FSMH32	FSMH33	44.28	204.050	202.980	1.17	41.4	150.6	0.012	1.53
FSMH33	FSMH34	36.50	201.810	199.880	1.05	18.9	150.6	0.012	2.27
FSMH34	FSMH78	30.43	198.830	196.950	2.41	16.2	150.6	0.012	2.45
FSMH35	FSMH37	31.75	206.500	204.450	0.05	15.5	150.6	0.012	2.51
FSMH36	FSMH37	24.45	204.750	204.450	0.05	81.5	150.6	0.012	1.09
FSMH37	FSMH38	55.55	204.400	203.500	0.05	61.7	150.6	0.012	1.26
FSMH38	FSMH39	44.00	203.450	202.710	0.05	59.5	150.6	0.012	1.28
FSMH39	FSMH40	60.68	202.660	201.750	0.84	66.7	150.6	0.012	1.21
FSMH40	FSMH65	7.97	200.910	200.276	0.94	12.6	150.6	0.012	2.78
FSMH41	FSMH42	5.24	207.370	207.250	1.80	43.7	296.6	0.012	2.35
FSMH42	FSMH43	47.15	205.450	204.030	1.16	33.2	296.6	0.012	2.69
FSMH43	FSMH44	13.29	202.870	202.610	0.05	51.1	296.6	0.012	2.17
FSMH44	FSMH45	75.00	202.540	200.100	1.50	30.7	296.6	0.012	2.80
FSMH45	FSMH46	31.87	198.600	198.00	0.05	53.1	296.6	0.012	2.13
FSMH46	FSMH47	77.39	197.950	196.320	0.05	47.5	296.6	0.012	2.25
FSMH47	FSMH82	5.85	196.270	196.094	2.6	33.3	296.6	0.012	2.69
FSMH48	FSMH49	45.00	208.500	205.120	0.05	13.3	150.6	0.012	2.70
FSMH49	FSMH50	41.36	205.070	201.980	0.05	13.4	150.6	0.012	2.70
FSMH50	FSMH51	80.00	201.930	198.680	0.05	24.6	150.6	0.012	1.99
FSMH51	FSMH52	80	198.630	195.790	0.05	28.2	150.6	0.012	1.86
FSMH52	FSMH63	51.19	195.740	195.150	0.05	86.8	150.6	0.012	1.06
FSMH53	FSMH54	72.88	205.840	204.010	0.05	39.8	150.6	0.012	1.56

FSMH54	FSMH55	71.71	203.960	202.230	0.05	41.5	150.6	0.012	1.53
FSMH55	FSMH61	20.52	202.180	200.970	1.70	17.0	150.6	0.012	2.40
FSMH56	FSMH57	80.00	208.920	207.420	0.05	53.3	150.6	0.012	1.35
FSMH57	FSMH58	80.00	207.370	206.090	0.05	62.5	150.6	0.012	1.25
FSMH58	FSMH59	17.31	206.040	205.550	0.05	35.3	150.6	0.012	1.66
FSMH60	FSMH61	6.11	202.110	201.840	2.60	22.6	150.6	0.012	2.07
FSMH61	FSMH63	53.90	199.270	195.150	0.05	13.1	150.6	0.012	2.73
FSMH63	FSMH88	10.15	195.100	194.590	2.55	19.9	150.6	0.012	2.21
FSMH64	FSMH65	7.57	199.450	199.390	0.05	126.2	376.4	0.012	1.62
FSMH65	FSMH71	10.05	199.340	199.280	1.18	167.5	376.4	0.012	1.40
FSMH66	FSMH67	4.43	199.590	199.560	0.05	147.5	235.2	0.012	1.09
FSMH67	FSMH68	78.12	199.510	199.070	0.05	177.5	235.2	0.012	1.00
FSMH68	FSMH69	39.54	199.020	198.800	0.05	179.7	235.2	0.012	0.99
FSMH69	FSMH70	38.75	198.750	198.560	0.05	203.9	235.2	0.012	0.93
FSMH70	FSMH71	67.34	198.510	198.150	0.05	187.1	235.2	0.012	0.97
FSMH71	FSMH72	40.21	198.100	197.880	0.05	182.2	376.4	0.012	1.34
FSMH72	FSMH73	64.41	197.830	197.460	0.05	174.1	376.4	0.012	1.38
FSMH73	FSMH74	45.91	197.410	196.360	0.05	43.7	376.4	0.012	2.75
FSMH74	FSMH75	75.01	196.310	195.690	0.05	121.0	376.4	0.012	1.65
FSMH75	FSMH76	59.00	195.640	195.270	0.05	159.5	376.4	0.012	1.44
FSMH76	FSMH77	40.00	195.220	194.980	0.05	166.7	376.4	0.012	1.41
FSMH77	FSMH78	44.52	194.930	194.590	0.05	131.0	376.4	0.012	1.59
FSMH78	FSMH79	9.97	194.540	194.440	0.05	99.7	376.4	0.012	1.82
FSMH79	FSMH80	47.99	194.390	194.020	0.05	129.7	376.4	0.012	1.60
FSMH80	FSMH81	54.12	193.970	193.720	0.05	216.5	376.4	0.012	1.24
FSMH81	FSMH82	27.10	193.670	193.550	0.05	225.8	376.4	0.012	1.21
FSMH82	FSMH83	59.80	193.500	193.240	0.05	230.0	376.4	0.012	1.20
FSMH83	FSMH84	57.45	193.190	192.950	0.05	239.4	376.4	0.012	1.17
FSMH84	FSMH85	9.37	192.900	192.860	0.05	234.3	376.4	0.012	1.19
FSMH85	FSMH86	57.74	192.810	192.570	0.05	240.6	376.4	0.012	1.17
FSMH86	FSMH87	39.52	192.520	192.350	0.05	232.5	376.4	0.012	1.19
FSMH87	FSMH88	50.45	192.300	192.090	0.05	240.2	376.4	0.012	1.17
FSMH88	FSMH89	7.75	192.040	192.010	0.05	258.5	376.4	0.012	1.13

