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Bospoort Pipeline: Storm Water Management Plan

Report

Version – 1

26 March 2019

GCS Project Number: 18-1138

Client Reference: Bospoort Pipeline Stormwater Management Plan



BOSPOORT PIPELINE: STORMWATER MANAGEMENT PLAN

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Ecoleges Environmental Consultants

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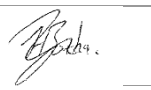
Document Reviewer	Henri Botha (MSc, PriSciNat)		26 March 2019
Director	Pieter Labuschagne (MSc, PriSciNat)		26 March 2019

EXECUTIVE SUMMARY

GCS (Pty) Ltd was appointed by Ecoleges Environmental Consultants to conduct a hydrological study for the proposed Bospoort Water Treatment Works (WTW), reservoirs, pipeline and the associated infrastructure, within the Rustenburg Municipality in the North West Province of South Africa. The study includes a storm water management plan for the site and the identification of potential risks that may result from the proposed developments. Measures were recommended that should be implemented in order to mitigate the identified potential impacts of the proposed development.

This study forms part of an Integrated Water Use License Application (IWULA), in terms of the South Africa National Water Act, 1998 (Act No. 36 of 1998).

The scope of work which was allowed for during the study included the following;

- Catchment hydrology;
- Calculation of Mean Annual Runoff (MAR);
- Calculation of potential 1:5-year storm rainfall events;
- Identification of potential clean and dirty water areas;
- Design of a conceptual SWMP; and
- The identification and mitigation of potential impacts associated with the proposed developments.

After evaluation of all the relevant information and data and working according to legislation the study concluded the following;

- A potential SWM concern is the potential of erosion, sedimentation and pollution of receiving waterbodies during the construction of the proposed developments and spillages and leaks from the WTW that may contaminate receiving waterbodies;
- The proposed conceptual SWMP would be enough to minimize and mitigate the potential impacts; and
- The implementation of the maintenance and monitoring plans are essential in the optimal functioning of the SWMP.

CONTENTS PAGE

LIST OF TABLES

LIST OF FIGURES

LIST OF PHOTOGRAPHS

LIST OF APPENDICES

LIST OF ACRONYMS

Acronym	Description
DWS	Department of Water and Sanitation
GCS	GCS Water and Environment (Pty) Ltd.
WTW	Water treatment works
MAE	Mean annual evaporation
CSWMP	Conceptual stormwater management plan
NWA	National Water Act, 1998 (Act No. 36 of 1998)
GN704	General Notice 704
WR2012	Water Resources of South Africa 2012
WMA	Water Management Area
IWULA	Integrated Water Use Licence Application
PCD	Pollution Control Dam

DISCLAIMER

The opinions expressed in this Report have been based on the information supplied to GCS Water and Environment (Pty) Ltd (GCS) by Ecoleges Environmental Consultants and data extracted from reliable public databases.

GCS has exercised all due care in reviewing the supplied information. Whilst GCS has compared key supplied data with expected values, the accuracy of the results and conclusions are entirely reliant on the accuracy and completeness of the supplied data. GCS does not accept responsibility for any errors or omissions in the supplied information and does not accept any consequential liability arising from commercial decisions or actions resulting from them.

Opinions presented in this report, apply to the site conditions and features as they existed at the time of GCS's investigations, and those reasonably foreseeable. These opinions do not necessarily apply to conditions and features that may arise after the date of this Report, about which GCS had no prior knowledge nor had the opportunity to evaluate.

1 INTRODUCTION

GCS Water and Environment (Pty) Ltd. (GCS) was appointed by Ecoleges Environmental to provide a conceptual storm water management plan (CSWMP) for the upgrade of the existing Bospoort WTW, a proposed pipeline route to carry potable water from the Bospoort water treatment works (WTW) to reservoirs and other associated infrastructure. Bospoort is situated in in Rustenburg, Quaternary Catchments A22H and A22J, within Crocodile West and Marico Water Management Area (WMA 3). The locality map of the site can be seen in Figure 1-1.

According to the Department of Water and Sanitation (DWS), a Water Use Licence (WUL) is required for water use not classified as a Schedule 1 use, which pertains to the water use specifications (refer to Section 4). A person who wishes to use, or who uses water in a manner that is not a Schedule 1 use, not covered under a General Authorisation, or in a manner that is not regarded or declared as, an existing lawful use, may only use that water under the authority of a licence.

