

SCHAAPKOP RIVER MANAGEMENT PLAN

Final – December 2025

**Prepared in terms of the National Environmental Management Act 107 of 1998:
Environmental Impact Assessment Regulations, 2014 as amended;
and the**

National Water Act (No. 36 of 1998) (NWA)

DEA&DP Reference Number: 16/3/3/6/3/D2/19/0068/25

Prepared by Zutari, on behalf of George Municipality (December 2025)



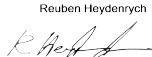
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Executive Summary

1. Introduction to the Schaapkop River Management Plan

The George Municipality commissioned the Schaapkop River Management Plan (RMP) to guide river management and authorise management actions under the National Environmental Management Act, 1998 (Act No. 107 of 1998) and the National Water Act, 1998 (Act No. 36 of 1998).

The Schaapkop RMP has two objectives:

► **Infrastructure maintenance under NEMA**

To approve the commencement of applicable listed activities, associated with maintenance activities for existing infrastructure within a defined site, under the Environmental Impact Assessment Regulations of the National Environmental Management Act, 1998 (Act No. 107 of 1998). This will allow the municipality to carry out maintenance activities without requiring environmental authorisation and ensure that such work does not cause significant harm to the river system.

► **Ecological protection and improvement**

To improve the protection of freshwater ecosystems in the Schaapkop River catchment by recommending actions to improve the Present Ecological State. The identified actions aim to monitor, restore and improve the ecological benefits the river provides.

The George Municipality adopted the document as a **River Management Plan (RMP)** rather than a Maintenance Management Plan (MMP) because:

1. The plan covers more than the minimum MMP requirements and lists the actions that will be taken to manage both infrastructure and river health.
2. It recognises the ecological and socio-economic benefits provided by the Schaapkop River, which a standard MMP does not address.
3. The MMP component is included to allow maintenance under NEMA and the NWA, while the RMP also guides actions to improve the river's ecological state.

The project background is discussed in detail in Section 1 of this document.

2. Defining the 'Site' for the RMP

To effectively manage maintenance activities and environmental considerations, a specific geographical area, referred to as "the site", has been meticulously defined. The step-by-step process of delineating "the site" is described in detail in Section 2 of the RMP. The Schaapkop River is divided into a single River Management Unit (RMU) which is depicted in Figure 1-3 of the RMP and in a series of high-resolution maps:

- Appendix A: Schaapkop RMU High-Resolution Site Maps.

3. Understanding the Environmental Baseline Conditions

Desktop and site inspections were conducted in 2024 and 2025 to assess the environmental baseline conditions of the Schaapkop River, using the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) standards. Assessments considered regional context, conservation frameworks such as the Western Cape Biodiversity Spatial Plan, and hydrological data. Field inspections identified watercourses, evaluated vegetation, and assessed potential impacts from maintenance activities.

A detailed description of the environmental baseline is included in Section 4 of the RMP.

4. Legal and Regulatory Framework

The Schaapkop RMP is structured to meet the applicable requirements under both the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) and the National Water Act, 1998 (Act No. 36 of 1998) (NWA). A detailed legal framework is included in Section 6.

- ▶ In terms of NEMA, the plan is proposed for authorisation as a MMP for the undertaking applicable Listed Activities required for maintenance actions.
- ▶ In terms of the NWA, the RMP will be authorised through a General Authorisation (GA) as per the requirements in GN R 4167 of 2023¹.

5. Implementation and Responsibilities under the RMP

The table below lists the stakeholders identified for the approval and implementation of the RMP. Refer to Section 7 for more detail.

Stakeholder	Identified Responsibilities
George Municipality	Custodian of the RMP. Ensure overall compliance; communicate plan requirements; oversee implementation.
Department of Environmental Affairs and Development Planning (DEA&DP)	Approve MMP under NEMA; review compliance; enforce NEMA requirements
Breede-Olifants Catchment Management Agency (BOCMA)	Approve RMP under NWA; review compliance; enforce NWA requirements
Environmental Control Office (ECO)	Monitor compliance; approve methods; conduct inspections; compile reports; advise on remedial actions
Staff/Contractors	Implement approved methods; follow MMP requirements; attend environmental training

6. Maintenance Management Plan (MMP)

The MMP component is contained in Section 8 of this document. The MMP lists the identified maintenance activities for municipal infrastructure within the Schaapkop MMP site, including bridges, stormwater outlets, pipelines, pump stations, and vegetation management (both indigenous and alien plants). Environmental considerations and mitigation measures are provided for each activity. Section 8 also contains the framework for compliance monitoring and reporting standards.

7. Strategies for Improving River Health

In addition to managing maintenance impacts, the RMP sets objectives and actions to improve the overall health of the Schaapkop River. The primary objectives are to (Section 9.1):

- ▶ Increase protection of freshwater ecosystems.
- ▶ Improve the Present Ecological State (PES) of the Schaapkop RMU from Category D → C.

The management actions for achieving the river health objectives are discussed in Section 9.2.

8. Monitoring

An Ecological Monitoring Program is proposed to track progress toward river health objectives. Monitoring includes biomonitoring techniques such as SASS5 (macroinvertebrates), diatom assessments, the Index of Habitat Integrity (IHI), and water quality sampling. Parameters and monitoring frequency are defined to evaluate the effectiveness of management actions and inform adaptive management. The monitoring actions to track progress of management actions are discussed in Section 9.3 of this document.

9. Conclusion

The Schaapkop RMP is the first step in enabling interventions needed for the management of the Schaapkop RMU, as defined in this document. It is intended to provide a legally approved framework that allows George Municipality to achieve the RMP's objectives in compliance with the National Environmental Management Act, 1998 (Act No. 107 of 1998), Environmental Impact Assessment

¹ General Authorisations in terms of Section 39 of the National Water Act, 1998 (Act No. 36 of 1998) for Water Uses as defined in Section 21(c) or Section 21(i)

Regulations and the National Water Act, 1998 (Act No. 36 of 1998). The plan also establishes reporting standards to allow oversight by the DEA&DP and the BOCMA.

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Definitions

"Activity" means an activity identified in any notice published by the Minister or MEC in terms of section 24D(1)(a) of the Act as a listed activity or specified activity. Activity in this document refers to the activities as listed in Listing Notice 1, 2 and 3 of the Environmental Impact Assessment Regulations, 2014 (as amended).

"Bush Encroachment" means stands of plants of the kinds specified in column 1 of Table 4 of the Conservation of Agricultural Resources Act (Act No. 43 of 1983) where individual plants are closer to each other than three times the mean crown diameter.

"Diverting" as defined in the General Authorisation, in terms of section 39 of the National Water Act, 1998 (Act No. 36 of 1998) for Water Uses as defined in Section 21(c) and 21(i) (GN. 509 of 2016), means to, in any manner, cause the instream flow of water to be rerouted temporarily or permanently.

"Ecological Infrastructure" refers to naturally functioning ecosystems that deliver valuable services to people, such as water and climate regulation, soil formation and disaster risk reduction.

"Estuary" has the meaning assigned to it in the National Environmental Management: Integrated Coastal Management Act, 2008 (Act No. 24 of 2008)

"Flood event" is the event where land is inundated by the overflowing of water from a river channel and where this event causes significant damage to infrastructure or results in watercourse erosion and/or sediment deposition.

NOTE that flooding can be a natural phenomenon in many river or wetland systems which, due to encroachment and human modification of the form and function of the affected system, may have evolved into a potential hazard to life or property.

"Flow-altering" as defined in the General Authorisation, in terms of section 39 of the National Water Act, 1998 (Act no 36 of 1998) for Water Uses as defined in Section 21(c) and 21(i) (GN. 509 of 26 August 2016), means to, in any manner, alter the instream flow route, speed or quantity of water temporarily or permanently.

"General Authorisation" in this document refers to the General Authorisation in terms of section 39 of the National Water Act, 1998 (Act No. 36 of 1998) for Water Uses as defined in Section 21(c) or Section 21(i) (GN R 509 of 2016).

"Impeding" as defined in the General Authorisation, in terms of section 39 of the National Water Act, 1998 (Act no 36 of 1998) for Water Uses as defined in Section 21(c) and 21(i) (GN. R 509 of 2016), means to, in any manner, hinder or obstruct the instream flow of water temporarily or permanently, but excludes the damming of flow so as to cause storage of water.

"Indigenous vegetation" refers to vegetation consisting of indigenous plant species occurring naturally in an area, regardless of the level of alien infestation and where the topsoil has not been lawfully disturbed during the preceding ten years.

"Maintenance" means actions performed to keep a structure or system functioning or in service on the same location, capacity and footprint.

"Maintenance Management Plan" means a management plan for maintenance purposes defined or adopted by the competent authority.

"River Management Plans" as defined in the General Authorisation, in terms of section 39 of the National Water Act, 1998 (Act No. 36 of 1998) for Water Uses as defined in Section 21(c) and 21(i) (GN R 509 of 2016), any river management plan developed for the purposes of river or storm water

management in any municipal/metropolitan area or described river section, river reach, entire river or sub quaternary catchment that considers the river in a catchment context.

"River reach", a length of river characterised by a particular channel pattern and channel morphology, resulting from a uniform set of local constraints on channel form. A river reach is typically hundreds of meters in length.

"Stretch" a section of watercourse, delineated between two or more mapped coordinates, within which proposed maintenance activities are to take place as guided by an MMP.

"Thalweg" refers to the line of lowest elevation within a valley or watercourse.

"Watercourse" means:

- (a) a river or spring;
- (b) a natural channel in which water flows regularly or intermittently;
- (c) a wetland, lake or dam into which, or from which, water flows; and

any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse as defined in the National Water Act, 1998 (Act No. 36 of 1998); and a reference to a watercourse includes, where relevant, its bed and banks.

"Wetland" means, land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil.

Abbreviations

CBA	Critical Biodiversity Area
CFE	Cape Fold Ecoregion
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CMB	Catchment Management Branch
CR	Critically Endangered
DEA&DP	Department of Environmental Affairs and Development Planning
DWS	Department of Water & Sanitation
EAP	Environmental Assessment Practitioner
EIS	Ecological Importance and Sensitivity
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EN	Endangered
ESA	Ecological Support Area
ESA	Early Stone Age
DFFE	Department of Forestry, Fisheries, and the Environment
DTM	Digital Terrain Model
DWS	Department of Water and Sanitation
GA	General Authorisation
GM	George Municipality
GN	Government Notice
HGMs	Hydrogeomorphic Units
LC	Least Concern
LSA	Late Stone Age
MAP	Mean Annual Precipitation
MMP	Maintenance Management Plan
MSA	Middle Stone Age
NBA	National Biodiversity Assessment
NEMA	National Environmental Management Act, 1998 (No. 107 of 1998)
NEMAQA	National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004)
NEMBA	National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004)
NEMPAA	National Environmental Management: Protected Areas Act, 2003 (Act No. 57 of 2003)
NEMLAA	National Environmental Management Laws Amendment Act, 2022 (Act No. 02 of 2022)
NFA	National Forest Act, 1998 (Act No. 84 of 1998)
NFEPA	National Freshwater Ecosystem Priority Area
NHRA	National Heritage Resources Act, 1999 (Act No. 25 of 1999)
NNR	No Natural Remaining
NWA	National Water Act, 1998 (Act No. 36 of 1998)
OHSA	Occupational Health and Safety Act, 1998 (Act No. 85 of 1998)
ONA	Other Natural Area
PES	Present Ecological State
PFA	Probabilistic Flood Analyses

PHS	Provincial Heritage Site
PIA	Paleontological Impact Assessment
PPP	Public Participation Process
RI	Recurrence Interval
RMU	River Management Unit
SAHRA	South African Heritage Resources Agency
SAHRIS	South African Heritage Resources Information System
SANBI	South African National Biodiversity Institute
SCS	Soil Conservation Services
SQC	Sub-Quaternary Catchment
SuDS	Sustainable Drainage System
SWSA	Strategic Water Source Area
UCT	University of Cape Town
VU	Vulnerable
WCBSP	Western Cape Biodiversity Spatial Plan
WULA	Water Use Licence Authorisation
WWTW	Wastewater Treatment Works

1 Background and Introduction

1.1 Objectives of the River Management Plan

The George Municipality commissioned the Schaapkop River Management Plan (RMP) to guide river management and authorise management actions under the National Environmental Management Act, 1998 (Act No. 107 of 1998) and the National Water Act, 1998 (Act No. 36 of 1998).

Section 8 of the RMP contains the Maintenance Management Plan (MMP) and is the subject of the application to the Department of Environmental Affairs and Development Planning (DEA&DP).

The MMP was developed as part of the RMP to authorise applicable listed maintenance activities in a watercourse² in terms of the Environmental Impact Assessment Regulations made under the National Environmental Management Act, 1998 (Act 107 of 1998). Similar plans have been developed for the Gwaing and Meulen rivers (see Figure 1-1):



The overarching objectives of these RMPs are two-fold:

1. To facilitate efficient maintenance of existing infrastructure along the watercourses; and
2. To improve the ecological functioning of the watercourses and enhance ecosystem services benefits that the watercourses provide through targeted interventions.

The George Municipality adopted the document as a River Management Plan (RMP) rather than a Maintenance Management Plan (MMP) because:

- ▶ The plan covers more than the minimum MMP requirements and lists the actions that will be taken to manage both infrastructure and river health.
- ▶ It recognises the ecological and socio-economic benefits provided by the Schaapkop River, which a standard MMP does not address.
- ▶ The MMP component is included to allow maintenance under NEMA and the NWA, while the RMP also guides actions to improve the river's ecological state.

This document focuses on the Schaapkop River only. Separate RMPs have been prepared for the Gwaing and Meulen Rivers.

All three river systems are located within the area of jurisdiction of George Municipality, and they are located largely within urbanised areas (particularly in the lower portions of their catchments). A large proportion of this area is designated as the Outeniqua Strategic Water Source Area (SWRA) as indicated by Figure 1-2 below.

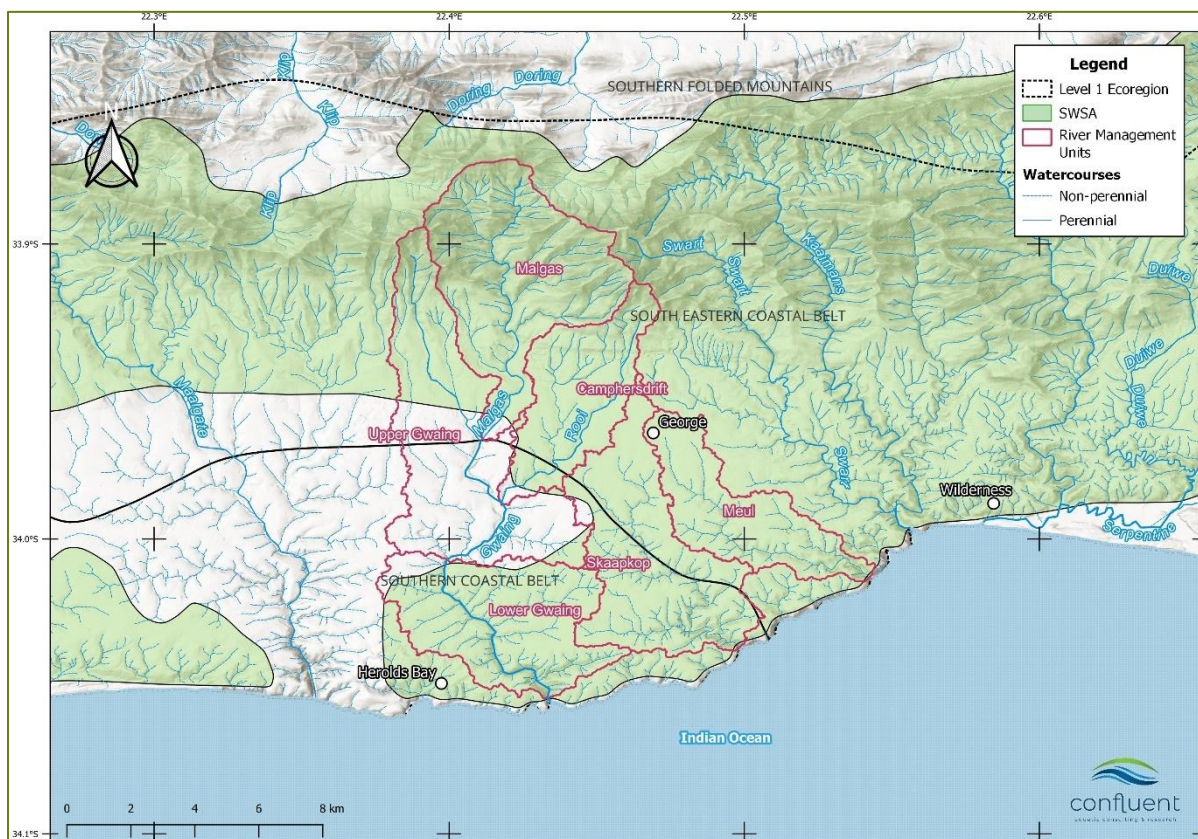


Figure 1-2: The Outeniqua Strategic Water Source Area (SWSA) relative to the delineated RMUs.

A SWRA is defined as an area of land that is considered nationally important because it may provide either one of both of the following benefits:

1. It supplies a disproportionately high volume of mean annual surface water runoff in relation to its size; or

2. It has high groundwater recharge potential.

A large proportion of the Gwaing, Schaapkop and Meulen catchments are located in the Outeniqua Strategic Water Source Area (SWSA), which serves as an important source of high volumes of good quality water (see Figure 1-2).

Accordingly, another objective of the RMP is the protection of the quantities and quality of the water produced in the catchment through well-informed and proactive land management, land-use and development planning. Large proportions of the river basin fall within an urban 'working landscape'. Within this context, further management objectives are to:

1. Improve levels of protection currently afforded to freshwater ecosystems in the Schaapkop River catchment area;
2. Improve the Present Ecological State (PES) of freshwater ecosystems in the Schaapkop River catchment area, and
3. Monitor aquatic ecosystems with a view to auditing the objectives of the RMP.

Considering the strategic importance of the river systems in this area, it is vitally important to protect their ecosystem services and to try to improve their ecological and water-production potential

1.2 Location of the Schaapkop River Basin

The Schaapkop River originates in urban areas and its tributaries are mostly fed by stormwater run-off from industrial (e.g. Tamsui industrial area), commercial, and residential areas. The Outeniqua WWTW is situated west of the river and south of the N2. The river flows through an urban region, with Pacaltsdorp to the west and Thembaletu (a large informal settlement) to the east. Thereafter, it winds for about 3 km through mostly natural/rural areas before reaching the ocean.

The Schaapkop River can be managed under one River Management Unit (RMU) as depicted in the figure below.

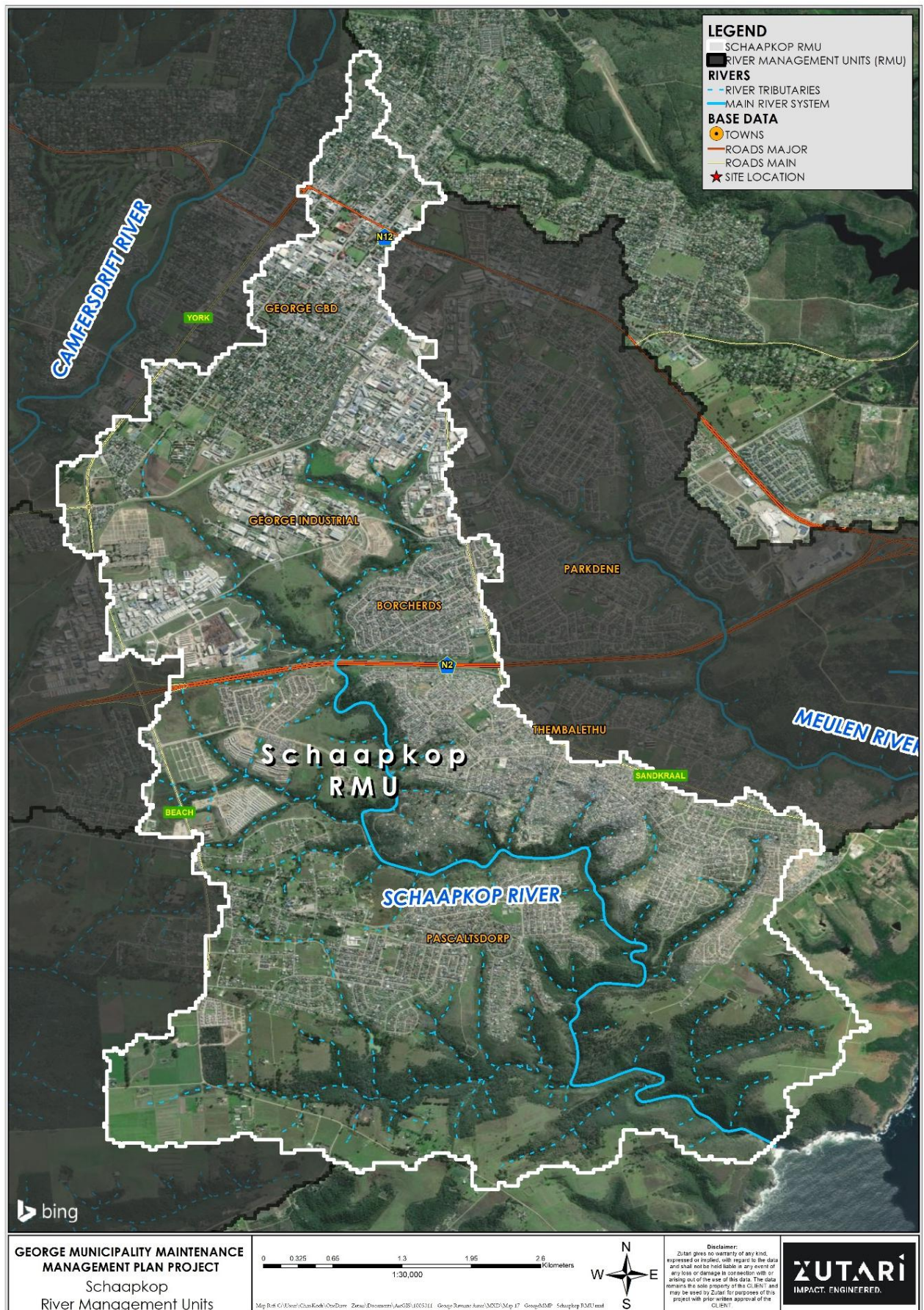


Figure 1-3: Extent of the Schaapkop River basin and the Schaapkop RMU.

1.3 Existing Pressures on the River Systems

Since large parts of the catchments in George Municipality are inside the urban area, the river systems are subject to many anthropogenic pressures and influences. The resulting baseline environmental conditions are discussed in Section 3. Further detail on these pressures and baseline conditions of the RMUs were discussed included under separate cover in a Status Quo Report (Zutari, 2024).

Large portions of their catchments have been urbanised and are no longer natural. Sources of transformation include dams, urban infrastructure such as roads, sewage and water pipelines, and the release of treated effluent. This infrastructure results in impacts like accelerated runoff and erosion due to high volumes of urban stormwater runoff, fragmentation of wetlands and changes in flow regimes due. Accelerated erosion causes sedimentation downstream of the point of erosion. Invasion by alien tree species is also a serious problem, as it reduces surface flows and threatens biodiversity in and around the river. Lastly, the accumulation of litter in the rivers and wetlands is also a serious issue that needs to be constantly addressed. All these pressures on the river systems result in the need for intensive management of these systems.

Table 1-1 shows a summary the current conditions of the Schaapkop River Management Unit (RMU). As indicated in rows 3 (refer to Table 1-1), the Present Ecological State (PES) of the Schaapkop RMU is D. George Municipality intends to improve the PES of the RMUs.

This RMP is an over-arching plan for the management and improvement of the river courses to achieve the above-mentioned goals.

Table 1-1: Summary of current state of the Schaapkop River system, its Present Ecological State and ideal Intended Ecological State

1	ENVIRONMENTAL CONTEXT
	▶ Land use is almost entirely urban (residential, industrial, utilities, dense informal settlements) with limited agricultural use in the lowest reaches. ▶ The catchment area originates entirely from within the urban area of George. ▶ The N2 highway crossing over the Schaapkop River is located in the RMU.
2	EXISTING IMPACTS AND RISKS
	▶ Highly affected by stormwater inputs and pollution from formal and informal urban settlements and industrial areas. ▶ Leaking/blocked sewage infrastructure (i.e. pipelines and pumpstations). ▶ Discharge of stormwater onto steep, unprotected valley sides is widespread, leading to severe erosion. ▶ Littering ▶ Industrial land use ▶ Informal agriculture ▶ High level of alien plant infestation
3	PRESENT ECOLOGICAL STATE (PES)
	▶ D – Largely Modified ▶ A large loss of natural habitat, biota and basic ecosystem functions has occurred
4	IDEAL DESIRED ECOLOGICAL STATE
	▶ Improve PES from D to C Control alien invasive plants in riparian zones and wetlands, implement minimum land use specific river and wetland buffers, restore hydro-functional attributes of unchannelled valley bottom wetlands, adherence to Sustainable Drainage System (SuDS) principles for future developments, strict compliance of WWTW effluent to appropriate standards, survey and detailed mapping of wetlands, maintenance and repair of existing stormwater and sewage infrastructure, implementation of an aquatic water quality and biomonitoring programme to monitor progress in goals.
5	VEGETATION
	▶ Vegetation type of the catchment area is mapped as Garden Route Granite Fynbos (Critically Endangered) in the upper reaches and Groot Brak Dune Strandveld (Endangered) in the lower reaches. However, vegetation has been completely transformed. ▶ High levels of <i>A. mearnsii</i> and <i>Solanum mauritanum</i>.
6	ANIMALS
	▶ <i>Afrixalus knysnae</i>³ could possibly occur in wetland flats and depressions with appropriate emergent aquatic vegetation.
7	INFRASTRUCTURE
	▶ The river flows steep-sides valleys. Extensive erosion in the catchment area has necessitated upgrading of stormwater infrastructure, which will need ongoing maintenance. ▶ Sewers and water pipelines crossing watercourses or located inside or near riparian vegetation

1.4 Benefits of the RMP Approach

Protecting the natural environment will provide numerous benefits to the George Municipality in terms of safeguarding freshwater ecosystems and their associated ecological infrastructure. These natural systems, including rivers, wetlands, and streams, provide essential ecosystem services that support the human well-being and prosperity. Firstly, healthy freshwater ecosystems play a crucial role in

³ Knysna Spiny Reed Frog

maintaining water quality. They act as natural filters, trapping sediments, pollutants, and nutrients, thereby reducing the need for costly water treatment facilities. This natural purification process ensures a reliable supply of clean water for drinking, agriculture, and industrial use, which is fundamental for public health and economic activities.

Moreover, well-preserved freshwater ecosystems contribute to flood regulation and groundwater recharge. Wetlands and riparian zones absorb rainfall, reducing the risk of floods and mitigating the impacts of extreme weather events, which appear to become more frequent due to climate change. These areas also facilitate the gradual infiltration of water into the ground, replenishing aquifers and ensuring sustainable water availability during dry periods. This resilience is particularly vital for municipalities facing the dual challenges of droughts and flooding.

Protecting natural freshwater ecosystems also supports biodiversity and the functioning of ecological networks. These ecosystems provide habitats for a wide array of plant and animal species, many of which are integral to the ecological balance and health of the region. Biodiverse systems are more resilient to environmental changes and stresses, thus maintaining the stability and functionality of the ecological infrastructure. For municipalities, this means a reduction in the risks associated with ecological collapse, such as the loss of pollinators or the proliferation of invasive species, which can have detrimental effects on agriculture and natural landscapes.

Furthermore, preserving natural environments enhances the aesthetic and recreational value of a region, which can boost local tourism and improve the quality of life for residents. Parks, nature reserves, and clean water bodies attract visitors, support local businesses, and provide opportunities for outdoor activities that promote physical and mental well-being. Additionally, green spaces in urban areas improve air quality and provide spaces for community engagement and recreation.

Economic benefits also arise from the protection of ecological infrastructure. By investing in natural solutions, municipalities can often avoid or reduce the costs associated with hard infrastructure. For example, the restoration of wetlands may be more cost-effective than building new stormwater management systems. These natural solutions not only provide multiple ecosystem services but also require less maintenance and offer greater long-term sustainability.

Overall, the protection of natural freshwater ecosystems by local municipalities is essential for ensuring water quality, flood regulation, biodiversity conservation, and community well-being. The positive impacts on ecological infrastructure, economic savings, and enhanced quality of life underscore the importance of integrating environmental stewardship into municipal planning and development strategies. By valuing and preserving their natural environments, municipalities can create resilient, sustainable, and thriving communities.

The project has confirmed with the Breede-Olifants Catchment Management Agency (BOCMA) that a RMP can be authorised via the latest General Authorisation (GA), published in terms of the National Water Act (No. 36 of 1998) (NWA), if it complies with the requirements specified in Appendix B of the GA published on 8 December 2023. The requirements are outlined in Section 6.2.

1.5 Maintenance Management Plans

The RMPs include Maintenance Management Plans (MMPs) allowed for under the EIA regulations (GN R 982 of 2014). MMPs are allowed by these regulations for specified maintenance activities that trigger Listed Activities under the EIA regulations' Listing Notices 1, 2 and 3 (GN R 983, 984 and 985 of 2014). These activities would ordinarily need an Environmental Authorisation before being undertaken. However, in recognition of the repetitive and routine nature of many maintenance activities, environmental authorities are allowed to approve MMPs to avoid the need to obtain EAs for such activities. These activities may then be undertaken on a routine basis without the administrative burden of an application for an EA, subject to adherence to the approved MMP's conditions and recommendations.

MMP approvals must be sought in terms the Environmental Impact Assessment (EIA) Regulations 2014 and must meet the requirements of the “*Information Document for the Development of a Maintenance Management Plan for a Watercourse*” of the Western Cape Department of Environmental Affairs and Development Planning (DEA&DP).

2 Definition of the Site

For an MMP, it is necessary to define the specific locations at which maintenance activities of existing infrastructure will take place, or to define and delineate the specific area within which the prescribed maintenance activities will take place. For the purposes of this project the former is not practical and feasible for the following reasons:

- ▶ The intent of the RMP (inclusive of MMP component) is to cover the entire Schaapkop River system which is a very large area (broadly speaking);
- ▶ The RMP covers all municipal infrastructure types within the defined site and as such this RMP is not being completed for a specific section/point of infrastructure that required maintenance;
- ▶ The RMP provide management and mitigation measures that must be implemented when the need for maintenance arises (allowing the GM to carry out maintenance speedily whilst doing it in an environmentally friendly manner);
- ▶ Implementing a RMP for a large system like the Schaapkop River is more efficient when it is approached holistically and fragmenting maintenance actions into numerous specific projects is administratively more intensive and inefficient from a practical perspective;
- ▶ The broader approach provides more adaptability and cost effectiveness as maintenance issues arise; and
- ▶ Stakeholder engagement relates to the entire Schaapkop River system and as such stakeholders are given the opportunity to provide input into how the river system will be managed and not just specific projects.

Therefore, based on the above reasons, “the site” was geographically defined and are illustrated in the Appendix A.

It is important to remember that the project relates to **existing municipal infrastructure** and not the development of new infrastructure. There is therefore an obligation on the GM to maintain its infrastructure in a manner that does not harm the environment.

The general approach used to define “the site” was to investigate each watercourse and determine its centreline and if the centreline was not clear the lowest elevation on a cross section through the watercourse or wetland was used. The known outer-most limits i.e., the furthest boundary from the centreline of a watercourse (e.g., 1:100-year flood line or mapped wetlands) or the lowest elevation on a cross section through a stream and/or wetland was used as starting point. The boundaries of the site were then adjusted closer to the centreline of a stream or lowest elevation of a stream / wetland, based on cadastral and other constraints.

Each step in this approach is described below, using a small portion of the Schaapkop River basin as an example:

Steps	Description
Step 1 Figure 2-1	▶ Where available, the 1:100-year flood line is used as a starting point to define the boundary of the site. This constitutes the widest known boundary of the watercourse. ▶ Refer to Figure 2-1 below where the 1:100-year flood line boundary is mapped for a section of the river.
Step 2 Figure 2-2	▶ The boundary of the 1:100-year flood line was compared (mapped) against the boundary of the urban area. All built-up areas zoned residential, industrial or similar are considered part of the urban area as these properties have existing rights for development and needs to be managed in that manner (as part of the urban fabric)⁴.

⁴ It is acknowledged that actions taken inside the urban area could potentially impact negatively on the nearby watercourses however urban properties retain established development rights, which cannot be overridden by the measures outlined in a river management plan. Examples of these rights include freedom to build, modify, and maintain properties within legal town planning/zoning parameters and requirements and illegal activities need to be dealt with in line with the applicable requirements.

Steps	Description
	▶ Where it was found that the urban area occurs inside the 1:100-year flood line, the outer boundary of the site was adjusted to exclude the urban area. ▶ This exercise is illustrated in Figure 2-2. ▶ The adjusted site boundary is then taken into the next step.
Step 3 Figure 2-3	▶ The adjusted site boundary from Step 2 was then overlaid with both the 1:100-year flood line and the National Wetland Map (NWM) 5. ▶ Where the NWM5 layer extends further/wider than the 1:100-year flood line, this widest point (defined by the NWM5) constitutes the new site boundary to be taken into the next step. ▶ Refer to Figure 2-3Figure 2-1 below where the NWM5 boundary and the 1:100-year flood line are mapped for a section of the river.
Step 4 Figure 2-4	▶ The boundary of the NWM5 layer (which is now the new site boundary) was compared (mapped) against the boundary of the urban area⁵. ▶ Where it was found that the urban area occurs inside the NWM 5 wetlands boundary, the outer boundary of the site was adjusted to exclude the urban area. ▶ This exercise is illustrated in Figure 2-4. ▶ The adjusted site boundary is then taken into the next step.
Step 5 Figure 2-5	▶ Where there was no 1:100- year flood line and NWM 5 data available for sections of the subject river, a 32m buffer (on either side of the stream) was generated from the centre line of these watercourses. ▶ The adjusted site boundary from Step 4 was then overlaid with the 1:100-year flood line, the National Wetland Map (NWM) 5, and the 32m buffer. ▶ Where the 32m buffer extends further/wider than the 1:100-year flood line and NWM5 layer, this widest point (defined by the 32m buffer) constitutes the new site boundary to be taken into the next step. ▶ Refer to Figure 2-5Figure 2-1 below where the 32m buffer and the NWM5 boundary and the 1:100-year flood line are mapped for a section of the river.
Step 6 Figure 2-6	▶ The boundary of the 32m buffer (which is now the new site boundary) was compared (mapped) against the boundary of the urban area⁵. ▶ Where it was found that the urban area occurs inside the 32m buffer boundary, the outer boundary of the site was adjusted to exclude the urban area. ▶ This exercise is illustrated in Figure 2-6. ▶ The site for the project is now defined following the adjustments in this step.
Step 7 Figure 2-7	▶ The defined site boundary determined through Steps 1 – 6 is mapped for the subject river. ▶ Refer to Figure 2-7 where the site is defined for the portion of the Schaapkop used to illustrate the methodology.
Since watercourses are dynamic, their alignments were adjusted to match stream courses shown on the most recent aerial photos. Information obtained during the site visits was applied to adjust the mapped courses of rivers and streams.	

The “site” was therefore defined through the methodology described above and will be used for the purpose of the DEA&DP application form for the “Adoption of a Maintenance Management Plan” (April 2024).

⁵ It is acknowledged that actions taken inside the urban area could potentially impact negatively on the nearby watercourses however urban properties retain established development rights, which cannot be overridden by the measures outlined in a river management plan. Examples of these rights include freedom to build, modify, and maintain properties within legal town planning/zoning parameters and requirements and illegal activities need to be dealt with in line with the applicable requirements.