Table 1: Pipe Analysis Report

Stormwater:

Nadeson Consulting Services was appointed by George Municipality to prepare a Storm Water Master Plan. The Storm Water Master Plan has indicated the need for the upgrades as discussed above. Refer to Annexure C.

The initial pipe sizes used in this report were preliminary designed by Lyners based on the Storm Water Master Plan by Nadeson. The Nadeson Report only checked for the 1:2 year recurrence period and the Client confirmed that the 1:5 year recurrence period should be used. The proposed detail design pipe size calculated by Lyners made allowance for the 1:5 year recurrence period.

The following parameters were used for the calculations:

- **Flood Estimation**

  Due to the lack of calibrated statistical flood data (e.g. from Smithers and Schulze or WADISO), runoff calculations were determined using the Rational Method, combining results from Duration-Depth-Frequency method, Hersfield Method and Standard Design Flood method.

  An average of these three methods was used for the design in determining the post-development Runoff (m^3/s). For a 5-year return period: **2.44** m^3/s

- **Hydraulic Pipe Flow Analysis**

  Design assumptions:

  Flow depth limited to 80% of pipe diameter for capacity assurance

  The entire catchment design flow of 2440 l/s (T=5 years).

  Manning's (n): 0.013

  Hydraulic performance:

	600mmØ Pipe	750mmØ Pipe	1050mmØ Pipe
Design Flow:	482 l/s	976 l/s	1626 l/s
Flow Rate:	591.34 l/s	1132.03 l/s	1842.90 l/s
Flow Velocity:	2.6 m/s	3.2 m/s	2.8 m/s

Refer to Annexure I for calculations of pipe sizes.

Proposed Stormwater- Pipe Analysis Report

The proposed stormwater route was modelled and analysed using the design flows as calculated, the drawings for the horizontal and vertical alignments based on the design flows are included in Annexure A.

From	To	Length (m)	Inlet Elevation (m)	Outlet Elevation (m)	Drop (m)	Gradient 1:XXX	Internal Diameter (mm)	Manning	Max Flow Velocity (m/s)
SWKI 1	SWMH1	10.56	206.500	206.290	2.48	50.3	0.585	0.013	3.36
SWMH1	SWHW	36.33	203.810	203.448	0	36.3	1.050	0.013	3.46
SWKI2	SWMH1	11.68	206.450	206.290	2.48	73.0	0.730	0.013	3.24
SWKI3	SWMH2	9.52	211.100	211.010	0	105.7	0.445	0.013	1.91
SWMH2	SWMH3	75.14	211.010	210.400	0	123.2	0.445	0.013	1.77
SWMH3	SWMH4	4.28	210.400	210.360	0	107.0	0.445	0.013	1.90
SWMH4	SWKI4	5.96	210.360	210.310	0	119.3	0.445	0.013	1.80
SWKI5	SWKI6	23.49	207.210	206.940	0	87.0	0.585	0.013	2.55
SWKI6	SWMH5	3.28	206.940	206.890	0	65.6	0.585	0.013	2.94
SWMH5	SWMH6	75.84	206.890	206.150	0	102.5	0.585	0.013	2.35
SWKI7	SWMH6	7.43	207.250	207.100	0.95	49.5	0.585	0.013	3.39
SWMH6	SWMH7	21.74	206.150	205.910	1.5	90.6	0.585	0.013	2.50
SWMH7	SWHW2	21.09	204.410	204.190	0	95.9	0.585	0.013	2.43
SWMH8	SWMH9	42.75	201.880	201.600	0.94	152.9	1.050	0.013	2.80
SWMH9	SWHW5	34.28	200.660	200.480	0	190.5	1.050	0.013	2.51
SWKI10	SWHW6	21.95	198.470	198.120	0	62.7	0.445	0.013	2.48

Table 2: Pipe Analysis Report

2.2.4 Safety and Environmental Considerations

The Occupational Health and Safety Act, 2014 Construction Regulations and National Environmental Management Act, was taken into consideration during the detail design for the benefit of the construction force, community, and the environment.