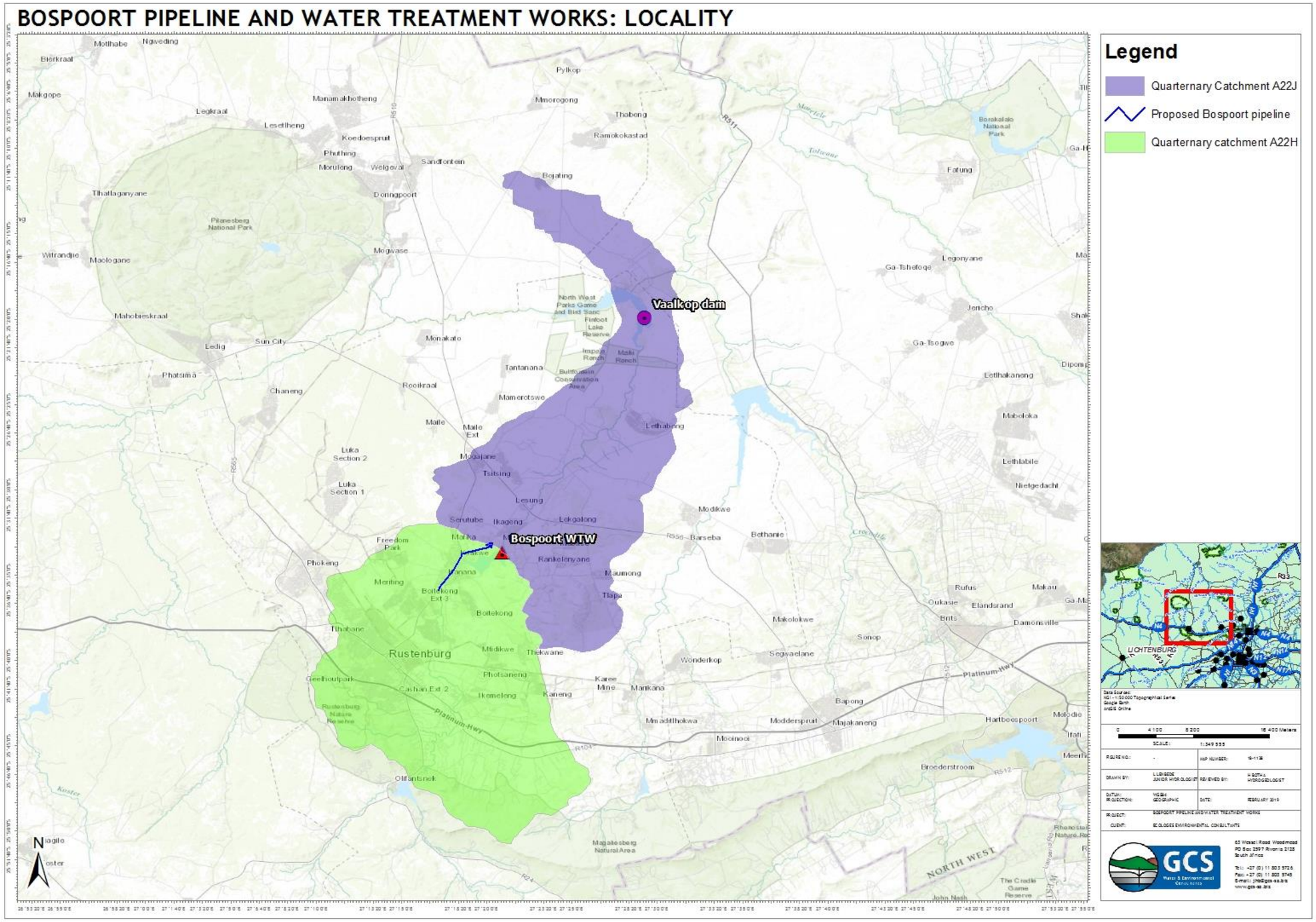


Figure 1-1: Locality map of the proposed Bospoort site

2 SCOPE OF WORK

The objective of the study was to develop a conceptual storm water management plan (CSWMP) for the proposed upgrade of the Bospoort WTW, the proposed pipeline route and associated infrastructure for their compliance with the National Water Act (1998). This was done by undertaking the following:

1. Information sourcing and literature review including:
    - Acquisition and an assessment of existing literature, and
    - Investigation and summary of legislative and policy frameworks relating to the relevant surface water resource management.
2. Hydrology assessment - the following was undertaken:
    - Catchment delineation for the conceptual SWMP. This was undertaken based on the site topography and site layout, and
    - Runoff calculations were performed for the areas of interest.
3. A CSWMP that included:
    - Identification of clean and dirty catchments,
    - Determination of storm water flows and volumes were undertaken, and
    - Indication and explanations of the placement of storm water attenuation infrastructure were offered.
4. Risk identification and mitigation
    - A description of all surface water impacts and proposed mitigation measures, was undertaken using GCS' standard EIA Impact and Mitigation methodology.
5. A report which includes details of the abovementioned points, conclusions and recommendations.

3 METHODOLOGY

The study methodological approach is outlined in the sub-sections below.

3.1 Information Sourcing / Literature Review

A desktop assessment of the area of interest was carried out, including a review of existing data pertaining to the Bospoort pipeline and water treatment works (WTW).

An investigation and summary of legislative and policy frameworks relating to the relevant surface water resource management was undertaken.

3.2 Baseline Hydrology

Climate data were obtained from the WR2012 database (WRC, 2015). This included monthly runoff from 1920 to 2009, rainfall and fixed monthly Symons Pan evaporation.

Drainage areas around the proposed site were reviewed using 20 m topographical contour data (WRC, 2015).

Local hydrology and simulated peak flood runoff on the site were determined.

3.3 Conceptual SWMP

The CSWMP was designed using the provided proposed infrastructure layout plans, reviewing the topographical data in order to delineate areas of clean and dirty water and to contain dirty water on site. Measures to be taken to achieve an efficient and legally-compliant conceptual SWMP were compiled.

The CSWMP was designed with adherence to relevant South African legislation – General Notice 704 of the South African National Water Act (Act 36 of 1988) (NWA, 1998).

4 LEGISLATION AND GUIDELINES

The following legislative guidelines are relevant to this CSWMP study.

4.1 The National Water Act (Act No. 36, 1998)

As mentioned, the SWMP assessment aims to demonstrate compliance with the National Water Act (Act No. 36, 1998).

The National Water Act provides the broad legal framework for water resources management. The requirements of The Act must be implemented. Details about implementation are outlined in Regulations that are issued by the Department of Water and Sanitation (DWS) and published in the Government Gazette.

- Government Notice No. 1352, 12 November 1999, National Water Act, 1998 (No. 36 of 1998): Regulations requiring that a water use be registered.