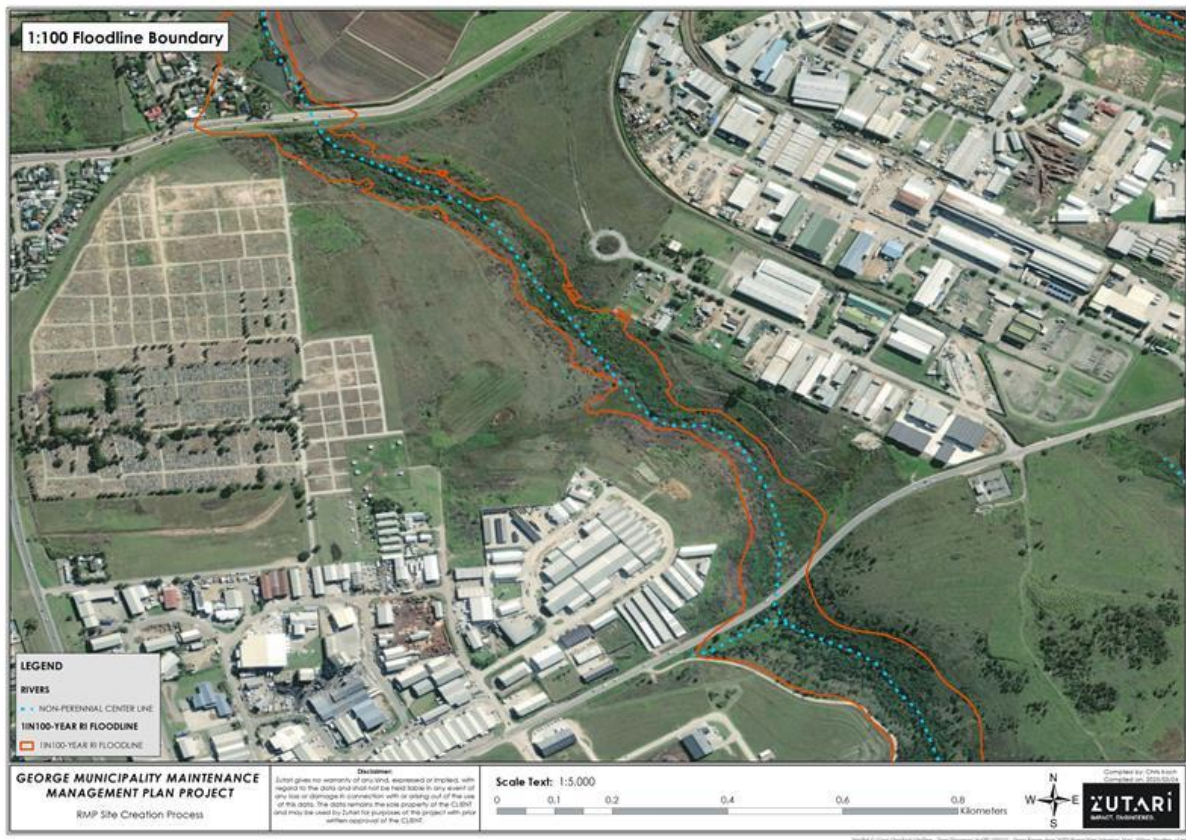


Figure 2-1: Step 1 in defining the site – 1:100 Year flood line boundary

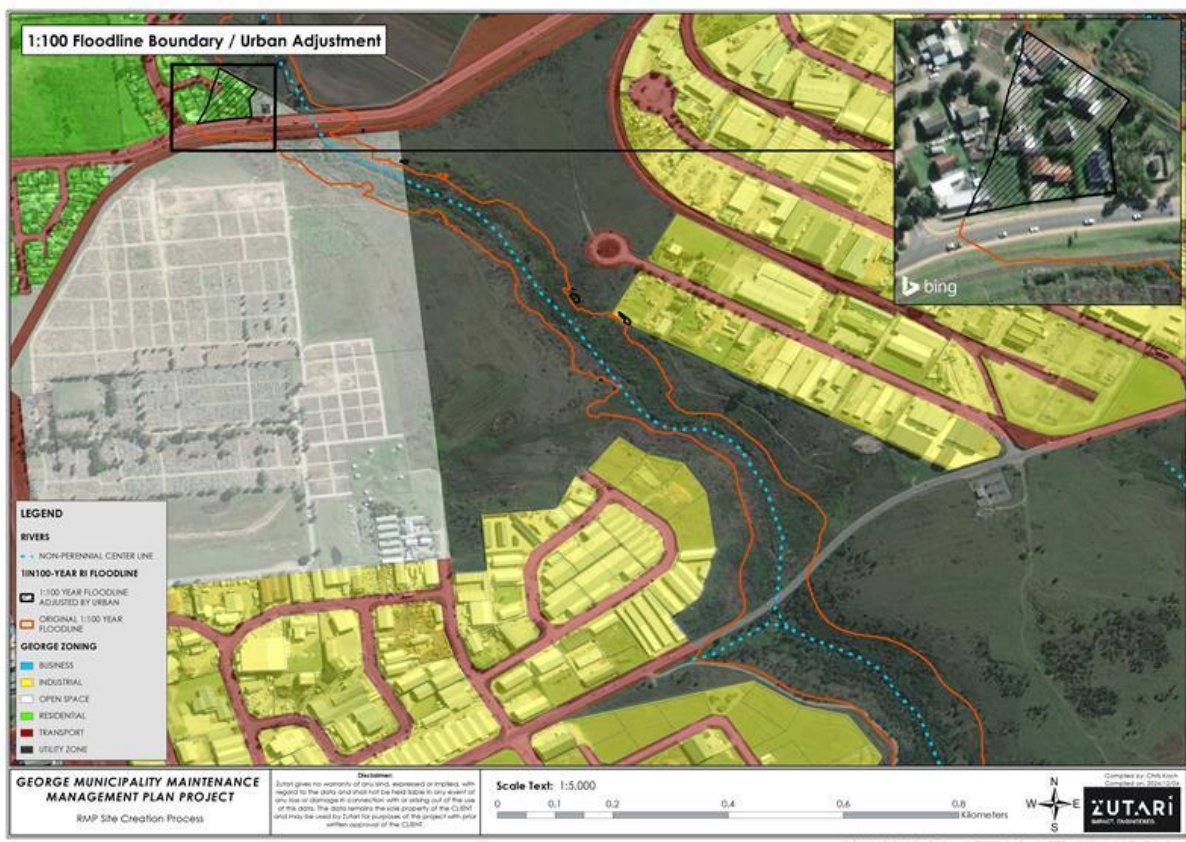


Figure 2-2: Step 2 in defining the site – exclude urban area from the 1:100-year flood line.

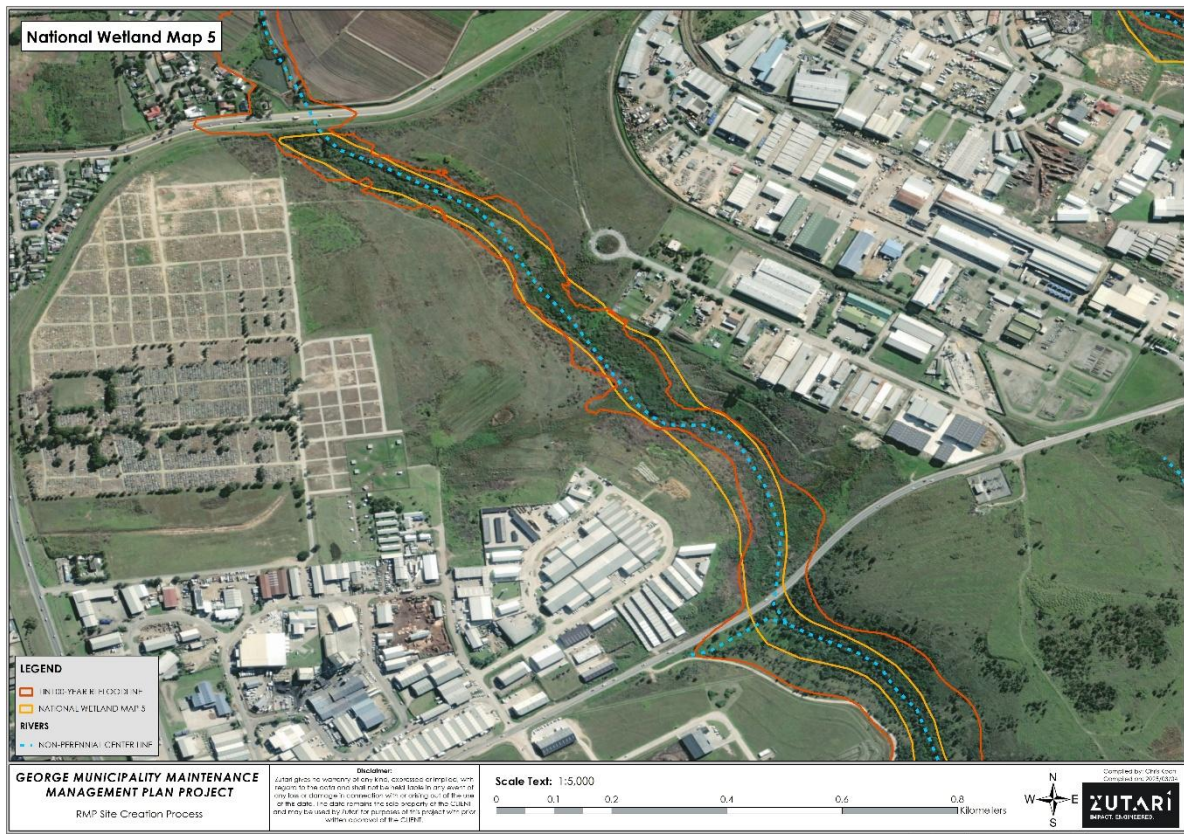


Figure 2-3: Step 3 in defining the site – overlay National Wetland Map 5 boundaries and 1:100-year flood line.

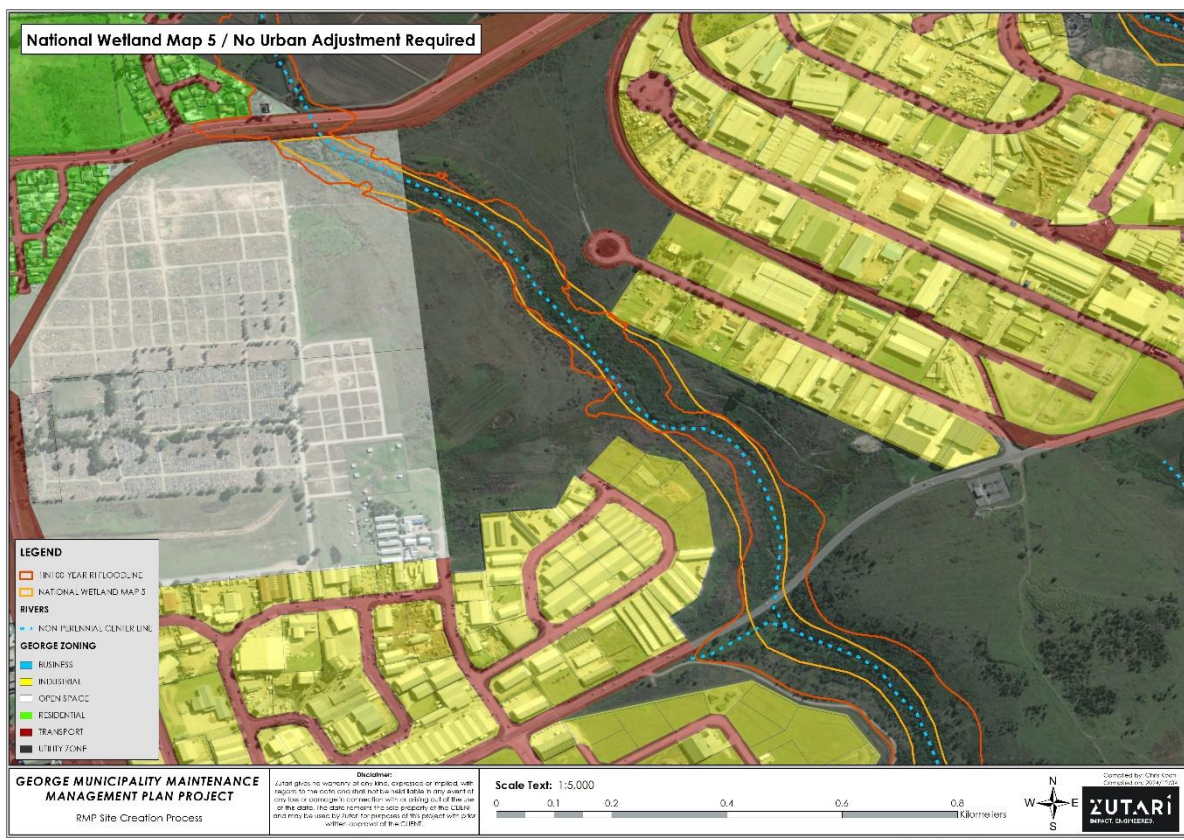


Figure 2-4: Step 4 in defining the site – exclude urban area from the NWM5 layer/boundary.

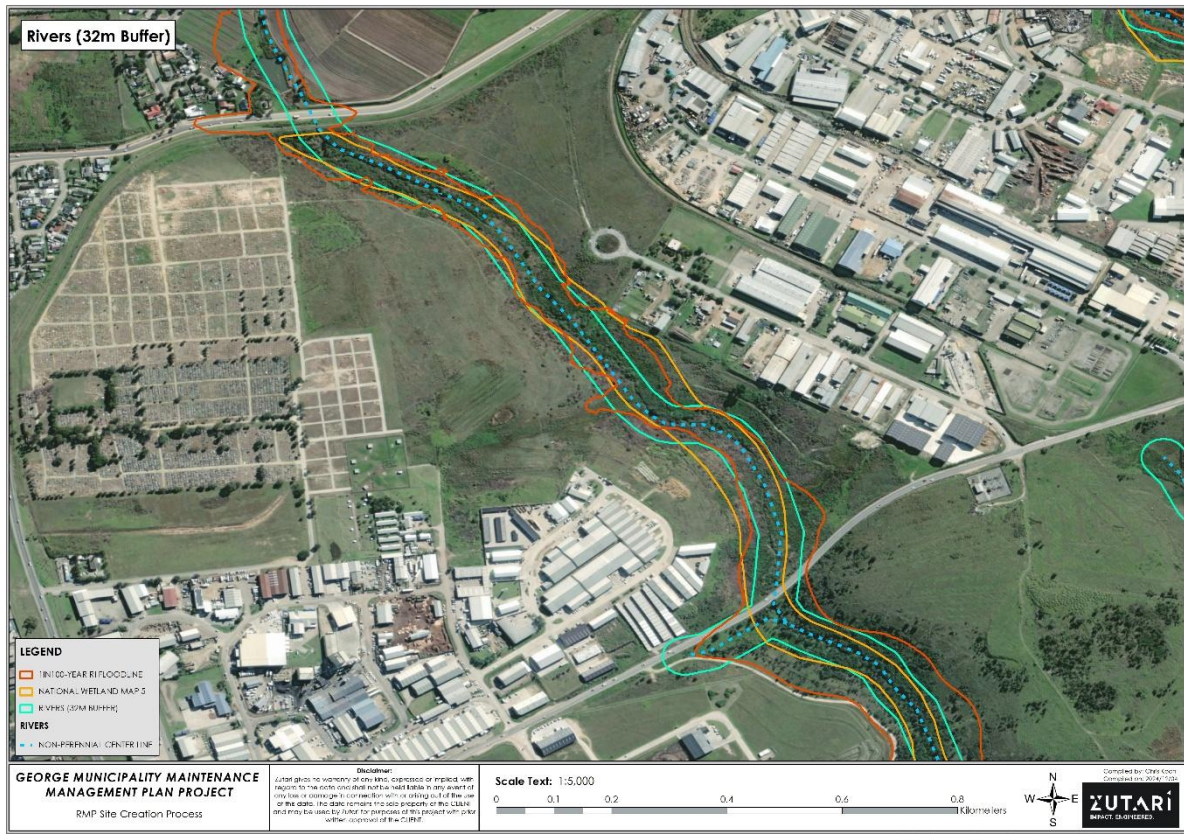


Figure 2-5: Step 5 in defining the site – overlay 32m buffer and 1:100 Year flood line boundary and National Wetland Map 5 boundaries.



Figure 2-6: Step 6 in defining the site – exclude urban area from the 32m buffer boundary.



Figure 2-7: Step 7 in defining the site – final site boundary is confirmed.

2.1 Final Site Maps and Orientation

The resulting “site” for the purpose of the RMP (inclusive of MMP component) is set out in a series of high-resolution maps attached in Appendix A. An example of the ‘key maps’ for the coverage area of these high-resolution maps are indicated in Figure 2-8.

In order to maintain as much as possible detail and to allow users to zoom in on digital copies, the detailed maps have been created on A0 sheets.

The map set starts with a ‘key map’ which orientates the reader in the landscape and the area where maintenance is planned. The reader can then navigate to the correct map and inspect whether the work to be undertaken falls within the defined site of the RMP. Should the works fall within the site, then the mitigation measures and requirements detailed in this document need to be adhered to.

- ▶ The map set for the Schaapkop RMU is included in Appendix A.

Below is an example of the Schaapkop RMU’s key map (Figure 2-8), followed by Map 9 (Figure 2-9) as indicated on the key map, which shows the infrastructure currently in place

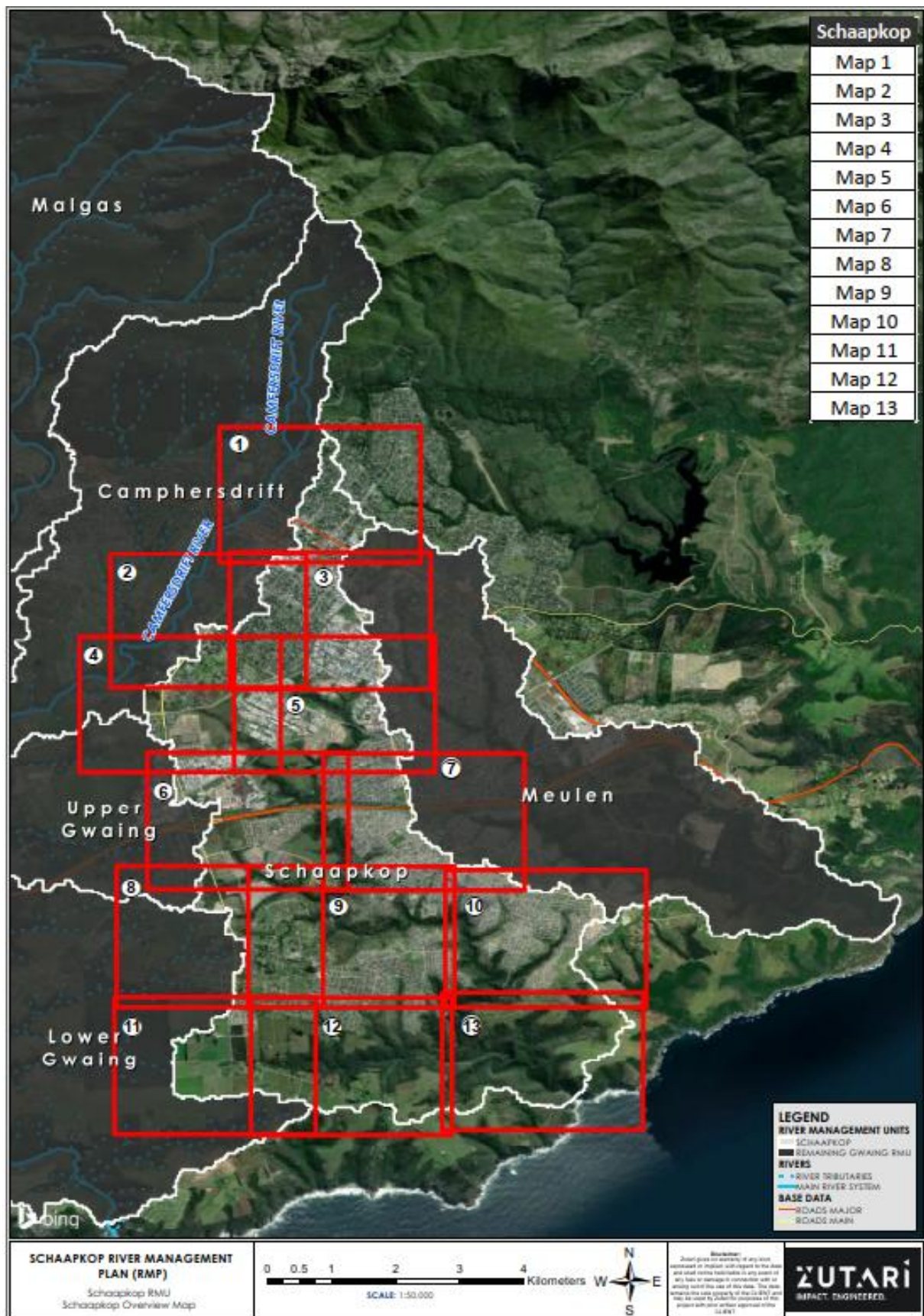


Figure 2-8: Key map for the definition of the MMP site for the Schaapkop River.

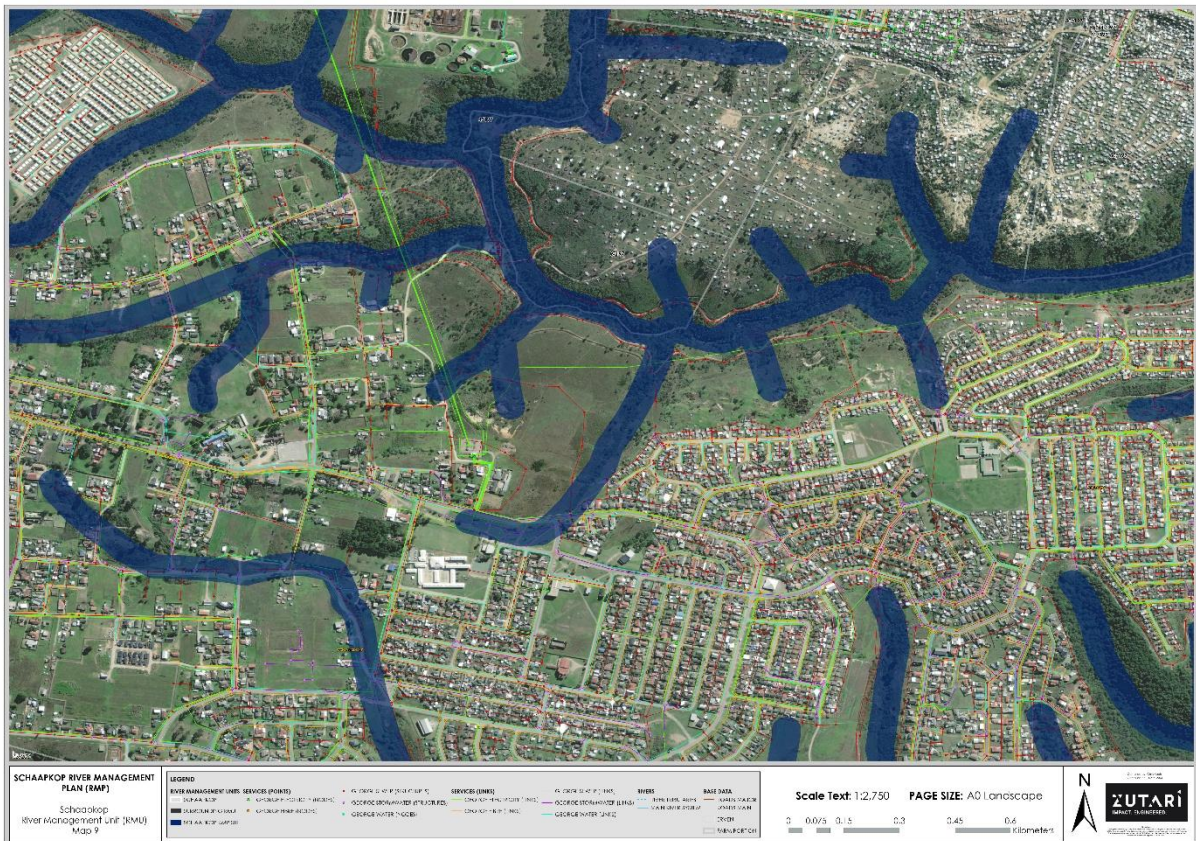


Figure 2-9: Map 9 from the Schaapkop River key map, showing existing infrastructure in the area.

2.2 Updates and Amendments to the Site and New Infrastructure

Section 2, “Definition of the Site,” outlines the method used to delineate the boundary relevant to this River Management Plan (RMP). The primary criteria were the natural watercourses and wetlands within the area. Additionally, the applicability of Activity 19 in Listing Notice 1 and Activity 12 in Listing Notice 3 of the NEMA EIA Regulations, 2014 (as amended), was a key consideration. These activities deal with the movement of soil and other materials **inside** a watercourse and the applicable watercourse-area therefore needed to be defined.

The RMP applies to both the current conditions of the site and the existing infrastructure within its defined boundaries. However, it is **critical to highlight** that any new infrastructure constructed within the site boundary will automatically fall under the scope of the RMP. This means that maintenance activities for such new developments must fully adhere to the standards, controls, and best management practices outlined in the plan. By treating new infrastructure as part of the regulated site, the plan will allow consistent management approaches to be implemented across the site boundary.

To support effective planning and decision-making, it is recommended that GM integrate the defined site into its digital data portals to facilitate monitoring and data-driven management efforts

It is also acknowledged that watercourses and urban developments are inherently dynamic systems that are subject to change over time. This poses a challenge to long-term planning and highlights the importance of adaptable management frameworks and tools. It is therefore recommended that the site be reassessed within 5 years from the date of approval of the RMP by the relevant competent authority.

3 Socio-Cultural and Socio-Environmental Context

3.1 Overview of Social Context

The Schaapkop River system flows through a landscape that includes urban and peri-urban communities. These communities engage with the river through informal access, recreational use, and proximity to residential areas. The river's role in the urban fabric of George necessitates a nuanced understanding of its social dimensions.

3.2 Community Use and Cultural Significance

The Schaapkop River is used by the public for:

- ▶ Recreational activities such as walking and informal nature appreciation.
- ▶ Informal access to green spaces and natural corridors.
- ▶ Cultural and spiritual practices, particularly in areas with historical significance

Informal settlements and urban pressures contribute to pollution and erosion, which directly impact community use and access.

3.3 Historical and Cultural Landscape

The George area has a rich history dating back to the early 1800s, with settlements such as Pacaltsdorp and Blanco originating from missionary and colonial activities. The Schaapkop River traverses an area of aesthetic and cultural significance for local communities which must be protected for long-term cultural sustainability.

3.4 Stakeholder Engagement and Participative Management

Another important aspect is the management of fire. In this regard, communities and groups are encouraged to contact the Southern Cape Fire Protection Agency (FPA) to understand how collaborative and focussed fire management can be implemented. A crucial aspect to fire management is decreasing the fuel load added by alien plants, making alien plant management an essential tool to long-term management of fire. A potential solution could be the establishment of a multi stakeholder fire task team, however the legal and practical basis for this must be explored with the FPA.

Participative management structures, such as community advisory forums or stewardship programs, must be explored to foster co-management and shared responsibility for river health and heritage conservation.

3.5 Socio-Environmental Connection

It is acknowledged that there are many links between the health of the river systems and human activities, including amongst others littering, illegal occupation, illegal farming and harvesting. These matters are identified in the RMP, however they need to be dealt with under the relevant legislation applicable to the matter. There are many anthropogenic pressures exerted on the river systems, but the RMP cannot act as a 'catch-all' document/plan to cover all issues as this will introduce complexities beyond the scope of the RMP.

From an improvement of river health perspective, the RMP provides the basis for motivation to implement actions or new projects to improve the health of the river. Where appropriate the RMP forms

the legal basis for projects and actions, however certain actions (like relocation of illegal occupation) must be dealt with under the relevant legislation.

4 Environmental Baseline Conditions

4.1 Methods

This section describes the methods that Zutari and its sub-consultants, Confluent Environmental, employed to collect data and classify the current state of the environmental baseline in the study area.

4.1.1 Desktop Assessment

A desktop assessment was conducted to contextualize the affected watercourses in terms their local and regional setting, and conservation planning. An understanding of the biophysical attributes and conservation and water resource management plans of the area assists in the assessment of the importance and sensitivity of the watercourses, the setting of management objectives and the assessment of the significance of anticipated impacts. The following data sources and GIS spatial information were consulted to inform the desktop assessment and are included in subsequent sections of this report:

- ▶ National Freshwater Ecosystem Priority Area (NFEPA) atlas (Nel et al., 2011);
- ▶ National Wetland Map 5 and Confidence Map (CSIR, 2018);
- ▶ Western Cape Biodiversity Spatial Plan (CapeNature, 2017); and
- ▶ DWS hydrological spatial layers.

4.1.2 Watercourse Assessment

One of the objectives of the site visit was to: identify and classify watercourses (including tributaries) likely to be affected by maintenance activities; determine their Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS); and assess the potential impacts of the maintenance activities on watercourses.

4.1.2.1 Watercourse Classification

Classification of watercourses is important as this determines the PES and EIS assessment methodologies that can be applied. Furthermore, classification of the watercourse provides a fundamental understanding of the hydrological and geomorphic drivers that characterise the watercourse and therefore assists in the interpretation of impacts to the watercourse. Watercourses will be categorised into discrete hydrogeomorphic units (HGMs) based on their geomorphic characteristics, source of water and pattern of water flow through the watercourse. These HGMs will then be classified according to Ollis et al. (2013).

4.1.2.2 Wetland Delineation

Wetlands are described by the National Water Act (Act 36 of 1998) as:

“Land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil.”

According to DWAF (2005) wetlands must have one or more of the following attributes:

- ▶ Wetland (hydromorphic) soils that display characteristics resulting from prolonged saturation;

- ▶ The presence, at least occasionally, of plants that grow in water saturated conditions (hyrdophytes or obligate wetland plants);
- ▶ A high water table that results in saturation at or near the surface, leading to anaerobic conditions developing in the top 50cm of the soil.

The boundaries of wetlands are typically delineated in accordance with DWAF (2005) guidelines which consider the following four specific indicators:

- ▶ The Terrain Unit Indicator: Identifies those parts of the landscape where wetlands are more likely to occur;
- ▶ The Soil Form Indicator: Identifies the soil forms, as defined by the Soil Classification Working Group (1991), which are associated with prolonged and frequent saturation;
- ▶ The Soil Wetness Indicator: Identifies the morphological "signatures" developed in the soil profile as a result of prolonged and frequent saturation (i.e. mottling and gleying within 50 cm of the soil surface); and
- ▶ The Vegetation Indicator: Identifies hydrophilic vegetation associated with frequently saturated soils.

Given the large spatial extent, the wetland assessment relied primarily on desktop wetland delineations in accordance with the National Wetland Map 5 and Confidence Map, which were verified during site visits and using satellite imagery.

4.1.3 Present Ecological State

An important factor that influences the diversity and abundance of aquatic communities is the condition of the surrounding physico-chemical habitat. Habitat loss, alteration, or degradation generally results in a decline in species diversity. The PES of affected watercourses was assessed using methods applicable to the classification of the watercourse (i.e. river or wetland). PES assessments for rivers and wetlands were conducted using the Index of Habitat Integrity (IHI) and Wet-Health methodologies, respectively.

An IHI class indicating the present ecological state of the river reach can be interpreted using Table 4-1.

Table 4-1: Index of habitat integrity (IHI) classes and descriptions

Integrity Class	Description	IHI Score (%)
A	Unmodified, natural.	> 90
B	Largely natural with few modifications. The flow regime has been only slightly modified and pollution is limited to sediment. A small change in natural habitats may have taken place. However, the ecosystem functions are essentially unchanged.	80 – 90
C	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.	60 – 79
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40 – 59
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.	20 – 39
F	Critically / Extremely modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.	0 – 19

4.1.4 Ecological Importance and Sensitivity

The ecological importance (EI) of a watercourse is an expression of its importance to the maintenance of ecological diversity and functioning on local and wider scales. Ecological sensitivity (ES) refers to the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred (resilience). Both abiotic and biotic components of the system are taken into consideration in the assessment of ecological importance and sensitivity. EI and ES are assessed in order to obtain an indication of its vulnerability to environmental modification within the context of the PES. This would relate to the ability of the river reach to endure, resist and able to recover from various forms of human use. The Department of Water and Sanitation (DWS) conducted a desktop ecological assessment of all quinary catchments in South Africa and was used as the primary input to provide an overview of the EI and ES of rivers included in this assessment. Results of these EI and ES assessments can be interpreted using Table 4-2.

Table 4-2: Ecological importance and sensitivity categories - interpretation of average scores for biotic and habitat determinants

Ecological Importance and Sensitivity Category (EIS)	Range of Median	Recommended Ecological Management Class
<u>Very high:</u> Quaternaries/delineations that are considered to be unique on a national or even international level based on unique biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) are usually very sensitive to flow modifications and have no or only a small capacity for use.	>3 and ≤4	A
<u>High:</u> Quaternaries/delineations that are considered to be unique on a national scale due to biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) may be sensitive to flow modifications but in some cases, may have a substantial capacity for use.	>2 and ≤3	B
<u>Moderate:</u> Quaternaries/delineations that are considered to be unique on a provincial or local scale due to biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) are usually not very sensitive to flow modifications and often have a substantial capacity for use	>1 and ≤2	C
<u>Low/marginal:</u> Quaternaries/delineations that are not unique at any scale. These rivers (in terms of biota and habitat) are generally not very sensitive to flow modifications and usually have a substantial capacity for use.	>0 and ≤1	D

4.1.5 Terrestrial Biodiversity and Plant Species

The terrestrial biodiversity and plant species of the various rivers were investigated via the desktop assessment and during the site visits. Due to the project relating to the river systems, the vegetation is mostly described as part of the wetland description. A summary of the national vegetation types is provided and the animal species information relating to species of conservation concern is also included.

4.1.6 Ecosystem Services Assessment

Ecosystem services were assessed using WET-EcoServices Version 2 (Kotze *et al.* 2020). Sixteen different ecosystem services were evaluated and included:

- ▶ Flood attenuation
- ▶ Streamflow regulation
- ▶ Sediment trapping
- ▶ Phosphate assimilation
- ▶ Nitrate assimilation
- ▶ Toxicant assimilation
- ▶ Erosion control
- ▶ Carbon storage
- ▶ Provision of water for human use
- ▶ Provision of harvestable resources
- ▶ Food for livestock
- ▶ Provision of cultivated foods

- ▶ Cultural and spiritual experience
- ▶ Tourism and recreation
- ▶ Education and research
- ▶

WET-EcoServices provides a set of indicators (e.g. slope of the wetland) rated on a five-point scale of 0 to 4 that reflect the supply/capability of a wetland for each of the 16 different ecosystem services listed above. An Excel™-based spreadsheet tool has been developed to conduct the assessment. For each ecosystem service, indicator scores are combined automatically in an algorithm given in the spreadsheet that has been designed to reflect the relative importance and interactions of the attributes represented by the indicators to arrive at an overall supply score. In addition, the demand for the ecosystem service is assessed based on the wetland's catchment context (e.g. toxicant sources upstream), the number of beneficiaries and their level of dependency, which are also all rated on a five-point scale. Again, an algorithm automatically combines the indicator scores relevant to demand to generate a demand score.

A single overall importance score is generated for each ecosystem service by combining the supply and demand scores. This aggregation therefore places somewhat more emphasis on supply than demand, with the supply score acting as the starting score for a “moderate” demand scenario. The importance score is, however, adjusted by up to one class up where demand is “very high” and by up to one class down where demand is “very low”. The overall importance score can then be used to derive an importance category for reporting purposes.

4.2 Photographic Record

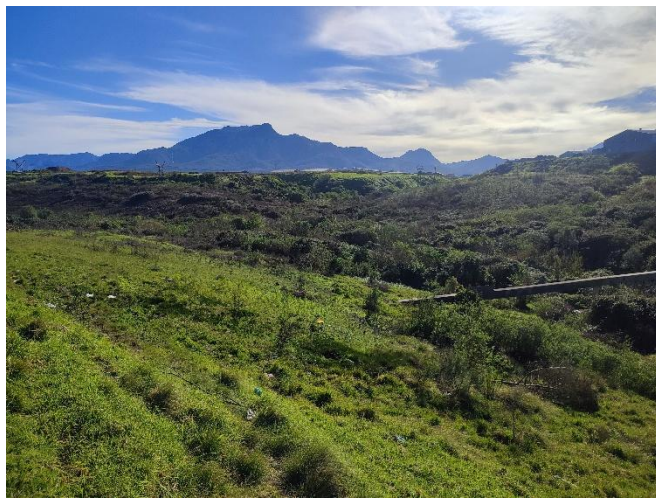
Site visits were undertaken to all RMUs to undertaken to understand the environmental context. The main focus of these visits was to understand the aquatic systems and to investigate where these systems interact with municipal infrastructure. The site visits provided valuable information about vegetation, aquatic ecology and typical issues that will be used for development of the RMP. The figures in the table below provide a photographic record of the state of the Schaapkop River System at the time of the site visits undertaken in July 2024.

Table 4-3: Selected photographs of the current state of environment along the Schaapkop River.

	▶ Showing a eroded tributary of the Schaaopkop River. ▶ Large parts of the Schaapkop River flow through urbanised areas that are subject to more intense runoff from paved areas, potentially leading to erosion,. ▶ Notice rubble in the foreground likely from damaged infrastructure. Maintaining structures would improve infrastructure protection and lifespan whilst at the same time improving erosion and flood control.
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- ▶ Pipeline across a tributary of the Schaapkop River
- ▶ Maintenance of the pipeline and its associated structures would need to adhere to the measures included in the RMP.
- ▶ Maintenance activities that are done appropriately would ensure that systems such as these are appropriately protected and ecological value is maintained.



- ▶ Illustrating the vegetation along a stretch of the Schaapkop River.
- ▶ Areas such as these would likely need to be entered for maintenance purposes and result in clearance of vegetation. Minimisation of impacts are considered as part of the RMP .



- ▶ An example of control of Black Wattle (*Acacia mearnsii*) along the banks of one of the tributaries of the Schaapkop River.
- ▶ The removal of alien invasive plants like these will be ongoing in the Schaapkop River basin and should be carried out according to the measures contained in this RMP and the GMs alien plant management plan.
- ▶ Areas such as these would likely need to be entered for maintenance purposes and result in clearance of vegetation. Minimisation of impacts are considered as part of the RMP.



- ▶ Showing an area heavily infested by Bugweed (*Solanum mauritianum*).
- ▶ The picture illustrates the typical mix of alien vegetation along the southern parts of the Schaapkop River.
- ▶ These large alien trees are growing directly inside the river basin and wetland, negatively impacting on the system.
- ▶ Alien plant clearing should be carried out according to the measures contained in this RMP and the GMs alien plant management plan.
- ▶ Maintenance of infrastructure in areas such as this would result in vegetation clearance and access the river system and must be carried out using the mitigation measures included in this RMP.



- ▶ An example of the build-up of silt in the streambed downstream of a road bridge at PW Botha boulevard, near PG Bison.
- ▶ Silt removal and control of alien invasive vegetation is essential to ensure the free flow of water at sites like this.
- ▶ Maintaining gabions and associated structures would improve infrastructure protection and lifespan whilst at the same time improving erosion and flood control.