Safety measures will be implemented to protect workers and the surrounding environment during the pipe installation process. Additionally, adherence to environmental regulations should be ensured.

2.2.5 Quality Control and Testing

Quality control measures, including pressure testing and inspection of all new pipelines and structures, will be implemented to verify the integrity and performance of the installed pipes.

The necessary quality control procedures and plans, to ensure adequate implementation and successful completion of the project, will be developed and incorporated during the design and implementation stage.

2.2.6 Water Supply

Water supply to households should be interrupted as little as possible. Sufficient notification to the affected community must be provided when water supply will be interrupted. Care must be taken working close to the existing pipeline and provision will be made for a temporary water supply to the existing dwellings to ensure that the households have access to water at all times during the installation of the new pipes.

2.2.7 George Municipality's Civil Engineering Standards

Refer to Annexure D.

Water:

2.2.7.1 Isolating Valves

- Valves to be placed such that a maximum of 4 valves need to be closed to isolate a section.
- Valves shall be spaced so that the length of main included in an isolated section does not exceed 600 metres.
- All valves to be installed at splays where applicable and not within the road surface.
- All valves shall be in accordance with SABS 1200 / SABS 664/1974 and approved by the relevant department head.
- Valves shall be clockwise opening / left hand closing.
- Direction of opening to be clearly marked on the valve body or spindle cap.
- All valves shall be heavy duty, class 16.
- All valves shall have non rising spindles.
- All valves shall be fitted with cast iron cap, secured with retaining bolts.
- Note: Isolating valves to be placed in brick chamber with a lockable polymer concrete cover and frame (Smartlock chambers).
- Only valves supplied with minimum thickness of 225 micron Copon EP 2300 epoxy paint allied to all internal surfaces after it has been thoroughly cleaned by grit blasting to SA ½ finished in compliance with the requirements of SIS 05 90 00 or valves with similar approved coatings, will be accepted.

2.2.7.2 Fire Hydrants

- Fire hydrants are to be spaced at a maximum of 120 m.
- All fire hydrant types shall be in accordance with SABS 1200, comply with the local Fire Department standard regulations, and approved by the relevant department head.

- All fire Hydrants shall be 65 mm diameter (Internal).
- Outlets shall be London round thread with loose cap and securing chain.
- Hydrant spindles shall be provided with cast iron caps, secured with retaining bolts.
- Hydrants shall be clockwise opening / left hand closing.
- Hydrant covers shall be polymer concrete as per AV Moulding, concrete recycled plastic or cast iron depending on area and relevant conditions (Smartlock chambers).
- All hydrants shall be supplied installed complete with flanged CI extension piece complete with cadmium plated nuts and bolts to ensure depth not greater than 400mm.
- Hydrants chambers will be constructed in accordance with drawing no CES/WI1 or TSIWI2.

2.2.7.3 Fittings and Specials

- Fittings and specials shall be manufactured from SS304L pipe with SS316L flanges with either a FBE coating or two-pack epoxy inside and out for corrosive soil conditions.
- uPVC & HDPE fittings and specials shall be class 16, fitted with spigot and socket rubber ring joints and shall comply with the relevant requirements of SABS 966.
- Only stainless-steel bolts and nuts to be used on all underground saddles, flanges, short collar couplings, etc.
- George Municipality have in addition specified that all bolts and flanges shall be Denso wrapped for corrosion protection.
- All pipe fittings (Valves, Hydrants and scour valve, beds) shall have thrust blocks as per drawing CES/W/5.
- 90° bends will be avoided as far as possible, and a combination of two 45° degree bends will be utilised.

2.2.7.4 Road Crossing and Reinstatement

Road crossings for the main reticulation as well as house connections will be constructed by means of conventional open trench excavation. Road crossings will be reinstated, and road layers will be benched into underlaying layers to overlap 150mm across the width of the trench with the following layer works:

- 40 mm Continuously Graded Asphalt. The joint between new and existing asphalt will be sealed with Via Seal or similar approved product.
- 80mm Bitumen treated base compacted to 98% MOD AASHTO
- 150 mm G5 sub-base compacted to 95% MOD AASHTO.
- Subbase in 150 mm layers from top of bedding to underside of base consisting of G7 material compacted to 95% MOD AASHTO.