Act 36 stipulates that the following tasks should be undertaken;

- Separate clean and dirty water systems:
    - Demarcation of dirty water footprint areas;
    - Delineation of upstream catchment areas that would naturally drain into dirty water areas;
    - Estimation of peak flood runoff from relevant catchments;
    - Design of drains, diversion channels and berms to prevent clean water from entering dirty water areas.
- Control and contain dirty water runoff (where applicable):
    - Design of drains and berms to prevent dirty water from leaving dirty water areas;
    - Design dams that will not spill more than once in 50 years, on average, to contain dirty water runoff.
- Prevent or reduce pollution to water resources:
    - Prevent or reduce the pollution of water resources;
    - Evaluate processes and adapt systems to minimize the contact between potential pollutants and water resources.

5 CLIMATE

Climate parameters were calculated from data obtained from the WR2012 database for quaternary catchment A22H and A22J, within which the Bospoort site is located (WR, 2012). Quaternary catchment A22H and A22J falls within the Crocodile West and Marico Water Management Area (WMA 3).

5.1 Rainfall

The rainfall data used to calculate Mean Annual Precipitation (MAP) was obtained from the Rustenburg (Police) weather station (0511400W) (WR, 2012). The Rustenburg (Police) weather station is situated approximately 9 km away from the study site. The MAP for the catchment was recorded as 662 mm, based on a historical record of 89 years (i.e. 1920-2009). Monthly rainfall for the site is likely to be distributed as shown in Figure 5-1.

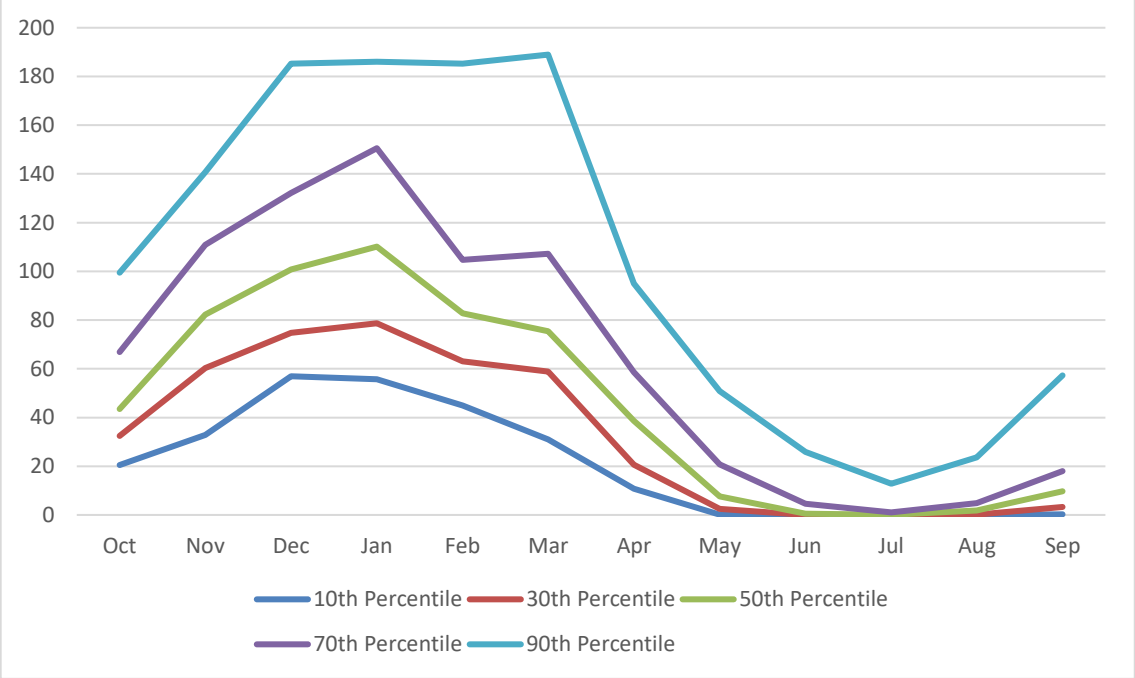


Figure 5-1: Rainfall Distribution according to the Rustenburg weather station (WR, 2012)

5.2 Evaporation

Both quaternary catchments fall within evaporation zone 3B. Mean Annual Evaporation (MAE) of quaternary catchment A22H was 1 700 mm, while MAE was recorded as 1 7500 mm for quaternary catchment A22J. Monthly evaporation is likely to be distributed as shown in Figure 5-2 and Figure 5-3 for quaternary catchments A22H and A22J, respectively.