- ▶ Example of an overflowing manhole along the Schaapkop River.
- ▶ Instances like these would require clean-up.
- ▶ The river is visible at the top of the picture and illustrates the proximity of infrastructure to watercourses and the risk they pose to the aquatic system.
- ▶ The RMP provides measures that will promote responsible management of instances such as this.

	▶ A wetland in which maintenance activities may be needed.. ▶ Areas such as these would likely need to be entered for maintenance purposes and result in clearance of vegetation. Minimisation of impacts are considered as part of the RMP
	▶ An example of gabion structures along the Schaapkop River that have been installed to protect the structural integrity of a structure that crosses the stream. ▶ If damaged, maintenance activities will be needed in and adjacent to the stream to repair the gabions. ▶ Access here is easier than in areas with dense vegetation, however care must still be taken to not damage natural vegetation unnecessarily or pollute the river systems

4.3 Soils

The soils in the catchment area are relatively shallow and consist of a diagnostic pedocutanic duplex soil, with a clear textural contrast between the A and B horizon. The B horizon is heavily enriched with clay, which serves as a barrier to both root growth and water movement. This causes sub-surface water that drains through the coarsely textured A horizon to flow laterally when it reaches the top of the B horizon. Furthermore, the catchment areas often receive intense rain in a short period of time. For this reason, soils are highly erodible, and erosion of the bed and banks of rivers is a common problem. In addition, discharge of high volumes of stormwater onto relatively steep, unprotected river embankments has led to severe erosion.

4.4 Land Cover

Natural vegetation is confined to the steeper mountain catchment areas north and east of the George urban area. Most of the vegetation in the Schaapkop River basin has been completely transformed or is heavily influenced by exotic invasive species by anthropogenic influences. As shown in Figure 4-1, most of the Schaapkop River basin has urban land cover, with very limited natural vegetation cover in the downstream areas near the coast. Most riparian areas along the river are heavily invaded by alien tree species (particularly *A. mearnsii* and *S. mauritianum*). Land cover along the flatter coastal plain is dominated by agriculture (Figure 4-1).

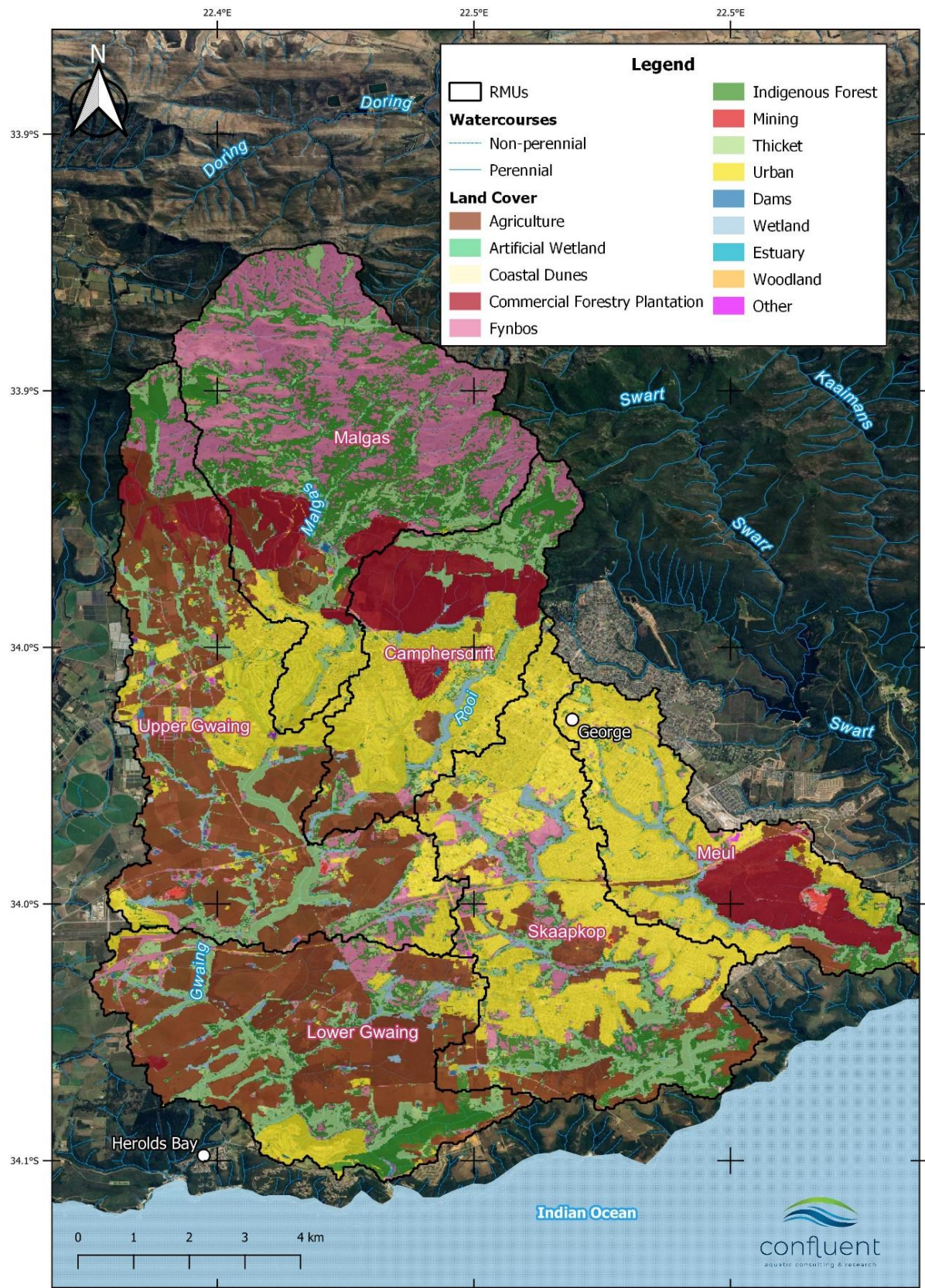


Figure 4-1: Present day land cover (2022) across all subject river basins

4.5 Biodiversity Spatial Information

The available environmental and biodiversity overlay information are presented in this section to provide context in terms of where the site options are located relevant to the known high level environmental information.

4.5.1 CBAs and ESAs

Figure 4-2 shows Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs) in the Schaapkop River basin according to the 2023 Western Cape Biodiversity Spatial Plan (WCBSP). This plan is the outcome of a comprehensive biodiversity planning assessment to guide sustainable development. This plan identifies CBAs and ESAs that need protection to ensure the survival and functionality of species and terrestrial and freshwater ecosystems, as well as the provision of ecosystem services. It supersedes all previous biodiversity planning products and sector plans (CapeNature, Western Cape Biodiversity Spatial Plan Handbook, 2023).

CBAs are crucial for meeting conservation targets as they represent areas that are essential for conserving viable samples of all ecosystem types and species. They help maintain ecological processes and support landscape-level ecological functioning. There are two categories of CBA namely CBA1 and CBA2 for which a brief description is provided below:

- ▶ **CBA1 – highest priority for conservation:** CBA1 areas are identified as the highest priority conservation zones, essential for maintaining biodiversity and ecological infrastructure. These areas include locations with endangered species, habitats supporting key ecological processes, and sites that provide critical ecosystem services. In the WCBSP, CBA1 areas are typically areas with the least disturbance and highest ecological integrity. As far as possible these areas must be managed in such a manner that they remain in a near-natural state as far as possible. New developments in these areas must be looked at carefully to ensure that any impacts on biodiversity are appropriately investigated and managed.
- ▶ **CBA2 – high conservation priority (some flexibility):** CBA2 areas are also significant for biodiversity conservation, but they tend to have lower levels of ecological integrity than CBA1 areas. These areas have typically experienced some level of disturbance, but maintain essential habitats, species, or ecological functions that contribute to biodiversity goals. Project proposed in CBA2 areas will have less impact on existing biodiversity levels, however the impacts must still be considered carefully as with the correct management practices many of the CBA2 areas can be promoted into the CBA1 category.

The WCBSP also includes Other Natural Areas (ONAs) and No Natural Remaining (NNR) areas. ONAs are regions that are not currently critical for biodiversity but still contribute to the overall ecological network, while NNR areas are that have been completely transformed (CapeNature, 2017)

The WCBSP includes a Biodiversity Spatial Plan Map (BSP Map), which highlights biodiversity priority areas and provides contextual information and land use guidelines. This map is a crucial tool for land use and development planning, environmental assessment, and natural resource management. The plan also covers major coastal and estuarine habitats, ensuring a comprehensive approach to biodiversity conservation (CapeNature, 2017).

The Schaapkop River falls within areas mapped as both CBA1 and CBA2. Most of the Schaapkop River's course from its origin to the southern boundary of Pacaltsdorp is a CBA 2. Thereafter, the further downstream portions of the river course classified area up to the coast classified as CBA1.

Based on the site inspection and knowledge of the area, many of the sections of rivers/streams mapped as CBA1 rather qualify to be considered as CBA2 areas, particularly the degraded portions in urban areas. However, even if the CBA classification were to change like this, it would not change the conservation management objectives, as all watercourses are considered sensitive and worthy of protection for their biodiversity values.

This is the approach that was taken for the RMP.

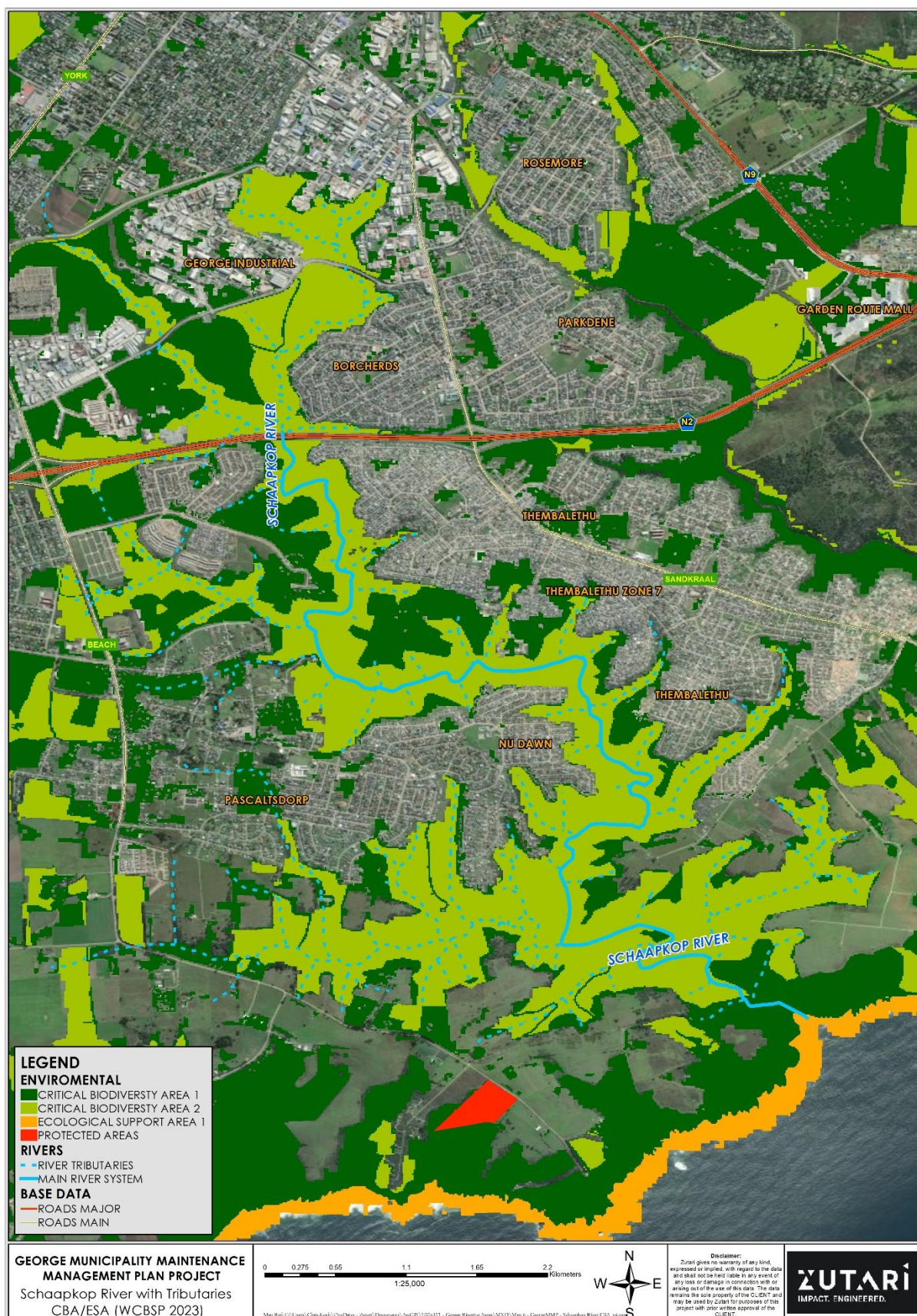


Figure 4-2: CBAs and ESAs in the Schaapkop River basin

4.5.2 Wetlands and Watercourses

Watercourses and wetlands identified in the database of the National Freshwater Ecosystems Priority Areas (NFEPA) and 2018 National Biodiversity Assessment (NBA) databases for the Schaapkop River basin are shown in Figure 4-3.

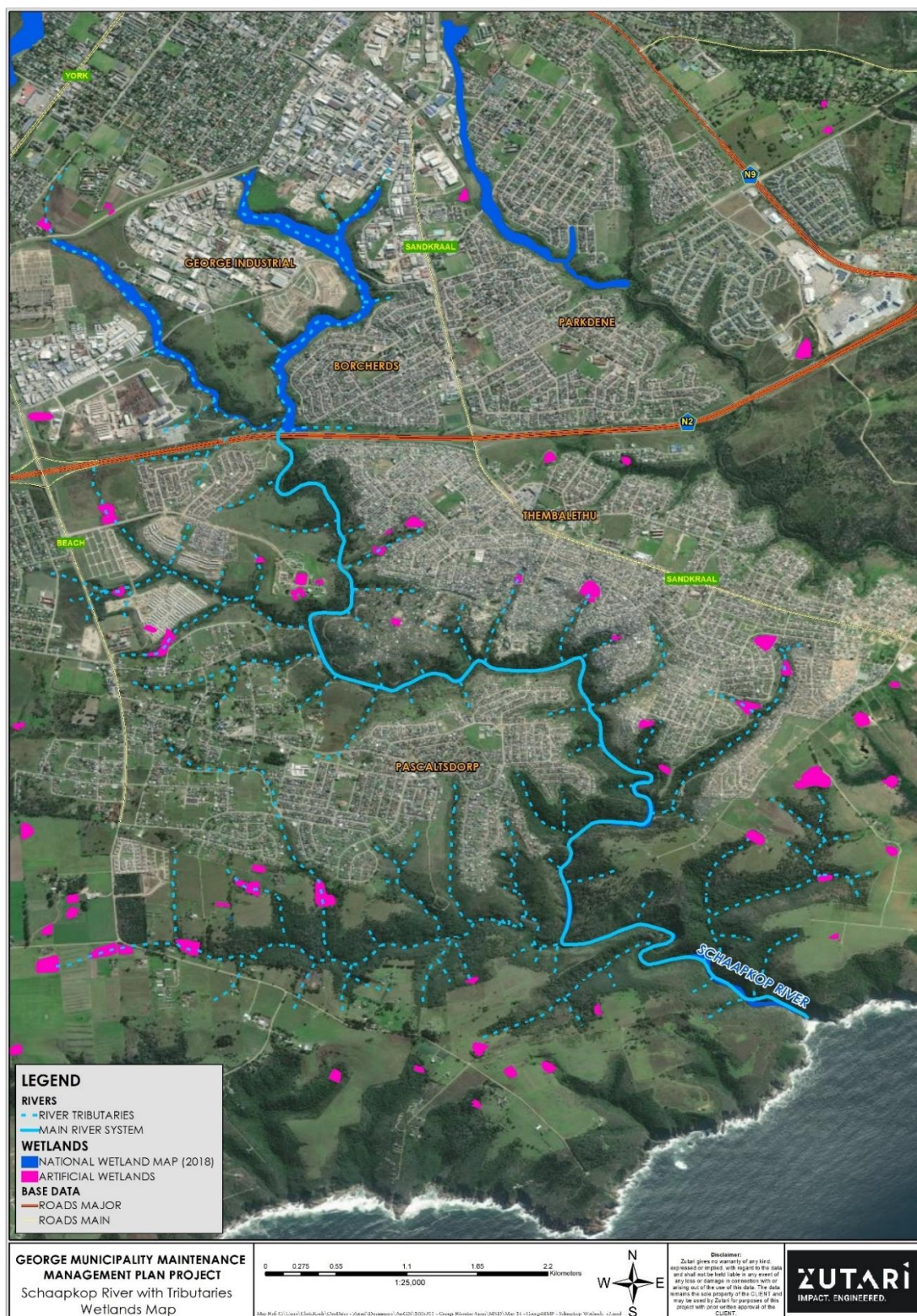


Figure 4-3: Wetlands and rivers identified by the NFEPA and NBA in the Schaapkop River basin.

4.5.3 Vegetation Type and Ecosystem Threat Status

According to the 2018 National Vegetation Map (SANBI, 2006 – 2018), three national vegetation types occur within the study area (Figure 4-4). The vegetation types together with their threat status according to the Revised National List of Threatened Terrestrial Ecosystems (GN 2747 of 2022) that occur within the Schaapkop RMP site are listed below:

- ▶ Groot Brak Dune Strandveld (Critically Endangered)
- ▶ Garden Route Granite Fynbos (Critically Endangered)
- ▶ Southern Afrotropical Forest (Least Threatened)

The definitions of these threat categories are provided below:

- ▶ **Critically Endangered (CR):** Ecosystems that are at an extremely high risk of collapse.
- ▶ **Endangered (EN):** Ecosystems that are at a very high risk of collapse but not as imminent as critically endangered ones.
- ▶ **Vulnerable (VU):** Ecosystems that are at a high risk of degradation and loss but are not currently endangered.

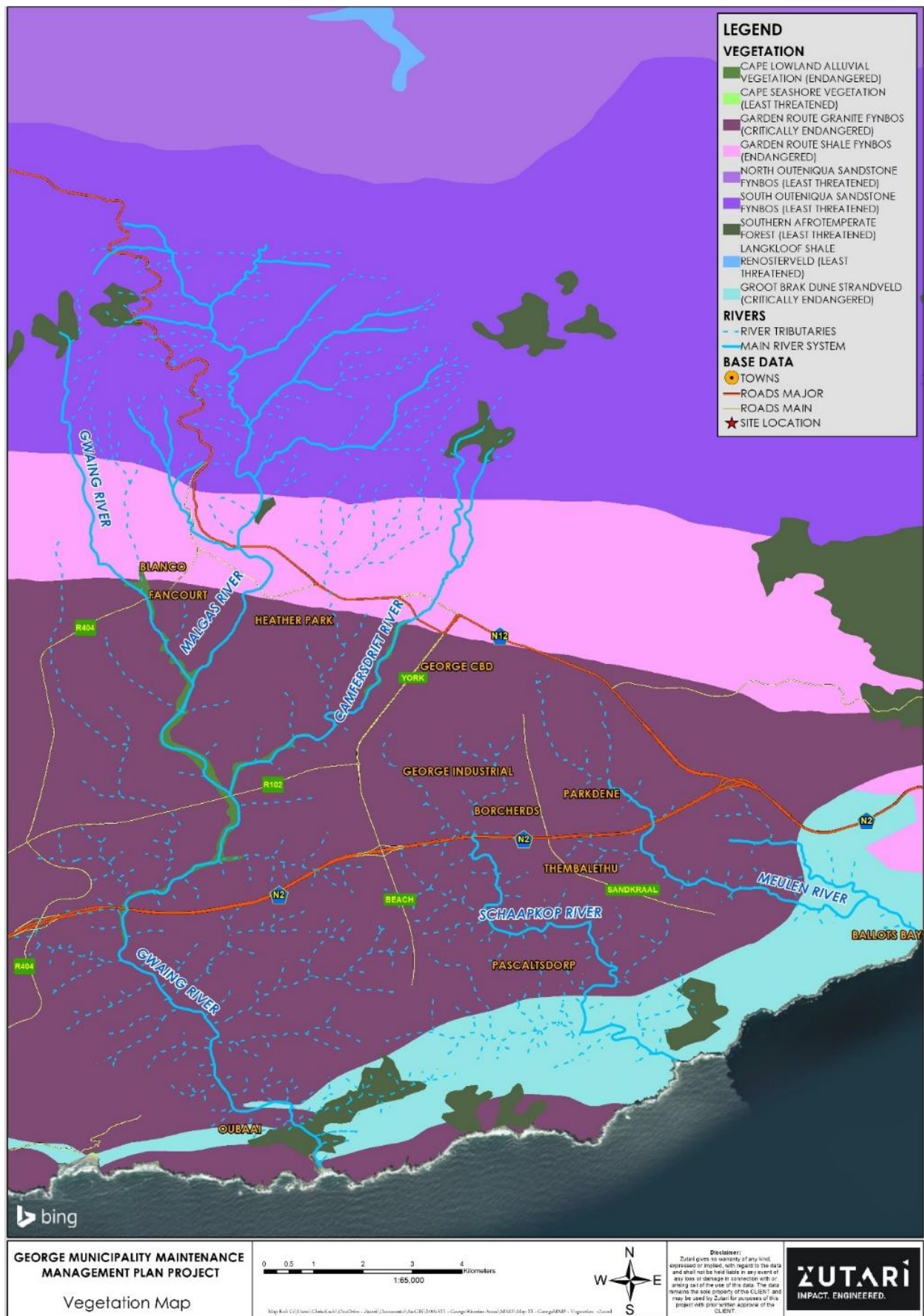


Figure 4-4: National vegetation types and ecosystem threat status across the river Schaapkop river basin.

4.5.4 Protected and Conservation Areas

Protected areas and conservation areas within the Schaapkop River basin are shown in Figure 4-5. This shows that the only protected area located south-west of the basin is the Kwelanga Private Nature Reserve. However, this protected area is outside of the defined site.



Figure 4-5: Conservation areas and protected areas in the Schaapkop River basin

4.6 Aquatic Ecology

4.6.1 Overview of Wetlands

The source of the Schaapkop River is in the industrial area of George. Thereafter the river flows through the suburbs of Thembaletu and Pacaltsdorp, after which it passes through a short stretch of undeveloped land (mainly unirrigated pastures) before discharging into the sea. The catchment area is in the Southern Coastal Belt, which is characterised by moderately undulating plains that slope steeply towards the river valleys. These steep slopes generate high surface runoff volumes, and the entire catchment area is in the Outeniqua SWSA.

Industrial and residential development (a mixture of formal and informal) are generally constrained to flat plains, and while some informal housing encroaches onto the steep slopes, most of the riparian zone is intact, and the urban reaches of the river are relatively well buffered against non-point source pollution from the surrounding development. The lower gradient slopes adjacent to the upper reaches of the river channel and its tributaries (upstream of the N2 highway) typically present as hillslope seep wetlands dominated by *Cliffortia odorata*. Further downstream, as the gradient of these slopes becomes steeper and water is retained in the soil profile for a shorter duration, wetland habitat is replaced by woody vegetation typical of a riverine riparian zone. The river flows at a moderate gradient and substrate consists of a combination of bedrock and coarse sediment and fine gravel - Figure 4-6).



Figure 4-6: A view of the upper reaches of the Schaapkop River through a relatively confined valley with prominent bedrock and sediment deposition zones

Seep wetlands are common and are generally associated with gentle to moderate gradient valley slopes adjacent to river channels, particularly along the upper reaches of the Schaapkop River and along small first order tributaries of all the river systems. The formation of seep wetlands along the gentle slopes of valleys is consistent with a coarsely textured A soil horizon overlying a relatively impervious clay enriched B horizon. Seep wetland features are formed by lateral sub-surface flow which is prevented from penetrating the deeper impervious B horizon and expresses near the surface as it travels down the relatively gentle slopes. The gentle slopes allow water to be retained in the soil profile for an extended period of time, leading to seasonally saturated conditions and the establishment of wetland vegetation that is typically dominated by *Cliffortia odorata* and *Nidorella ivifolia* (along the drier margins). As the

gradient of the slopes steepen towards the coastline water is retained in the soil profile for a shorter duration, and wetland habitat is replaced by woody vegetation typical of a riverine riparian zone. These riparian zones have become heavily invaded by *A. mearnsii*. Wetland flats are also common throughout the flat coastal plain areas where water accumulates in the A horizon for extended periods of time, leading to the formation of wetland conditions. The three different wetlands type found within the study area are diagrammatically depicted in Figure 4-7.

These wetland systems provide important aquatic habitat in a largely transformed urban area and also provide important ecosystem services. Unchannelled valley bottom wetlands are characterised by diffuse flow through the wetland (as opposed to a more concentrated channelled flow) which typically favours dense growth of wetland vegetation. The combination of low gradient, dense vegetation and diffuse flows through the provides valuable hydro-functional attributes that include flood attenuation, assimilation of pollutants and carbon storage. They typically also offer important stream regulation services, by continuously releasing water to downstream habitats long into dry periods. Many of the smaller wetland seeps and flats have not been mapped at a coarse or fine scale and it is recommended that George Municipality should conduct a high-resolution wetland mapping exercise.

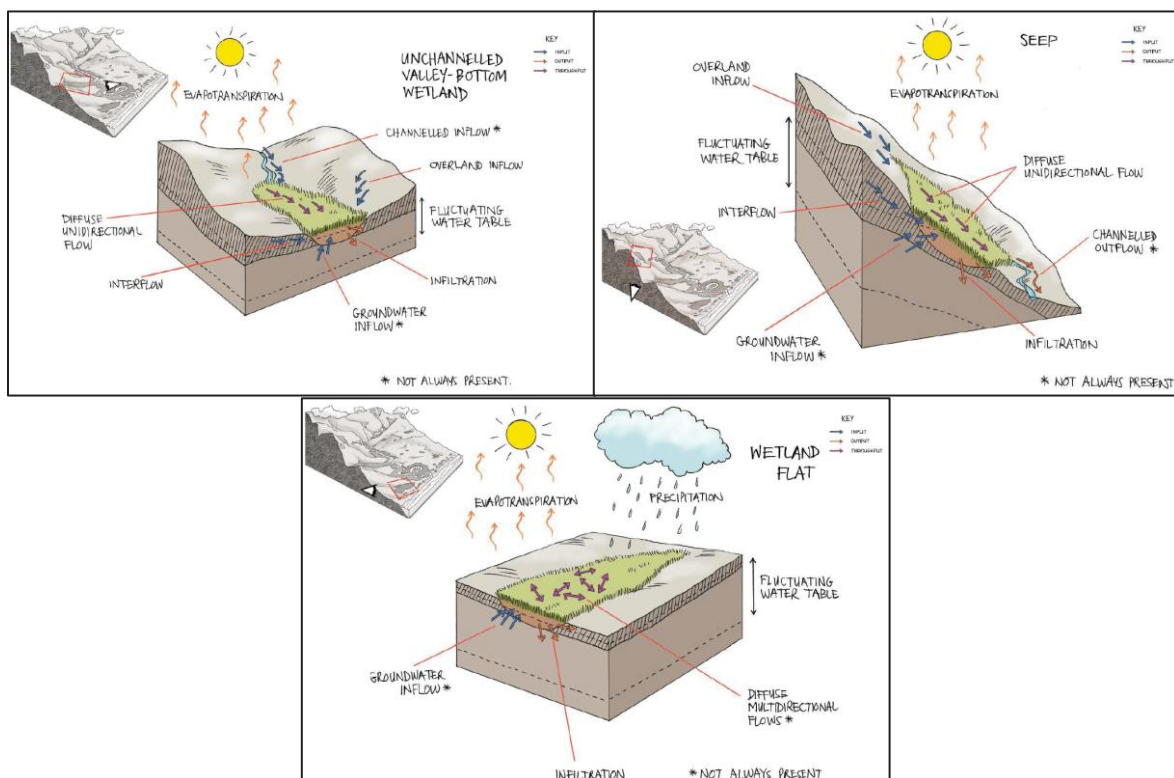


Figure 4-7: Landscape setting and dominant hydrological pathways influencing unchannelled valley-bottom (top left), seep wetlands (top right) and wetland flats (bottom)

4.6.2 Schaapkop RMU

4.6.2.1 Present Ecological State (PES)

The Schaapkop River originates entirely within the urban and industrial area of George and is heavily impacted by formalized and unformalized development. The most significant impacts are associated with point source inputs of stormwater and wastewater (treated wastewater from the Outeniqua WWTW and untreated raw sewage from leaking/blocked pipelines and manholes) and solid waste and litter from poorly serviced formal and informal settlements. The well-established buffer along the majority of the watercourse offers little protection against this point source impacts and water quality is poor from the source all the way to the sea. The hydrology of the river and its tributaries (including wetlands) has been modified by increased inputs of stormwater discharge which has led to channelisation of wetland

systems and erosion of the bed and banks and in parts, a heavily incised channel – particularly the smaller tributaries. Stormwater outlets generally discharge relatively high up on the steep slopes leading down to watercourses resulting in severely eroded banks (Figure 4-8) and the municipality is currently in the process of rehabilitating erosion and upgrading stormwater outlets at several locations throughout the catchment area. Stormwater outlets are also targeted as informal dumping areas, resulting in blockage of outlets which exacerbates erosion problems. Blockage of sewage pipes also results in erosion of the banks (Figure 4-9). The riparian zone downstream of the wetland seep areas is heavily invaded by alien invasive species, the most common of which are *A. mearnsii*, *S. mauritanium* and *Rubus sp.*

The PES of the Schaapkop RMU is determined as D – Largely Modified.



Figure 4-8: Photographs illustrating erosion of embankment down to Schaapkop River at stormwater outlets.



Figure 4-9: Example of a blocked sewer manhole (left) that caused erosion down the embankment to the river (right).

4.6.2.2 Ecological Importance and Sensitivity (EIS)

According to DWS (2014) the Ecological Importance of the Schaapkop RMU can be summarised as follows:

- ▶ Importance of fish diversity and rarity are of Low importance relative to other SQCs in the secondary catchment.
- ▶ Invertebrate diversity and rarity is Low relative to other SQCs in the secondary catchment.
- ▶ Moderate loss of riparian and wetland vegetation due to urbanisation. The biodiversity importance of the vegetation is Moderate.
- ▶ Diversity of habitat and size system is Low (limited geomorphological variation along the river reach and a small catchment area).

- ▶ Importance of instream and riparian migration corridors is High (low fragmentation of instream habitat) and Moderate (loss of riparian habitat has occurred due to urbanisation).
- ▶ Instream and riparian habitat integrity is Low, due to high impacts associated with urbanisation.
- ▶ Overall, the Ecological Importance is **Low**.

In terms of Ecological Sensitivity, the Schaapkop RMU can be summarised as follows:

- ▶ Sensitivity of fish to modifications in flow and physico-chemistry is Low.
- ▶ Sensitivity of invertebrate and other vertebrates to modification in flow and physico-chemistry is **Low** and **Moderate**, respectively.
- ▶ Instream and riparian habitat is not sensitive to changes in flow (**Low**).
- ▶ Overall, the Ecological Importance is **Low**.

4.6.2.3 Ecosystem Services

Table 4-4: Results of the WET-EcoServices assessment for the Schaapkop RMU

Regulating and Supporting Services
Water quality in the RMU is severely compromised mainly by discharge of treated waste from the Outeniqua WWTW (located just upstream of the RMU), raw sewage from leaking infrastructure and failing pump stations, urban stormwater runoff from poorly serviced informal settlements and dumping of solid waste. There is thus a relatively high demand for regulating services that improve water quality. The supply of these services is however relatively limited due the natural geomorphological zonation of the river which provides limited instream pollutant assimilation capabilities. The riverine nature of the RMU also provides limited carbon storage and stream flow regulation service. Implementation and maintenance (e.g. rehabilitation, removal of alien tree species etc.) of river buffers is regarded as a key intervention to improve the supply of these services. Maintenance of sewage and stormwater infrastructure is also a key factor in reducing the demand for these services. The demand for biodiversity maintenance services is high due to the threat status of the vegetation type in this RMU and the fact that sections of the Schaapkop River have been mapped as an aquatic CBA. These services are however not being supplied to an adequate level due to large-scale environmental degradation associated with urban land use in the catchment and severe invasion of riparian habitat by alien invasive tree species. Erosion control is also not adequately supplied due to modifications to riparian habitat (e.g. widespread invasion by <i>A. mearnsii</i>) and loss of seep wetland habitat capable of attenuating surface runoff.
Provisioning Services
Provisioning services are limited due to the highly degraded nature of the RMU and are generally of Very Low to Low importance.
Cultural Services
There are limited cultural services provided by the RMU and their importance is rated as Very Low .

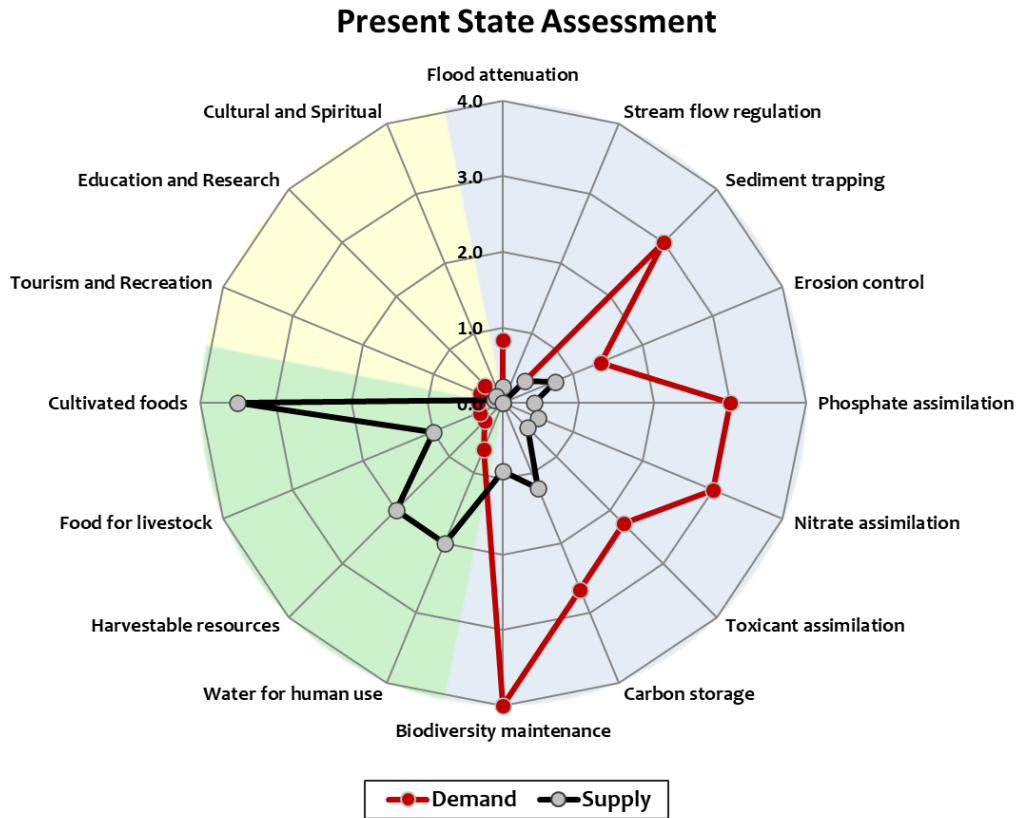


Figure 4-10: Supply and demand of ecosystem services in the Schaapkop RMU

4.7 Terrestrial Vegetation

The original extent of terrestrial vegetation types covering the RMU is illustrated in Figure 4-11 and includes mostly fynbos vegetation from the centre of George down to the coastal plain and Strandveld vegetation along the coast. Small Patches of Afrotemperate forest occur near the coastline, predominantly along deep river valleys.

Much of the natural vegetation has been completely transformed by urban development. Apart from the southern section of the RMU (south of the developed area) and portions of the steep river valleys, there are very few areas of natural vegetation remaining (Figure 4-1).