<u>Sewer:</u>

2.2.7.5 Manholes

Precast concrete manholes of 1000 & 1250 mm in diameter shall be constructed generally in accordance with the recommendations of SANS 1294 using dolomitic aggregates. The concrete rings of bulk sewers shall be sealed on the inside with IKA EPOCHEM 720 coating, with SIKAGARD-63N protective coating.

Joints between cylinders shall be sealed with Sika Cemflex and geofabric membrane. Bitu putty will be placed on lower ring prior to placing upper ring. Polypropylene encapsulated step irons to be staggered at 250mm vertically and 200mm horizontally starting 500mm below cover level.

All manholes shall be watertight to the specification and satisfaction of the engineer. Care shall be taken in the construction of manholes to prevent the infiltration of water. Each manhole shall be tested. Natural ground level to be sloped at 1:5 away from manhole.

All cover slabs to be reinforced with Y12 reinforcement bars @ 150mm C/C both ways with a minimum

cover of 30mm. Cover slabs shall be 150mm thick 25 MPa concrete with Smart Lock lids. Covers will be cast into concrete blocks 200mm thick 700mmx700mm wide with 25mm sleeves in the sides of the block in order for it to be lifted. Manhole covers shall be Type 2A polymer concrete which comply with the requirements of SANS 1882:2003. The covers will be cast into concrete blocks to ensure they cannot be easily opened to reduce possible vandalism.

For brickwork, mortar and plaster on benching to be as per SABS 1200 LD. Mortar to brickwork shall be class 2 (compressive strength of 7MPa at 258 days). All brickwork shall be plastered internally and externally (min 13mm thick). All bricks shall comply with SANS 227 and shall be engineering units with a nominal compressive strength of 12MPa. Masonry walling shall confirm to all aspects of the requirements of SANS 10164-1.

Benching to be minimum 85mm thick using 25MPa/13mm with 30mm granolithic finish (2:1 sand:cement mortar) placed while concrete is still green, with smooth trowel finish, at 1:6 slope towards channel. All concrete to be made with dolomite aggregate.

The foundations of the manholes to be reinforced 150mm thick constructed with 19mm/25MPa concrete foundations. The reinforcement shall be Y12 reinforcement bars @ 150mm C/C both directions with minimum cover of 40mm. Pipes should be cut flush with the inside surface of the manhole wall so that the channel extends the full length of the manhole. Where practical, the joints are to be situated on each side no further than 600mm from the inner face of manhole wall. Where pipe diameter changes at manhole, pipe crowns to line up. Full length pipes to be used where possible. Manhole positions to be adjusted by engineer on site to accommodate pipe lengths.

Pipes entering and exiting manholes will be rocker pipes. These are short flexible pipe sections (approximately 1 meter long) that will allow for slight movement of manhole if required. This is a safety precaution in the event that a manhole sags due to the effect of blockages or backfill issues. In such an event if the manholes sags or settles slightly the sewer line entering or exiting the manhole will not be damaged.

See attached Lyners standard Sewer detail drawings. Refer to Annexure H.

Stormwater:

2.2.7.6 Manholes, Catchpits and Headwalls

- Manholes to be constructed in accordance with the pipe diameter ranges as indicated on drawings no's STE/SW-28B.
- Manhole covers and frames to be CI type 2A (modified CCC) in accordance with SABS 558 in roadways of low risk areas and in high risk areas type 2A CI frame with steel reinforced concrete lid cast in galvanised steel cone, or Polymer Concrete.
- Catch pits to be side inlet kerb type, where possible, with precast concrete cover and frame as per drawing no MD2880-SD-001. In-situ cover and slabs shall be according to drawing CES/SW/8
- Catch pits constructed in concrete channels to be of same profile as drawing no CES/SW/6
- Headwalls to be constructed as per drawing MD2880-SD-001.
- Energy dissipation structures will be designed based on Client detail with necessary amendments to accommodate conditions on site.
- See attached Lyners standard Stormwater detail drawings. Refer to Annexure H.

2.2.7.7 Road Crossing and Reinstatement

Road crossings for the storm water pipes will be constructed by means of conventional open trench excavation. Reinstatement must be benched to overlap underlaying layers by 150mm across the width of the trench. Road crossings will be reinstated with at least the following layer works:

- 40 mm Continuously Graded Asphalt.
- 80mm Bitumen treated base compacted to 98% MOD AASHTO.

- 150 mm G5 subbase compacted to 95% MOD AASHTO
- 150 mm layers from top of bedding to underside of subbase consisting of G7 material compacted to 95% MOD AASHTO or 100% if sand.