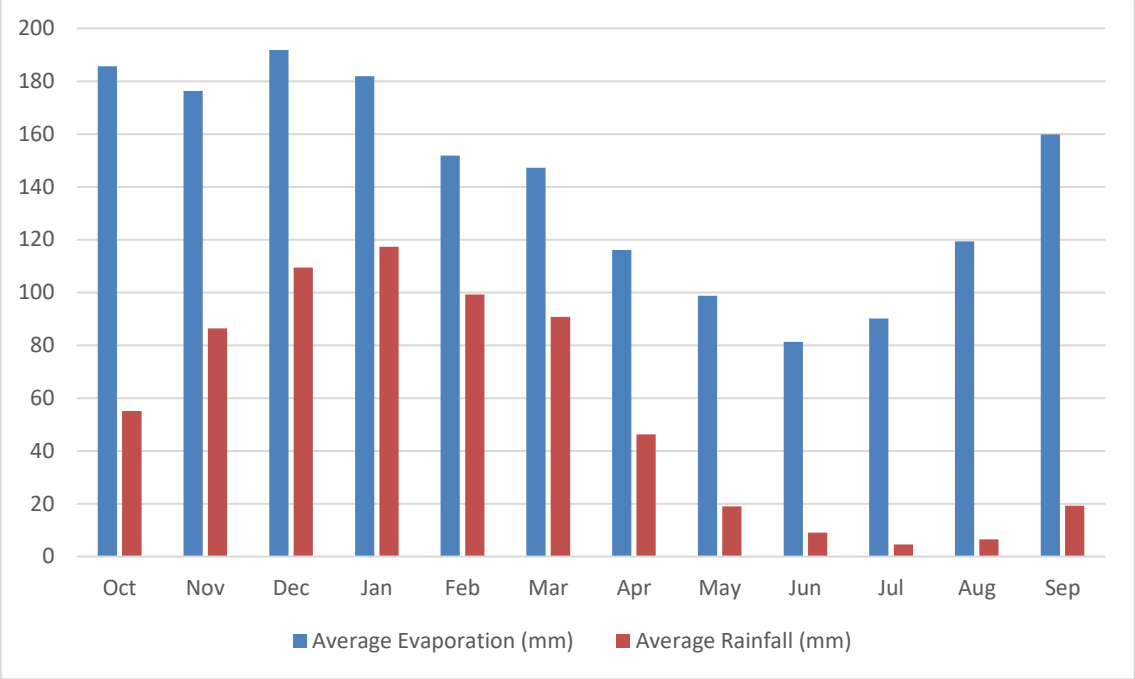


Figure 5-2: S-pan Evaporation for quaternary catchment A22H

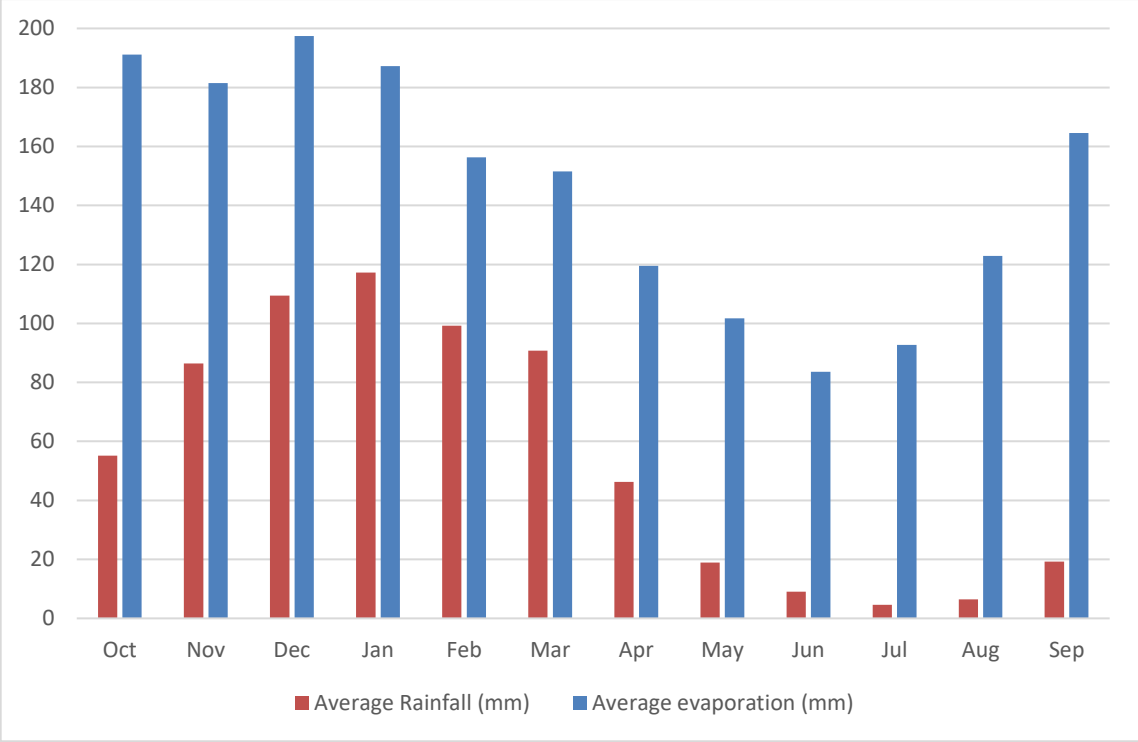


Figure 5-3: S-pan Evaporation for quaternary catchment A22J

5.3 Runoff

Runoff for Quaternary Catchment A22H and A22J is estimated as shown in Figure 5-4 and Figure 5-5, respectively. The MAR in the A22H catchment is 14.43 mm, which is approximately 2.2% of incidental rainfall. The MAR in the A22J quaternary catchment is 13.95, which is approximately 2.1% of incident rainfall.