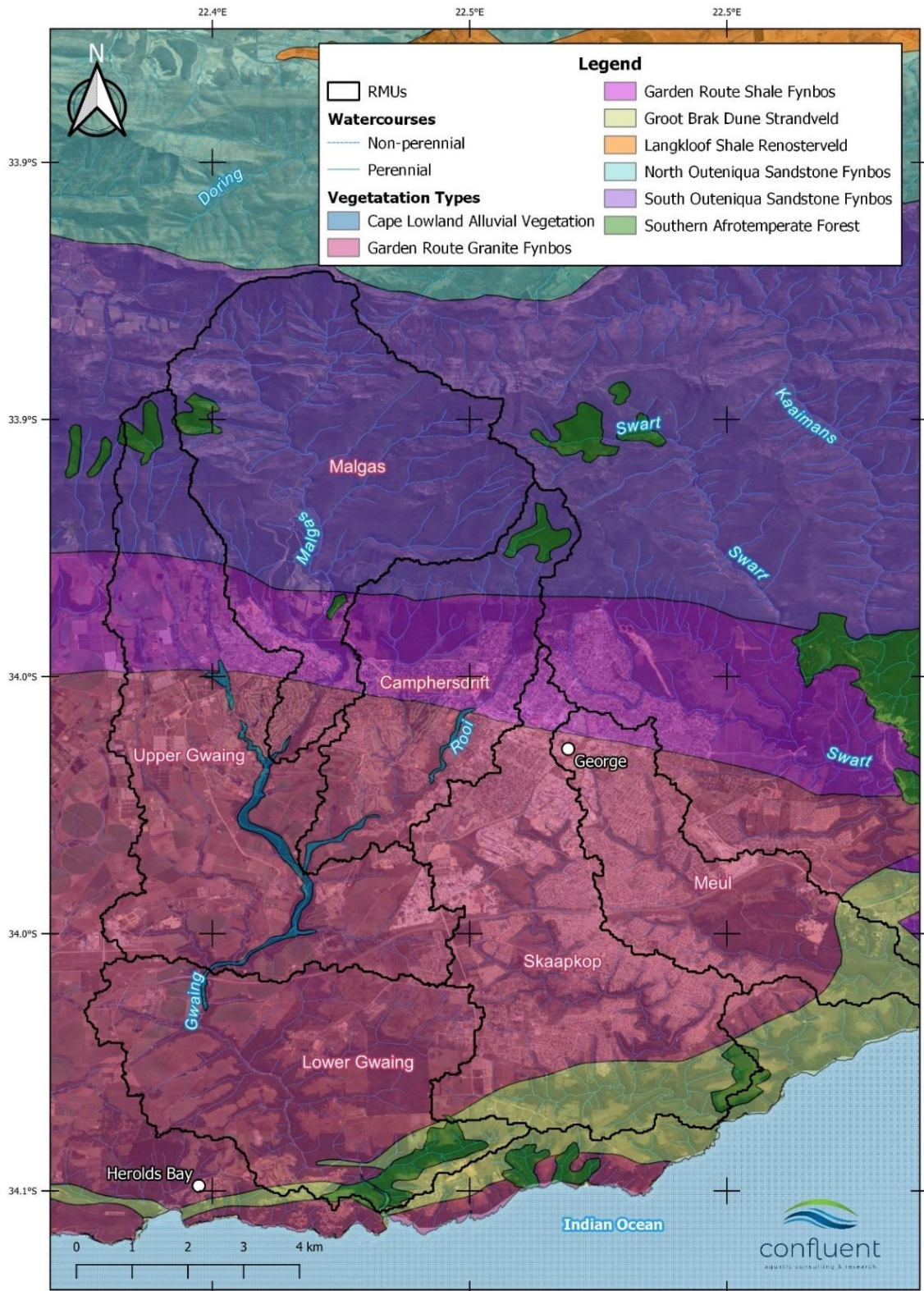


Figure 4-11: Original distribution of vegetation types across the RMUs

As mentioned in section 4.5.3, only three of these vegetation types occur in the Schaapkop River basin. Only these units are discussed below.

4.7.1 South Outeniqua Sandstone Fynbos

This vegetation type covers most of the coastal plain that extends from the foot of the Outeniqua Mountains to the sea (Figure 4-11). The vegetation is characterised by graminoid and ericaceous fynbos on the flat plateaus, with proteas confined to the steeper slopes (Mucina and Rutherford, 2006). Garden Route Granite Fynbos is Listed as a Critically Endangered according to the criterion B1(i) (SANBI, 2022)⁶. This ecosystem has experienced ongoing degradation (mainly from Alien and Invasive Plants, development, and agricultural expansion) over the past 28 years, placing it at serious risk of collapse.

This vegetation type covers the majority of RMU. This entire vegetation type has been historically transformed for by agriculture (since the 1930s) and the expansion of the George urban area. The only untransformed areas are drainage lines and steep valleys, although even these areas are not disturbed due to invasion by black wattles (*A. mearnsii*) and Bugweed (*Solanum mauritianum*). Vegetation in the urban portions of the Schaapkop River basin has been severely transformed, with drainage lines containing severely eroded and incised banks, multiple dumping grounds, polluted water, and a host of almost exclusively invasive plants. Seep wetlands in the upper reaches in the RMU maintain some natural vegetation (predominantly *Cliffortia odorata*).

4.7.2 Southern Afrotemperate Forest

This vegetation type is typically a tall, multilayered forest dominated by Yellowwood (*Podocarpus latifolius*) and is limited to isolated patches that occur along deeper mountain valleys and ravines along the southernmost extent of the coastal plain where the elevation drops steeply down to the sea (Figure 4-11). Since these forests are well conserved in the Garden Route and Table Mountain National Parks and in a variety of other provincial and privately owned nature reserves, it is classified as Least Concern (Mucina and Rutherford, 2006). The vegetation type remains largely untransformed in the RMU included in this assessment, although invasion by alien trees species around the margins is a serious threat (particularly in patches along the southern extent of the coastal plain).

4.7.3 Groot Brak Dune Strandveld

Groot Brak Dune Strandveld crosses the southernmost extent of the Schaapkop RMU (Figure 4-11), where it is generally confined to steep coastal slopes. It is characterised by dense and tall (up to 3 m), spiny, sclerophyllous scrub with gaps supporting shrublands with ericoids or succulent-leaved shrubs (Mucina and Rutherford, 2006). It is narrowly distributed with high rates of habitat loss since 1990 due to agricultural expansion, placing the ecosystem type at risk of collapse. It is classified as Critically Endangered. Invasion by *A. mearnsii* is prolific.

4.8 Animal Species

Several animal species of conservation concern are predicted to occur with the study area (Table 4-5). Most of these species are terrestrial birds that depend on terrestrial vegetation for roosting, hunting and breeding and are therefore unlikely to be affected by maintenance activities along watercourses. Some of these species that are more dependent on wetlands or riverine habitats and could potentially be affected by maintenance activities along watercourses have been highlighted in bold in Table 4-5. The most sensitive species are discussed below:

- ***Bradypterus sylvaticus*** (the Knysna warbler) is common along tangled thickets lining watercourses, even along heavily transformed, invaded watercourses in the George urban area. Therefore, clearance of vegetation to access maintenance points could disturb this species.

⁶ The B criterion refers to ecosystems that are experiencing unusually high rates of habitat loss.

- ▶ *Circus ranivorus* (African Marsh Harrier) favours large areas of wetland habitat, but is most often associated with large, expansive marsh areas with tall emergent vegetation (e.g. *Typha capensis* or *Phragmites australis*) that host a high number of bird and small mammal species. This habitat type is associated with large instream dams and modified wetland habitat where taller reedbeds are present.
- ▶ *Podica senegalensis* (the African Finfoot) inhabits slow-flowing rivers (i.e. at lower gradients) and streams with good vegetative cover along the banks. This species may occur in the lower reaches of the Schaapkop River where the river widens and deep, slow-flowing pools form. This species does not favour areas where water quality and riparian habitat have been modified.
- ▶ *Afrivalus knysnae* (Knysna Leaf-Folding Frog) depends on aquatic habitat for breeding and feeding. They prefer permanently inundated endhoreic (inward draining) wetlands with good water quality and suitable vegetation for constructing nests. They are generally not associated with running water and are unlikely to occur in fast flowing portions of rivers.

A summary of habitat, breeding and feeding requirements for SCCs likely to occur in or adjacent to watercourses is provided in Table 4-5.

Table 4-5: Animal Species of conservation concern derived from the DFFE screening tool

Sensitivity	Class	Species	Common Name
High	Amphibia	<i>Afrivalus knysnae</i>	Knysna Leaf-Folding Frog
High	Aves	<i>Circus maurus</i>	Black Harrier
High	Aves	<i>Stephanoaetus coronatus</i>	Crowned Eagle
High	Aves	<i>Bradypterus sylvaticus</i>	Knysna warbler
High	Aves	<i>Falco biarmicus</i>	Lanner Falcon
High	Aves	<i>Polemaetus bellicosus</i>	Martial Eagle
High	Aves	<i>Sarothrura affinis</i>	Striped Flufftail
High	Aves	<i>Aquila verreauxii</i>	Black Eagle
High	Aves	<i>Circus ranivorus</i>	African Marsh Harrier
High	Aves	<i>Neotis denhami</i>	Denhams Bustard
Medium	Aves	<i>Podica senegalensis</i>	African Finfoot
Medium	Aves	<i>Hydroprogne caspia</i>	Caspian Tern
Medium	Aves	<i>Afrotis afra</i>	Southern Black Korhaan
Medium	Insecta	<i>Tsitana dicksoni</i>	
Medium	Mammalia	<i>Chlorotalpa duthieae</i>	Duthie's Golden Mole
Medium	Mammalia	<i>Sensitivespecies 8</i>	
Medium	Mammalia	<i>Myosorex longicaudatus</i>	Long-tailed Forest Shrew
Medium	Invertebrate	<i>Forest invertebrate</i>	
Medium	Invertebrate	<i>Aneuryphymus montanus</i>	Yellow Agile-Winged Grasshopper
Medium	Arachnida	<i>Chumma striata</i>	
Medium	Arachnida	<i>Moggridgea terricola</i>	
Medium	Arachnida	<i>Ilisoa knysna</i>	
Medium	Arachnida	<i>Diores silvestris</i>	

Table 4-6: Summary of habitat, breeding and feeding preferences of species of conservation concern likely to occur along watercourses

Red List Status	Species	Habitat	Breeding	Feeding
Avifauna				
Vulnerable A3c; B2b(ii,iii,v); C1+2a(i) TOPS: No CITES: No	<i>Bradypterus sylvaticus</i> Knysna warbler	Inhabits dense understorey vegetation along riverbanks in fynbos forest patches, riverine woodland and afro-montane forest and has even adapted to thickets of non-native brambles (e.g. <i>Rubus</i>). (BirdLife International, 2016).	Breeds from August and December coinciding with the greatest abundance of invertebrate species. (BirdLife International, 2016).	Mostly on ground, creeping through dense, matted vegetation and scratches in humus. Eats mostly grasshoppers, insect larvae, spiders, slugs, worms
Endangered A2c+3c+4c; C1 TOPS: No CITES: Appendix II	<i>Circus ranivorus</i> Marsh Harrier	Considered a waterbird. Roosts on taller trees around wetland edges from where it has a good vantage point. Can adapt to novel wetland habitats such as wastewater treatment works.	Breeding occurs between September and December. Egg-laying is from August to November in South Africa. Nests made of grass, reed stems or sticks in reedbeds, short sedge areas or in trees along the water's edge. The same nest is often reused by the same pair in following years.	Dietary assessment (Simmons et al., 1991) of pellets and prey deliveries to nests includes birds, frogs, fish, eggs and micromammals (<i>Rhabdomys</i> , <i>Otomys</i> , and Shrews). Hunts primarily in wetland habitats using various flight methods including soaring, hovering and low flight over wetlands and along the water's edge. May hunt in open grasslands or pastures near wetland areas.
Vulnerable B2b(ii,iii); C1; D1	<i>Podica senegalensis</i> African Finfoot	Mostly along quiet, wooded streams and rivers flanked by thick riparian vegetation and overhanging trees. Also dam verges, especially where there is sufficient overhanging vegetation and reed cover. Avoids stagnant and very fast-flowing watercourses, with a preference for clear rather than silted water.	Monogamous, territorial. Territories range from a few hundred meters to a few kilometers in length. Cover and open water necessary for courtship rituals. Laying dates August to April.	Forages close to the water's edge and river banks, usually under overhanging vegetation. Most prey taken from above water surface and from surrounding vegetation, but also takes prey within bill length below the surface without diving. Also leave the water to catch prey. Eats mostly insects; diet regularly includes dragonflies, (and their nymphs), grasshoppers, spiders, crabs, snails, shrimps, frogs, millipedes, beetles, fish, and molluscs. Recorded eating a 50cm snake.

Red List Status	Species	Habitat	Breeding	Feeding
Amphibia				
Endangered B1ab(i,ii,iii,v)+ 2ab(i,ii,iii,v) TOPS: No CITES: No	<i>Afrixalus knysnae</i> Knysna Leaf-folding Frog	Typically inhabit endorheic (inward draining) wetlands with shallow water (< 50cm), high clarity, and sufficient vegetation suitable for breeding (De Lange & Du Preez, 2018). No streaming or running water recorded at any of the sites where they've been recorded. The frog is associated with vegetation it can use for breeding which includes indigenous and exotic species. For example, slender knotweed (<i>Persicaria decipiens</i>) and kikuyu grass (<i>Pennisetum clandestinum</i>). It requires a habitat with diverse plant species, including shrubs, grasses, and ferns, providing shelter and breeding sites (Lange and Preez, 2018).	Females lay eggs on leaves which are folded and sealed by males, creating a protected environment (Du Preez & Carruthers, 2017). Breeding occurs during warmer wetter months such as September to November (De Lange, 2019). Breeding takes place near deeper parts of the waterbody, but still close to the water's edge.	The Knysna Leaf-folding Frog is an insectivorous amphibian feeding on small invertebrates found in its habitat (e.g. insects and spiders). Foraging behaviour includes actively searching for prey on the forest/fynbos floor and in the leaf litter. The frog uses its sticky, projectile tongue to capture and quickly ingest prey. It is primarily active at night, relying on its vision to locate and capture prey in the darkness.

4.9 Historical Aspects and Built Environment

Heritage/historic structures refer to “architectural works found in urban or rural settings providing evidence of a particular civilisation, a significant development or a historic event. It includes groups of buildings, structures and open spaces constituting past or contemporary human settlements that are recognised as cohesive and valuable from an architectural, aesthetic, spiritual or socio-cultural perspective”.

Some of the better-known historical structures include the woodcutter's outpost established in 1776 by the Dutch East India Company, the Dutch Reformed Church built between 1831 and 1842, St Mark's Anglican Cathedral built in 1849, Hoogekraal Mission Station (now renamed to Pacaltsdorp Station) established in 1813 by the London Missionary Society, and Blanco town built between 1844 and 1847 northwest of George. No known historical structures occur in watercourses.

The Montagu Pass is an important historical structure that affects watercourses. This pass was built between 1844 to 1847 and includes culverts and bridges that may be older than 60 years. Other older structures along the road include the stone-built toll house that dates to around 1847 and the Craddock Kloof Pass dating to 1812 (amongst others). The Montagu Pass is a highly significant route and has been declared a Provincial Heritage Site. Other sites of similar importance are the Keur River Bridge and the old Tollhouse.

Historical bridges that are older than 60 years occur along George Street (at 33°57'2.30"S 22°25'23.08"E) and along C.J. Langenhoven Street (at 33°57'21.56"S 22°27'6.03"E) – see Figure 4-12 and Figure 4-13 respectively. These bridges respectively date to 1964 and 1963.



Figure 4-12: 1936 and modern aerial views of the bridge along George Street



Figure 4-13: 1936 and modern aerial views of the bridge along C.J. Langenhoven Street

Historic topographic maps show that the George urban area has grown massively since the 1960s in all directions, especially to the south. This expansion has placed more pressure on the river systems with built-up areas encroaching far closer to the watercourses in modern times than was the case in the past.

Due to the immense growth of the town, it is unlikely that historical features remain along the watercourses. Bridges, in particular, are likely to have been replaced and/or expanded as roads became larger.

The following potential historical features could be of concern:

- ▶ Some buildings occur within the 1:100-year flood lines and some of these may be older than 60 years and thus protected by the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA) – see section 6.2.1.
- ▶ Culverts and bridges over the rivers may sometimes be older than 60 years. Features noted here include the various bridges mentioned above and possibly some other bridges and culverts along the Montagu Pass in the northern part of the study area. It is generally not possible to determine their age from aerial photography because older and newer (modern replacement) bridges would appear largely similar on aerial imagery.

4.10 Flood Risk Assessment

Zutari undertook flood risk assessments for the Schaapkop River and the objective was to ensure compliance with standards set by the Western Cape Department of Environmental Affairs and Development Planning (DEA&DP) and to guide the maintenance of ecological and human-made infrastructure, improve watercourse conditions and reduce negative impacts, thereby ensuring the preservation and enhancement of ecosystem services.

The full flood risk assessment, containing flood mapping for the entire catchments, is available in Appendix I).

4.10.1 Methodology

The flood risk assessment included on-site inspections, development of design floods, hydraulic models, and determination of floodlines for 1:50- and 1:100-year recurrence intervals.

The key tasks carried out in pursuit of this assessment were as follows:

- ▶ Site visits were conducted on 29-30 April 2024 to gather data on river conditions. Observations included vegetation types, riverbed materials, and flow control structures like weirs, culverts, and bridges.
- ▶ Design Flood Determination: Catchments and sub-catchments were delineated using QGIS and a 5m grid Digital Terrain Model (DTM). Design rainfall data and streamflow records were sourced and processed. Various methods were used to determine floods, including the Rational Method, Soil Conservation Services (SCS) Hydrograph Method, and Probabilistic Flood Analyses (PFA) Method.
- ▶ Hydraulic Model Configuration: HEC-RAS software was used for 2D modelling of the river hydraulics. Input data included topography, design flood peaks, land cover data, and structures like bridges and culverts. The model configuration aimed to ensure accurate representation of floodplain storage and attenuation during large flood events.

The resultant sub-catchments of the Schaapkop River basin are shown in Figure 4-14.

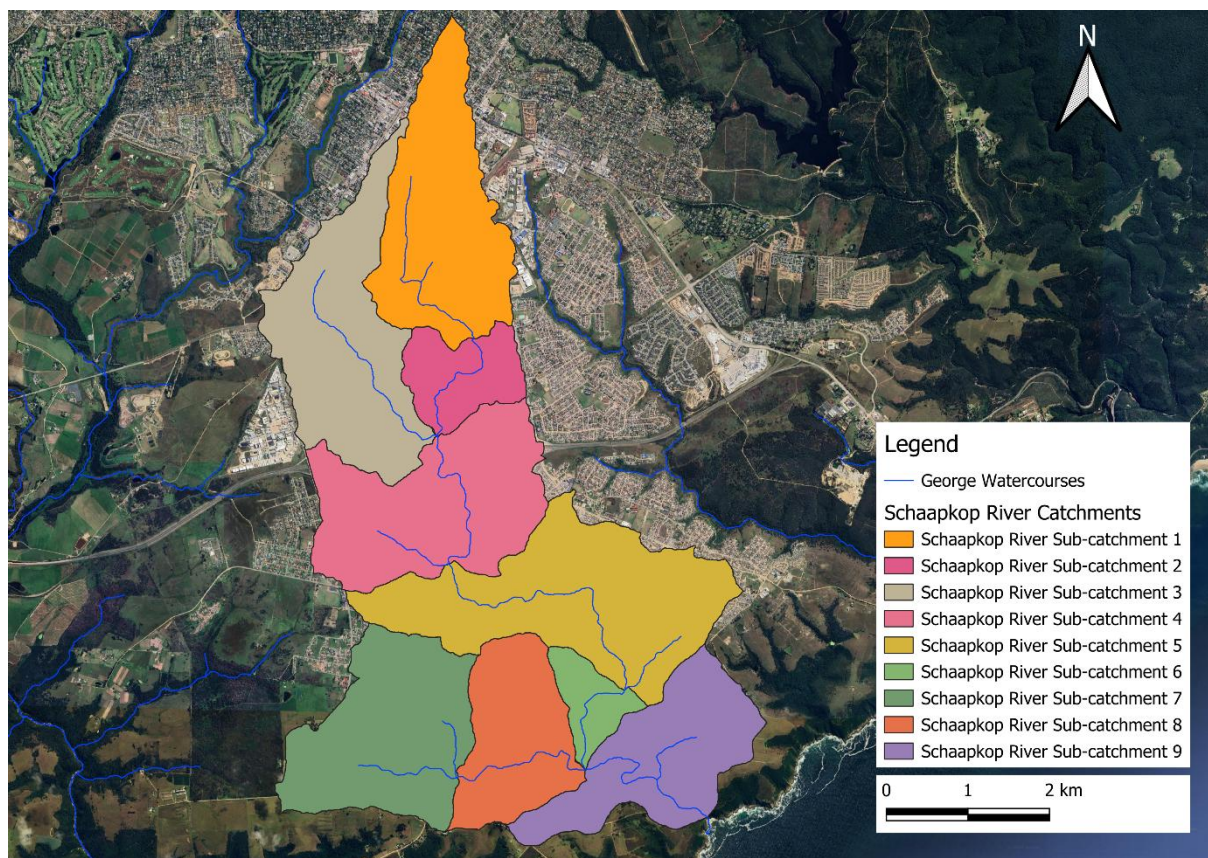


Figure 4-14: Schaapkop River delineated sub-catchments and watercourses

The highest design flood peak values were obtained from the two deterministic methods, the SCS and Rational Methods, as presented in Table 4-7.

Potential future increases in flood peaks due to climate change in the study region were also accounted for by consulting Schütte et al. (2021). Considering the projected climate change impacts in this region, it is postulated that climate change could potentially raise extreme stream flows by up to 15%. Therefore, the recommended design floods have been increased by 15% to account for the climate change effects. The final recommended 1:50- and 1:100-year RI design flood peaks, inclusive of climate change, are presented in Table 4-7.

Table 4-7: Recommended design flood peaks for all sub-catchments, including potential impacts of climate change

Sub-Catchment (SC)	Recommended Design Flood Peaks (m ³ /s)		Recommended Design flood Peaks accounting for climate change (+15%) (m ³ /s)	
Return Period	1:50-year RI	1:100-year RI	1:50-year RI	1:100-year RI
Schaapkop River				
Schaapkop River SC 1	129.5	156.6	148.9	180.1
Schaapkop River SC 2	23.6	29.6	27.1	34.0
Schaapkop River SC 3	73.2	91.4	84.2	105.1
Schaapkop River SC 4	64.0	77.7	73.6	89.4
Schaapkop River SC 5	67.4	82.2	77.5	94.5
Schaapkop River SC 6	10.2	13.4	11.7	15.4
Schaapkop River SC 7	84.2	108.6	96.9	124.9
Schaapkop River SC 8	45.4	58.7	52.2	67.5

Sub-Catchment (SC)	Recommended Design Flood Peaks (m ³ /s)		Recommended Design flood Peaks accounting for climate change (+15%) (m ³ /s)	
Schaapkop River SC 9	22.5	28.7	25.8	33.0

4.10.2 Results

Areas of the Schaapkop River catchment that could face inundation by either or both of the 1:50- and 1:100-year return interval (RI) floods are shown in Figure 4-15. Riverside properties in Bocherd could be affected by the 1:100-year RI flood, because a downstream culvert could cause backwater effects and inundation over the east bank of the river.

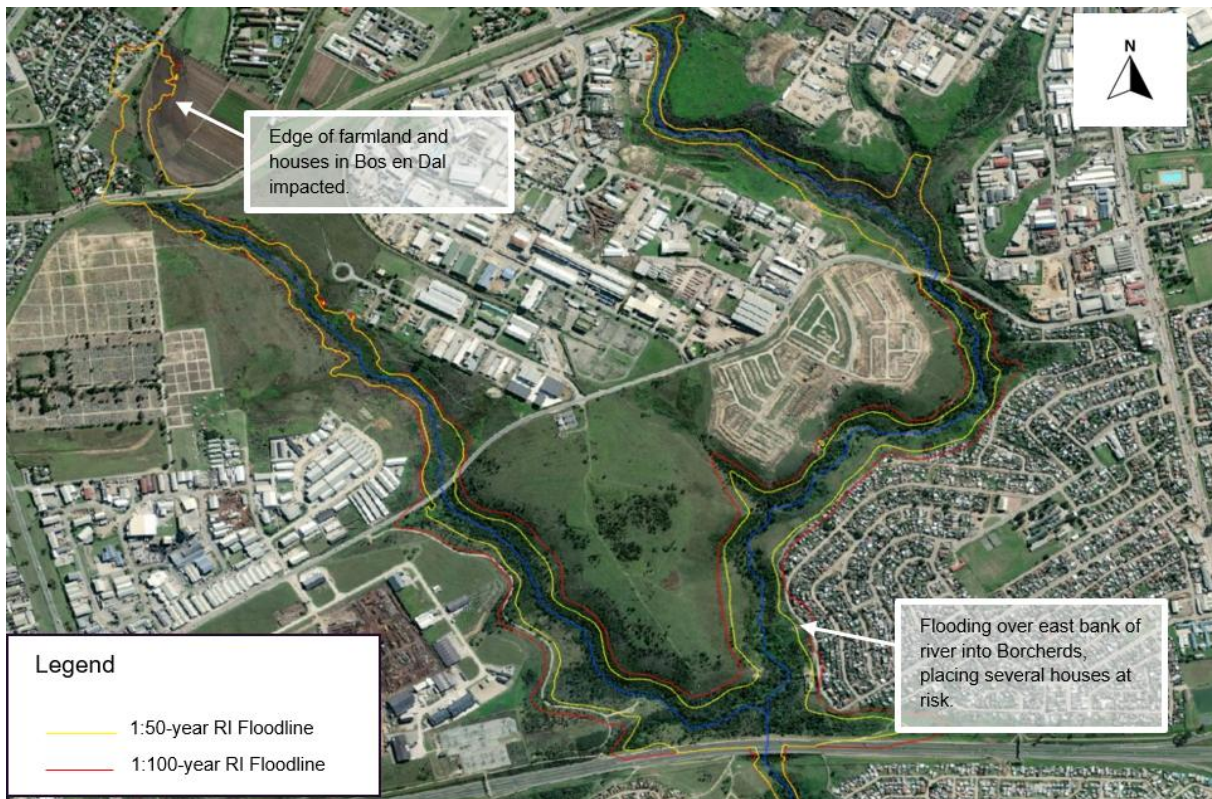


Figure 4-15: Floodlines at Bos en Dal and Borchers along the Schaapkop River.

5 Infrastructure Baseline

During the site visits mentioned in Section 3 of the report, municipal infrastructure inside or near rivers were visited. Recommendations are in no way meant to be prescriptive or to cover all types and/ or variations of infrastructure, but rather to recommend assessment measures.

To aid in establishing the probable cause of existing structure failures, the municipality could consider evaluating and recording such structures based on failure modes. Technically almost all structures could present one or more of the below failure modes:

- ▶ **‘Design’** failure when the design of a structure was either done incorrectly for whatever reason or it has been rendered inferior with regards to the intended design performance because of some or other parameter change (e.g. catchment development causing an increase of runoff intensity). Such an example (not in study area) of how a design was adjusted (before and after) to regain the functionality loss is provided in Figure 5-1.



Figure 5-1: Example of how a design could be adjusted to regain functionality (not in study area, for illustrative purposes.

- ▶ **‘Structural’** failure refers to when the structural integrity of a structure has been compromised (e.g. gabion structure missing segments, loose baskets or rocks) or if it was not constructed according to the specified design. Examples of such instances (not in study area) where even though structures might have been compromised, they are still performing the intended functionality, are provided in Figure 5-2.



Figure 5-2: Structural failure but still functioning.

- ▶ An example of design-, structural- and functional failure could be explained in Figure 5-3. It appears that the design was not adequate to withstand erosion during high flow conditions. Inadequate compaction of backfill material/ road may have contributed to the structural failure that in turn resulted in the functional failure.



Figure 5-3: Example of a combination of multiple failure types (not in study area, for illustrative purposes)

- ▶ **‘Functional’** failure, even though the structure was designed correctly and constructed accordingly, it may not be performing the intended function e.g. stream flow retention structure that has subsequently filled with silt/sediment and the storage capacity is compromised as a result. Examples of functional failures (not in study area) are illustrated in Figure 5-4 and Figure 5-5. Typical functions for municipal infrastructure may include:
 - For conveyance purpose (e.g. channels and pipes for water and/or sewerage).
 - To provide access over rivers, streams and stormwater channels (e.g. road bridges for vehicles and pedestrian/ animal crossing).
 - For erosion protection, either as stand-alone structures (e.g. retaining walls, embankment protection etc.) or supporting infrastructure in combination of any of the above types (e.g. like bridge pier/ footing protection, pipe crossing anchors on either side of rivers etc.).



Figure 5-4: Water retaining structure (storage) compromised due to infilling by debris (not in study area).



Figure 5-5: Road bridge design and/or function being impacted by debris (not in study area).

Above-mentioned modes of evaluating (determining the baseline) of existing structures could also be used as inputs and/or in combination with the prioritisation of maintenance and potential new structures as discussed in 'Section 8.9 - Infrastructure prioritisation and planning'.

6 Legal Framework

The section provides an overview of the national and provincial legislation that regulates the planning and management of rivers and their tributaries.

6.1 National Environmental Management Act (Act No. 107 of 1998) (NEMA)

The National Environmental Management Act (NEMA), Act No. 107 of 1998, is the cornerstone of environmental governance in South Africa and gives effect to the environmental right enshrined in Section 24 of the Constitution. The NEMA establishes a framework for cooperative environmental governance through principles that guide decision-making on all matters affecting the environment. It mandates organs of state to coordinate their environmental functions to promote sustainable development and ensure that environmental management decisions are inclusive and equitable.

The National Environmental Management Principles in Section 2 of NEMA guide all decisions and activities subject to the Act and aim to ensure that environmental considerations are integrated into development planning at all levels. These principles include the duty to prevent environmental harm, the need to take a risk-averse and cautious approach, and the promotion of sustainable development that balances environmental, social, and economic factors.

In terms of Section 28 of the National Environmental Management Act (NEMA), every person has a duty of care to prevent environmental degradation and protect natural resources. While George Municipality carries ultimate responsibility for implementing the River Management Plans, this duty extends to all individuals and organisations, reinforcing the shared responsibility for safeguarding river health.

6.1.1 Listed Activities in Terms of NEMA

The NEMA provides the framework for environmental decision-making in the country and the EIA Regulations (GN No. R982 of 2014) serve as the instrument through which development decisions are made.

Section 28(1) of NEMA places a “duty of care and remediation of environmental damage” on every person who causes, has caused, or may cause significant environmental degradation. This is a far-reaching obligation, and accordingly, those parties responsible for the degradation of the environment have a legal duty to avoid, minimise, or mitigate such impacts.

The duty of care imposed by Section 28(1) operates independently from the EIA Regulations. While Section 28(1) imposes a general obligation on all parties to prevent or remediate environmental harm, the EIA Regulations regulate the formal environmental authorisation process for specific listed activities. The EIA Regulations serve a different, more focused function by requiring that certain activities undergo a thorough assessment before they are authorised. It is crucial to distinguish between these two provisions to avoid conflating the general duty of care with the procedural requirements of the EIA Regulations.

The EIA regulations contain a set of Listed Activities that can be triggered by developments. If a development triggers a Listed Activity, it is required to undergo a Basic Assessment (BA) or Scoping and EIA process.

Table 6-1, Table 6-2 and Table 6-3 below provide an extract of Listed Activities contained in Listing Notices 1, 2 and 3 that have been considered in the context of the maintenance activities in the Schaapkop River. Approval of the Maintenance Management Plan (MMP) portion (see section Maintenance Management Plan8) of this RMP will allow these identified activities to take place without the need for a prior Basic Assessment (in the case of Listing Notices 1 and 3) or without a Scoping and EIA (in the case of Listing Notice 2).

It is important to note that this RMP does not constitute approval for the development of new infrastructure where such development triggers listed activities in terms of the EIA Regulations. Any new infrastructure or development (e.g., walkways) that may require environmental authorisation must be subjected to a separate application process, such as a Basic Assessment or a Scoping and EIA process, as applicable.

Table 6-1: Potentially applicable Listed Activities in Listing Notice 1 (GN No. 983 of 2014)

No.	Basic Assessment (BA) Listed Activity(ies) in Listing Notice 1	Applicability
19	The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 10 cubic metres from a watercourse; But excluding where such infilling, depositing, dredging, excavation, removal or moving – (b) is for maintenance purposes undertaken in accordance with a maintenance management plan	Movement of any material exceeding 10 m ³ within a watercourse requires prior Environmental Authorisation unless the activity/ies are for maintenance purposes in accordance with an MMP. Maintenance of existing infrastructure located inside the site would trigger this activity and thus approval is being sought via the approval of an MMP which forms part of a greater RMP.
27	The clearance of an area of 1 hectares or more, but less than 20 hectares of indigenous vegetation, except where such clearance of indigenous vegetation is required for – (ii) maintenance purposes undertaken in accordance with a maintenance management plan .	The clearance of more than 1ha of indigenous vegetation requires prior Environmental Authorisation unless the activity/ies are for maintenance purposes in accordance with an MMP. Maintenance of existing infrastructure would in some cases result on the clearance of indigenous vegetation for creating workspace, replacing structure, carrying out maintenance and for access purposes. Approval is being sought via the approval of an MMP which forms part of a greater RMP.

Table 6-2: Potentially applicable Listed Activities in Listing Notice 2 (GN No. 984 of 2014)

No.	Scoping and EIA Listed Activity(ies) in Listing Notice 2	Applicability
	None	

Table 6-3: Potentially applicable Listed Activities in Listing Notice 3 (GN No. 985 of 2014)

No.	Basic Assessment (BA) Listed Activity(ies) in Listing Notice 3	Comment Regarding Applicability
12	The clearance of an area of 300 square metres or more of indigenous vegetation except where such clearance of indigenous vegetation is required for maintenance purposes undertaken in accordance with a maintenance management plan. i). Western Cape i. Within any critically endangered or endangered ecosystem listed in terms of section 52 of the NEMBA or prior to the publication of such a list, within an area that has been identified as critically endangered in the National Spatial Biodiversity Assessment 2004;	The clearance of more than 300sqm of indigenous vegetation requires prior Environmental Authorisation unless the activity/ies are for maintenance purposes in accordance with an MMP. Maintenance of existing infrastructure would in some cases result on the clearance of indigenous vegetation for creating workspace, replacing



No.	Basic Assessment (BA) Listed Activity(ies) in Listing Notice 3	Comment Regarding Applicability
	ii. Within critical biodiversity areas identified in bioregional plans; Within the littoral active zone or 100 metres inland from high water mark of the sea or an estuarine functional zone, whichever distance is the greater, excluding where such removal will occur behind the development setback line on erven in urban areas; iii. On land, where, at the time of the coming into effect of this Notice or thereafter such land was zoned open space, conservation or had an equivalent zoning; or iv. On land designated for protection or conservation purposes in an Environmental Management Framework adopted in the prescribed manner, or a Spatial Development Framework adopted by the MEC or Minister.;	structure, carrying out maintenance and for access purposes. The site falls within an area indicated to comprise of Garden Route Granite Fynbos and Groot Brak Dune Strandveld which are both classified as Critically Endangered in terms of ecosystem threat status and as such this activity would be triggered by maintenance activities. The project site also falls within areas indicated as CBAs. Approval is being sought via the approval of an MMP which forms part of a greater RMP.

6.1.2 Public Participation

The draft MMP (as a component of the RMP) were subjected to a public participation process in accordance with the requirements of Section 24O of NEMA and the public participation procedures prescribed in the NEMA EIA Regulations. All interested and affected parties were afforded a reasonable opportunity to comment. Supporting evidence of PPP related actions, including written correspondence, is included in Appendix J.

6.1.2.1 PPP Period

A draft version of the Schaapkop RMP document was provided for comment and made accessible to all interested and affected parties (I&APs) and the DEA&DP for 30 calendar days.

The following PPP actions were undertaken for the Draft Schaapkop RMP:

- ▶ The Draft RMP was made available to the public for a 30-day comment period from: 15 August 2025 to 15 September 2025.
- ▶ The report was made available via the following means:
 - Online via Google Drive:
 - Hard copy at the George Public Library, Caledon Street, George; and
 - Hard copy at the First Floor Reception, GM: Planning and Development Offices, 46 Market Street
- ▶ Site notices were placed on 14 August 2025 at a number of locations along the boundary of the site where accessible and visible to the public.
- ▶ An advert was placed in the George Herald on 14 August 2025.
- ▶ On 28 August 2025 a public open day and presentation was held at the George Municipality's Planning and Development offices at 46 Market Street, George.
- ▶ Two articles appeared in the George Herald on 18 August 2025 and 9 September 2025. These articles were not published by Zutari, however it shows that the public had knowledge and were made aware of the project and PPP.
- ▶ The WESSA monthly newsletter for September 2025 also included the project and comment period in one of its segments.

6.1.2.2 Comments Received

All comments received during the comment period were responded to and captured in a Comments and Responses Report (CRR).

- ▶ The CRR is included in Appendix J6.
- ▶ Proof of all PPP related actions, including written correspondence, is included in Appendix J.

6.2 National Water Act (Act No. 36 of 1998) (NWA)

The Department of Water & Sanitation (DWS) is the custodian of South Africa's water resources and therefore assumes public trusteeship of water resources, which includes watercourses, surface water, estuaries, or aquifers. The National Water Act (No. 36 of 1998) (NWA) aims to protect water resources, through:

- ▶ The maintenance of the quality of the water resource to the extent that the water resources may be used in an ecologically sustainable way;
- ▶ The prevention of the degradation of the water resource;
- ▶ The rehabilitation of the water resource;
- ▶ A watercourse means;
 - A river or spring;
 - A natural channel in which water flows regularly or intermittently;
 - A wetland, lake or dam into which, or from which, water flows; and
 - Any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks.

No activity may take place within a watercourse unless it is authorised by the DWS. According to Section 21 (c) and (i) of the NWA, a WUL is required for any activities that impede or divert the flow of water in a watercourse or alter the bed, banks, course or characteristics of a watercourse. The regulated area of a watercourse for section 21(c) or (i) of the NWA water uses means:

- a. *The outer edge of the 1 in 100-year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam;*
- b. *In the absence of a determined 1 in 100-year flood line or riparian area the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench (subject to compliance to section 144 of the Act); or*
- c. *A 500 m radius from the delineated boundary (extent) of any wetland or pan.*

Water uses that occur within the regulated area of a watercourse must be assessed using the DWS Risk Assessment Matrix prescribed in GN R 509 of 2016⁷ to determine whether activities may be approved under a General Authorisation (GA) – this applies to Low-risk activities according to the Risk Assessment Matrix) - or a full WUL – this applies to Medium or High-risk activities according to the Risk Assessment Matrix.