Where the storm water pipes will be constructed in paved or covered sidewalks the layer works will conform to at least the following:

- 20 mm Continuously Graded Asphalt or 60mm Clay / Concrete pavers (colour to be approved)
- 150 mm G5 subbase compacted to 98% MOD AASHTO
- 150 mm layers from top of bedding to underside of subbase consisting of G7 material compacted to 95% MOD AASHTO or 100% if sand.

2.2.7.8 Procurement Strategy

The construction contract will be prepared in accordance with the relevant legislation and George Municipality's supply chain management policy and will consist of the following:

- The format of the Tender / Contract will be prepared in accordance with George Municipality's template document and checked for compliance with SANS10845.
- The contract will be advertised on the online tender bulletins with the relevant CE CIDB grading depending on the estimated value of construction.
- Preference scoring will be applied in accordance with the prevailing Preferential Procurement Policy at the time of tender.
- Functionality will be used as a prequalifying criterion.
- The form of contract will be the General Conditions of Contract for Construction Works, Third Edition, 2015.
- A re-measurable (Bill of Quantities) pricing strategy will be used.
- SANS1200 Construction Standards as amended will apply.
- George Three-year Ad-hoc Tender for Contractors will be considered to expedite the procurement process. It will be confirmed at a later stage.

2.2.7.9 Project specific challenges

The following project specific challenges exist in terms of construction in general:

- Location of existing water mains and connections.
- Location of existing sewer mains and connections.
- Sewer mid-block infrastructure that must be relocated to existing streets.
- Reconstructing existing streets due to new civil services being installed within the streets.
- Avoiding damage to existing services.
- Maintaining public safety.
- Maintaining vehicular and pedestrian access and movement.
- George three-year ad-hoc tender for contractors will be considered to expedite the procurement process. It will be confirmed at a later stage.

3. DESIGN DATA

3.1 Engineering Survey

A detailed topographical site survey was carried out to accurately determine the location of existing services on site. Joubert & Brink were appointed to undertake this survey. The resulting data informed the detailed design phase. This report has been updated accordingly based on the completed survey information.

3.2 As-built Data

The available as-built data have been retrieved from the George Municipality GIS system. GLS

Consulting also provided existing services drawings indicating the existing water and sewer systems and they received form the Municipality. (See Annexure E).

3.3 Geotechnical Investigation

A geotechnical investigation was required to identify the:

- Prevailing ground conditions.
- Presence of ground water.
- Presence of hard rock.
- Existing layer works of the existing streets and sidewalks.

Outeniqua laboratory conducted the relevant geotechnical investigations. (See Annexure F).

4. DETAIL DESIGN OPTIONS

Two concept design options were originally considered for the replacement of the Rosemoor sewer network pipelines (in Area A), namely conventional open trench excavation and pipe cracking. For the sections of the water network replacement in Area A only open trench excavation were considered, as we only anticipate the replacement of small sections of pipelines if any. For the stormwater related work in Area A only open trench excavation was considered.

Based on the findings of the concept and viability report, conventional construction is proposed as the upgrade technique. The items below provide more details to justify this decision.

4.1 Conventional Construction

Conventional open trench excavations are most commonly used for all pipeline installations. This method involves digging a trench along the pipeline route to accommodate the pipe and related structures.

The following is a typical overview of the process:

1.1.1 Planning:

Determine the pipeline route, considering factors like terrain, existing services, and environmental considerations if applicable. Obtain necessary permits and wayleaves etc.

1.1.2 Excavation:

Use sufficient machinery, such as excavators, to dig an open trench along the planned route. The trench's dimensions depend on pipe size, depth requirements, and soil conditions.

1.1.3 Support and Shoring:

If required install support structures like trench boxes or shoring systems to prevent cave-ins and ensure worker safety. This is particularly important for deep excavations or unstable soil.

1.1.4 Pipe Installation:
Lay the water/sewer/stormwater pipeline into the trench, ensuring proper alignment and grade. Connect pipe sections using appropriate fittings and jointing methods.

1.1.5 Backfilling:

Once the pipe is in place, backfill the trench with suitable materials, such as compacted soil, gravel, layer works etc. This provides support, protects the pipe, and restores the ground surface.

1.1.6 Compaction and Restoration:

Compact the backfilled materials to ensure stability and minimize settling. Restore the surface areas to its previous condition, including e.g., grassing or repaving affected areas.

1.1.7 Testing and Commissioning:

Perform pressure tests and other necessary inspections to ensure the integrity and functionality of the installed water pipeline.