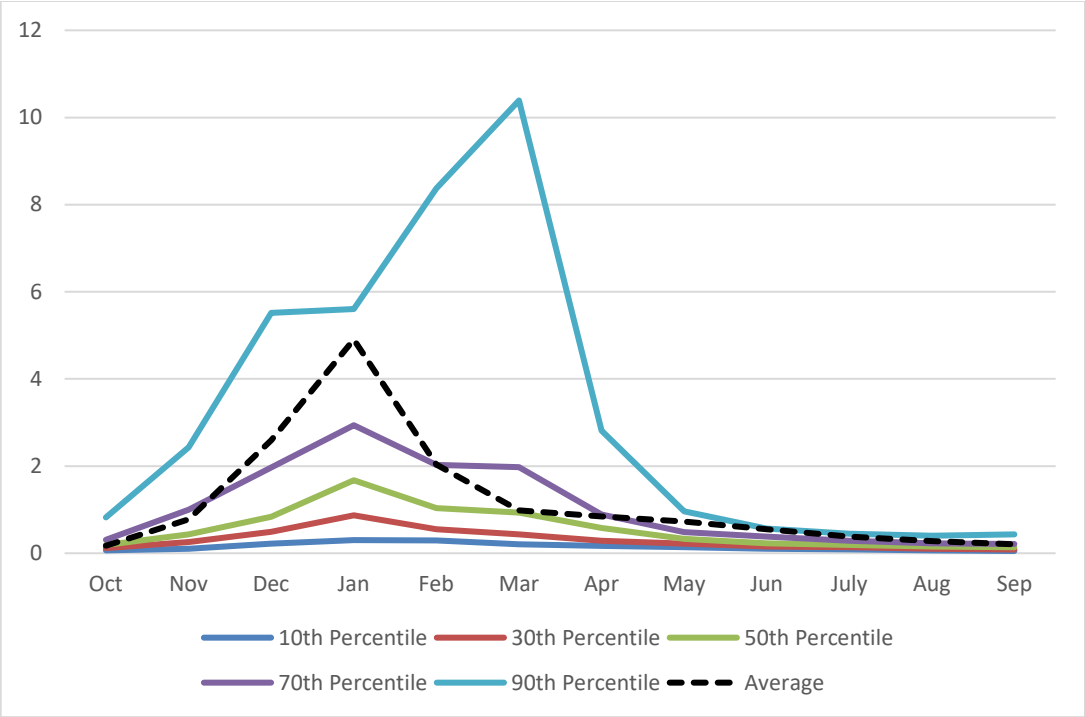


Figure 5-4: Naturalised runoff for quaternary catchment A22H

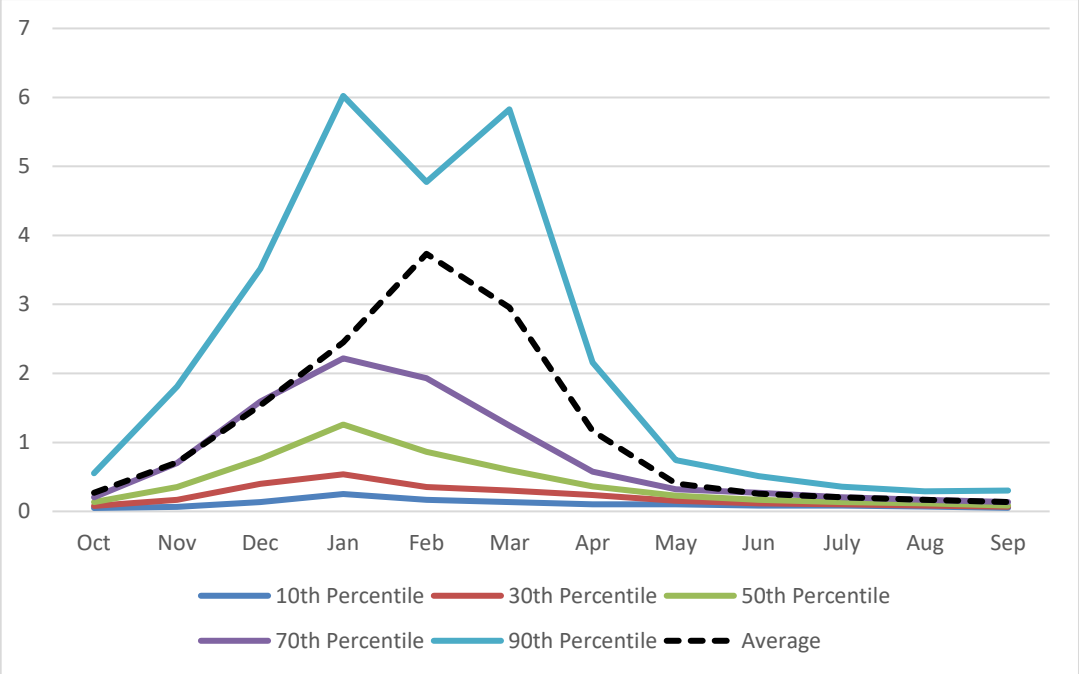


Figure 5-5: Naturalised runoff for quaternary catchment A22J

6 CONCEPTUAL STORM WATER MANAGEMENT PLAN

The following section describes the CSWMP developed and is based on available hydrological data and field investigation data for the site.

6.1 Delineation of clean and dirty water areas

The proposed infrastructure development consists of a pipeline from the Bospoort water treatment works (WTW) to the Bospoort reservoirs. The potential for dirty water as a result of the proposed developments are within the specific localities of the construction sites. The sub-catchments intersecting the pipeline, access roads and the WTW site were delineated and the peak flow events determined (refer to Table 6-1). The aim of the stormwater management plan is to mitigate the impacts of high flows that may lead to erosion, siltation and sedimentation during the construction phase of the proposed developments.

Some residential areas were identified in the delineated sub-catchments and it was assumed, based on site observations that adequate municipal storm water management is in place so as to ensure that contaminated water is disposed of in an acceptable manner (refer to Photograph 6-1 to Photograph 6-3).