However, GN R 4167 of 2023⁸ automatically grants GAs to categories of water uses under section 21(c) and 21(i) as long as the water use remains within the limits and conditions of this GA. Hence, if the proposed water use complies with the limits and conditions of GN R 4167 of 2023, there is no need to apply for a water use through the processes prescribes by GN R 509 of 2016. Importantly, **GN R 4167**

⁷ General Authorisation in terms of Section 39 of the National Water Act, 1998 (Act No. 36 of 1998) for Water Uses as defined in Section 21(c) or Section 21(i)

⁸ General Authorisations in terms of Section 39 of the National Water Act, 1998 (Act No. 36 of 1998) for Water Uses as defined in Section 21(c) or Section 21(i)

of 2023 applies only if the risk class is “Low” and does not apply if the risk class is “Medium” or “High” according to the Risk Assessment Matrix.

6.2.1 GN 4167 Requirements of a River Management Plan

The project team has confirmed with the Breede-Olifants Catchment Management Agency (BOCMA) that a RMP can be authorised via the latest General Authorisation (GA), published in terms of the National Water Act (No. 36 of 1998) (NWA). The requirements listed in Appendix B of the GA published on 8 December 2023 are set out below.

APPENDIX B: Aspects that must be addressed in any RIVER MANAGEMENT PLAN or Similar Management Plan as specified under paragraph 6 (1)(vi) of this Notice. (There is no requirement to comply with all the conditions of this notice for activities executed in terms of this plan except for section 7(7)-(12) which must be complied with).

River Management Plans for storm water and river management activities and maintenance management plans MUST:

Contain information on all the river and storm water management activities in terms of section 21(c) or (i) water uses of the Act with a section addressing all relevant supporting technical information used to ensure a LOW risk will be posed to the resource quality of the watercourses and that this management plan have been submitted to the relevant regional operations or Catchment Management Agency (CMA) office for APPROVAL. The report must include, but may not be limited to:

When developing a River Management Plan:

- 1. Identify River Management Plan domain, preferably from a whole-catchment perspective;*
- 2. Identify an accountable, representative body that should take unbiased custodianship of the RMP and drive its implementation;*
- 3. Identify key stakeholders;*
- 4. Divide the river into useful management units;*
- 5. Identify major drivers of river disturbance and instability – human and natural, and their primary and secondary effects;*
- 6. Solicit input from stakeholders on their priorities and objectives;*
- 7. Define best practice measures for rehabilitation and maintenance implementation;*
- 8. Design a plan for ecological monitoring which is specifically linked to the stated objectives; and*
- 9. Develop an implementation programme and review mechanism.*

Report should contain supporting technical information used to ensure the low risk to resource quality like:

- a) Impact Assessment Report completed by an independent consultant;*
- b) All the relevant specialist reports supporting the proposed mitigation measures:*
 - Specialist Reports must address the level of modification/risk posed to resource quality, i.e.: flow regime, water quality, geomorphological processes, habitat, and biota of the watercourses, and contain Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) data for relevant watercourses;*
- c) Environmental management plan giving effect to all actions required to mitigate impacts (What, When, Who, Where, and How);*

- d) *Best practices applicable to these activities, where applicable;*
- e) *Generic designs and method statements, where applicable.*
- f) *Norms and standards, where available;*
- g) *Maintenance plan for any work done;*
- h) *Monitoring programme that must include "present day" conditions to be used as baseline values;*
- i) *Monitoring, auditing, and reporting programme (reports must be sent on request to the region or CMA); and*
- j) *Internalized controls and auditing, where applicable.*

PLEASE NOTE: Any activities outside the scope of the approved plan that is required for river or storm water management (example: building of new gabion structures to stop bank erosion) must comply with all the provisions in Section 6 of this notice

6.3 National Forests Act, 1998 (Act No. 84 of 1998)

Government Gazette 46094 (Notice No. 1935) of 25 March 2022 (List of Protected Tree Species) under the National Forests Act (NFA) lists tree species that are protected in South Africa. Such trees may not be removed or damaged in any way without a permit issued by the Department of Environment, Forestry and Fisheries (DEFF).

The following protected trees could occur at areas where maintenance is required:

- ▶ Podocarpus falcatus (Afrocarpus falcatus) – Outeniqua Yellowwood
- ▶ Podocarpus henkelii – Henkel's Yellowwood
- ▶ Podocarpus latifolius – Real Yellowwood
- ▶ Pittosporum viridiflorum – Cheesewood
- ▶ Ocotea bullata – Stinkwood (unlikely to occur)
- ▶ Sideroxylon inerme – White Milkwood

These trees are not allowed to be disturbed, pruned, cut, transplanted/relocated or destroyed with obtaining the necessary tree permit from the local forestry office

6.4 National Heritage Resources Act (Act No. 25 of 1999) (NHRA)

Section 34 of the National Heritage Act (No. 25 of 1999) (NHRA) protects buildings and structures older than 60 years.

Section 38 of the NHRA identified activities that would require a heritage authorization.

- (a) the construction of a road, wall, powerline, pipeline, canal or other similar form of linear development or barrier exceeding 300 m in length;
- (b) the construction of a bridge or similar structure exceeding 50 m in length;
- (c) the re-zoning of a site exceeding 10,000 m² in extent; or
- (d) any development or other activity which will change the character of a site —
 - (i) exceeding 5,000 m² in extent; or
 - (ii) involving three or more existing erven or subdivisions thereof; or
 - (iii) involving three or more erven or divisions thereof which have been consolidated within the past five years; or
 - (iv) the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority;

- (e) any other category of development provided for in regulations by SAHRA or a provincial heritage resources authority,

Zutari and the heritage specialist have engaged Heritage Western Cape (HWC) re the need to submit a Notice of Intent to Develop (NID). The specialist explained that a desktop study that aims to identify any possible heritage resources along the three rivers (e.g. bridges, or possibly shell middens at the river mouths) will be undertaken and a site visit carried out if deemed necessary. The report would flag/highlight any areas where individual permit applications would be required if heritage resources are affected by maintenance work.

Heritage Western Cape confirmed their support of the approach to the desktop study and heritage inputs. It further stated that it an archaeological finds protocol be included in the MMPs and that it will provide further comment as part of the public participation process.

6.5 National Environmental Management: Biodiversity Act (Act No. 10 of 2004) (NEMBA)

Provides a framework for conservation of biodiversity. The national biodiversity framework must provide for an integrated coordinated and uniform approach to biodiversity management by organs of state in all spheres of government.

The National Environmental Management: Biodiversity Act (Act 10 of 2004) (NEMBA) provides for listing threatened or protected ecosystems, in one of four categories: critically endangered (CR), endangered (EN), vulnerable (VU) or protected. The Draft National List of Threatened Ecosystems (Notice 1477 of 2009, Government Gazette No 32689, 6 November 2009) has been gazetted for public comment.

The list of threatened terrestrial ecosystems supersedes the information regarding terrestrial ecosystem status in the NSBA 2004.

NEMBA also deals with endangered, threatened and otherwise controlled species. The Act provides for listing of species as threatened or protected, under one of the following categories:

- ▶ Critically Endangered: any indigenous species facing an extremely high risk of extinction in the wild in the immediate future.
- ▶ Endangered: any indigenous species facing a high risk of extinction in the wild in the near future, although it is not a critically endangered species.
- ▶ Vulnerable: any indigenous species facing an extremely high risk of extinction in the wild in the medium-term future; although it is not a critically endangered species or an endangered species.
- ▶ Protected species: any species which is of such high conservation value or national importance that it requires national protection. Species listed in this category include, among others, species listed in terms of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

Certain activities, known as Restricted Activities, are regulated by a set of permit regulations published under the Act. These activities may not proceed without environmental authorization.

6.6 National Environmental Management: Protected Areas Act (Act No. 57 of 2003) (NEM: PAA)

This act provides for the declaration and management of specifically identified protected areas in South Africa. The Act must be read in conjunction with the NEMBA.

6.7 National Environmental Management: Air Quality Act (Act No. 39 of 2004) (NEM: AQA)

To reform the law regulating air quality in order to protect the environment by providing reasonable measures for the prevention of pollution and ecological degradation and for securing ecologically sustainable development while promoting justifiable economic and social development; to provide for national norms and standards regulating air quality monitoring, management and control by all spheres of government.

7 Implementation

7.1 Roles and Responsibilities

7.1.1 Names and Details of Key Role Players

Key role players' details are provided below.

Table 7-1: Key role players from the George Municipality

Proponent:	George Municipality
Contact Person:	Godfrey Louw
Role:	Municipal Manager
Email:	tlduplooy@george.gov.za
Tel.:	044 801 9111
Proponent:	George Municipality
Contact Person:	Lionel Daniels
Role:	Deputy Director: Streets and Stormwater Directorate: Civil Engineering Services
Email:	rldaniels@george.gov.za
Tel.:	044 801 9184
Proponent:	George Municipality
Contact Person:	Fabian Abrahams
Role:	Senior Engineering Technician (CAD/GIS): Planning, PMU & Support Services) Directorate: Civil Engineering Services
Email:	fabrahams@george.gov.za
Tel.:	044 801 9348
Proponent:	George Municipality
Contact Person:	Melanie Geyer
Role:	Manager: Infrastructure Planning Directorate: Civil Engineering Services
Email:	mgeyer@george.gov.za
Tel.:	044 801 9268
Proponent:	George Municipality
Contact Person:	Danie Greeff
Role:	Deputy Director: Planning & Design Directorate: Electro-Technical Services
Email:	dgreeff@george.gov.za
Tel.:	044 874 3917 / 044 801 9221
Proponent:	George Municipality
Contact Person:	Ernest Claassen
Role:	Deputy Director: Wastewater Services Directorate: Civil Engineering Services
Email:	eclaassen@george.gov.za

Tel.:	044 801 9352
Proponent:	George Municipality
Contact Person:	Henriette Koch
Role:	Senior Manager: Spatial and Environmental Planning Directorate: Planning & Development
Email:	hkoch@george.gov.za
Tel.:	044 801 9024
Proponent:	George Municipality
Contact Person:	Delia Power
Role:	Deputy Director: Development and Environmental Planning Directorate: Planning & Development
Email:	dpower@george.gov.za
Tel.:	044 801 9476

Table 7-2: Details of the competent authority

Competent Authority:	Department of Environmental Affairs and Development Planning (DEA&DP)	
Contact Person:	Marlin Henry	Danie Swanepoel
Role:	Case Officer	Head of Component: EIA (Region 3: Garden Route and Central Karoo)
Email:	Marlin.Henry@westerncape.gov.za	Danie.Swanepoel@westerncape.gov.za
Tel.:	044 814 2016	044 814 2008

7.1.2 George Municipality

George Municipality, as the official “Holder” of the MMP, is responsible for complying with the MMP and conditions, as well as any person acting on its behalf, including but not limited to, an agent, sub-contractor, employee, or any person rendering a service to them. Therefore, George Municipality must inform any employees and contractors of the MMP and make them aware of relevant provisions with respect to their activities that have involve activities prescribed in this document.

7.1.3 Western Cape Department of Environmental Affairs and Development Planning

The DEA&DP has a legal mandate to enforce the requirements of the NEMA and associated EIA regulations in the Western Cape. As such, it is the decision-making authority on applications for Environmental Authorisation and for the approval of MMPs.

The DEA&DP has the power to review compliance with the approved MMP and, if necessary, to enforce compliance with it. The DEA&DP has the authority to review the degree of compliance by reviewing ECO reports or to undertake site inspections in its own right.

7.1.4 Contractors

Contractor working on behalf of George Municipality must:

- ▶ ensure that their methods of work are compliant with the requirements on this MMP;
- ▶ implement the MMP insofar as it relates to their scope of work; and

- ▶ ensure that all third parties who carry out all or part of their contractual obligations comply with the requirements of this MMP to the same extent that they are required to do.

7.1.5 Environmental Control Officer (ECO)

George Municipality (GM) must appoint or assign a suitably qualified Environmental Control Officer (ECO) to monitor, review and verify the contractors/team's compliance with the MMP's. The ECO will play a crucial role in ensuring that maintenance activities are carried out in alignment with environmental regulations, minimising environmental impacts, and upholding the objectives of the River Management Plan (RMP), inclusive of the MMP.

Given the nature of the RMP and the scope of maintenance activities involved, it is recommended that GM appoint an internal ECO rather than an external consultant. The rationale for this approach is based on the following key considerations:

- ▶ **Ad Hoc Nature of Maintenance Activities**
 - Many maintenance interventions will not follow a fixed schedule but will instead be performed on an as-needed basis. Having an internal ECO ensures flexibility in responding to environmental compliance needs as they arise.
- ▶ **Short-Duration and Minor Works**
 - Some maintenance tasks may be small in scale or require only brief intervention. Appointing an internal ECO allows for cost-effective and efficient oversight without the need for repeated external consultant appointments for each minor activity.
- ▶ **Immediate Availability for Compliance Oversight**
 - As a full-time employee of GM, the internal ECO will be readily available to conduct site inspections, provide guidance, and ensure compliance with the MMPs whenever required, reducing delays in maintenance execution.
- ▶ **Enhanced Coordination and Implementation**
 - An internal ECO will have direct access to GM's management structures, technical teams, and operational staff. This proximity fosters improved communication, quicker decision-making, and more seamless integration of environmental management practices into daily operations.
- ▶ **Institutional Knowledge and Continuity**
 - An internal ECO will develop in-depth familiarity with the municipality's environmental policies, management plans, and specific site conditions over time. This continuity ensures consistent application of best practices and long-term environmental compliance.
- ▶ **Capacity Building Within GM**
 - An internal ECO can contribute to internal training and capacity development, equipping municipal staff with better environmental awareness and management skills, reducing reliance on external expertise over time.
- ▶ **Better Stakeholder Engagement**
 - The ECO will be directly engaged with local communities, contractors, and regulatory authorities, fostering stronger relationships and ensuring smoother communication regarding environmental responsibilities.
- ▶ **Integration with Municipal Planning and Decision-Making**
 - Having an in-house ECO allows for direct participation in municipal planning discussions, ensuring that environmental considerations are incorporated into decision-making from the outset, rather than as an external afterthought.

By appointing an internal ECO, GM can enhance the effectiveness and efficiency of environmental compliance monitoring while fostering a proactive approach to environmental management within its jurisdiction.

The ECO must—

- ▶ Be appointed or assigned before commencement of any maintenance activities.
- ▶ Be informed by the relevant municipal department prior to the commencement of any maintenance activities that are covered by this RMP.
- ▶ Review and approve method statements with input from the relevant municipal departments.
- ▶ Undertake an inspection of the site prior to work commencing to establish whether any plant rescue will be required or to advise whether specific areas or plants (e.g., protected trees) must be demarcated as no-go.
- ▶ Undertake routine inspections of the works to monitor and provide guidance relating to the conditions of this RMP. Following each inspection the ECO must compile a construction checklist / ECO Report to capture the information gathered during the sit inspection, the checklist must:
 - Clearly state where work is being done and include a GPS coordinate.
 - Contain photographic record.
 - Confirm whether mitigation measures and recommendations required by the RMP are implemented, and where such measures are not implemented that it is recorded.
 - Identify any non-compliance requiring remedial action.
 - Confirm whether environmental impacts are being managed.
 - Detail any remedial action necessary.
 - Include record of any discussions or meetings held with the construction team.
 - Submit the checklist/ECO Report to the George Municipality's environmental department and the relevant civils department/s for record keeping, on a weekly basis (i.e., weekly ECO Reports).
- ▶ Following the completion of any routine or emergency maintenance activities, the ECO shall inspect the work and compile a Completion Report, which must include:
 - All the construction checklists compiled during the maintenance work.
 - A dated photographic record of the completed works.
 - Detail any remedial actions that still need to be undertaken post construction.
 - Detail the timeline for remedial actions to be undertaken.
 - Minutes of site inspections or meetings pertaining to any environmental incidents, or of non-compliance with this MMP where applicable.
 - The completion audit report will be submitted to both GM and the DEA&DP to demonstrate adherence to regulatory requirements and to provide a record of environmental performance.
- ▶ Report environmental incidents⁹ to the relevant authorities.

7.1.6 Department of Water and Sanitation

The DWS has a legal mandate under the National Water Act, 1998 (NWA) to protect South Africa's freshwater resources. Specifically, in terms of Section 21 of the NWA, it has the power to authorise consumptive and non-consumptive "water uses", which include a range of activities as described in section 6.2.

⁹ In South Africa, an "environmental incident" is defined by the NEMA as an "unexpected, sudden, and uncontrolled release of a hazardous substance, including from a major emission, fire, or explosion, that has caused or may cause significant harm to the environment, human life, or property."

The DWS has no direct authority over “listed activities” approved as part of an MMP (RMP), unless these activities also trigger water uses under the National Water Act.

Relating to this RMP, the BOCMA must be informed of activities and projects implemented to improve the ecological health of the river.

7.2 Method Statement

Method Statements are to be prepared for works that require very specific actions to be undertaken by the contractor. The mitigations included on this RMP will be sufficient for most of the work, however there may/will be instances where the contractor will need to be very specific during implementation. An example would be when accessing very wet or sensitive areas for which an access method statement will need to be prepared.

The ECO must inform the contractor, based on the proposed works and the conditions of the site, whether specific method statements need to be completed and approved prior to implementation.

Attached to this RMP are a number of method statements relating to works such as stream diversion, rehabilitation and erosion control which provide specific measure relating to those actions. The method statements attached provide a baseline of actions for e.g. revegetation and can be modified by the ECO to fit the requirements of the site and works.

Refer to Section 8.5 for more details regarding method statements.

7.3 Notification of Authorities

George Municipality must, for the period during which the RMP remains valid, submit to the DEA&DP (for attention the Directorate: Development Management Region 3) Completion Reports following the conclusion of any maintenance activities.

7.4 Review of the RMP

It is recommended that the George Municipality appoint an independent EAP to review the RMP considering the Completion Reports on a yearly basis in order to determine whether impacts are being managed appropriately and whether any changes to the RMP is required.

A review report must be compiled by the EAP and submitted to the DEA&DP. In the report the EAP must state whether the RMP sufficiently mitigates and manages impacts or whether changes would be required.

7.5 Training (Induction)

The Contractor must ensure that all workers, plant operators, drivers and anyone under their employ successfully complete environmental induction training prior to commencing with any site activities.

The induction training material shall address, but not be limited to:

- ▶ An environmental Code of Conduct;
- ▶ basic environmental awareness;
- ▶ basic health and safety awareness;
- ▶ prevention of water, soil, and air pollution;
- ▶ prevention of soil erosion and sedimentation;
- ▶ basic principles of materials handling and storage;
- ▶ fire risks;
- ▶ protection of fauna and flora;
- ▶ emergencies and incident responses;

- ▶ spill response provisions;
- ▶ social responsibility; and
- ▶ administrative and reporting procedures.

Relevant chapters of the EMMP shall be presented during this course to facilitate compliance.

Proof of completing such training shall be provided to the ECO (attendance register or similar).

It is recommended that the environmental awareness and education for staff on site be delivered in one or more languages to ensure that all staff fully understand their obligations.

Contractors shall provide appropriate supervision, depending on the nature and scale of the operations.

Contractors must monitor the performance of their site staff towards meeting environmental requirements of this RMP on an on-going basis. Shortcomings must be addressed constructively and proactively through appropriate communication and training.

7.6 Housing/Availability of the RMP

A copy of the adopted RMP and MMP must be kept at the site whenever maintenance activities will be undertaken. The aforesaid document must be produced to any authorised official of the DEA&DP who requests to see the documents and such documents must be made available for inspection by any employee or agent of the Holder who works or undertakes work at the site.

7.7 Amendment, Suspension or Withdrawal of Maintenance Management Plan

7.7.1 Extension

George Municipality may submit a written request to the DEA&DP for an extension of the validity period of the MMP prior to the validity period lapsing. Such a request must contain a review of the MMP in terms of the need and desirability of such an extension and the objectives contained in the MMP. The review must make recommendations on possible amendments to the MMP or give reasons for maintaining the status quo.

7.7.2 Amendments

Any changes to, or deviations from, the project description or maintenance activities set out in the adopted MMP must be approved in writing, by this Department, before effect may be given to such changes or deviations. In assessing whether to grant such approval or not, the Department may request such information as it deems necessary to evaluate the significance and impacts of such changes or deviations and it may be necessary for the Holder to apply for further authorisation in terms of the regulations pertaining to environmental impact assessments under sections of the National Environmental Management Act, 1998 (Act No. 107 of 1998).

7.7.3 New infrastructure or Expansion of Existing Infrastructure

Any erection/construction of new structures or the expansion of an existing structure or infrastructure, which constitutes any other activity listed in the NEMA Listing Notices (currently Government Notice R.983; R.984 or R.985 of 4 December 2014) may require environmental authorisation. This must first be confirmed with the competent authority.

The DEA&DP may:

- ▶ revise the adopted MMP or its initial comments; or
- ▶ define further measures to be incorporated into the MMP, based on any new or revised information received and to request further information from the Holder where necessary.

7.7.4 Suspension or Withdrawal

The DEA&DP may suspend or withdraw the MMP based on non-compliance with the MMP or a condition of its approval thereof.

8 Maintenance Management Plan (MMP)

8.1 Introduction to the MMP

The Maintenance Management Plan (MMP) for the Schaapkop Riverine area has been developed to undertake the Listed Activities as contained in Listing Notice 1 and 3 of the EIA Regulations, 2014 that make provision for the adoption of an MMP in a watercourse. The purpose of this MMP is to maintain both man-made and ecological infrastructure in a manner that improves the current state of and reduces the negative impacts on the Schaapkop Riverine area to ensure that ecosystem services are preserved/improved and to prevent further deterioration of the watercourse.

The MMP is a regulatory document established in compliance with the National Environmental Management Act (NEMA) and the Environmental Impact Assessment (EIA) Regulations of 2014, as amended, and documents the processes the George Municipality will adhere to when conducting maintenance of existing infrastructure in the Schaapkop Riverine area, as defined in this MMP.

Properly managed maintenance activities help maintain the integrity of both man-made and natural systems. The MMP provides the means to anticipate, minimise, and mitigate potential adverse environmental impacts, that result from faulty infrastructure in the watercourses and natural hazards such as floods and erosion.

8.1.1 Purpose and Scope

The geographical scope of the Schaapkop MMP is mapped in Appendix A. The Schaapkop MMP site includes all associated existing service infrastructure.

The MMP will be used by the George Municipality's Technical and Planning Directorates to undertake required work as permitted by the MMP, and includes all subcontractors, consultants, contractors employed by the George Municipality.

8.1.2 Legal and Regulatory Compliance

The Schaapkop River MMP complies with the requirements set forth by the NEMA, the NWA and the minimum requirements set out by DEA&DP for the adoption of an MMP in a watercourse.

The MMP is developed according to the maintenance management principles identified by the DEA&DP, which include:

- ▶ Anticipating and preventing negative impacts and risks, followed by minimisation, rehabilitation, or repair. A sequence of possible mitigation measures to avoid, minimise, rehabilitate, and/or remedy negative impacts is considered.
- ▶ Avoiding and reducing unnecessary maintenance.
- ▶ Ensuring that maintenance and management of a watercourse are informed by the condition of the physical and ecological processes that drive and maintain aquatic ecosystems within the Schaapkop River catchment, relative to the desired state of the affected system.
- ▶ Aiming to prevent further deterioration of the Schaapkop Riverine area and being guided by a general commitment to improving and maintaining ecological infrastructure for the delivery of ecosystem services.
- ▶ Identifying, addressing, and, where feasible, eliminating the factors that necessitate intrusive, environmentally damaging maintenance.
- ▶ Applying a process of continuous management improvement, which includes: planning, implementing, checking (monitoring, auditing, determining corrective actions), and acting (management review).

8.2 Primary Management Objectives

The primary management objectives of the Schaapkop MMP are to:

- ▶ ensure legal compliance by adherence to the requirements of an approved MMP (this document);
- ▶ minimise environmental impacts of maintenance activities while ensuring that delivery of basic services is not inhibited to ensure that operational functionality is maintained;
- ▶ improve awareness of necessary environmental protection measures amongst relevant role players like the employees of George Municipality and contractors; and
- ▶ allow the continuation and enhancement of ecosystem services that are delivered by aquatic ecosystems.

8.3 Overview of Maintenance Actions and Infrastructure Types

The infrastructure on which maintenance will be performed, and the forms of routine maintenance activities relevant to each one, are listed in Table 8-1 below. This is not necessarily an exhaustive list, since unscheduled or unusual forms of maintenance may be necessary at times due to unplanned-for circumstances. Examples of the infrastructure that requires these maintenance activities is shown in Section 4.2.

Table 8-1: Types of infrastructure and maintenance activities

Structures	Maintenance activities
Stormwater structures (stormwater pipes, open channels, culverts, outlets, etc.)	▶ Maintenance of water infrastructure and pipe burst may necessitate excavations in watercourses. ▶ A pipe burst, for instance, may result in undercutting under a waterpipe, resulting in a risk of further damage to the pipe. Removing sediment, debris, vegetation to maintain flow. ▶ Repairing damaged culverts, pipes, and outlets. ▶ Reinforcing culvert headwalls and outlet structure
Sewer Infrastructure (sewer pipelines, manholes, pump stations)	▶ Unblocking sewer lines ▶ Unblocking sewer manholes ▶ Replacing sewer lines ▶ Repairing or replacing damaged manhole covers and chambers ▶ Repairing pump stations
Water Supply Pipelines (potable water mains, bulk supply lines)	▶ Flushing pipelines to prevent sediment build-up ▶ Cleaning and maintaining valve chambers to prevent blockages ▶ Replacing faulty valves to maintain pressure control ▶ Reinforcing pipeline supports with gabions or concrete structures (pipelines passing through watercourses) ▶ Repairing protective coatings or encasements to prevent corrosion (pipelines passing through watercourses) ▶ Removing sediment build-up that may compromise stability (pipelines passing through watercourses)
Road Infrastructure (road surface, bridges, culverts, stream and wetland crossings)	▶ Maintaining and reinforcing culverts at stream crossings ▶ Reinforcing bridge abutments and piers ▶ Clearing drainage structures to prevent flooding ▶ Reconstructing sections lost to erosion or flooding. ▶ Diverting water away from road surfaces with drainage ditches. ▶ Removing excessive vegetation to restore accessibility. ▶ Strengthening embankments to prevent collapse. ▶ Replacing lost gravel or compacted fill material.
Electrical infrastructure (powerlines, pylons, substations)	▶ Clearing vegetation to prevent electrical faults. ▶ Repairing and reinforcing pylons/poles affected by erosion
Erosion Control, Stabilisation & Support Structures (gabions, reno mattresses, retaining walls etc.)	▶ Constructing or repairing structures (e.g., gabions) to stabilise riverbanks. ▶ Stabilising eroded areas around infrastructure. ▶ Replacing eroded or damaged rock-fill materials.
Activities common to all infrastructure	
Access: ▶ In areas where there are no established access roads, maintenance teams may need to drive through indigenous vegetation and or clear portions to create access. ▶ Alien plant management ▶ George Municipality has a regular control programme for removal of invasive alien vegetation, especially <i>Acacia mearnsii</i> and <i>A. melanoxylon</i>. During such activities, only alien woody vegetation is targeted while indigenous vegetation is left unaffected. Vegetation clearance Some vegetation clearance may be needed directly around infrastructure. There is generally done in a very narrow strip less than 0.5m wide from the edge of the infrastructure, however this is situational dependent. Soil removal and replacement In cases where excessive erosion places structures such as roads or pipeline at risk of washing away, infilling of soil and stabilisation of slopes may take place. In some cases, infilling may occur in wetlands of watercourses.	

Activities common to all infrastructure

In other cases, debris and soil that has been deposited may need to be removed under and downstream from a culvert or bridge to maintain the free flow of water and prevent overtopping of these structures during storms.

Pollution cleanup

In the case of pollution incidents, contaminants like oils may be deposited in a watercourse or wetland. In such instances, contaminated soil must be removed from the watercourse to prevent further downstream impacts on aquatic organisms.

8.4 Environmental Impacts and Mitigation Measures

The maintenance of existing infrastructure, including electrical, sewerage, stormwater management, and road infrastructure, within the Schaapkop MMP site, as well as the rehabilitation activities aimed at improving the health of the watercourse, may have several environmental impacts. These impacts are anticipated to vary depending on the specific maintenance or rehabilitation activity being carried out.

This section documents the measures that will be implemented by George Municipality or any persons acting on their behalf, including subcontractors, to minimise environmental impacts during maintenance activities in the Schaapkop Watercourse. This MMP is only applicable to activities related to maintenance of existing infrastructure. Activities involving the development of new or expanded structures or infrastructure beyond the existing footprint do not qualify for inclusion under the MMP.

All users of this MMP must first consult the defined site and description of activities to ensure that the maintenance activities qualify for inclusion under this MMP.

The mitigation measures contained in the sections to follow will be implemented and monitored to reduce disturbances to the environment.

Maintenance and repair in the context of this document means routine or emergency actions performed to keep a structure or system functioning or in service in the same location, capacity, and footprint. The requirements of this Chapter are only relevant to maintenance and repair activities.

8.4.1 Communication Procedures

8.4.1.1 Initial Maintenance Project Meeting

An initial project meeting shall be held between the ECO and the contractor (if relevant) to:

- ▶ Ensure all parties have full sets of this MMP and any other documentation or plans required.
- ▶ Discuss the required reconstruction and maintenance work.
- ▶ Discuss communication channels including contact details for relevant parties.
- ▶ Demarcation of all the work areas including the site camp, access roads, stockpile areas, excavation sites, storage facilities, and parking areas.
- ▶ The work areas must be indicated in a site plan which must be approved by the Environmental Planning section of the George Municipality.
- ▶ Discuss procedures to temporarily halt work during adverse weather conditions (with clear criteria for suspension based on forecasted weather conditions).
- ▶ The ECO must inform the contractor and the George Municipality's technical department of any environmental processes that could potentially halt or delay maintenance e.g., fish breeding season, bird breeding season, migratory activity or any similar ecological process that could be negatively impacted as a result of maintenance.

The contractor together with the ECO must compile an appropriate method statement fit for purpose of the specific maintenance task to be performed. The contractor shall then adopt that specific method statement. Examples of method statements are appended to this RMP.

Should the mitigation measures not be implemented according to this MMP or method statement, the contractor will be liable for the damages caused due to his negligence.

The ECO will also advise and/or recommend remedial actions should these mitigation measures not be implemented accordingly or as circumstances change during the course of the maintenance activities.

It is important that the contractor, ECO and municipal officials are aligned with the maintenance activities to be undertaken and the requirements of this MMP.

8.4.1.2 ECO Monitoring & Reporting/Record Keeping

The following communication procedures apply to the responsibilities of the ECO during the maintenance activities (refer to Section 7.1.5 for a detailed breakdown of the responsibilities of the ECO):

- ▶ Review and approve method statements with input from the relevant municipal departments.
- ▶ Undertake routine inspections of the works to monitor and provide guidance relating to the conditions of this RMP. Following each inspection the ECO must compile a construction checklist to capture the information gathered during the sit inspection (refer to Section 7.1.5 which details the contents of the construction checklist). The checklist must be submitted to the George Municipality's relevant departments.
- ▶ Following the completion of any routine or emergency maintenance activities, the ECO shall inspect the work and compile a Completion Report (refer to Section 7.1.5 which details the contents of the Completion Report). The Completion Report must be submitted to the George Municipality and DEA&DP.

8.4.1.3 Emergency Reporting and Environmental Incidents

Potential impacts	▶ Accidental fire ▶ Accidental leaks ▶ Accidental spillage of pollutants
Actions	The following emergency reporting and procedures will minimise the risk associated with emergency events: ▶ The Contractor shall ensure that his employees are aware of the procedure to be followed for dealing with, and reporting emergencies, including accidental fire, which shall include notifying the relevant authorities of the event: • All site staff shall be briefed regarding the requirements for dealing with potential emergencies including fires, accidental leaks and spillage of pollutants. • Education of site staff shall focus not only on the prevention of emergencies but also on proactive and appropriate interventions where such emergencies occur. ▶ The contact details of the nearest hospital, police and ambulance services shall be made available to staff whilst undertaking any maintenance work on site. ▶ Emergency equipment including spill kits and fire extinguishers shall accompany staff to site for the duration of the maintenance activities. ▶ Inform the ECO of any spills that have occurred.
Environmental Incidents	In South Africa, an "environmental incident" is defined by the NEMA as an "unexpected, sudden, and uncontrolled release of a hazardous substance, including from a major emission, fire, or explosion, that has caused or may cause significant harm to the environment, human life, or property. In the event of an environmental incident or contravention of the environmental law, the DEA&DP Law Enforcement needs to be informed via the contact details below.

	▶ Johan Oelofse ▶ Email: Johan.Oelofse@westerncape.gov.za ▶ Tel: 044 805 8601 Alternatively: ▶ Law.enforcement@westerncape.gov.za ▶ 0800 205 005 (toll free incidents hotline)
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8.4.1.4 Environmental Awareness

- ▶ All staff receive site environmental awareness and staff induction training in appropriate languages, as well as any refresher courses, pertaining to their role on the project.
- ▶ All personnel (including sub-contractors) shall receive induction training on the specific environmental requirements of the RMP and method statements prior to commencing construction.
- ▶ An attendance register for induction training must be kept.
- ▶ The ECO shall cover, amongst other, the following as part of the environmental induction training:
 - Explain that a RMP is in place and its requirements.
 - Explain and point out the environmental sensitivity of the area where work is being undertaken and why it is important to protect these resources.
 - Provide detail as to why mitigation measures are required.
 - The role of the ECO and of each person as it relates to duty of care

8.4.2 Road Infrastructure Maintenance

Potential maintenance requirements	After large storm events: ▶ Riverbank erosion, ▶ Road damage, ▶ Culvert damage, ▶ Debris build-up, etc.
Potential Maintenance Actions	All work will be a like-for-like and/or within the existing infrastructure footprint. Activities include: ▶ Maintaining and reinforcing culverts at stream crossings ▶ Reconstructing sections lost to erosion or flooding. ▶ Diverting water away from road surfaces with drainage ditches. ▶ Strengthening embankments to prevent collapse ▶ Clearing drainage structures to prevent flooding ▶ Fix or replace infrastructure ▶ Removal of flood debris and silt ▶ Excavating and removing sediment (dredging) inside the watercourse to obtain access to infrastructure ▶ Replacing infill material for stabilisation and support of infrastructure ▶ Clearance of vegetation for accessibility ▶ Replace lost gravel
Potential Impact of Maintenance Activities	Freshwater and Terrestrial Ecology ▶ Destabilisation of slopes, banks and beds of wetlands and rivers, leading to increased mobility of sediments into sensitive areas. ▶ Increased sedimentation in sensitive areas, such as wetlands, riparian areas and channels. ▶ Smothering of cobble, boulder and bedrock habitat in rivers. ▶ Smothering of wetland substrates. ▶ Damage to vegetation when accessing working area.
Severity of impacts	Freshwater

(post mitigation)	Low Terrestrial Ecology Low
Measures to mitigate impacts	▶ Demarcate the work area. All areas outside of the demarcated work are considered no-go. It is recommended that an average working width around the site/infrastructure should start at 2m and must only be widened if practically required. ▶ Minimise the working width in sensitive habitats. ▶ Clearing of vegetation must be minimised. Access for machinery must be limited to the width of the machinery and the same track must be used to enter and exit the site. ▶ Access roads must ideally not exceed 4m in width. The ECO must be consulted where site conditions dictate an access road wider than 4m. ▶ Provision should be made to divert stream flows during the maintenance of roads and culvert structures – refer to Appendix B for a guide depicting how the streamflow can be diverted using sandbags. ▶ Straw bale check dams should be used where there is a strong likelihood that concentrated flow through a disturbed/exposed area could lead to erosion and high sediment transport into an adjacent watercourse – refer to Appendix D for a guide on how to implement check dams (also consult the ECO if considering). ▶ Grading may only be undertaken on roads designated to be graded (e.g. no grading of jeep/vegetated tracks). Where grading is permitted, such will assist to prevent or repair the formation of erosion gullies and must promote intermittent run-off by means of berms across the roads created with graded road material. ▶ Larger roads must be managed according to the standards for such roads, whilst smaller roads and tracks (low traffic) must be managed in such a way that the road does not erode. Refer to Appendix E for a guide on implementing berms ('walleltjies') on low traffic roads/tracks such as access tracks. ▶ No lateral berms of graded materials on the sides of roads or tracks must be created except where specified by the engineering team. ▶ Clearing of vegetation in V-drains on the sides of roads blocking flows should be cleared by brush cutting rather than by grader, except where the V-drain requires shaping. ▶ Potholes should be filled and compacted with the appropriate material (e.g., G5). ▶ Repair/rehabilitate eroded areas with sandbags, wood chip filled socks or other similar materials. ▶ Areas vulnerable to erosion and sedimentation, such as steep, unvegetated slopes, or areas downslope of steep slopes, must be stabilised using appropriate materials. ▶ Temporary stabilisation measures such as sandbags, wood-chip filled socks or appropriate geotextiles should also be placed on vulnerable slopes or around roads, before rainfall events (or as demanded by the situation) to slow the flow of water along or from steep access tracks and to encourage the settling of sediment along steep sections.
Additional considerations	▶ Should a plant search and rescue be required, the ECO or appointed sub-contractor shall record the types of species collected as well as the number of specimens collected, the habitat they were removed from and their general condition. The rescued plants should be used in rehabilitation and if not possible, be replanted at a nearby suitable location. ▶ The ECO must identify any remedial actions that must be undertaken if mitigation measures are not appropriately implemented.