1.1.8 Advantages of Conventional Construction:

- Versatility: Open-cut trenching is applicable to a wide range of pipe materials, sizes, and soil conditions. It can be used for various types of pipes, including PVC, HDPE, concrete, and metal, making it a versatile method for different projects.
- Accessibility: With open-cut trenching, the entire length of the pipe is accessible for inspection, repair, or replacement. This allows for comprehensive assessments of the pipe condition and facilitates accurate measurements and fittings during installation.
- Cost-effective for certain scenarios: In some cases, conventional pipe excavation can be more cost-effective than trenchless methods. If the project involves short pipe runs or areas with easy access and minimal obstructions, open-cut trenching may require fewer specialized equipment and skilled labour, resulting in lower overall costs.
- Simplicity: Open-cut trenching is a straightforward and well-established method. Contractors and workers are generally familiar with the process, and it can be easier to plan and execute in certain cases compared to trenchless techniques.

1.1.9 Disadvantages of Conventional Construction:

- Extensive disruption: Open-cut trenching involves significant excavation, which can cause disruptions to traffic, utilities, and nearby properties. Roads may need to be closed or rerouted, and disruption to utility services can inconvenience residents and businesses in the area. Disruption of potable water supply to the residents during connections.
- Longer project duration: Excavation-based methods typically take longer to complete compared to trenchless methods. The process of digging the trench, installing the pipe, backfilling, and restoring the surface can be time-consuming, relating to increased cost.
- Costly restoration: After the pipe installation or repair is complete, the site needs to be restored to its original condition. This may involve repaving roads, reseeding vegetation, and restoring landscaping features, which can add to the overall project time and cost.
- Relocation of other existing services is required in many instances to allow for trench excavations.
- Risk of trenches settling on sidewalks and in roads due to substandard compaction of backfill in trenches.
- Multiple joints in pipe network (as least every 6 m in the case of PVC pipes) creating multiple risks of failures and leaks.
- Limited access in certain areas: Open-cut trenching may not be feasible or practical in certain locations, such as densely populated urban areas with limited space, areas with underground utilities or structures that make excavation challenging.

1.1.10 Reasons to Justify decision of Conventional Construction

- Concrete stormwater pipes cannot be replaced using pipe-cracking methods.
- Limited replacement of water pipes is expected, which does not justify trenchless methods.
- Sewer pipelines in certain areas will be relocated from mid-block erven into road reserves, making pipe-cracking impossible.
- In some sections, the existing sewer pipe alignments within the streets are not desirable and will therefore need to be realigned.

5. EXISTING SERVICES & WAYLEAVES

Various existing services are located in the vicinity of the proposed works including municipal services and external services such as fibre. Lyners have obtained all the existing services details of the municipal services (Civil Engineering Services Directorate and Electrotechnical Directorate) and have applied for wayleaves for the following services:

1. **Telkom/Openserve;**
2. **Neotel/Liquid Telecoms;**
3. **Frogfoot;**
4. **Octotel;**
5. **Eskom;**
6. **Fibre Contractors not listed above, such as MTN, Vodacom etc;**

All services will need to be carefully opened prior any excavations to confirm locations. Crossing of various services as well as roads is anticipated in all the road reserves.

The existing service details received have been indicated in detail design drawings and incorporated into the detail design.

5.1 Existing Services

5.1.1 Water

In accordance with the Water Masterplan received from GLS Consulting and the GIS data provided by the George Municipality, existing water services are distributed throughout Area A in Rosemoor, where the proposed works are to take place. The detailed design of the relevant civil services to be upgraded have considered the locations of the existing water reticulation pipelines.

5.1.2 Sewer

In accordance with the Sewer Masterplan received from GLS Consulting and the GIS data provided by the George Municipality, existing sewer services are distributed throughout Area A in Rosemoor, where the proposed works are to take place. The detailed design of the relevant civil services to be upgraded have considered the locations of the existing sewer reticulation pipelines.

The existing sewer pipelines consist of Santar pipes, also known as fibre/pitch pipes. Due to their structural degradation over time and unsuitability for long-term use, these pipelines will be replaced with uPVC Class 34 pipes to ensure durability, reliability, and compliance. The old, abandoned pipes will be left in place. Manholes will be demolished and filled up.

5.1.3 Stormwater

The proposed civil services upgrades are expected to intersect with the existing stormwater drainage infrastructure. The new stormwater pipelines will mostly be installed in the same position as the existing infrastructure. The current existing pipes will need to be removed during construction.

5.1.4 Streets

The proposed civil services upgrades are expected to have a significant impact on the existing streets within Area A of Rosemoor. Due to the narrow street reserves and the presence of existing civil services within/on the sidewalks, most of the new sewer infrastructure will need to be installed within the roadway itself. Given the already deteriorated condition of these streets, substantial street upgrades will be required following the installation of the sewer infrastructure.