Photograph 6-1: A bridge located upstream of the proposed Bospoort pipeline

Photograph 6-2: A culvert situated upstream of the proposed Bospoort pipeline

Photograph 6-3: A diversion channel situated within the proposed study area

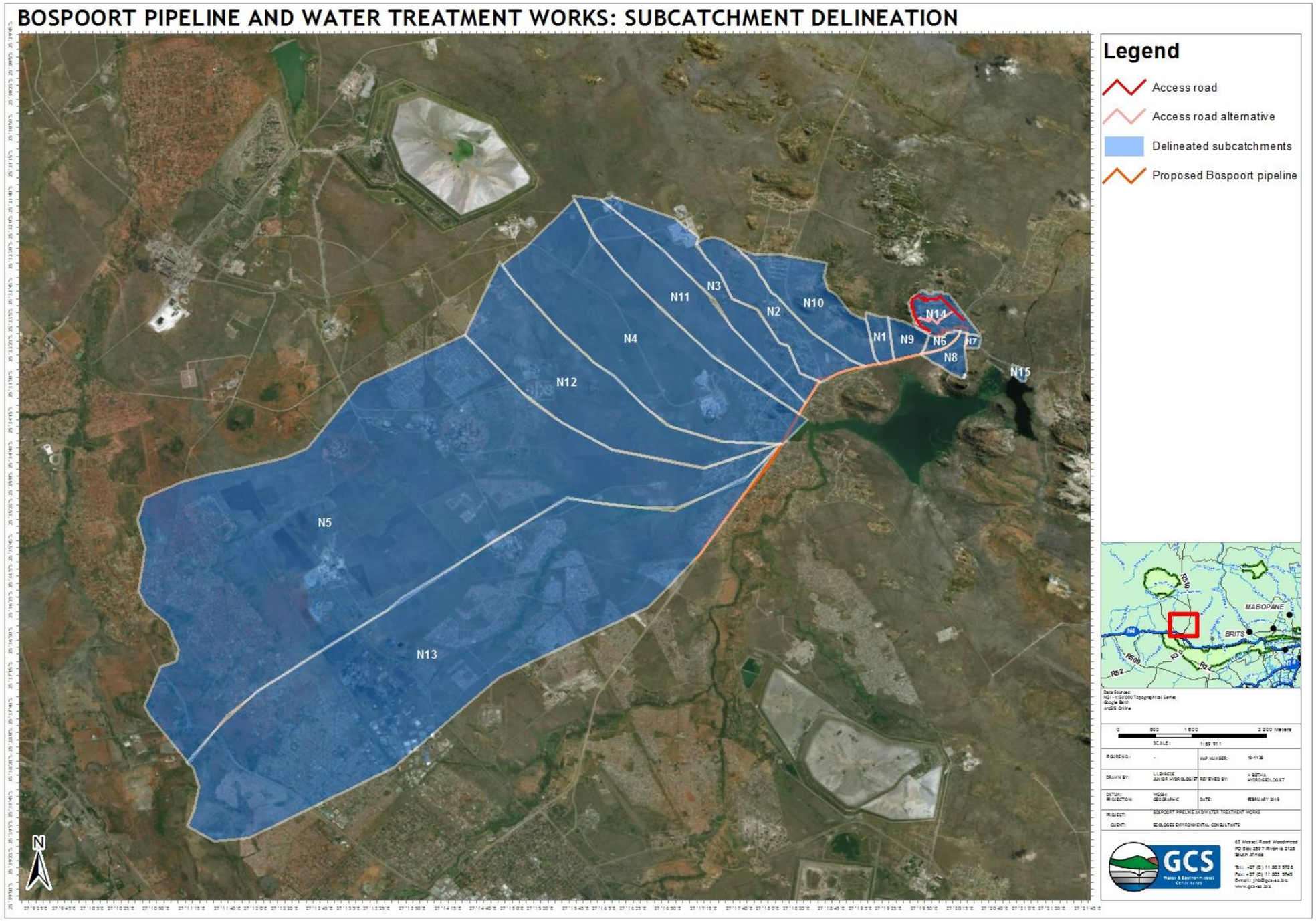


Figure 6-1: Delineation of water areas in the Bospoort site

6.2 Proposed storm water management plan measures

Since the only potential dirty areas are at the specific localities of the proposed developments, runoff may be diverted from the specific sites and released back into the natural environment, provided that on-site pollution control measures are implemented. Hence, there was no need for additional infrastructure to contain dirty water from the site, such as pollution control dams.

The main area of concern would be to minimize peak flow at the trench lines to reduce soil erosion and sedimentation during the construction phase of the proposed pipeline route and access roads. The recommended measures required for an efficient storm water management plan have been detailed in Section 7. The recommended mitigation measures have also been detailed (refer to Table 7-3 and Table 7-4).

6.3 Design flood peaks

The rational method was used to calculate the design flood peaks for the relevant delineated areas. This is one of the most widely-used methods of peak flow calculation and the study site characteristics fit the criteria for the use of this method (SANRAL, 2013). The rational method incorporates a runoff factor that is based on surface slope, perviousness (ability of water to infiltrate into the ground) of the site and vegetation.

Design flood peaks with a return period of 5 years were calculated, as recommended by the CSIR guidelines for minor systems (CSIR, 2005). The expected flood peaks under the current land use can be seen in Table 6-1.

Table 6-1: 5-year design flood peaks for the sub-catchments intersecting the proposed developments

Sub-catchment	Surface Area (m^2)	Design Flood Peak (m^3/s)
Proposed Pipeline Route		
N1	0.4	7.18
N2	2.46	9.85
N3	2.89	11.65
N4	10.88	21.58
N5	41.45	68.9
N6	0.26	25.92
N7	0.08	6.05
N8	0.42	13.90
N9	0.51	21.42
N10	2.58	13.16
N11	4.18	10.92
N12	7.36	20.64
N13	29.44	67.87
Proposed Access Roads and Reservoirs		
N14	0.79	77.32
Water Treatment Works Site		
N15	0.06	7.26

7 RISK IDENTIFICATION AND MITIGATION

The risk identification and mitigation assessment was undertaken with adherence to GCS' risk assessment methodology. The risk assessment was conducted to identify the risks that the proposed pipeline route may pose to the receiving environment (refer to Figure 7-1). This was undertaken using a risk matrix whereby the various impacts are scored according to qualitative measures of the extent, magnitude, duration, reversibility and probability of the risk occurring.