8.4.3 Stormwater Infrastructure Maintenance

Potential maintenance requirements	Repair existing stormwater infrastructure due to: ▶ Damage ▶ Infrastructure aging ▶ Debris build-up
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	▶ Blockages ▶ Vandalism ▶ infrastructure no longer fit for purpose
Potential Maintenance Actions	All work will be a like-for-like and/or within the existing infrastructure footprint. Activities include: ▶ Replacement and/or repair of broken infrastructure e.g. culverts, outlets, gabion structures etc. ▶ Redirecting of culverts or outlets which are incorrectly located in relation to the natural direction of flow in a stream. ▶ Clearing of vegetation from inside or down/up-stream of infrastructure. ▶ Excavating and removing sediment (dredging) inside the watercourse to obtain access to infrastructure. ▶ Removal of flood debris and silt. ▶ Infilling of material for stabilisation and support of infrastructure. ▶ Clearance of vegetation for accessibility ▶ <u>Reinforcing culvert headwalls and outlet structures</u>
Potential impacts of maintenance activities	Freshwater and Terrestrial Ecology ▶ Destabilisation of slopes, banks and beds of wetlands and rivers, leading to increased mobility of sediments into sensitive areas. ▶ Increased sedimentation in sensitive areas, such as wetlands, riparian areas and channels. ▶ Smothering of cobble, boulder and bedrock habitat in rivers. ▶ Smothering of wetland substrates. ▶ Discharge of construction-related pollutants, such as cement, leading to deterioration in water quality in rivers and wetlands. ▶ Damage to vegetation when accessing working area.
Severity of impacts (post mitigation)	Freshwater Low Terrestrial Ecology Low
Measures to mitigate impacts	▶ Demarcate the work area. All areas outside of the demarcated work are considered no-go. It is recommended that an average working width around the site/infrastructure should start at 2m and must only be widened if practically required. ▶ Minimise the working width in sensitive habitats. ▶ Clearing of vegetation must be minimised. Access for machinery must be limited to the width of the machinery and the same track must be used to enter and exit the site. ▶ Limit access to essential equipment only. ▶ Access roads must ideally not exceed 4m in width. The ECO must be consulted where site conditions dictate an access road wider than 4m. ▶ Control any erosion along the access track/road. Refer to Appendix E for a guide on implementing berms ('wallejtjies') on low traffic roads/tracks. ▶ Revegetate the temporary access track and any disturbed areas using indigenous grass species, e.g., <i>Cynodon dactylon</i> and/or <i>Eragrostis curvula</i> or preferably with a fast-growing indigenous fynbos reclamation mix. For example, the seed company Sakata produces a mix of perennial grasses consisting of <i>Eragrostis curvula</i>, <i>Digitaria erianthus</i>, <i>Cynodon dactylon</i>, <i>Cenchrus ciliaris</i> and <i>Eragrostis tef</i> and is considered ideal for revegetating disturbed areas. ▶ Where water may accumulate, install a stormwater run-off control system using berms (compacted soil barriers) and ditches. • Ensure the system effectively collects and directs run-off from hardened surfaces to prevent erosion downslope. • These measures must be implemented as needed around the area of works and/or the access track. ▶ Where necessary, use grassed or vegetated swales to channel stormwater from the road to a watercourse - only seed or vegetation from within the local areas may be used for such purposes.

	▶ Provision should be made to divert stream flows during the maintenance of roads and culvert structures – refer to Appendix B for a guide depicting how the streamflow can be diverted using sandbags. ▶ Straw bale check dams should be used where there is a strong likelihood that concentrated flow through a disturbed/exposed area could lead to erosion and high sediment transport into an adjacent watercourse – refer to Appendix D for a guide on how to implement check dams (also consult the ECO if considering). ▶ Concrete or cement mixing • Not permitted at or in the vicinity (50m) of the watercourse. • Any cement mixing cannot take place on bare ground. • An impermeable or bunded area must be established in a way that cement slurry will not run off into the surrounding environment. ▶ Unblock/clear/remove debris and sediments from all existing stormwater infrastructure in the vicinity of the works.
Additional considerations	▶ Should a plant search and rescue be required, the ECO or appointed sub-contractor shall record the types of species collected as well as the number of specimens collected, the habitat they were removed from and their general condition. The rescued plants should be used in rehabilitation and if not possible, be replanted at a nearby suitable location. ▶ The ECO must identify any remedial actions that must be undertaken if mitigation measure are not appropriately implemented

8.4.4 Bridge Crossing Infrastructure Maintenance

Potential maintenance requirements	Repair existing bridge/stream crossing infrastructure due to: ▶ Damage ▶ Infrastructure aging ▶ Debris build-up ▶ Vandalism ▶ Infrastructure no longer fit for purpose
Potential Maintenance Actions	All work will be a like-for-like and/or within the existing infrastructure footprint. Activities include: ▶ Repair and/or replace low water crossings ▶ Repair bridges and stream crossing hard surfaces ▶ <u>Reinforcing bridge abutments and piers</u> ▶ Clearing of vegetation from inside or down/up-stream of infrastructure ▶ Replacement of broken culverts ▶ Redirecting of culverts which are incorrectly located in relation to the natural direction of flow in a stream ▶ Removing sediment (dredging) inside the watercourse to obtain access to infrastructure ▶ Removal of flood debris and silt ▶ Infilling of material for stabilisation and support of infrastructure
Potential impacts of Maintenance Activities	Freshwater and Terrestrial Ecology ▶ Damage to indigenous vegetation that has not been identified for maintenance ▶ Disturbance of endangered or protected species ▶ Disturbance to riparian vegetation and stream banks ▶ Negligible harm to the fauna and flora ▶ Disturbance of nesting birds ▶ Destabilisation of slopes, banks and beds of wetlands and rivers, leading to increased mobility of sediments into sensitive areas. ▶ Increased sedimentation in sensitive areas, such as wetlands, riparian areas and channels. ▶ Smothering of cobble, boulder and bedrock habitat in rivers. ▶ Smothering of wetland substrates.

	► Discharge of construction-related pollutants, such as cement, leading to deterioration in water quality in rivers and wetlands.
Severity of impacts (post mitigation)	Freshwater Low Terrestrial Ecology Low
Measures to mitigate impacts	► Work undertaken at historic bridges need to obtain any necessary Heritage Western Cape approvals as it pertains to the specific bridge and proposed works. ► Demarcate the work area. All areas outside of the demarcated work are considered no-go. It is recommended that an average working width around the site/infrastructure should start at 2m and must only be widened if practically required. ► Minimise the working width in sensitive habitats. ► Clearing of vegetation must be minimised. Access for machinery must be limited to the width of the machinery and the same track must be used to enter and exit the site. ► Access roads must ideally not exceed 4m in width. The ECO must be consulted where site conditions dictate an access road wider than 4m. ► Limit access to essential equipment only. ► Control any erosion along the access track/road. Refer to Appendix E for a guide on implementing berms ('walletjies') on low traffic roads/tracks ► Revegetate the temporary access track and any disturbed areas using indigenous grass species, e.g., <i>Cynodon dactylon</i> and/or <i>Eragrostis curvula</i> or preferably with a fast-growing indigenous fynbos reclamation mix. For example, the seed company Sakata produces a mix of perennial grasses consisting of <i>Eragrostis curvula</i>, <i>Digitaria erianthus</i>, <i>Cynodon dactylon</i>, <i>Cenchrus ciliaris</i> and <i>Eragrostis tef</i> and is considered ideal for revegetating disturbed areas. ► Provision should be made to divert, or in some instances pond, stream flows during the maintenance of water crossings – refer to Appendix B for a guide depicting how the streamflow can be diverted using sandbags. • Over pumping / ponding / diverting the rivers must be done with maximum care and forethought with inputs from the ECO and must be implemented accordingly. • Pond and divert the water on the upstream side of the structure by building a wall with sandbags. Dig a sump hole near the structure to pump water over the road or dig a sump hole behind the sandbag wall on the upstream side if needed. ► Straw bale check dams should be used where there is a strong likelihood that concentrated flow through a disturbed/exposed area could lead to erosion and high sediment transport into an adjacent watercourse – refer to Appendix D for a guide on how to implement check dams (also consult the ECO if considering). ► No debris, silt or other obstruction must be allowed to enter the stream from the maintenance activities. Scaffolding and/or screens/netting must be erected around the work area to contain any flying debris from the breaking of concrete. • Where the works are of such a nature that sandbags are not required to pond or divert the flow, silt fencing must be installed with guidance from the ECO. ► Care shall be taken to avoid disturbing any nesting birds at bridges and stream crossings, where practical. ► Ideally, large and maintenance that is of long duration should take place towards mid to late summer when the river discharge is at a minimum (acknowledged that this is not always feasible). ► It is crucial that the ECO monitors any cement casting processes. A slurry tank and dewatering pumps must be on site and any contaminated water or slurry must be pumped from the system and disposed of immediately at a suitable site outside of the river channel and riparian habitat.

Additional considerations	▶ Should a plant search and rescue be required, the ECO or appointed sub-contractor shall record the types of species collected as well as the number of specimens collected, the habitat they were removed from and their general condition. The rescued plants should be used in rehabilitation and if not possible, be replanted at a nearby suitable location. ▶ The ECO must identify any remedial actions that must be undertaken if mitigation measures are not appropriately implemented.
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8.4.5 Above Ground Pipeline and Powerline Infrastructure

Potential maintenance requirements	Repair or replace existing aboveground pipeline and powerline infrastructure due to: ▶ Damage ▶ Infrastructure aging ▶ Debris build-up ▶ Vandalism ▶ Infrastructure no longer fit for purpose ▶ Blockages Pipeline infrastructure includes all pipelines i.e., potable water, non-potable water, sewerage etc.
Potential maintenance actions	All work will be a like-for-like and/or within the existing infrastructure footprint. Activities include: ▶ Unblocking sewer manholes ▶ Replacing sewer lines ▶ Repairing or replacing damaged manhole covers and chambers ▶ Clear flood debris ▶ Repair or replace damaged concrete or steel support structures (of any material) ▶ Combat erosion that compromises the infrastructure integrity ▶ Regular clearing of culverts ▶ Infilling of material for stabilisation and support of infrastructure ▶ Clearance of vegetation ▶ Excavating and removing sediment (dredging) inside the watercourse to obtain access to infrastructure ▶ Flushing pipelines to prevent sediment buildup ▶ Cleaning and maintaining valve chambers to prevent blockages. ▶ Replacing faulty valves to maintain pressure control ▶ Removing sediment buildup that may compromise stability
Potential impacts of maintenance activities	Freshwater and Terrestrial Ecology Potential impacts associated with above ground crossings include: ▶ Disturbance to channel banks and beds and riparian areas at crossing points. ▶ Potential erosion of the channel margins. ▶ Destabilisation of slopes, banks and beds of wetlands and rivers, leading to increased mobility of sediments into sensitive areas. ▶ Increased sedimentation in sensitive areas, such as wetlands, riparian areas and channels. ▶ Smothering of cobble, boulder and bedrock habitat in rivers. ▶ Smothering of wetland substrates. ▶ Discharge of construction-related pollutants, such as cement, leading to deterioration in water quality in rivers and wetlands.
Severity of impacts (post mitigation)	Freshwater Low Terrestrial Ecology Low

Measures to mitigate impacts	▶ Demarcate the work area. All areas outside of the demarcated work are considered no-go. It is recommended that an average working width around the site/infrastructure should start at 2m and must only be widened if practically required. ▶ Minimise the working width in sensitive habitats. ▶ Clearing of vegetation must be minimised. Access for machinery must be limited to the width of the machinery and the same track must be used to enter and exit the site. ▶ Access roads must ideally not exceed 4m in width. The ECO must be consulted where site conditions dictate an access road wider than 4m. ▶ Limit access to essential equipment only. ▶ Control any erosion along the access track/road. Refer to Appendix E for a guide on implementing berms ('walletjies') on low traffic roads/tracks. ▶ <u>Concrete Plinth Repairs:</u> • No debris, silt or other obstruction must be allowed to enter the stream from the work activities being conducted at the plinths. • Ground plastic sheeting must be laid around the plinth under and over layers of sandbags to create a dam to prevent unwanted run-off from the work area. • Scaffolding must be erected around the concrete plinth and then completely wrapped in netting to contain any flying debris from the breaking of the plinth. • Sediment traps consisting of geofabric- wrapped sandbags, will be installed if and when required by the ECO. • Provision should be made to divert stream flows during the maintenance activities – refer to Appendix B for a guide depicting how the streamflow can be diverted using sandbags.
Additional considerations	▶ Should a plant search and rescue be required, the ECO or appointed sub-contractor shall record the types of species collected as well as the number of specimens collected, the habitat they were removed from and their general condition. The rescued plants should be used in rehabilitation and if not possible, be replanted at a nearby suitable location. ▶ The ECO must identify any remedial actions that must be undertaken if mitigation measures are not appropriately implemented.

8.4.6 Below Ground Pipeline and Powerline Infrastructure

Potential maintenance requirements	Repair or replace existing aboveground pipeline and powerline infrastructure due to: ▶ Damage ▶ Infrastructure aging ▶ Debris build-up ▶ Vandalism ▶ Infrastructure no longer fit for purpose ▶ Blockages Pipeline infrastructure includes all pipelines i.e., potable water, non-potable water, sewerage etc.
Potential maintenance actions	All work will be a like-for-like and/or within the existing infrastructure footprint. Activities include: ▶ Unblocking sewer manholes ▶ Replacing sewer lines ▶ Repairing or replacing damaged manhole covers and chambers ▶ Clear flood debris ▶ Repair or replace damaged concrete or steel support structures (of any material) ▶ Combat erosion that compromises the infrastructure integrity ▶ Regular clearing of culverts ▶ Infilling of material for stabilisation and support of infrastructure ▶ Clearance of vegetation

	▶ Excavating and removing sediment (dredging) inside the watercourse to obtain access to infrastructure ▶ Flushing pipelines to prevent sediment buildup ▶ Cleaning and maintaining valve chambers to prevent blockages. ▶ Replacing faulty valves to maintain pressure control ▶ Removing sediment buildup that may compromise stability ▶ Reinforcing pipeline supports with gabions or concrete structures (pipelines passing through watercourses) ▶ Repairing protective coatings or encasements to prevent corrosion (pipelines passing through watercourses) ▶ Removing sediment build-up that may compromise stability (pipelines passing through watercourses)
Potential impacts of maintenance activities	Freshwater and Terrestrial Ecology In terms of the below ground crossings, the likely impacts include: ▶ Disturbance to channel banks and beds at crossing points. ▶ Potential erosion of the channel margins. ▶ Construction-related water quality impacts. ▶ Destabilisation of slopes, banks and beds of wetlands and rivers, leading to increased mobility of sediments into sensitive areas. ▶ Increased sedimentation in sensitive areas, such as wetlands, riparian areas and channels. ▶ Smothering of cobble, boulder and bedrock habitat in rivers. ▶ Smothering of wetland substrates. ▶ Discharge of construction-related pollutants, such as cement, leading to deterioration in water quality in rivers and wetlands.
Severity of impacts (post mitigation)	Freshwater Low Terrestrial Ecology Low
Measures to mitigate impacts	▶ Demarcate the work area. All areas outside of the demarcated work are considered no-go. It is recommended that an average working width around the site/infrastructure should start at 2m and must only be widened if practically required. ▶ Minimise the working width in sensitive habitats. ▶ Clearing of vegetation must be minimised. Access for machinery must be limited to the width of the machinery and the same track must be used to enter and exit the site. ▶ Limit access to essential equipment only. ▶ Access roads must ideally not exceed 4m in width. The ECO must be consulted where site conditions dictate an access road wider than 4m. ▶ Control any erosion along the access track/road. Refer to Appendix E for a guide on implementing berms ('walletjies') on low traffic roads/tracks. ▶ Trench excavation must take place in short sections where possible. ▶ Excavated top material must then be returned to the same habitat from which it was removed following pipe/cable laying, making sure that bed material and topsoil are not compacted more than they are naturally. ▶ Ensure that the profile of the trench once top material is returned has the same cross section profile as it was prior to trench excavation. Thus, any excess material would need to be disposed of elsewhere, so that a raised mound is not created along the pipeline ▶ Work should ideally be carried out during the dry season (if preventative maintenance is being undertaken). ▶ Provision should be made to divert or pond stream flows during the maintenance of underground pipelines and powerlines – refer to Appendix B for a guide depicting how the streamflow can be diverted using sandbags. • If the flow cannot be diverted or temporarily ponded for the duration of the works, then the flow must be pipe across the trench using either gravity or by digging a sump hole on the upstream side of the sandbags and pumping the water across.

	▶ Silt fencing must be used if required based on the site conditions and after consultation with the ECO. ▶ Straw bale check dams should be used where there is a strong likelihood that concentrated flow through a disturbed/exposed area could lead to erosion and high sediment transport into an adjacent watercourse – refer to Appendix D for a guide on how to implement check dams (also consult the ECO if considering). ▶ Trenching: • Trench excavation must take place in short sections with the storage of topsoil adjacent to the excavated trench. • Top material must then be returned to the same habitat from which it was removed following pipe/cable laying, making sure that bed material and topsoil are not compacted more than they are naturally. • One topsoil has been replaced, ensure that the surface profile of the trench is similar to what it was before excavation. Excess material must be disposed elsewhere, so that raised mounds are not created along the pipeline. • During the maintenance activities such as replacement of an underground pipeline/powerline, it must be placed at least 50 cm below ground level (i.e., top material following construction should be at least 50cm above the top of the pipe) to reduce or minimise changes in the nature of subsurface flows through wetland habitats. ▶ The disturbed area must be revegetated to ensure re-establishment and stabilisation of slopes, based on the conditions and requirement of each site. The ECO must be consulted on the level of rehabilitation that would be required on a per-site basis. ▶ No canalisation of flow is permitted except under specified conditions and with the approval of the ECO. ▶
Additional considerations	▶ Should a plant search and rescue be required, the ECO or appointed sub-contractor shall record the types of species collected as well as the number of specimens collected, the habitat they were removed from and their general condition. The rescued plants should be used in rehabilitation and if not possible, be replanted at a nearby suitable location. ▶ The ECO must identify any remedial actions that must be undertaken if mitigation measures are not appropriately implemented.

8.4.7 Pumpstations

Potential maintenance requirements	Maintenance to pumpstation infrastructure due to: ▶ Damage ▶ Infrastructure aging ▶ Erosion ▶ Damaged support structures
Potential maintenance actions	All work will be a like-for-like and/or within the existing infrastructure footprint. Activities include: ▶ Repairing pump stations ▶ Rehabilitation of eroded areas around pumpstation ▶ Clear vegetation for accessibility ▶ Infilling of material for stabilisation and support of infrastructure ▶ Repairing and supporting of boundary walls
Potential impacts of maintenance activities	Freshwater and Terrestrial Ecology ▶ Localized changes in the runoff that may promote erosion and contaminate these systems through increasing sediment loads into natural systems (particularly during maintenance). ▶ Disturbance of river or wetland habitat during removal of sediment.

	▶ Destabilisation of slopes, banks and beds of wetlands and rivers, leading to increased mobility of sediments into sensitive areas. ▶ Increased sedimentation in sensitive areas, such as wetlands, riparian areas and channels. ▶ Smothering of cobble, boulder and bedrock habitat in rivers. ▶ Smothering of wetland substrates. ▶ Discharge of construction-related pollutants, such as cement, leading to deterioration in water quality in rivers and wetlands.
Severity of impacts (post mitigation)	Freshwater Low Terrestrial Ecology Low
Measures to mitigate impacts	▶ Demarcate the work area. All areas outside of the demarcated work area are considered no-go. It is recommended that an average working width around the site/infrastructure should start at 2m and must only be widened if practically required. ▶ Minimise the working width in sensitive habitats. ▶ Clearing of vegetation must be minimised. Access for machinery must be limited to the width of the machinery and the same track must be used to enter and exit the site. ▶ Limit access to essential equipment only. ▶ Access roads must ideally not exceed 4m in width. The ECO must be consulted where site conditions dictate an access road wider than 4m. ▶ Control any erosion along the access track/road. Refer to Appendix E for a guide on implementing berms ('walletjies') on low traffic roads/tracks. ▶ Revegetate the temporary access track and any disturbed areas using indigenous grass species, e.g., <i>Cynodon dactylon</i> and/or <i>Eragrostis curvula</i> or preferably with a fast-growing indigenous fynbos reclamation mix. For example, the seed company Sakata produces a mix of perennial grasses consisting of <i>Eragrostis curvula</i>, <i>Digitaria erianthus</i>, <i>Cynodon dactylon</i>, <i>Cenchrus ciliaris</i> and <i>Eragrostis tef</i> and is considered ideal for revegetating disturbed areas. ▶ Control stormwater run-off using silt fencing, berms, or dips. ▶ Implement erosion control measures as included in
Additional considerations	▶ Should a plant search and rescue be required, the ECO or appointed sub-contractor shall record the types of species collected as well as the number of specimens collected, the habitat they were removed from and their general condition. The rescued plants should be used in rehabilitation and if not possible, be replanted at a nearby suitable location. ▶ The ECO must identify any remedial actions that must be undertaken if mitigation measures are not appropriately implemented.

8.4.8 Clearing of Indigenous Vegetation for Maintenance Activities

Potential maintenance requirements	Indigenous vegetation would need to be cleared for: ▶ Removal from infrastructure where plants are growing inside the infrastructure ▶ Indigenous vegetation obstructing infrastructure ▶ Indigenous vegetation jeopardising the integrity of infrastructure ▶ Access to the work area
Potential clearing activities	The following clearing techniques could be implemented, including: ▶ Cutting ▶ Felling ▶ Hand pulling ▶ Brush cutting ▶ Digging out

	The list above is not exhaustive, and additional methods can be recommended by the ECO.
Potential impacts clearing indigenous vegetation	Freshwater and Terrestrial Ecology ▶ Clearance of natural vegetation ▶ Loss of habitat ▶ Damage to environment due to use of machinery to remove indigenous vegetation. ▶ Damage to fauna (may cause death) if not encouraged to leave the area ▶ Pollution of environments if chainsaws are used and petrol leaks occur ▶ Erosion of areas that are cleared of vegetation cover, or that remain bare during times of heavy rainfall.
Severity of impacts (post mitigation)	Freshwater Low Terrestrial Ecology Low
Measures to mitigate impacts	▶ Clearing should be done by hand as far as possible, using hand tools. ▶ Selective clearing must be implemented for access purposes. ▶ Indigenous trees inside the working area must be demarcated using danger tape or shade cloth to ensure that these are not damaged during the maintenance works. ▶ In dense vegetation under a canopy, clearing should be selective to preserve the canopy. ▶ When clearing for an access track, limit the width to the minimum required. Avoid disturbing soil layers to promote regrowth of cut vegetation. ▶ Access roads must ideally not exceed 4m in width. The ECO must be consulted where site conditions dictate an access road wider than 4m. ▶ Do not use a bulldozer unless absolutely necessary and approved by the ECO. ▶ Do not clear, cut, or prune protected tree species without the required forestry permit (see Section 6.3). ▶ Powered clearing equipment must be well-maintained and free of fuel or oil leaks. ▶ Encourage fauna to leave the area before clearing. ▶ Indigenous trees inside the site area must be protected and not be removed, unless absolutely necessary and following confirmation from the ECO. ▶ If indigenous trees must be permanently removed, consult the ECO for potential transplanting. ▶ If clearing involves topsoil removal, consult the ECO beforehand. Store topsoil appropriately for use in rehabilitation where possible. ▶ Surplus cleared indigenous vegetation may be disposed of at a licensed facility or chipped/stockpiled for rehabilitation. ▶ Cleared vegetation not immediately removed must be placed away from banks and channels until disposal.
Additional Considerations	▶ Clearing of indigenous vegetation is necessary for maintenance purposes and it must always be done with care. ▶ If in doubt regarding the clearance methods or species, always first consult the ECO. ▶ The ECO must consult the appropriate specialist for additional advice or inputs where there is uncertainty regarding the best way forward as it relates to clearing of indigenous vegetation.

8.4.9 Clearing of Alien Invasive Vegetation from Watercourses

Potential maintenance requirements	Invasive alien plants would need to be cleared for: ▶ Removal from infrastructure where plants are growing inside the infrastructure ▶ Alien plants obstructing infrastructure
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	▶ Alien plants jeopardising the integrity of infrastructure ▶ Access to the work area								
Potential clearing activities	A number of clearing methods exist, including: ▶ Hand pulling ▶ Cutting ▶ Digging out ▶ Ring barking ▶ Bark stripping ▶ Felling ▶ Foliar spray Included in Appendix F is the “George Municipality Invasive Alien Plant Monitoring, Control & Eradication Plan” dated May 2021.								
Potential impacts of clearing invasive alien plants	Freshwater and Terrestrial Ecology ▶ Damage to environment due to use of machinery to remove alien vegetation. ▶ Damage to fauna (may cause death) and flora due to use of diesel-based pesticides ▶ Poisoning of aquatic systems due to off-target damage from herbicides to riparian areas ▶ Erosion of areas that are cleared of vegetation cover, or that remain bare during times of heavy rainfall.								
Severity of impacts (post mitigation)	Freshwater Low Terrestrial Ecology Positive overall, low on flora								
Measures to mitigate impacts	Included in Appendix F is the “George Municipality Invasive Alien Plant Monitoring, Control & Eradication Plan” dated May 2021. The mitigation measures included below are additional (in support of) to the aforementioned plan. ▶ Staff must be trained in the methods of clearing alien plants and the risks associated with clearing and application of herbicides on cut vegetation/stumps. ▶ For the purposes of the MMP, manual control is the preferred method of clearing as it targets specific trees/plants that is required to be removed for maintenance purposes as described above. The method is targeted and best for sensitive environments. ▶ It is recommended that all alien vegetation within the immediate vicinity of the work area be cleared. ▶ Wherever possible, manual methods of alien vegetation removal shall be selected instead of using machinery, as this will have far less impact on the environment. ▶ Alien invasive vegetation shall not be buried or burned and shall be disposed of at licenced waste disposal facility. ▶ The alien plants that are to be cleared must be inspected to ensure that no fauna will be destroyed as part of the clearing. Any fauna found must be encouraged to flee the area or must be placed in a nearby spot that is safe ▶ The table below provides a breakdown of the manual control methods used for managing alien invasive plants. <table><tr><th>Manual Control Method</th><th>Description</th><th>Best Used For</th><th>Key Considerations</th></tr><tr><td>Hand Pulling</td><td>Small plants are pulled out by hand, ensuring that the roots are removed to prevent regrowth. Kicking the base of the plant may help loosen the roots.</td><td>Seedlings, young plants, shallow-rooted species.</td><td>Best done when the soil is moist (after rain) for easier root removal. Gloves should be worn for protection.</td></tr></table>	Manual Control Method	Description	Best Used For	Key Considerations	Hand Pulling	Small plants are pulled out by hand, ensuring that the roots are removed to prevent regrowth. Kicking the base of the plant may help loosen the roots.	Seedlings, young plants, shallow-rooted species.	Best done when the soil is moist (after rain) for easier root removal. Gloves should be worn for protection.
Manual Control Method	Description	Best Used For	Key Considerations						
Hand Pulling	Small plants are pulled out by hand, ensuring that the roots are removed to prevent regrowth. Kicking the base of the plant may help loosen the roots.	Seedlings, young plants, shallow-rooted species.	Best done when the soil is moist (after rain) for easier root removal. Gloves should be worn for protection.						

	Cutting	Plants are cut down as close to the ground as possible using slashers, pangas, machetes, handsaws, bow saws, or axes.	Woody plants, non-resprouting species.	Works best for species that do not coppice (resprout). If used on resprouting species, herbicide must be applied to prevent regrowth.
	Digging Out	The entire plant, including the root system, is removed using tools like hoes, spades, tree poppers, or sticks.	Plants with deep or extensive root systems.	Labour-intensive but effective. Soil disturbance should be minimised to prevent erosion.
	Ring Barking (Girdling)	A continuous strip of bark (at least 25 cm wide) is removed from around the trunk of a tree, cutting off nutrient flow and eventually killing the tree.	Large trees with thick trunks where felling is impractical.	Not effective for all species, especially those that resprout aggressively. Can take months to kill the tree.
	Bark Stripping	The bark is removed from the trunk from ground level up to 1 metre to disrupt nutrient transport. Can be combined with herbicide application.	Trees that resprout after ring barking or cutting.	Should not be used near rivers or infrastructure as dead trees may fall and cause damage.
	Frilling	Shallow cuts are made into the bark around the tree, creating an opening for herbicide application.	Large trees with thick bark.	A controlled way to kill trees while minimising herbicide use. Must be done carefully to avoid harming non-target species.
► Should the use of registered herbicides be the most effective option for control of alien invasive vegetation, and agreed to by the ECO, then this shall be undertaken in compliance with the terms and conditions of the SANS for handling, storage and disposal of pesticides (SANS 10206:2010, Edition 2.2): • The use of diesel-based herbicides near watercourses shall not be permitted. • Only herbicides registered for the particular plant species requiring control shall be used – refer to Appendix F which includes a list of herbicides and mixing instructions for the most popular invasive alien plants in the Georg Municipal area. Where no herbicide has been registered, the least hazardous herbicide registered for a similar plant species (i.e. another species of tree or shrub or grass) may be used. • Herbicide operators mixing and applying herbicides shall be appropriately trained and supervised and shall be equipped with the requisite personal protective clothing in accordance with the SANS requirements and the herbicide labels. • Supervisors shall be literate, shall understand the instructions on the herbicide labels, and shall ensure that the necessary safety protocols are implemented. • The requisite washing facilities and herbicide mixing area shall comply with the SANS requirements, as shall the transport, handling and storage of herbicides. • There is a very high risk of off-target damage from herbicides within riparian areas as many herbicides are toxic to aquatic systems, and only herbicides that are approved for use near a watercourse shall be used. • Herbicides shall not be used in windy or rainy conditions, and care shall be taken to avoid drift onto indigenous plants.				
Additional Considerations	► For the purposes of the MMP, manual control is the preferred method of clearing as it targets specific trees/plants that is required to be removed for maintenance purposes as described above. The method is targeted and best for sensitive environments. ► The control methods contained in this section are not to replace alien plant control practices implemented by GM over the larger municipal area (Appendix F). These are to aid the maintenance teams in dealing with alien plants on an as needed basis.			

8.4.10 General Best Practices

8.4.10.1 Site Camp

If a site camp is used, it must adhere to the following requirements:

- ▶ The location of the Contractor's main site camp must be approved by the ECO.
- ▶ All emergency numbers and the site safety officer's name and telephone numbers will be prominently displayed within the camp site.
- ▶ There will be adequate fire extinguishers within the site to deal with fires. Litter bins will be provided and placed at the site office. These bins will be lockable to prevent baboons from accessing the bins.
- ▶ All tools and equipment will be stored in the storage container at the site camp or removed from site daily. The site camp will be fenced off with fencing panels and all relevant signage displayed.

8.4.10.2 Topsoil Management

- ▶ Topsoil (top 20 cm of excavate soil) must be stockpiled separately from the underlying subsoil.
- ▶ Stockpiles of topsoil must not be higher than 2m and may not be removed from the site or used for any purpose other than in the final rehabilitation of the site – unless authorised by the ECO.
- ▶ Stockpiles must be covered with a suitable fabric to prevent erosion and runoff and must be stored outside of the delineated area and buffer of a watercourse.
- ▶ Following completion of the maintenance activity soil must be replaced sequentially, sub-soil, followed by topsoil
- ▶ These materials will need to be covered using at least 60% shade cloth. Note that hessian cover, if used, needs to be strong and dense and able to function through environmental rigours for extended periods, as the stockpile areas will be utilized for the duration of the construction activities.
- ▶ The stockpiled topsoil is to be left undisturbed until backfilling is finished.

8.4.10.3 Site and Access Road Demarcation

- ▶ All working areas shall be clearly demarcated with no traffic, access, walking and trampling outside these areas.
- ▶ The ECO must be consulted to aid in avoiding sensitive environmental features at the site.
- ▶ The work area must be demarcated using the appropriate barrier fencing e.g., droppers with danger tape and or wire (or similar methods proven successful).
- ▶ All areas outside of the designated working area are considered no-go.
- ▶ The ECO needs to state his/her approval of the demarcated work area.
- ▶ The Contractor may be penalised if they encroach outside of the working area.

8.4.10.4 Search and Rescue of Plants and Animals

- ▶ Plants
 - The ECO must be consulted regarding any search and rescue that needs to be undertaken. The ECO must give guidance in terms of which plants are suitable for storage and how they should be handled.
 - Rescued plants should be used in rehabilitation and if not possible, be replanted at a nearby suitable location.
 - Rescued plants should be placed in plastic bags with sufficient soil still around the roots.
 - The plants must be kept in the bags and cared for until work is completed and it then be used for rehabilitation.

- Larger plants that are not suitable for rehabilitation should be transplanted to a suitable location immediately. Larger plants/trees are more susceptible to stress and are not ideal for keeping in bags for prolonged periods.
- Protected tree species and plants that require a permit from CapeNature for removal or destroying must not be impacted without the appropriate permit being in place.

► **Animals**

- It is anticipated that all animals will move away due to the noise and disturbance caused by the maintenance activities. However, should any fauna be present within proximity to the working area, these should be encouraged to move away from the area (by means of noisy gestures) and no fauna should be harmed in the process.
- Should any snakes or venomous / dangerous animals be found inside the working areas, the ECO must be informed. A person (potentially the ECO) who are suitably trained in handling snakes and dangerous animals must be assigned to remove the animal from the working area and to release it at a safe location.
- Open containers/drums of water must be secured with lids in order to prevent fauna falling into them.
- Accumulations of water in pools and in excavated areas must be regularly inspected for fauna that are using the water source (frogs) or have fallen in.

8.4.10.5 Disposal of Vegetation

- The disposal of vegetation by burying or burning is prohibited in terms of national legislation, and shall not occur.

► **Indigenous vegetation**

- Cut plants that will not be removed from site immediately shall be placed well away from the top of banks and channels until such time that they are removed.
- Surplus indigenous vegetation that has been cleared can either be disposed of at licenced waste disposal facility, or chipped / stockpiled for use in the rehabilitation of the surrounds.

► **Alien vegetation**

- Seeding alien vegetation should not be chipped and used as mulch or for rehabilitation.
- Cut plants should be removed well away from watercourses to prevent further spread of these species via the watercourse.
- Alien vegetation should be disposed of at a licenced waste landfill site.
- Management of cleared/cut alien plant biomass must be assessed on a case-by-case basis with guidance from the ECO.
- Seeds can spread via watercourses during maintenance, so alien plants should be moved away from the river.
- Cut alien plant material must be made accessible to communities for firewood or other practical uses, provided it contains no seeds and where practical to do so (consult ECO).
- Smaller volumes of alien plant material with seeds must be bagged and securely covered for transport to landfill.
- Alien plant material may be chipped for mulch ONLY if all seeds are removed beforehand.
- Large volumes of alien plant material without practical use must have seeds removed and bagged before disposal at landfill. With guidance from the ECO, it is also possible to pack windrows with the cut vegetation - this method is mostly recommended in areas where there are high levels of alien infestation.
- Clearing of alien plants on a larger scale to improve the river health must be done in accordance with the GM's approved alien plant control management plan.

8.4.10.6 Temporary Stockpile Location

- ▶ Temporary stockpile areas must be identified by the ECO prior to use. These areas would be for bedding materials, pipes, cables, cleared vegetation, and spoil materials (e.g., rock and soil). The stockpiles areas must be clearly demarcated.
- ▶ Sufficient space must always be designated for vehicles and machinery so that these will not drive into the natural areas.
- ▶ The topsoil of all temporary stockpile locations must be stored for rehabilitation purposes (see Section 8.4.10.2 for topsoil management requirements).
- ▶ If suitable in terms of the site (i.e., work not directly inside a watercourse) a bermed top materials approach can be implemented where the topsoil and subsoil can form a boundary to the site. A subsoil berm must be placed along the inner boundary of the topsoil berm, to protect the topsoil. Consult the ECO in this regard.
- ▶ Natural wash or flow of surface water leading onto the stockpile site must be diverted away from the stockpile site, with input from the ECO.
- ▶ Flow from the stockpile sites will need to be contained if it is an issue. Sandbags, eco-logs and/or silt fences should be used to prevent erosion of stockpiled materials into the surrounding environment.
- ▶ The perimeters of the construction stockpile and storage areas will need to be marked to avoid ingress into the surrounding veld and to prevent people from entering an area that could potentially be dangerous.
- ▶ Stockpile locations are to be fully rehabilitated after completion.

8.4.10.7 Heritage Resources

- ▶ If an object of heritage, archaeological or paleontological origin is discovered, the activity in the area must be stopped. The site personnel must then be informed that the area is a no-go area, and the ECO and Heritage Western Cape (HWC) must be informed to advise on the way forward:
 - hwc.hwc@westerncape.gov.za / ceoheritage@westerncape.gov.za
 - General enquiries: 021 483 9729
 - Office of the CEO: 021 483 5959, 09:00-15:00, Monday - Friday

8.4.10.8 Noise and Light Control

- ▶ No sound amplification equipment such as sirens, loud hailers or hooters must be used on site after normal working hours, except in emergencies.
- ▶ Maintenance would in some cases have to be done after normal working hours and in such instances the contractor must take reasonable steps (if possible) to limit noise as much as possible.

8.4.10.9 Dust Management

- ▶ The contractor and ECO must determine whether dust suppression is required.
- ▶ Clear only areas necessary for undertaking planned works.
- ▶ Implement speed limits on site where necessary due to dust generation.
- ▶ Appropriate dust suppression measures shall be used when dust generation is unavoidable, e.g., dampening with non-potable water, particularly during prolonged periods of dry weather in summer. Such measures shall also include the use of temporary stabilising measures e.g., chemical soil binders, straw, brush packs, chipping, etc.