5.2 Proposed Phasing of Construction

Due to budgetary constraints and consultant appointments on different municipal term tenders, the project will be implemented in multiple phases across various financial years. Phase 1 will focus

exclusively on Area A, as shown in Figure 2 above. Subsequent phases thereafter will address the remaining areas (infrastructure upgrades) based on available funding.

6. SUB-CONSULTANTS AND SPECIALIST SERVICE PROVIDERS

6.1 Engineering Survey

Joubert and Brink was appointed to conduct an engineering survey of the site to identify all the existing features and services along the proposed pipeline routes to position the new proposed civil infrastructure by limiting the impact on the existing services.

The engineering surveyor provided the survey information electronically, complete with all features, contours, existing services, and cadastral information indicating the erf numbers etc for Rosemoor Area A.

6.2 Health and Safety Agent

A Health and Safety Agent will be required to:

- Attend design meetings.
- Prepare baseline risk assessments and site-specific health and safety specifications.
- Evaluate and approve successful Service Providers / Contractors Health and Safety Plans, which will be prepared in response to the risk assessments and specifications.
- Prepare and apply for a Construction Work Permit if required.
- Attend monthly site meetings and perform monthly audits (minimum two site visits per month).
- Prepare and submit monthly Health and Safety audit reports.
- Manage the Contractor's compliance with his Health and Safety Plan, the Health and Safety Specifications and the OHS legislation.
- Prepare and submit a Health and Safety close-out report on completion.
- Accept the duties and responsibilities of the Client as set out in the Construction Regulations.

A Health and Safety Agent will be appointed by George Municipality before implementation of this project.

6.3 Environmental

Sharples Environmental Services has been appointed as the environmental consultant to undertake the necessary statutory environmental authorisation processes for the project. The project requires General Authorisation (GA) in terms of applicable environmental legislation, as well as a Water Use Licence (WUL) specifically for the proposed stormwater outlet structures. They are currently in the process of obtaining environmental approval. All relevant requirements to date have been included in the detail design. Once the Environmental Approval is obtained a Environmental Management Plan will be compiled that must form part of the contract document.

6.4 Geotechnical Investigation

Outeniqua Laboratory was appointed to carry out the geotechnical investigation for the project. In summary, most of the test pits within the roads indicated asphalt surfacing at about 30mm thick, with a G4 base course below. The depth overall varies between approximately 180mm to 200mm.

The material below the base course is classified between a G7 and G8 selected subgrade as per COLTO specifications. The stability of the site appears suitable for excavating in dry conditions. If moisture is allowed into open trenches the stability at the slopes could be affected.

6.4.1 Summary of investigation

In summary, most of the test pits within the roads indicate asphalt surfacing at about 30mm thick, with a G4 base course below. The overall depth varies between approximately 180mm to 240mm. the

material below the base course is classified between a G7 and G8 selected subgrade as per COLTO specifications. The material stability of the site appears suitable for excavations in dry conditions. If moisture is allowed into the open trenches the stability of the slopes could be affected.

The investigation indicated that the site is suitable for the pipeline upgrades with the material being easily excavatable with a TLB in most areas, with no hard rock encountered along the proposed routes. The site is also stable under dry conditions, but care must be taken to shore the walls of the trenches where any possible perched water tables could be encountered. Consideration must be taken when selecting backfilling material from the site and bedding and blanket material should be imported from commercial sources.

7. COST ESTIMATE

The cost estimate below is based on recent unit prices of similar projects. A summary of the construction cost and professional services is indicated below in Table 3:

CIVIL ENGINEERING SERVICES FOR ROSEMOOR PHASE 1 (AREA: A) GEORGE: COST ESTIMATE

8/9/2025

Project no.: 24052CG	Erven	**247 Erven**		
	Unit	Rate	Quantity	**TOTAL**
Civil Engineering Services:				
Internal Services				
Water				
Preliminary and General @ 15%		15%		R 142 334,40
160mm dia. uPVC Class 12	R/m	R 1 039,48	200	R 207 896,00
Smart water meters	Sum	R 3 000,00	247	R 741 000,00
Sub-Total A				**R 1 091 230,40**
Sewer				
Preliminary and General @ 15%		15%		R 683 823,07
110mm uPVC Class 34	R/m	R 1 180,00	1530	R 1 805 400,00
160mm uPVC Class 34	R/m	R 1 358,21	2 260	R 3 069 550,79
200mm uPVC Class 34	R/m	R 1 395,00	110	R 153 450,00
315mm uPVC Class 34	R/m	R 1 464,69	260	R 380 819,66
House connections	Sum	R 5 000,00	191	R 955 000,00
Sub-Total B				**R 7 048 043,51**
Stormwater				
Preliminary and General @ 15%		15%		R 263 772,00
450mm 100D	R/m	R 2 300,00	120	R 276 000,00
600mm 100D	R/m	R 2 600,00	165	R 429 000,00
750mm 100D	R/m	R 2 790,00	12	R 33 480,00
1050mm 100D	R/m	R 3 000,00	115	R 345 000,00
Inlet structure (catchpits)	Sum	R 15 000,00	10	R 150 000,00
Outlet structure (head, wing and gabions)	Sum	R 25 000,00	6	R 150 000,00
Gabion structures (Erosion management)	R/m3	R 2 500,00	150	R 375 000,00
Sub-Total C				**R 2 022 252,00**
Roads				
Preliminary and General @ 15%		15%		R 2 130 960,00
Rip and clear exisitng asphalt road surface	R/m2	R 75,00	2 500	R 187 500,00
Reinstate paving road (Including layer works)	R/m2	R 850,00	20	R 17 000,00
Reinstate asphalt road (Including layer works)	R/m2	R 900,00	14 905	R 13 414 500,00
Reinstate sidewalk (Gravel surface)	R/m2	R 130,00	980	R 127 400,00
MK10 Kerb	R/m	R 250,00	800	R 200 000,00
CK5 Kerb	R/m	R 260,00	1 000	R 260 000,00
Sub-Total D				**R 16 337 360,00**
Sub-Totals Combined A-D				**R 26 498 885,91**
Bulk Services				
Sewer				
Preliminary and General @ 15%		15%		R 501 796,81
250mm uPVC Class 34	R/m	R 1 512,37	230,00	R 347 844,60
400mm uPVC Class 34	R/m	R 3 709,74	808,00	R 2 997 467,44
Sub-Total E				**R 3 847 108,84**
Sub-Totals Combined A-E				**R 30 345 994,75**
Contingencies @ 10%		10%		R 3 034 599,48
Sub-Total				**R 33 380 594,23**
CPA (7.5% per year, 1 year allowance)		7,5%		R 2 503 544,57
Total				**R 35 884 138,79**
Professional Fees				
Engineering Fees				R 3 109 250,87
Construction Monitoring Level 2				R 324 000,00
Sub-Soncultant - Survey				R 177 500,00
Sub-Consultant - Geo Tech				R 70 000,00
Sub-Consultant - Environmental Authorization				R 385 000,00
Health and Safety Agent				R 270 000,00
Environmental Control Officer				R 270 000,00
Sub-Total C				**R 4 605 750,87**
Sub-Totals Combined A-B-C				**R 40 489 889,66**
Vat @ 15%				R 6 073 483,45
TOTAL				**R 46 563 373,11**

Table 3: Estimated Project Cost

8. CASHFLOW AND PROGRAM

Please refer to Annexure G for the estimated project programme and cash flow

9. CONCLUSION

The upgrading of stormwater, water, and sewer infrastructure in Rosemoor (Area A) is a necessary intervention to enhance the reliability, efficiency, and safety of essential private property, and to improve the livelihood of the community in this area. By addressing aging and inadequate infrastructure, the project will not only improve service delivery but also reduce the risk of system failures, flooding, and health hazards. This upgrade will form part of a broader strategy to ensure long-term sustainability and quality of life for the Rosemoor community.

10. RECOMMENDATION

Based on the detail assessments and the nature of the existing infrastructure in Rosemoor (Area A), the following is recommended to ensure the effective and practical implementation of the proposed civil upgrades. These recommendations are aimed at addressing current constraints and facilitating efficient construction within the available project budget and timelines:

1. Open trench excavation is recommended for the upgrade of the stormwater, water, and sewer infrastructure. This approach is necessary due to the following reasons:
    - Concrete stormwater pipes cannot be replaced using pipe-cracking methods.
    - Limited replacement of water pipes is expected, which does not justify trenchless methods.
    - Sewer pipelines in certain areas will be relocated from mid-block erven into road reserves, making pipe-cracking impossible.
    - In some sections, the existing sewer pipe alignments within the streets are not desirable and will therefore need to be realigned.
2. The Rosemoor upgrades must commence as per the detail layout drawings included under Annexure A.
3. Consultant to proceed with tender documentation.

ANNEXURE A

DETAIL DESIGN DRAWINGS

ANNEXURE B

WATER & SEWER MASTER PLANS FROM GLS CONSULTING

ANNEXURE C

NADESON CONSULTING SERVICES
STORMWATER MASTER PLAN

ANNEXURE D

GEORGE MUNICIPALITY CIVIL ENGINEERING DESIGN STANDARDS

ANNEXURE E

EXISTING SERVICES

ANNEXURE F

GEOTECHNICAL INVESTIGATION

ANNEXURE G

CASHFLOW AND PROGRAM

ANNEXURE H

SEWER AND STORMWATER TYPICAL DETAILS

ANNEXURE I

SEWER AND STORMWATER CALCULATIONS