The risk rating matrix methodology used within this study is based on the quantitative measures listed in Table 7-1, below.

Table 7-1: Risk Rating Matrix

Status of Impact	
+: Positive (A benefit to the receiving environment)	
N: Neutral (No cost or benefit to the receiving environment)	
-: Negative (A cost to the receiving environment)	
Magnitude: = M	***Duration: = D***
10: Very high/don't know	5: Permanent
8: High	4: Long-term (ceases with the operational life)
6: Moderate	3: Medium-term (5-15 years)
4: Low	2: Short-term (0-5 years)
2: Minor	1: Immediate
0: Not applicable/none/negligible	0: Not applicable/none/negligible
Scale: = S	***Probability: = P***
5: International	5: Definite/don't know
4: National	4: Highly probable
3: Regional	3: Medium probability
2: Local	2: Low probability
1: Site only	1: Improbable
0: Not applicable/none/negligible	0: Not applicable/none/negligible

The ratings are combined to determine the risk significance points for the impacts according to the following equation: Risk significance value = (Magnitude + Duration + Scale) x Probability.

The maximum value that can be achieved is 100 Significance Points (SP). Environmental effects were rated as summarised in Table 7-2, below.

Table 7-2: Risks Significance Points

Significance	*Environmental Significance Points*	*Colour Code*
High (positive)	>60	H
Medium (positive)	30 to 60	M
Low (positive)	<30	L
Neutral	0	N
Low (negative)	>-30	L
Medium (negative)	-30 to -60	M
High (negative)	<-60	H

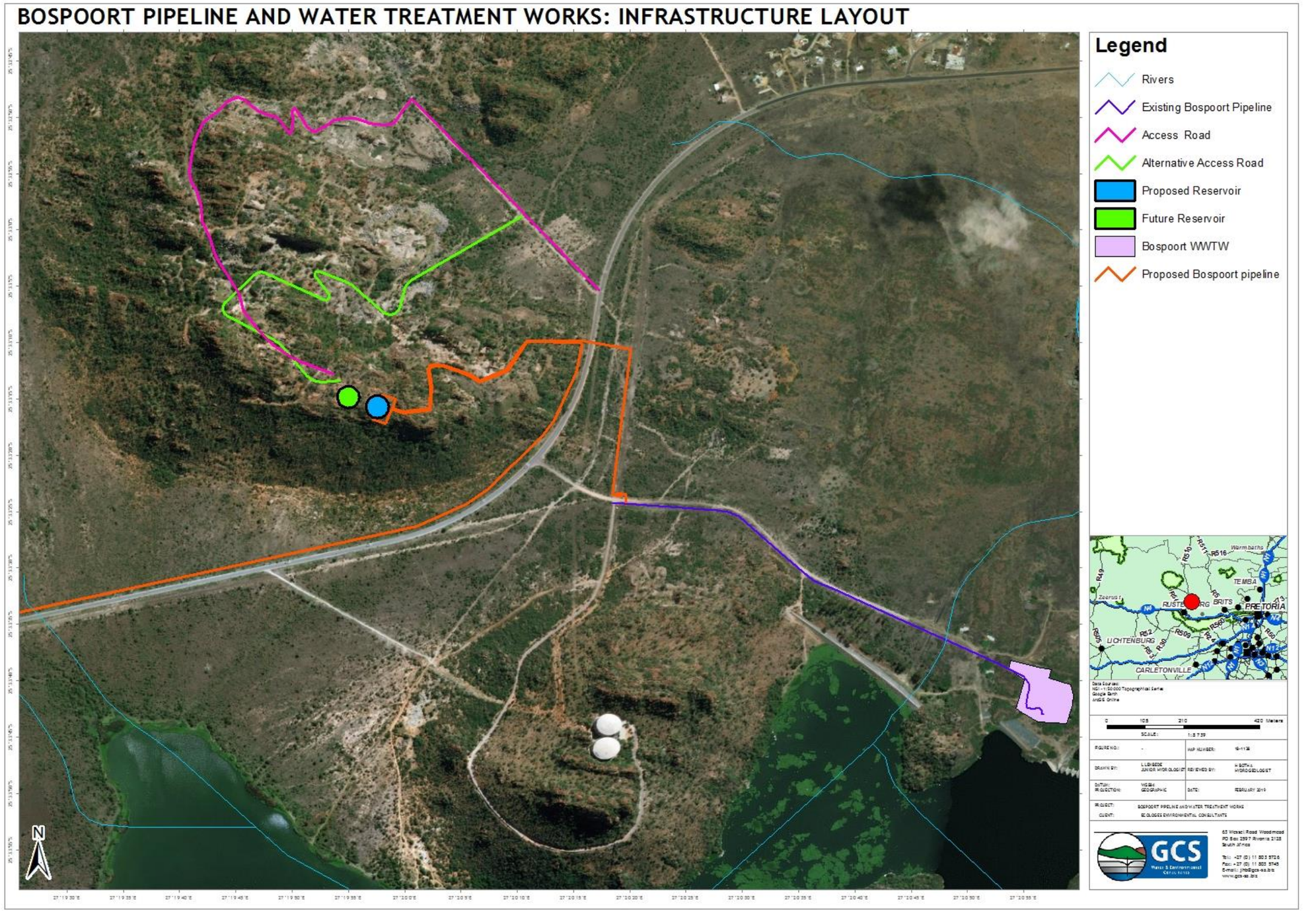


Figure 7-1: Layout plan for the proposed infrastructure at the Bospoort site

7.1 Bospoort pipeline route, access roads and reservoir installation

Activities to be undertaken during construction and operation of the Bospoort site have the potential to cause environmental impacts. In this instance, the anticipated environmental impacts are of low to no significance, given the limited infrastructure required and the anticipated short duration of the construction phase. The impacts of the construction of access roads and the pipelines are expected to be similar. These impacts are discussed in the following sections and the significance rating for each impact is presented in Table 7-3 for access roads, the pipeline route and reservoir installation.