8.4.10.10 Waste Management

- ▶ Waste management on site should aim to avoid, reduce, reuse, recycle, recover and treat waste where possible, where disposal is the last resort.
- ▶ No waste is to be buried on the site.
- ▶ Waste must not be burned on site.
- ▶ All waste shall be disposed of at a licensed waste disposal facility.
- ▶ All waste storage areas on site must be kept tidy.
- ▶ All waste stored on site shall be secured so that it is not blown off site by the wind.
- ▶ Sufficient weather- and vermin- proof bins shall be provided for the disposal of solid waste.
- ▶ The collected refuse from the working areas must be removed from site at least once a week.
- ▶ Wherever possible, materials used or generated by construction shall be recycled.
- ▶ Hazardous wastes e.g. used oils shall be separated from general wastes, stored separately in appropriate containers and disposed of to a licensed hazardous waste disposal facility or certified recycling facility.
- ▶ On completion of the construction works, a search for any litter on site and in the immediate surrounds must be conducted.

8.4.10.11 Hydrocarbon Management

- ▶ Surfaces, where the possibility of oil spillage exists, shall be prepared in such a way as to mitigate these risks.
- ▶ Drip trays will be placed under all parked or stationary plant. Drip trays to be cleaned out if there is any spill with spill kits, and hazardous waste disposed of licenced waste disposal facility, with proof thereof retained.
- ▶ Machinery prone to oil or fuel leakage must be located at least 50m away from the edge of any watercourse or wetland, and the area adequately bunded in order to contain leakages.
- ▶ Leaking equipment shall be repaired immediately or removed from the site.
- ▶ Each refuelling, or storage site shall be in possession of a chemical/hydrocarbon spill kit and fire extinguisher.
- ▶ Drip trays, spill kits and fire extinguishers to be in place for plant re-fuelling.
- ▶ Where practical, all maintenance of equipment and vehicles shall be performed off-site. However, if it is necessary to do any maintenance on-site, an impermeable surface (e.g. drip tray or plastic sheeting) shall be used to collect the waste oil and other lubricants.
- ▶ Drip trays shall be provided for all plant including stationary plant and for “parked” plant (such as scrapers, loaders or any vehicle). Drip trays shall be inspected and emptied daily (more frequently during rain events) to ensure that they do not overflow. Oil from the drip trays shall be temporarily stored in a 200 litre (ℓ) drum prior to being removed for disposal.

8.4.10.12 Hazardous Chemical Management

- ▶ The only hazardous materials on site are anticipated to be fuels, oils, paint and cement.
- ▶ All hazardous building materials shall be dealt with in accordance with the relevant Safety and Environmental Legislation.
- ▶ All hazardous chemicals will be stored in contained areas to prevent spills, and spill kits and fire extinguishers will be available wherever hazardous chemicals or fuel are stored or used.
- ▶ Hazardous waste and waste fuels and oils shall be stored in appropriate containers that will not corrode or leak. These containers shall be properly marked to indicate contents.
- ▶ Drip trays will be placed under all plants and machinery using hazardous chemicals as well as under containers of hazardous materials being used on site.
- ▶ All hazardous material/waste shall be separated on site and disposed of at a licensed waste disposal facility.

8.4.10.13 Ablutions

- ▶ Appropriate ablation facilities must be provided for construction workers during construction.
- ▶ Temporary toilets must not be placed within 30m of watercourses or wetland areas, unless agreed otherwise with the ECO.
- ▶ Toilets shall be secured to the ground.
- ▶ Chemical toilets must be cleaned and emptied regularly, especially prior to any temporary site closure or long weekend.
- ▶ Proof of disposal of portable toilet content at a wastewater treatment works must be retained on site.
- ▶ Temporary toilets must be animal proof.

8.4.10.14 Fire Prevention and Management

- ▶ Fires shall not be permitted on the site for cooking, heating, or any other purposes.
- ▶ An appropriate number of serviced fire extinguishers and fire beaters shall be provided in all working areas.
- ▶ Smoking shall not be permitted in areas where it could result in a fire hazard, including fuel storage areas, vegetation stockpiles or within proximity to fire prone vegetation types (e.g. Fynbos).
- ▶ In the event of a fire, the appropriate emergency personnel must be informed and be dispatched if required.

8.4.10.15 Concrete Building and Cement Handling

- ▶ The use of ready-mix concrete instead of batching onsite should be implemented as far as possible and best practicable option for the works.
- ▶ During the construction process, no plant or equipment will be allowed to be washed in, or near, any watercourse or wetland or near any surface water. Trucks are to be cleaned at the supplier's yard.
- ▶ If small batching is required, this will be done next to the relevant structure after approval from the ECO.
- ▶ If on-site concrete mixing is necessary, plastic must be laid on the ground and a wooden board (or metal plate) must be used on which mixing will occur. A berm will be created around the plastic to contain any run-off material. All contained runoff will be controlled and disposed of as builder's rubble once dried. Cement bags will be stored in containers.
- ▶ Any tools or equipment that requires cleaning will be cleaned at one fixed location. This will be agreed with and approved by the ECO. A bunded area that is sloped, lined with 250 micron DPC plastic covered with sand, will be constructed. Any wastage and water runoff that will be a result of this cleaning process must be contained in this wash area. This wash area must be cleaned regularly or as required and the waste will be disposed of off-site.
- ▶ Any visible spillages will be removed immediately from site area.
- ▶ Excess concrete will be stored in a skip provided and disposed of as building rubble

8.5 Method Statements

- ▶ Method statements must be submitted to the ECO for review and inputs.
- ▶ George Municipality, the ECO and/or the Contractor shall review, adopt, and sign off on the provided method statements.
- ▶ Method Statements must be submitted and approved prior to maintenance activities commencing.
- ▶ The content and required actions of the method statements must be communicated to site staff through the induction training.

- ▶ Approved method statements shall be readily available on the site and shall be communicated to all relevant personnel. The contractor shall carry out the works in accordance with the approved method statement.

Below is a guide of what needs to be included in method statements:

Who:	Nominated representative and their assigned responsibilities (in relevant instances).
What:	A brief description of the activity to be undertaken (and in relevant instances, the proposed variation from or deviation to the Contract Documentation, or this RMP).
How:	A detailed description of the work, methods, materials, or process proposed (and in relevant instances any reinstatement/rehabilitation requirements).
Where:	A description/sketch map of the locality of work or layout proposed (if available).
When:	The sequencing of actions with due commencement dates and completion date estimates.

Refer to Appendix H for a method statement template that can be modified as needed.

Attached in the following appendices are mitigation measures described in more detail for implementation and can be used for method statement compilation:

- ▶ Appendix B: Streamflow Diversion Mitigation
- ▶ Appendix C: Erosion Control and Revegetation of Exposed Slopes Mitigation
- ▶ Appendix D: Check Dams Mitigation
- ▶ Appendix E: Gravel Berm Mitigation Example

8.6 DWS Risk Assessment

In terms of legislation pertaining to the NWA, any maintenance activities that take place within the regulated area of a watercourse require a water use authorisation. Risks to the PES and EIS of RMUs associated with maintenance activities were assessed according to the risk assessment matrix developed as part of GN 4167 of 2023 (Section 21 (c) and (i) water use Risk Assessment Protocol). The first stage of the risk assessment is the identification of proposed maintenance activities and possible impacts associated with those activities. These are clearly described in Sections 8.4.2 to 8.4.9 and correspond directly to those that are included in the risk assessment matrix (for ease of cross-referencing).

The intensity of impact to abiotic drivers (hydrology, geomorphology and water quality) and receptors biotic responses (aquatic fauna and vegetation) is rated (from 0 to 5, representing negligible and very high impact, respectively), which allows for an understanding of the impact pathway and an assessment of the sensitivity to change. Risks were then quantified based on the anticipated spatial scale, duration and likelihood of occurrence and assumed the full implementation of recommended mitigation measures for each maintenance activity described in Sections 8.4.2 to 8.4.9. In addition, general best practices for management of construction sites, which are applicable to all activities listed in the risk assessment matrix, have been described in Section 8.4.10. Implementation of these best management practices were also considered as additional mitigation measures applicable to all maintenance activities.

Risks took the PES and EIS of the Skaapkop RMU into account. In summary, considering the current PES and EIS and assuming mitigation measures specified in Section 8.4 are implemented, proposed maintenance activities included in the MMP are likely to present a Low Risk to watercourses.

Table 8-2: Summary of DWS Risk Assessment ratings for each maintenance activity included in the RMP.

Activity	Impact	Risk Score	Risk Ratings
8.4.2 Road Infrastructure Maintenance	See Section 8.4.2	9.6	L
8.4.3 Stormwater infrastructure maintenance:	See Section 8.4.3	8.4	L
8.4.4 Bridge crossing infrastructure maintenance	See Section 8.4.4	8.4	L
8.4.5 Above Ground Pipeline and Powerline Infrastructure:	See Section 8.4.5	5.6	L
8.4.6 Below Ground Pipeline and Powerline Infrastructure:	See Section 8.4.6	10.8	L
8.4.7 Maintenance of pumpstations	See Section 8.4.7	8.4	L
8.4.8 Clearing of indigenous vegetation for maintenance activities:	See Section 8.4.8	3.2	L
8.4.9 Clearing of alien invasive vegetation from watercourses:	See Section 8.4.9	3.2	L

8.7 Monitoring and Reporting

Monitoring activities involve the structured observation, measurement, and evaluation of environmental data over a period of time.

George Municipality has the overall responsibility of implementation and must appoint appropriate engineering, environmental and contracting teams to undertake the work as needed.

Please refer to Sections 7.1.5 and 8.4.1.2 for details relating to ECO reporting.

Relevant specialists shall be commissioned to undertake site visits annually to monitor key areas of concern (if deemed necessary by the ECO).

8.8 Non-Compliance

The approved MMP is a legally binding document and non-compliance with it may result in disciplinary action being taken, depending on the merits of the circumstances and environmental impacts. Such action may take the form of (but is not limited to) financial penalties, legal action, fines, instructions to stop work and rehabilitate at own cost, and/or dismissal.

A variety of legislation dictates behaviour/action associated with environmental management and identifies suitable action in the event of non-compliance. Legislation relevant to non-compliance with the MMP includes the following:

- ▶ The National Environmental Management Act, 1998 (No.107 of 1998) (NEMA)
- ▶ The National Water Act, 1998 (No. 36 of 1998) (NWA)

The Contractor shall be deemed to have not complied with the EMMP if:

- ▶ Within the boundaries of the site there is evidence of contravention of the MMP and its associated reports.
- ▶ Unnecessary environmental damage ensues due to negligence.
- ▶ The Contractor fails to comply with corrective or other instructions issued by the ECO or DEA&DP within a specified time.
- ▶ Contractors fail to respond adequately to complaints from the public.

The disciplinary action shall be determined according to the nature of the non-compliance, and exact penalties determined by George Municipality (on advice by the ECO). Penalties may be applied in terms of the Environmental Specification of a contract. If the Contractor is being prosecuted by the DEA&DP or DWS in terms of the NEMA or NWA, respectively, then the courts will apply appropriate criminal penalties.

8.9 Infrastructure Prioritisation and Planning

In contrast to 'reactive' (after the fact) maintenance, the benefits of regular planned 'proactive' (preventative) maintenance to municipal infrastructure is obvious and goes without saying. This is even more beneficial when the consideration of interventions to reduce climate change-related impacts are included in the planning and design of new infrastructure. A quick turnaround time when reacting to and conducting maintenance to damaged infrastructure obviously minimise the potential for environmental impact and further damage to the infrastructure itself.

Typical proactive maintenance may include:

- ▶ Clearing of debris from streams that may potentially cause blockages and in turn erosion (e.g. culverts, low level road crossings etc.).
- ▶ Removal from and/or treating of alien vegetation (e.g. spraying with herbicide) growing stormwater conveyance systems, stream and rivers to optimise the efficiency thereof and maintain the designed functionality.
- ▶ Maintenance of servitude corridors (i.e. cutting vegetation short to maintain ease of access).
- ▶ Safeguarding and repair of pedestrian crossings where vandalism and other damage has occurred.
- ▶ Repair/ replace missing gabion basket sections and refill baskets with rock at gabion structures.
- ▶ Backfilling and repair of erosion at positions where sewerage spillage has occurred to prevent damage of the sewerage conveyance system itself. Install preventative measures to prevent future/future erosion.

Proactive maintenance would not only reduce the replacement cost and decrease the potential for damage but also reducing the risk of localised erosion. Such erosion, if not addressed, may in turn impact on nearby/adjacent properties and result in environmental degradation and even result in legal claims. To document, prioritise and plan for such maintenance, the municipality may consider introducing a form of a 'Prioritisation Tool'.

An example of the 'prioritisation sheet' is shown in Figure 8-1.

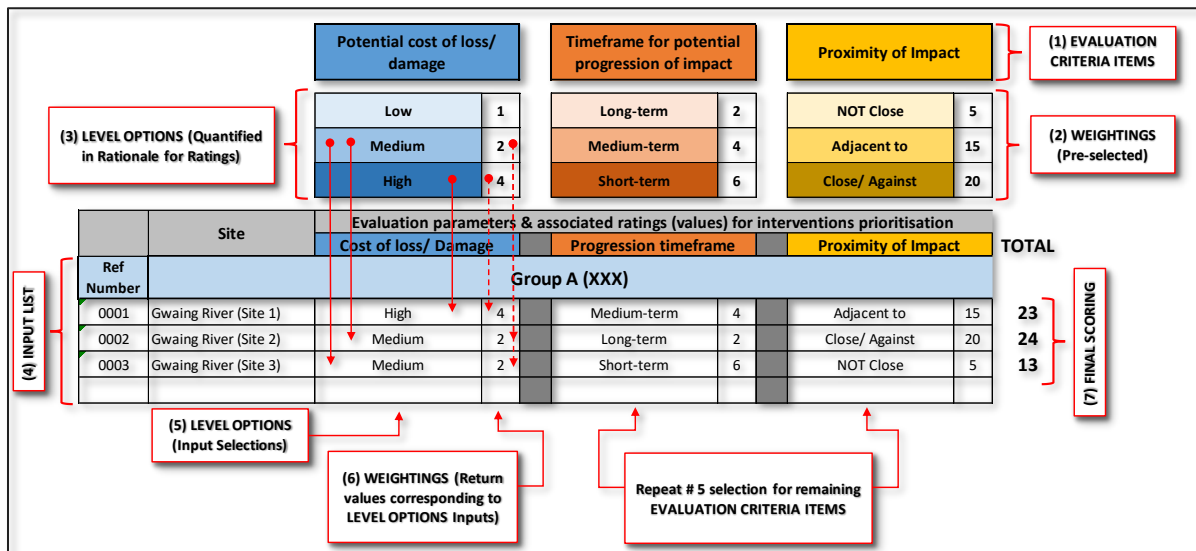


Figure 8-1: Example of the prioritisation sheet

The 'Prioritisation Tool' can be highly customised to incorporate several disciplines and scenarios, depending on the expected objective(s) and could also serve as a record of decision (RoD) to motivate e.g. budgeting, expenditure priorities etc. It could be set up and recorded in a simple spreadsheet format consisting of two (2) parts:

- Rationale for ratings – Stating the quantification of the 'evaluation criteria' to enable the selection of the respective 'level options', best illustrated by example:

- **Potential cost of loss/ or impact** - For municipal infrastructure the 'loss' could be expressed as potential replacement/ repair cost of infrastructure expressed as **Low** (value below R 1 million), **Medium** (R 1 million to R 5 million) or **High** (above R 5 million).
- **Timeframe for erosion progress** - Identified as **Short-term** (has/will potentially progress within the next rain event), **Medium-term** (progress within the next rain season) or **Long-term** (will only progress in more than a year)
- **Proximity of impact** - The proximity of erosion to municipal infrastructure could be evaluated and indicated as **Close/ Against** (against of within 5 m thereof), **Adjacent to** (between 5 m and 10 m in any direction) or **NOT close** (more than 10 m away).

- Prioritisation sheet – Pre-selection criteria, input- and outputs parameters consisting of:

Three (3) pre-selection criteria (Refer to Figure 8-1 as reference)

1. **EVALUATION CRITERIA ITEMS** – These items form the basis of the intended evaluation and are further described in the 'rationale for ratings'.
2. **WEIGHTINGS** – Assigned weightings to each 'level options' reflect what the significance of the respective 'evaluation criteria items' in combination with the 'level options' is.
3. **LEVEL OPTIONS** – Should be clearly quantified in the 'rationale for ratings' to make the evaluation as objective as possible.

Two (2) input parameters (Refer to Figure 8-1 as reference)

4. **INPUT LIST** – Any number of identified reactive-, proactive maintenance and/or new infrastructure planning items could be included in the list to be prioritise per for instance geographical area, river, catchment etc.
5. **LEVEL OPTIONS** – By using the criteria for each level option (outlined in the 'rationale of ratings') the items the conditions are evaluated and selections are made under each 'evaluation criteria'.

Two (2) output parameters as results (Refer to Figure 8-1 as reference)

6. **WEIGHTINGS** – By selecting the ‘level options’ the corresponding pre-selected weighting is returned in the corresponding cell.
7. **FINAL SCORING** – The ‘final scoring’ is calculated by added the returned/ output weightings for each item in the ‘input list’. These could be sorted to reflect a priority list.

Newly planned supporting structures should take the potential effect of erosion into account during the design of the sizing, positioning and intended function thereof. This is also the case where erosion may be caused by e.g. incidental overflow from sewer manholes on steep slopes due to the lack of erosion prevention measures in the design thereof.

9 Improvement of River Health

9.1 Objectives

Improving river health in the Schaapkop River is necessary because the system flows through a highly urbanised area where stormwater runoff, sewage leaks, and the loss of riparian vegetation place continuous pressure on its ability to function. These pressures reduce the river's capacity to provide important ecosystem services such as water purification, flood attenuation, sediment regulation, and habitat for aquatic and riparian species. By improving ecological condition, especially water quality, channel stability, and riparian cover, the river is better able to filter pollutants, slow and store stormwater, support biodiversity, and contribute to downstream water availability and recreational value.

This section of the RMP documents the management interventions required to improve the health of the Schaapkop River.

9.1.1 Management Objective A: Improve levels of protection currently afforded to freshwater ecosystems in the Schaapkop River catchment

The Schaapkop River originates entirely within the urban surrounds of George. Furthermore, it does not receive high volumes of good quality water from the Outeniqua Mountains to the north. The river is therefore heavily influenced by urban wastewater (from the Outeniqua WWTW), stormwater and poor sanitation and solid waste management in informal residential areas. Despite these urban pressures many reaches of the river and its tributaries are adjacent to undeveloped pieces of land. This is in part due to steep slopes along part of the catchment which limits development. Given the rate of development in George, these areas will come under increasing pressure, and it is essential that these further degradation of watercourse is avoided through improved levels of protection.

This management objective focuses on identifying and protecting water resources from existing and future development through the following interventions:

- ▶ Identification and protection of wetlands. Seep and unchannelled valley bottom wetlands are common throughout George and provide valuable regulating and provisioning ecosystem services including streamflow regulation (which is particularly important during drier periods), flood attenuation, assimilation/filtration of pollutants and biodiversity maintenance. Many of these systems have been degraded due to urban and agricultural encroachment into buffers and excessive stormwater inputs and improved protection of these systems is critical;
- ▶ Establishment and maintenance of minimum buffers between wetlands and rivers and adjacent land uses; and
- ▶ Re-instatement of buffers to prevent ongoing degradation of wetland systems.

9.1.2 Management Objective B: Improve the Present Ecological State (PES) of freshwater ecosystems in the Schaapkop River catchment

Rapid formal (including residential, industrial and commercial) and informal urban development within George has led to a significant decline in water quality and instream and riparian habitat quality, which in turn affect biodiversity and PES as well as the ability of these systems to provide valuable ecosystem services. Targeted approaches aimed at improving existing water quality and minimising impacts associated with future developments are essential to improving the ecological health of watercourses and include the following:

- ▶ Prevention of the continuous cycles of downcutting/erosion of river channels, channelisation of unchannelled valley bottom wetlands and erosion of seep wetlands – all of which lead to loss of biodiversity and valuable wetland ecosystem services at a catchment level;
- ▶ Focused rehabilitation efforts on identified, priority areas, where riparian and wetland vegetation, and/or geomorphological characteristics and/or fauna (fish, birds, invertebrates or mammals) are recognised as being of particular importance for biodiversity or supply of ecosystem services. These areas may comprise whole rivers or just particular segments of rivers within identified RMUs;
- ▶ Improving water quality by reducing the frequency of sewage spills and leaks from municipal infrastructure; and
- ▶ Alien invasive tree removal from wetlands and riparian areas.

9.2 Management Actions

9.2.1 Management Objective A: Improve levels of protection currently afforded to freshwater ecosystems in the Schaapkop River catchment

9.2.1.1 Identification and Protection of Wetlands

- ▶ Currently available national scale mapping layers, while beneficial in identifying larger systems are a) not accurate (i.e. are narrower or wider than mapped) and b) miss many smaller wetland systems. Mapping of wetlands in the George area should be undertaken as a matter of urgency. Similar exercises have been undertaken for the for the Knysna Municipality. This project focused on the use of aerial photography to delineate wetland extent, with limited ground truthing of wetlands, and desk-top classification of wetland type and description of wetland condition. Mapping of wetland extent in a GIS compatible format will provide the Municipality with a powerful tool to inform management activities and development decisions and is considered one of the key resources needed for river and other wetland management in the municipal area. Wetland mapping must be prioritised in areas where erven are currently undeveloped and include the following areas:
 - All mapped watercourses and undeveloped erven north of the N2 and south of Hope Street
- ▶ Municipal approval for applications for new developments must be stringently vetted, and developments that include or abut mapped (or other) wetlands should be red flagged as having potentially negative implications for river condition, and for potentially threatening the River EMP objectives.
- ▶ The presence and extent of wetlands in a proposed development area must be confirmed by a wetland specialist prior to approval of any development plan, and where the development is likely to impact on such wetlands, the impacts must be assessed and mitigated through an appropriate EIA process. In this respect the proposed wetland map (as described above) can be actively used to identify and flag potentially affected wetlands and to institute development controls.
- ▶ An extensive education programme should be initiated by the municipality, aimed at promoting awareness by private landowners, particularly in agricultural and other rural areas, of the management objectives and recommended management actions proposed in this management plan. The new plans must link into the existing structures to ensure efficient roll-out. Targeted awareness and outreach to landowners is important to ensure parity between residents and the GM in terms of protection the natural water courses.

9.2.1.2 Establishment and Maintenance of Minimum Buffer Widths

Buffer zones are defined as a strip of land with a use, function or zoning specifically designed to act as a barrier between human activities and sensitive water resources with the aim of protecting these water resources from adverse negative impacts. Buffer zones are typically well vegetated zones adjacent to a watercourse that encourage diffuse flow and maximise infiltration and adsorption of pollutants from adjacent land uses. Buffers provide multiple functions and include the following:

- ▶ Buffers can reduce the impacts of poor water quality, particularly non-point source (or diffuse) runoff (e.g. from agricultural fields/orchards), depending on the type of vegetation in the buffer, as well as other factors such as soil type, slope and the nature of water quality impacts.
- ▶ Buffers can reduce hydrological impacts often associated with hardened urban catchments by improving soil infiltration upstream or adjacent to river channels and wetlands. This means that impacts such as erosion and rapid fluctuations in water level as a result of high runoff rates are mitigated.
- ▶ Buffers, (if adequately vegetated), provide protection from erosion associated with flood events. Appropriate vegetation along river banks and floodplains reduces flood velocities and retains topsoil. The buffer also protects adjacent infrastructure (e.g. residential homes, other buildings, municipal services etc.) and crops which, if located immediately adjacent to river channels, would otherwise be damaged or lost in flood events.
- ▶ Buffers protect rivers/wetlands from physical disturbance and degradation caused by adjacent activities which could result in impacts including compaction, dumping of rubble and waste and spread of alien seeds from nearby sources.
- ▶ Buffers provide space for future restoration activities, even if it is not feasible at the time. This is particularly important within the urban context of George where rehabilitation of watercourses typically requires widening of river channels and reshaping of streambanks from vertical to a more natural slope. Lack of an adequate buffer limits restoration options to hard engineering (e.g. gabion retaining walls, concrete channels etc.).
- ▶ Buffers allow conservation of longitudinal and lateral connectivity through establishing corridors for aquatic and terrestrial fauna with the catchment, thus contributing to the maintenance of key ecological processes.
- ▶ Buffers provide habitat for species that move, during part or all of their life cycle, between aquatic, semi-aquatic and adjacent terrestrial areas.

Buffers are therefore essential for the long-term protection of watercourses and aquatic and terrestrial biodiversity. Some valley bottom wetlands and river channels in the upper reaches of the Schaapkop catchment do still have intact buffer areas that are likely to provide protection from existing landuse activities in the catchment. Invasion by alien tree species is however a pervasive problem throughout the catchment and affects the integrity and function of buffers in the following ways:

- ▶ Heavy invasions shade the channel, its margins and the buffer area, preventing the establishment of indigenous shrubs, groundcovers, sedges and other plants that would otherwise play an important role in bank stabilisation, erosion protection and filtration. Lack of these lower growing plants compromise the ability of the buffer to effectively slow down the rate of surface runoff and promote infiltration into the soil.
- ▶ Dense stands of alien vegetation present a physical barrier and confine peak flood flows more towards the channel causing incision and/or bank erosion.
- ▶ Dense invasions reduce indigenous riparian and aquatic indigenous species assemblages and results in a deterioration in habitat quality and biodiversity.

Implementation of the following enabling measures would support their sustainability:

- ▶ Remove alien vegetation along river corridors and valley bottom wetlands. Priority areas are higher up in the catchment area (i.e., north of the N2 highway). Control of aliens in these areas should be prioritised before moving lower down in the catchment area (i.e., south of the N2) as these areas are an important source of seeds to lower lying areas.

- ▶ Ensure, through awareness programmes, that land users do not encroach in the future into existing buffer areas.

9.2.1.3 Reinstatement of Buffers

Implement minimum buffers of preferably **indigenous vegetation** alongside all channelled rivers, valley bottom wetlands and hillside seeps. For discussion around the management of these buffer areas, and activities that can and should not take place within them (see Section 9.2.3.1).

Buffer widths must take cognisance of both the sensitivity of the watercourse, the need to protect downstream systems of variable sensitivity and importance and the nature of impact that is occurring. They should also consider the vegetation composition of the buffer. Maintained (i.e. mowed) grass buffers (e.g. kikuyu), which are common in urban settings, offer less heterogeneity and are not as efficient in filtering pollutants. Grass buffers have shallow root systems and are therefore not as effective in stabilising banks. This is an important attribute that must be considered, particularly along incised riverbanks which are heavily impacted by stormwater inputs. In these cases, establishment of an indigenous buffer, comprising species with deeper root systems will be more effective in stabilising and protecting banks from flood events.

Watercourses in the Schaapkop catchment are generally confined to relatively steep sloped valleys, which result in increased surface runoff and associated pollutants. Steeper slopes are also far more susceptible to erosion. Minimum buffers of 50 m are therefore recommended.

9.2.2 Management Objective B: Improve the Present Ecological State (PES) of freshwater ecosystems in the Schaapkop River catchment

9.2.2.1 Stormwater Management

Channel degradation through erosion and incision (i.e. downcutting) was identified as one of the most serious issues affecting instream habitat in all watercourses running through the urban extent of George. This has been caused primarily by:

- ▶ Discharge of high volumes of stormwater into river channels
- ▶ Artificial canalisation of rivers (e.g. gabion streambank stabilisation or lining natural channels with concrete) which concentrates flow in the channel
- ▶ Concentration of flows (i.e. to narrower than the natural channel width) through inappropriately sized culverts.
- ▶ Channel narrowing caused by encroachment of developments through infilling of riverbanks.
- ▶ Water-thirsty alien vegetation leads to desiccation of soils and shrinkage of wetland areas. Dry, unvegetated channels become more prone to erosion and downcutting when high flows pass along them, thus exacerbating the cycle of wetland shrinkage and downcutting. Furthermore, dense invasions of woody alien species also concentrate flows within the main channel of the river.

High stormwater volumes not only degrade instream habitat quality but also cause significant damage to build instream infrastructure, requiring costly repairs and maintenance over the operational life of the infrastructure. In highly urbanised and industrial settings such as the Schaapkop catchment stormwater also introduces high concentrations of pollutants (e.g. hydrocarbons from fuel and oil). Therefore, managing stormwater effectively is fundamental to protecting infrastructure AND to preventing degradation of urban watercourses.

- ▶ Analysis of satellite imagery indicates high levels of dumping and uncontrolled discharge of stormwater from industrial properties located along Rand Street, Buitenkant Street, Diamant Street, Nywerheid Street and Ossie Urban Road. The water quality of stormwater from many of

these properties is likely an important source of pollution in these upper reaches of the catchment. An audit of all properties along these roads that lie adjacent to a watercourse is recommended to ensure compliance with existing municipal by-laws (at a minimum). Where stormwater discharge is leading to severe erosion or pollution, appropriate control measures must be implemented, based on guidance provided in Section 9.2.3.2.

- ▶ Further artificial channelisation of river and wetland systems must be avoided as far as possible. Channelisation is most often required for streambank stabilisation aimed at protecting municipal infrastructure or properties. In this respect future developments must allow sufficient buffers to protect watercourse and to accommodate alternative natural streambank rehabilitation options (e.g. channel widening and reshaping channel banks) that require more space to implement and may be required in the future.
- ▶ Existing head cuts and areas where gullies have formed should be addressed in a strategic rehabilitation programme. Working for Wetlands would potentially be the key implementing agency in this regard and should be involved in making strategic decisions about which areas should be prioritised for this type of intervention. A crucial aspect of such rehabilitation, however, is the need for widening of river and valley bottom channels - these systems are impacted precisely because development has resulted in constriction of the channel, a loss of geomorphological equilibrium, and thus, particularly in valley bottom wetlands, in erosion and downcutting. Allowance should be made for the resizing (widening) of channelised valley bottom wetlands, and an increase in channel roughness (e.g. by increasing sinuosity and/or vegetation cover), such that downcutting will no longer occur, once headwall erosion and gulley formation have been arrested. Implementation of this recommendation has important spatial implications, requires engineering and ecological input and may not be practical in many urban areas, where existing hard development limits the extent of available corridor.
- ▶ Concentration of flows into downstream areas resulting from hardened upstream catchment areas should be addressed through adequate sizing of pipes and culverts at new or upgraded road crossings and strategic re-sizing of pipes and culverts at existing river and wetland crossings where needed. Culverts should be spaced and sized such that they allow an adequate spread of flow downstream of the crossing that will sustain the natural channel width.
- ▶ Woody alien invaders should be cleared from all river channels and other wetland systems.
- ▶ Stipulation for detailed stormwater planning as a pre-requisite for development approval. Detailed stormwater design that is most often carried out only after development approval often indicates inadequate provision of space within development areas for the containment of post-development flows, resulting in erosion of downstream areas.
- ▶ Adequate space must be allocated for the retention of stormwater runoff from developed areas, upstream of valley bottom and river channel systems – prior to input into water resources. Importantly, these systems themselves must not be transformed into the stormwater retention/detention facilities, but can provide essential flood attenuation ecosystem services if rehabilitated. Implementation of these recommendations should take cognisance of likely future expansion of developed areas, and ensure that adequate buffer areas are in place, to protect systems from increased runoff volumes and the accompanying deterioration in water quality that is often associated with stormwater runoff.
- ▶ Provide guidelines that address best practice in stormwater management for existing and new developments in urban areas. Such guidelines should address appropriate mechanisms for treating both water quality and water quantity issues in stormwater runoff. As an interim measure, it is recommended that the George Municipality approach the City of Cape Town for access to their stormwater guidelines for new developments (Sawe 2002).
- ▶ Stormwater headwall outlets located near the top of embankments discharging onto unprotected banks has been a common historical practice within the urban extent of George. This has resulted in considerable erosion of embankments, placing infrastructure at risk and infilling wetland and river habitat. Stormwater outlets must be designed to discharge into watercourses at as low an elevation as possible. Alternatively stormwater must be discharged through multiple outlets (thus reducing the volume discharged per outlet) with appropriate energy dissipation and erosion protection incorporated into the design.

- ▶ While the existing stormwater management policy for George highlights the need to minimise stormwater discharge from a property, it does not stipulate a minimum standard that must be adhered to. It is strongly recommended that the following minimum standard is implemented for all future developments:
 - New developments must provide for 24-hour extended detention of the 1-year return interval 24-hour storm event.
- ▶ Adherence to this standard would require that SuDS principles be incorporated into the design of new developments and is considered a key intervention in preventing the continued degradation of urban watercourses in George.
- ▶ Disposal of harmful and toxic materials/chemicals (e.g. used/left over paints, pesticides, used oil etc.) into stormwater drains is a common practice and contributes to direct pollution of water resources. This is often due to a lack of awareness that stormwater drains discharge directly into watercourses with no treatment. An extensive education programme should be initiated by the municipality, aimed at promoting awareness of the function of stormwater drains and the environmental hazards of disposing harmful materials into storm drains. Consideration could be given to painted signage on residential storm drain inlets that warn residents of the environmental hazards of disposing harmful materials into storm drains.

9.2.2.2 Focused Rehabilitation

9.2.2.2.1 Schaapkop Wetlands

Watercourses upstream of the N2 and south of Hope Street were formerly channelled valley bottom wetlands. These wetlands are located along a relatively wide valley-bottom of relatively low gradient. Ordinarily these wetlands would have provided a variety of ecosystem services, particularly with respect to improving water quality, attenuating flood events and supporting biodiversity. These services have however been all but lost due to the extreme channelisation of the wetland caused by increased stormwater flows. Currently the wetlands are experiencing a net loss of sediment due to the natural erosion cycle. This has been exacerbated by the development of the surrounding areas. Priority interventions for these wetlands should focus on rehabilitation interventions that restore the hydro-functional characteristics of the wetlands.

The wetlands currently experience high levels of invasion from alien tree species. Removal of alien invasive plants from the delineated area wetlands will improve their PES and is aligned with the management objectives of this RMP.

Future developments adjacent to these wetlands must respect prescribed buffer widths to ensure protection of the wetlands.

Rehabilitation will require the construction of energy dissipation structures in the form of gabion weirs to halt incision of the channel, while simultaneously allowing flows to pass through. These gabions act as follows:

- ▶ Some water will be held back and of this retained water some will sink into the soil while some will dam up and stand for days within the confines of the weir or check dam, slowly seeping out on the down-stream side.
- ▶ The silt shall accumulate behind the weir and over time vegetation shall establish in the silt.
- ▶ Water passing downstream shall be filtered by the weir - leaves, seed, sand and silt shall be held back, creating a fertile site for plants to establish.
- ▶ More abrasive materials (sand and stones) are retained and prevented from contributing to erosion down-stream.
- ▶ Seepage from the retained water behind the weir will enable grasses and other plants to germinate and grow downstream.

- ▶ There is sufficient space along these wetlands to reshape/reprofile the banks in order to reduce lateral surface runoff velocities and encourage good vegetation growth. This would the need for engineered bank protection structures.
- ▶ Reprofiled banks can be prtected by laying an open geotextile (e.g. Soil Saver) on the bank before adding a layer of topsoil (30–40mm thick) mixed with grass seed over the top. The geotextile assists in binding the grass roots together.



Figure 9-1: Eroded channelled valley-bottom wetland along the upper reaches of the Schaapkop River

9.2.2.2.2 Erosion Gulley (RE/464)

A serious headcut erosion gulley has formed along a tributary of the Schaapkop River due south of P.W. Botha Boulevard. The gulley is moving upstream and is approaching the edge of a wetland seep area that has most likely formed from stormwater runoff discharged from P.W. Botha Boulevard. The wetland currently provides attenuating stormwater flows and filtering pollutants from the surface runoff. The advancing erosion is placing these valuable services at risk and urgent intervention is recommended to control the upstream migration of the knickpoint and avoid the loss of the wetland. This can be achieved in a number of ways, including:

- ▶ Installing instream check dams;
- ▶ Elevating the stream by filling the gully;
- ▶ Sloping the bank face by laying down fabric and rock; and
- ▶ Energy dissipation pools.

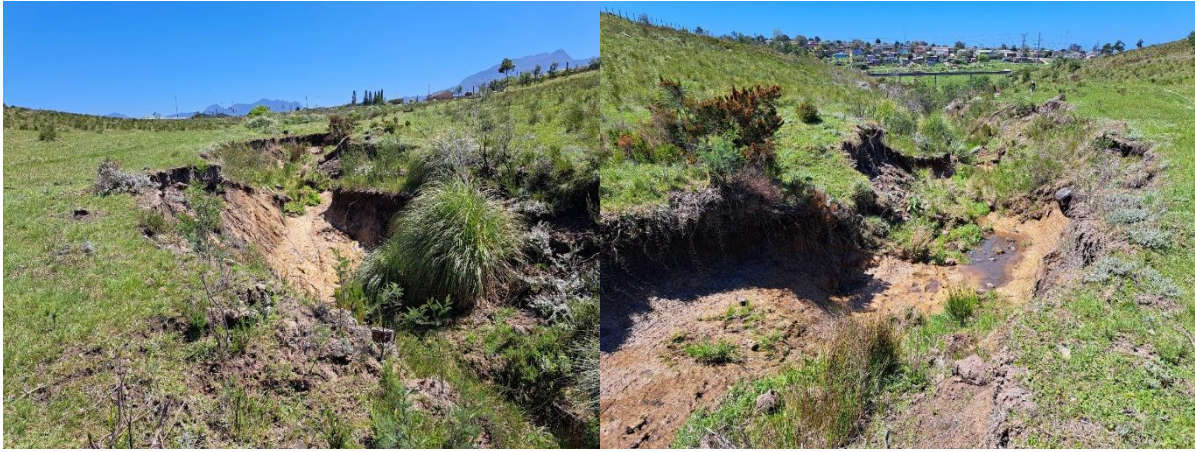


Figure 9-2: Erosion gully below P.W. Botha Boulevard on RE/464

9.2.2.3 Water Quality

Water quality in the Schaapkop River is seriously compromised, not only due to formalized effluent discharge from the Outeniqua WWTW but also from urban runoff and most importantly, from leaking sewage infrastructure, which is pervasive throughout this catchment (Figure 9-3). During the Status Quo assessment, three leaking sewer manholes were observed in the catchment area, all of which were discharging high loads of untreated effluent directly into the Schaapkop River. Additional developments will place this existing infrastructure under further strain and lead to continued pollution of watercourses.



Figure 9-3: Two examples of leaking manholes along a 500 m stretch of the Schaapkop River

Primary causes of leaking sewage infrastructure include the following:

- ▶ Aging and inadequate infrastructure of sewage systems. Sewer networks were generally designed and installed decades ago, and have insufficient capacity to accommodate the growing demands of expanding populations and urban development. As the city of George expands, so does the volume of wastewater produced, placing immense strain on infrastructure ill-equipped to handle the load.
- ▶ Lack of routine maintenance exacerbates the problem. Sewer pipes deteriorate over time due to corrosion, cracks, and the roots of trees, leading to leaks and blockages. Neglected maintenance schedules allow these issues to escalate, resulting in frequent overflows that threaten public health and pollute watercourses.
- ▶ Disposal of materials such as grease, oil, chemicals, fats, sanitary pads, diapers, condoms, and other forms of solid waste into sewer systems causes blockages which increases the risk of overflows and burdens the municipality with the added costs of cleaning and repairs.

- ▶ Rapid urbanisation and the proliferation of informal settlements strain sewage infrastructure beyond its capacity.

A strategy must be developed to deal with leaking sewage infrastructure and should consider the following:

- ▶ Investment in sewage infrastructure is paramount. The municipality must prioritize the rehabilitation and expansion of sewer networks, along with the upgrading of the existing treatment works, to meet the growing demands of urbanisation in George.
- ▶ Consistent proactive maintenance is essential to prevent overflows. Regular inspections, cleaning, and repairs can identify and address issues before they escalate, ensuring the reliability and efficiency of sewage systems.
- ▶ Strict law enforcement against illegal disposal of foreign materials into sewer systems is imperative, including fines and public awareness campaigns.
- ▶ Residents and business owners must be educated about proper waste disposal practices through dedicated public awareness campaigns. By fostering a culture of responsibility and environmental stewardship, municipalities can enlist the support of communities in safeguarding against sewage overflows. This must include well-publicized contact numbers for reporting sewage leaks/spills.
- ▶ Routine monitoring of effluent from the Outeniqua WWTW must be undertaken to ensure compliance with license conditions. These results must be audited on an annual basis

9.2.3 Best Practice Measures

9.2.3.1 Implementation of Buffers

The Status Quo report highlighted that the absence of adequate buffer areas was prevalent within the urban extent of George. Re-instatement of these buffer areas forms one of the key management tools recommended as a means of protecting water resources in the catchment. The following general measures apply:

- ▶ Buffer areas should be set for all river and other wetland systems, using the measures outlined in Section to set minimum widths.
- ▶ Buffer areas should be shown on all planning documentation, and provision of adequate buffers around all river and wetland systems must be a pre-requisite for approval of all developments.
- ▶ The edge of the buffer area does not necessarily denote the edge at which hard development can occur – no structures can be erected below the 1:100 year flood line of any river without authorisation in terms of the National Water Act, and where the 1:100 year floodline lies beyond the stipulated buffer area (usually in the case of large rivers) at least the recommended buffer width should be vegetated and managed as outlined in this section in terms of best practice, and the remainder of the area below the floodline should be used only for approved purposes, in terms of the National Water Act.
- ▶ Buffer areas should be specifically managed such that their use and management does not detract or conflict with their primary purpose, that of protection of the aquatic resource. Thus, where secondary uses for such buffers are required (e.g. recreational picnic areas, playing fields), the buffer should either be widened to accommodate such activities or the quality of the buffer in terms of its plant communities and vegetation cover should be improved, to maximise buffering function. The following best practice recommendations apply:
 - Buffer areas should be planted with appropriate indigenous vegetation. Where remnant indigenous vegetation occurs in the corridor or is likely to re-establish once alien removal has taken place, efforts should be made to encourage re-establishment actively.
 - Where buffer areas are grassed or otherwise planted, they need to be much wider than the recommended minimum widths, to compensate for loss of function.
 - Although minimum buffer width guidelines have been proposed, a freshwater ecologist should determine specific buffer widths for new developments on an individual basis.

- Riverine and valley bottom wetlands that have been identified as currently providing or needing to provide important corridor functions, need to be planted with appropriate locally indigenous vegetation to secure this function. Reshaping of the buffer may be required in some cases.
- Control of alien plants should be one of the management priorities within buffer areas – alien plants often detract significantly from buffer function and are likely to spread along the river corridor.
- The following activities should not be allowed to take place in buffer areas (and thus, should not take place within the specified setback distance from each river or other wetland):
 - Dumping of waste of any kind, including garden litter, grape skins, rubble, alien plant debris, dredged spoil from the river or wetland and any other waste.
 - No infilling should take place.
 - No hardened surfaces should be created. This includes structures such as paths, roads, decks, patios, houses. Unlined, informal paths may however be created, particularly if these will provide residents with an improved experience of the river.
 - Stormwater outlets should open into the upland edge of the buffer (i.e. the edge furthest from the channel) and stormwater flows should be managed so as to maximise the function of the buffer area in ameliorating water quality upstream of the aquatic resource. Appropriate management measures may include energy dissipating structures, specific vegetation etc.
 - No draining of buffer areas by means of channels and subsurface drains can take place, as this directly affects buffer function. This means that the use of buffer areas for sports facilities other than informal “kick-about” may not be feasible in an area where the buffers may be saturated in winter.
 - No agriculture, grazing, feeding or watering of livestock should take place – note that where agricultural fields abut rivers or other wetlands, even channelised systems, sufficient space must be left outside of the buffer area to allow for the passage of tractors and other vehicles along the buffer edge.

9.2.3.2 Stormwater

As highlighted in the Status Quo report, George is located in a high rainfall intensity zone and covers soils that are highly susceptible to erosion. Watercourses are very vulnerable to this combination of geographical characteristics which is exacerbated by poor management of stormwater which is possibly the leading cause of degradation of watercourses within the urban area of George. Impacts include:

- ▶ Erosion and channel incision in receiving water bodies, due to increased volumes and rates of flow.
 - Reduction in geomorphological heterogeneity and thus a deterioration in instream habitat quality and diversity for aquatic biota;
 - Artificial lowering of the water table causing more rapid drainage through rivers and wetlands. This can have severe effects on wetland function (particularly hillslope seep wetlands which are common throughout George), as well as survival of many terrestrial plant communities.
- ▶ A reduction in the base flows entering receiving water bodies, due to the implementation of efficient detention/infiltration and other devices.
- ▶ Pollution, as a result of road and parking areas runoff, industrial effluent, fertilisers and other pollutants that are conveyed directly to natural aquatic systems (receiving water bodies), without any attempts at water quality amelioration en route.

As highlighted above, the existing George Stormwater Policy does not provide adequate protection or guidance on protecting urban watercourses. A review of the policy is therefore recommended with a

specific focus on minimising the volume AND energy of stormwater discharged from a property. In this respect, the policy and associated guidelines should aim to achieve the following (after SAWE 2008):

- ▶ Inputs of stormwater into a natural freshwater system should be managed so as to result in a zero increase in the volume of runoff into the system, and no change in its seasonality (i.e. post-development runoff should aim to equal pre-development runoff).
- ▶ Inputs of stormwater must be managed so that no deterioration in the water quality of the receiving body occurs.
- ▶ Inputs of stormwater should be managed so as to result in no increase in sedimentation of natural watercourses.
- ▶ The need to design appropriate stormwater management systems for new developments should be seen as an opportunity to rehabilitate natural freshwater ecosystems that have suffered degradation as a result of past activities, and in some cases, to create additional freshwater habitats that will contribute to the availability of appropriate, high quality river and wetland habitat, that mimics the natural condition.

Based on these objectives, the following Best Management Practice Objectives for stormwater management should be applied:

- ▶ Increases in the volume of runoff from new developments must be minimized. This is achievable through the implementation of Sustainable Drainage Systems (SuDS) which requires that as much stormwater be attenuated on site as possible through strategies that include the following:
 - Rainwater harvesting - the direct capture of stormwater runoff, typically from rooftops, for supplementary water uses on-site (e.g. rainwater harvesting tanks installed at residential and commercial buildings);
 - Infiltration - the soaking of stormwater runoff into the ground thereby physically reducing the volume of stormwater runoff on the surface. This can be achieved with interventions that included permeable pavements, soakaways, swales and infiltration trenches;
 - Retention Ponds - have a permanent pool of water in them and are generally formed through the construction of a dam wall equipped with a weir outlet structure. The maximum storage capacity of retention ponds is larger than their permanent pond volume. Stormwater coming into the pond is mixed with the permanent pond water and released over the weir at a reduced flow rate. Retention ponds are usually capable of handling relatively large quantities of stormwater runoff and can be utilised as a source of water for various non-potable purposes (e.g. irrigation of landscaping).
 - Detention Ponds – typically in ponds that are normally dry except following large storm events when they temporarily store stormwater to attenuate flows by slowly releasing water at a pre-determined rate. They may also allow infiltration of stormwater into the ground storage and, to a lesser extent, filtration.
- ▶ Attention to site layout will also reduce surface runoff – e.g. location of parking areas; development elements likely to attract traffic and require larger roads/parking areas. Achieving this measure will provide protection to ecological resources, as well as to human safety and property.
- ▶ The velocity of stormwater runoff and the likelihood of erosion of the catchment, including receiving water bodies should be minimized. This objective might be achieved through detention, dissipation and filtration strategies.
- ▶ Negative impacts on water quality should be minimized, and improvements in existing stormwater quality should be achieved where possible. This is achievable through strategies such as addressing pollution at source, filtration, aeration and, to a lesser extent, infiltration, retention and detention.
- ▶ Sedimentation of natural ecosystems should be minimized by addressing erosion in the catchment (or at the level of the development) through location-planning and vegetation.
- ▶ Opportunities for the preservation /creation / rehabilitation of wetland/riverine habitat should be maximised, by following natural drainage routes and drainage types and incorporating natural rivers /wetlands into stormwater design where appropriate. Note however that where stormwater

impacts are likely to alter natural systems (e.g. in terms of their seasonality or water quality) then these systems, should be actively protected from stormwater impacts.

- ▶ Where stormwater design involves the construction or use of wetland areas for stormwater treatment or attenuation, active management of such systems must be allowed for through the full operational phase of the development or area involved. Failure to implement this will result in the creation of numerous unmanaged wetland systems of little value in terms of management of stormwater quality or quantity and with little aesthetic or ecological value either.
- ▶ Stormwater management plans must be designed to a detailed level during the EIA phase of any new development requiring authorisation. This allows the full impacts of stormwater management systems to be assessed during the EIA process, and ensures that adequate provision is made for stormwater, within the approved development layout.

9.2.3.3 Bank Stabilisation

There are numerous examples of streambank stabilisation throughout the urban area of George – nearly always associated with increased stormwater runoff combined with encroachment of agricultural areas and built structures into what should be protective buffer areas (e.g. residential homes and municipal infrastructure etc.). Hard structures required for bank stabilisation (e.g. gabion retaining walls) can be avoided through implementing adequately sized buffers that provide sufficient space to reconfigure or re-profile banks using more natural approaches (see Section #### above). Where space does not allow such interventions, more severe approaches have been adopted for protection of property. Given the current status quo with regards to stormwater runoff and zoning of properties it is likely that bank erosion will continue into the future, in which case the following recommendations should be considered:

- ▶ The reason for erosion should be ascertained, and steps taken as far as possible to address its cause(s), before any attempts to remediate the symptoms are implemented. Potential erosion triggers may include:
 - Intrusive alien or other trees in or beside the channel, and causing speeding up of flows or undercutting of banks;
 - The presence of constricting structures that reduce the natural width of the watercourse (e.g. inadequately sized culverts);
 - Unvegetated (e.g. footpaths down the banks)
 - Built infrastructure obstructing surface flow and causing concentrated, preferential flow down relatively steep embankments
- ▶ Bank stabilisation by means of hard engineering structures (e.g. gabion retaining walls) should only be considered as a last resort, and only implemented when other means of more natural bank stabilisation are not viable. Where gabions are used:
 - Efforts should be made to step them, with the lowest gabions forming a flat ledge at or just above water level, in which riverine plants will be able to establish themselves
 - River vegetation is usually difficult to sustain on higher gabion steps, where heat and rapid drainage are issues - where a vegetated effect is desired, landowners may do well to focus on planting non-invasive groundcovers on the upper banks, and allowing these plants to spread down the gabion shelves, while taller vegetation on the wetted bottom gabion shelves produce a visual shield
- ▶ Ideally, re-stabilisation of eroded banks should rather employ indigenous riverine vegetation as the main means of facilitating stabilisation. In such cases:
 - Bank stabilisation measures should be implemented outside of the wet season, allowing time for plants to establish effectively before the next wet season
 - Banks should be graded back at slopes no steeper than 1:4 – where a machine is used for this exercise, it should work from the land rather than the river side
 - Care should be taken to tie in the slopes of regraded banks with up- and downstream banks and to avoid the creation of potential erosion nick-points

- Bagged plants rather than cuttings or seed material should be used to achieve rapid stabilisation, particularly of the lower banks
 - Indigenous plant material appropriate to local conditions should be selected – where its main purpose is bank stabilisation, hardy, fast growing plants should be used in the short-term – these can be interspersed at a later stage with a more diverse species component, if this is desirable
 - It should also be noted that:
 - The lower river banks, where water is readily available, are usually self maintaining in perennial systems
 - The middle and upper banks are usually drier and often more vulnerable to trampling and grazing – hardy ground covers may be necessary to stabilise these areas
 - In many cases, allowance will need to be made for weeding and even irrigation of planted areas over at least one summer, until plants have established
 - Allowance should also be made for minor bank repair and replanting after the first one or two winters, while plants are still establishing
 - The use of temporary geotextiles (e.g. Soil Saver) for bank stabilisation while plants establish can be considered – an appropriate specialist should be consulted in this regard
- ▶ Where vertical erosion (i.e. head-cut erosion) is the problem, rather than bank erosion, addressing the problem by means of bank stabilisation will not be effective, and a mechanism to dissipate or manage instream energy must be sought instead. Some of the approaches commonly used include:
- Riprap lining (i.e. a loose armour of cobbles and small rocks over the stream bed)
 - Gabion weirs
 - Other weirs (e.g. concrete)
 - Artificial “riffles”.

All of these approaches require authorisation from DEA&DP and BOCMA and should be undertaken in consultation with a river ecologist and an engineer, so that a legal, sustainable and ecologically appropriate solution can be worked out, which considers:

- ▶ whether instream fauna migrate up- or downstream as part of their lifecycles and hence whether a structure across the channel will constitute a problem in this regard
- ▶ safety issues, such as the height of a gabion weir
- ▶ the most appropriate location for such structures
- ▶ maintenance issues – e.g. if sediment clearing is an ongoing issue in a channel, then riprap lining may be problematic
- ▶ ecological issues – the implications of different approaches in terms of habitat availability and desirability (e.g. hard lining a channel will reduce habitat diversity, speed up instream flows and may result in bank erosion downstream).

9.2.3.4 Road Crossings

Channelisation of formerly unchannelled valley bottom wetlands can often be traced to historical road crossings that reduced the width of the macro-channel, causing more concentrated flow through a narrower portion of the wetland. Specifically, these impacts are associated with inadequate attention to the provision of multiple culverts (or adequately sized culverts) at road crossings and to preventing downstream wetland shrinkage as a result of concentration of flows from diffuse systems into single culverts. The following measures are recommended for future developments:

- ▶ Road crossing design should take cognisance of the principle that wetland width downstream of the crossing should not shrink as a result of the crossing – this frequently happens where road crossings are narrow pipe culverts that concentrate flows, resulting in erosion and channel narrowing or channelisation of valley bottoms downstream. Thus, culverts should be designed

such that, at their outlet end, the flow is spread across the full extent of the natural wetland or channel width.

- ▶ Concentration of runoff from roads down the toe of the road and into rivers or wetlands can result in erosion. Road design should incorporate measures to reduce runoff velocity and promote infiltration along road verges.
- ▶ The placement of culverts beneath roads should equate to natural drainage lines – runoff from one drainage line should not be diverted into other drainage lines, as this practice results in concentration of flows into the downstream system and increases erosion risks.
- ▶ Watercourses that have been identified in the situation assessment as of importance for the maintenance of longitudinal connectivity between upland and lowland areas, or along particular systems should ensure that crossings allow for ecological connectivity as well as hydrological connectivity. For example, where major roads will act as a barrier to the movement of fauna over the road, culverts should be sized to permit faunal movement beneath the road. Bridges, or the construction of box culverts up to 2m in height may be necessary where such faunal movement is deemed important.

9.3 Monitoring and Reporting

Monitoring provides an indication of the current status and trends of the ecological health of a watercourse and is therefore fundamental to determining whether the objectives of the RMP and the MMP are being met. Furthermore it is a requirement for the authorisation and implementation of an RMP. Biomonitoring uses the sensitivity of aquatic organisms (e.g. macroinvertebrates and diatoms) to make an assessment of the ecological health of a system. These indices are mainly related to water quality and are advantageous in that they provide an integrated assessment of ecological health that may not necessarily be reflected by a once-off analysis of water quality parameters which can change rapidly from one day to another. Any decline in the status or trends of abiotic drivers or biotic responses that characterise ecological health must prompt an investigation into the cause and solution for the decline.

The intention of the monitoring is primarily to track status and trends over time. The key monitoring benchmark is therefore an improvement in water quality and biomonitoring indices over time. This would need to take inter-seasonal variation into account, which is why the monitoring plan has been designed across a seasonal approach. Water quality standards should ideally be guided by Resource Quality Objectives (RQOs) that have been gazetted for rivers in the Breede-Gouritz catchment area. RQOs are descriptive statements and numerical values that define the desired biological, physical, and chemical attributes of a water resource, such as a river or wetland. They are established to meet a resource's management class and ecological reserve, guiding resource managers to balance the need to protect water resources with the need for their use. Unfortunately, the rivers included in the RMP are not considered as priority rivers and RQOs were not set for these rivers. All rivers fall within the G15 Coastal Integrated Unit of Analysis (IUA). The Water Resource Class for this IUA is II, indicating moderate protection and moderate utilisation. Given the highly modified nature of the river the short-term objective should be to maintain at least a D ecological category, with a long-term goal of reaching a C ecological category.

The results of the ongoing water quality monitoring must be shared with the general public by means determined by GM.

9.3.1 SASS5

Version 5 of the South African Scoring System (SASS5) rapid bioassessment method for rivers (Dickens and Graham, 2002) must be used to evaluate ecosystem health based on the absence or presence of sensitive and tolerant macroinvertebrate species. This method is specific to South African rivers, uses a standardised methodology and is widely used as a biomonitoring protocol across the country. In summary, each family is rated between 1 to 15, based on their sensitivity to pollutants (1 indicating

lowest sensitivity or highest tolerance to pollutants and 15 indicating highest sensitivity or lowest tolerance to pollutants). The sum of all the ratings per family for a particular sample is the SASS5 score. The number of different taxa, (different families), is also taken into account as another measure of river condition. The Average Score per Taxon (ASPT) is calculated by dividing the SASS5 score by the number of different taxa identified and is often the most meaningful metric. While the method provides an indication of a deterioration in water quality (i.e. low ASPT scores) it does not provide any information on specific pollutants causing the deterioration.

9.3.2 Diatoms

Diatoms are unicellular algae and are commonly used for a variety of practical purposes in ecological assessment throughout Europe, North America and Africa. The sensitivity and tolerance of diatoms to a number of environmental characteristics, such as eutrophication, organic pollution, heavy metals, salinity, pH and pesticides, are known to differ among species and, similar to SASS 5, these species-specific sensitivities and tolerances can be used to infer environmental conditions in a habitat. Diatoms have been shown to be very sensitivity indicators of water quality perturbations and their presence is not highly dependent on habitat quality. The relative abundance and pollution sensitivity of each species collected in a sample is used to calculate the Specific Pollution Sensitivity Index (SPI) which is then used to derive one of five ecological health categories, ranging from High Quality to Bad Quality.

Table 9-1: Aquatic Ecological Health Categories

Interpretation of index scores		
Ecological Category (EC)	Class	Index Score (SPI Score)
A	High quality	18 - 20
A/B		17 - 18
B	Good quality	15 - 17
B/C		14 - 15
C	Moderate quality	12 - 14
C/D		10 - 12
D	Poor quality	8 - 10
D/E		6 - 8
E	Bad quality	5 - 6
E/F		4 - 5
F		<4

9.3.3 Index of Habitat Integrity

The Index of Habitat Integrity (IHI; Kleynhans, 1996) is widely regarded as the most appropriate method for assessing riverine habitats as it is not dependent on flow in the watercourse and, therefore, produces results that are directly comparable across perennial and non-perennial systems. The IHI was developed as a rapid assessment of the severity of impacts on criteria affecting habitat integrity within a river reach. Instream (water abstraction; flow modification; bed modification; channel modification; physico-chemical modification; inundation; alien macrophytes; rubbish dumping) and riparian (vegetation removal, invasive vegetation, bank erosion, channel modification, water abstraction, inundation, flow modification, physico-chemistry) criteria are assessed as part of the index. Each of the criteria are given a score (from 0 to 25, corresponding to no and very high impact, respectively) based on their degree of modification, along with a confidence rating based on the level of confidence in the score. Weighting scores are used to assess the extent of modification for each criterion. The estimated impacts of all criteria calculated this way are summed, expressed as a percentage and subtracted from 100 to arrive at an assessment of habitat integrity for the instream and riparian components, respectively. An IHI class indicating the present ecological state of the river reach is then determined based on the resulting score (ranging from Natural to Critically Modified).

9.3.4 Water Quality

Biotic responses (e.g. macroinvertebrate and diatom communities) are ultimately influenced by abiotic drivers which include habitat (described above) and water quality. Water quality is directly influenced by catchment activities and routine water quality monitoring is therefore important for identifying specific causes of ecosystem response and understanding trends in water quality over the medium to long term. Water quality parameters that must be included in the monitoring are listed in Table 9-2 and include the following:

- ▶ pH;
- ▶ Electrical Conductivity (EC) – as a measure of salinity;
- ▶ Major Ions - the concentration of these ions contributes mainly to the EC of the water, with higher concentrations leading to higher conductivity;
- ▶ Major nutrients – orthophosphate (PO₄-P); total phosphorus (TP); nitrate (NO₃-N) and nitrite (NO₂-N) which together make up the Total Inorganic Nitrogen (TIN) – these indicate issues such as eutrophication and the likelihood of algal blooms in standing water bodies;
- ▶ Un-ionised (or “free”) ammonia nitrogen (NH₃-N) – this can be toxic to aquatic organisms at even very low concentrations;
- ▶ Dissolved oxygen (DO) – this indicates organic pollution (when low) and is an essential component of healthy aquatic ecosystems;
- ▶ Faecal coliforms are one of the most commonly used bacterial indicators of faecal pollution and indicate the possible presence of pathogens responsible for the transmission of infectious diseases such as gastroenteritis, salmonellosis, dysentery, cholera and typhoid fever; and
- ▶ *Escherichia coli* bacteria (*E. coli*) – this is an indicator of the presence of faecal material from warm blooded animals (including humans) and in urban areas can indicate sewage pollution.

Table 9-2: Recommended water quality parameters that must be included in quarterly water quality sampling.

Major Ions	Major Nutrients	Other
Calcium (Ca ²⁺)	Ammonia	Fluoride (F ⁻)
Magnesium (Mg ²⁺)	Nitrate (NO ₃ -N)	Silica (Si ⁻)
Potassium (K ⁺)	Nitrite (NO ₂ -N)	Chemical Oxygen Demand (COD)
Sodium (Na ⁺)	Ortho-phosphate (PO ₄ -P)	Total Faecal coliforms
Total alkalinity (CaCO ₃)	Total Phosphorus (TP)	<i>E. coli</i>
Chloride (Cl ⁻)		pH
Sulphate (SO ₄ ²⁻)		Electrical Conductivity (EC)
Total Dissolved Solids		

Interpretation of water quality parameters for which guidelines have been derived is provided in Table 9-3 and provides an indication of the ecological condition of the water resource, ranging from “Good” and to “Unacceptable”. This categorical approach follows established national procedures commonly used in the assessment and reporting of inland water quality and correspond with PES categories as indicated in Table 9-3. Guidelines for faecal coliforms are provided in Table 9-4.

Table 9-3: Guidelines for water quality parameters included in the Schaapkop RMP (DWAF, 1996).

Parameters	Good	Fair	Poor	Unacceptable
NH ₃ -N (mg/L)	< 0.044	0.044 – 0.072	0.072 – 0.1	> 0.1
PO ₄ -P (mg/L)	< 0.025	0.025 – 0.075	0.075 – 0.125	> 0.125
TIN (mg/L)	< 0.7	0.7 – 1.75	1.75 – 3.00	> 3.00
DO (mg/L)	> 6		4 – 6	< 4
N:P	> 25		10 – 25	< 10
PES Category	A & B	C	D	E

** PO₄-P = orthophosphate phosphorus; TIN=Total inorganic Nitrogen; DO=Dissolved oxygen; N:P= ratio of TIN:PO₄-P; NH₃-N = nitrogen in un-ionised ammonia.

Table 9-4: Water quality guidelines for recreational use.

Parameters	Faecal Coliform
Acceptable Risk (full contact recreation)	< 400 cfu/100 ml
Acceptable Risk (intermediate contact recreation)	400 – 2500 cfu/100 ml
Tolerable Risk (intermediate contact recreation)	2500 – 4000 cfu/100 ml
Unacceptable Risk (intermediate contact recreation)	> 4000 cfu/100 ml

9.3.5 Monitoring Plan

Monitoring must be conducted at selected monitoring points (see Figure 9-4) and must include the following:

- ▶ SASS5 macroinvertebrate sampling (including an assessment of site-specific habitat conditions)
- ▶ Diatom sampling
- ▶ Habitat quality (undertaken at an RMU-scale using a combination of desktop and most recently available satellite imagery)
- ▶ In-situ and physico-chemical water quality sampling

The frequency and type of sampling to be conducted at each site is provided in Table 9-5.

Table 9-5: Recommended frequency and type of sampling

RMU	Monitoring	Frequency and Timing
Schaapkop	SASS5	Bi-annually (winter and summer)
	Diatoms	Bi-annually (winter and summer)
	Index of Habitat Integrity	Annually
	Water Quality Sampling	Quarterly (every 3 months)

- ▶ Sampling must be conducted by an appropriately registered SACNASP registered professional, specialising in aquatic science
- ▶ Monitoring results must be compared to the baseline assessment and against the desired PES category for the RMU (current PES of D with the objective of reaching a C).
- ▶ Water quality monitoring should include parameters recommended in Table 9-4.
- ▶ A report on the status and trends of water quality and biomonitoring must be prepared by appointed consultant annually. This must include the development of a database in which all relevant water quality and biomonitoring data is captured. The database must be updated on an annual basis and must be made available to consultants preparing the report for the purposes of

a) providing historic data in order to determine trajectories of change over time and b) updating the database with new data captured during the year.

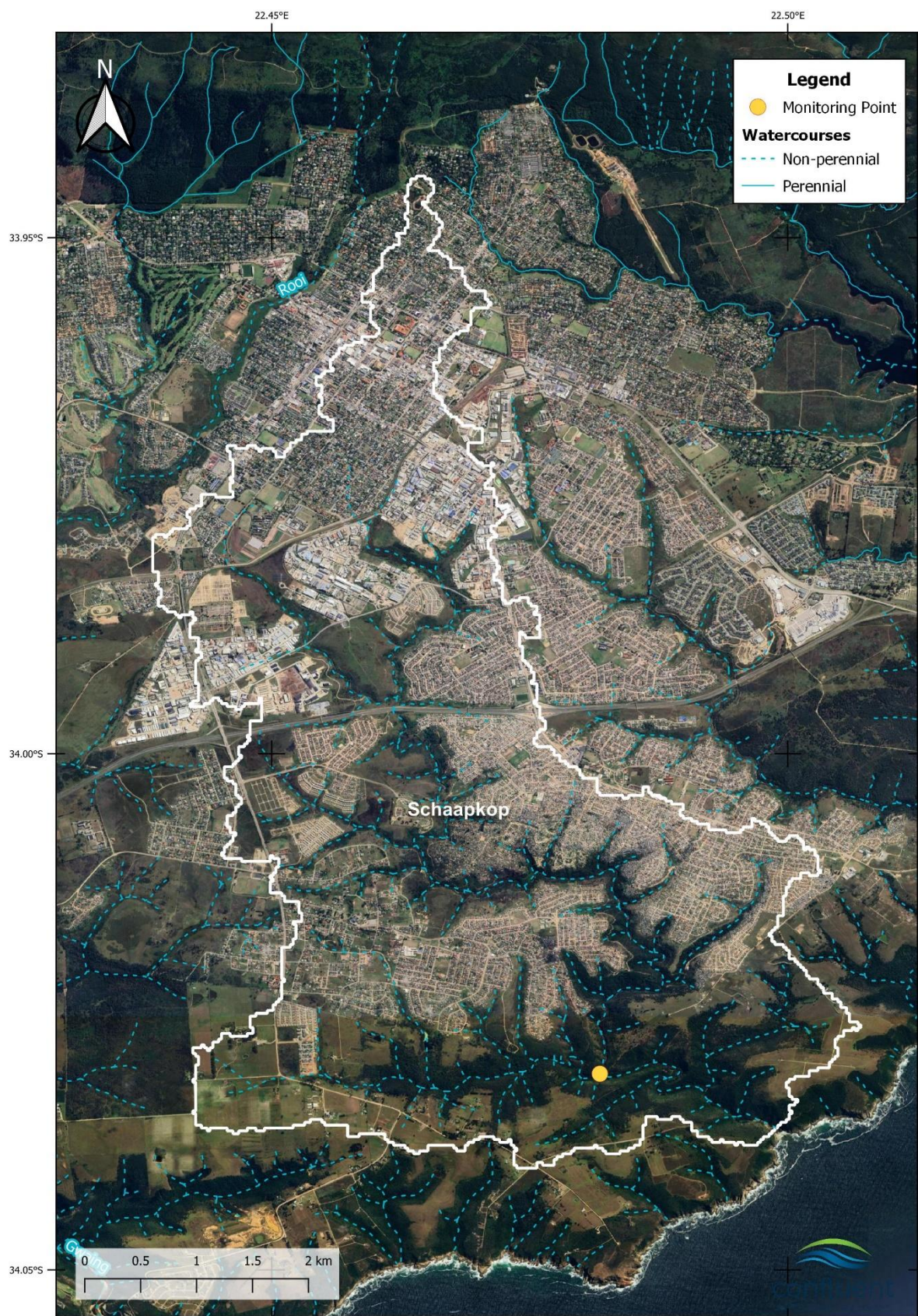


Figure 9-4: Map indicating the proposed location of monitoring points for the Schaapkop RMP.

9.4 Adopt-a-Spot – Community Involvement

George Municipality recognises the critical role that local communities play in achieving sustainable river management. To formalise this involvement, the municipality has adopted the Adopt-a-Spot Policy, which enables individuals, schools, businesses, and civic organisations to take responsibility for designated areas along rivers, wetlands, and riparian zones.

Under this policy, participants enter into an agreement with the municipality to maintain and enhance the ecological integrity of their adopted site. Activities may include alien invasive plant removal, litter clean-ups, riparian buffer maintenance, and reporting of environmental concerns. These actions directly support the objectives of the RMP, which aim to restore ecological function, improve water quality, and protect biodiversity.

The programme also promotes environmental awareness and education. Community groups are encouraged to organise awareness campaigns, monitor adopted areas for signs of erosion or pollution, and collaborate with the appointed ECO to ensure compliance with approved methods and standards. This partnership model strengthens accountability and promotes a culture of stewardship within the community.

Requirements regarding training needs to be discussed with GM during the process of adopting a spot. By linking the Adopt-a-Spot initiative to the RMPs, strategic objectives are turned into practical, on-the-ground action, creating a collaborative framework for long-term river health improvement.

10 Conclusion

The Schaapkop River Management Plan (RMP) provides a practical management framework that balances infrastructure maintenance with ecological improvement. The RMP comprises two components, namely a Maintenance Management Plan (MMP) for which approval is sought via the National Environmental Management Act (NEMA) and the RMP for which approval is sought via the National Water Act (NWA). Capturing these two components in a single document promotes the holistic management of the river.

For focussed management, the river is managed as a single River Management Unit (RMU). The current Present Ecological State (PES) and the desired PES for the RMU is as follows:

► Schaapkop RMU: Improve from Category D → C

This document includes a robust description and assessment of the baseline environment which is critical for management and mitigation measure formulation.

In terms of stakeholder engagement, the draft RMP was made available for public comment and presented at an open day. Notices, adverts, and media coverage ensured broad awareness. All comments were addressed and captured in a Comments and Responses Report (CRR), attached to this document.

The MMP provides the legal mechanism for maintaining municipal infrastructure within the defined site, including bridges, stormwater outlets, pipelines, pump stations, and erosion control structures. Implementation will be overseen by an appointed Environmental Control Officer (ECO), who will review method statements, conduct site inspections, and compile compliance reports. The MMP also includes training and awareness requirements for municipal teams and contractors, ensuring that maintenance is carried out efficiently and with minimal environmental impact.

In terms of improving river health, the two main objectives and the actions set out to reach the objectives are set out in the table below.

Objective	Key Actions
Improve protection of freshwater ecosystems	► Identify and protect wetlands through accurate mapping and development controls. ► Establish and maintain ecological buffers along watercourses. ► Reinstate degraded buffers. ► Audit river channels for point and diffuse pollution sources and implement setbacks with indigenous vegetation. ► Prioritise alien clearing in sensitive riparian and wetland areas..
Improve Present Ecological State (PES)	► Implement sustainable stormwater management (SuDS principles) and review stormwater policy. ► Focus rehabilitation on priority areas such as Schaapkop wetlands and erosion gulley on RE/464. ► Address channel degradation and erosion through strategic rehabilitation programs. ► Improve water quality by addressing sewage spills, industrial effluent, and illegal dumping through infrastructure maintenance and public awareness. ► Apply erosion and sediment control measures. ► Remove alien invasive vegetation from riparian zones. ► Implement aquatic biomonitoring and water quality programs (SASS5, diatoms, Index of Habitat Integrity).

Key achievements of the RMP include a legally compliant plan, detailed environmental baselines, and actionable strategies for both maintenance and ecological improvement. This positions GM to act proactively and manage its river systems effectively. Although there are many benefits to the RMP, the main benefit themes are:

- ▶ Ecological – Framework to improve river health, restore wetlands, and protect biodiversity.
- ▶ Social – Reduced flood risk, improved safety (infrastructure), and enhanced recreational value.
- ▶ Economic – Streamlined process for maintenance, cost savings, and long-term resilience.
- ▶ Governance – Compliance with legislation and clear roles for implementation.

The RMP is a starting point for future projects. It provides the basis for motivating and securing funding for river health improvement initiatives and integrating these into municipal planning. Continuous monitoring and adaptive management will ensure objectives are met. River health will be tracked through biomonitoring tools such as SASS5, diatom assessments, and habitat integrity indices, while water quality will be monitored quarterly to measure progress and guide interventions. By implementing this plan, GM commits to protecting the Schaapkop River as a vital ecological and community asset.

10.1 Submission of Final RMP

- ▶ The Draft RMP has been updated (where relevant) based on the comments received from the public.
- ▶ The Final RMP is now being submitted to the DEA&DP for decision-making.
- ▶ The Final RMP is also being made available to all registered I&APs at the following location:
 - https://drive.google.com/drive/folders/1K8sPSBXG0lbN2OKv948Si2heu8bxHzKv?usp=drive_link
- ▶ The DEA&DP's decision on the RMP will be communicated to all registered I&APs.
- ▶ All registered I&APs will be notified of their right to appeal the decision.

11 References

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Appendix A: Schaapkop RMU High-Resolution Site Maps

Appendix B: Streamflow Diversion Mitigation

Appendix C: Erosion Control and Revegetation of Exposed Slopes Mitigation

Appendix D: Check Dams Mitigation

Appendix E: Gravel Berm Mitigation Example

Appendix F: *George Municipality Invasive Alien Plant Monitoring, Control & Eradication Plan*” dated May 2021

Appendix G: Environmental Awareness Training

Appendix H: Method Statement Example

Appendix I: Flood Risk Assessment

Appendix J1: I&AP Database Schaapkop

Appendix J2: Advert and Site Notices

Appendix J3: PPP Notifications Proof

Appendix J4: Open House PPP

Appendix J5: Comments Received and Responses

Appendix J6: CRR – Comment and Responses
Report

Ultimately, the only wealth that can sustain any community, economy or nation is derived from the photosynthetic process - green plants growing on regenerating soil.

ALLAN SAVORY

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