7.1.1 Construction Phase

Impact:

Risk of soil erosion associated with the construction of the pipeline route and access roads.

Mitigation

- The pipeline must be buried at a sufficient depth so that it does not interfere with surface water movement leading to erosion;
- Keep vehicle movement to designated access roads to avoid spreading the impact to wider areas;
- Erosion control measures must be implemented in areas sensitive to erosion. These measures include but are not limited to - the use of sand bags, geotextiles such as soil cells which are used in the protection of slopes, silt fences and retention or replacement of vegetation;
- Construct silt traps to stop sediments from reaching nearby watercourses; and
- Ensure revegetation of cleared out areas as soon as possible.

Impact:

The excavation of trenches for the pipes can lead to the compaction, erosion and deposition of sediment within the river but this is considered to be an impact of low significance given the scale of the proposed development, short length of the construction period and mitigation measures proposed.

Mitigation:

- No stockpiling of any materials may take place within or directly adjacent to the watercourse channels;
- Erosion control measures must be implemented;
- Disturbed sites must be rehabilitated as soon as the pipeline has been installed; and
- Install sediment barriers to prevent sediment flow into the watercourses.

Impact:

Reduction of water quality resulting from hydrocarbon spills including grease, oils and other pollutants which are washed away by overland flow and cause pollution in nearby watercourses.

Mitigation:

- All waste generated during construction is to be disposed of in an approved manner;
- Minimise spills and keep vehicles away from the watercourse and conduct quick clean-ups when spills occur. Used oils and grease should be disposed of by accredited vendors.

7.1.2 Operational Phase

Impact:

Soil erosion may occur along the pipeline route.

Mitigation

- The pipeline must be buried at a sufficient depth so that it does not interfere with surface water movement leading to erosion.

Impact:

Post construction flooding may damage the pipeline.

Mitigation:

Ensure that the pipeline is not constructed within the delineated flood line area.

Table 7-3: Surface water impact assessment and mitigation for the proposed pipeline route, access roads and reservoirs

POTENTIAL ENVIRONMENTAL IMPACT	APPLICABLE AREA	ACTIVITY	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION							RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION						
			M	D	S	P	TOTAL	STATUS	SP		M	D	S	P	TOTAL	STATUS	SP
CONSTRUCTION PHASE																	
Soil erosion and sedimentation	Pipeline route alignment; access road site and reservoir installation	**Excavation of trenches for pipe laying; the disturbance of topsoil for the construction of access roads and the installation of the reservoir**	6	2	2	3	24	-	L	•The pipeline must be buried at a sufficient depth to prevent soil erosion; •Use existing tracks and roads to gain access to site; •Erosion control measures must be implemented; •Install sediment barriers to prevent sediment flow into the watercourses; •Disturbed sites must be rehabilitated as soon as the pipeline has been installed.	2	1	1	2	8	-	L
Siltation of water courses and drainage lines	Pipeline route alignment; access road site and reservoir installation	**Excavation of trenches for pipe laying; the disturbance of topsoil for the construction of access roads and the installation of the reservoir**	4	1	2	3	21		L	•No stockpiling of any materials may take place within or directly adjacent to the watercourse channels; •Erosion control measures must be implemented; •Disturbed sites must be rehabilitated as soon as the pipeline has been installed; •Install sediment barriers/silt traps to prevent sediment flow into the watercourses.	2	1	1	2	8	-	L
Pollution of water resources and soil	Pipeline route alignment; access road site and reservoir installation	**Excavation of trenches for pipe laying; the disturbance of topsoil for the construction of access roads and the installation of the reservoir**	6	1	2	3	27	-	L	•All waste generated during construction is to be disposed of in an approved manner; •Contain and divert any spillages and hazardous chemicals from receiving water bodies.	4	1	1	2	12	-	L
OPERATIONAL PHASE																	
Soil erosion and sedimentation	Pipeline route alignment	**Disturbed pipeline route**	6	2	2	3	24	-	L	•The pipeline must be buried at a sufficient depth to prevent soil erosion; •Disturbed sites must be rehabilitated as soon as the pipeline has been installed. •Silt traps should be installed if sedimentation is obvious.	2	1	1	2	8	-	L
Post construction flooding	Pipeline route alignment	**Disturbed pipeline route**	4	5	2	3	33	-	M	• No construction should take place within the floodline area	2	1	1	2	8	-	L

7.2 Bospoort Water Treatment Works

The proposed WTW upgrade is meant to increase the capacity of water purification works from 12 ml/day to 24 ml/day (Refer to Appendix A: The existing and proposed layout at the bospoort water treatment works). Bospoort WTW receives over 70% of inflows from upstream waste water treatment works, with limited fresh water inflows. The treated water is then transferred to the reservoirs for distribution as potable water.

The considerations undertaken for the assessment of the associated risk identification and mitigation measures are as follows:

- The proposed developments will only slightly modify the boundary of the site, hence no significant increase in impervious areas is anticipated;
- Because there is no defined watercourse within the site area sheet flow will occur over the area. Sheet flow is typical in small, flat catchments or in upper reaches of catchments where the runoff is in the form of thin layers of water flowing slowly over the uneven ground surface;
- ▫All the components such as treatment plants and fans will be totally enclosed components (thus all contaminated water will be sealed off and not exposed to the natural elements of the environment and is not likely to encounter potential drainage on site);
- There is no need for the storage of water on site (thus no need for a Pollution Control Dam (PCD) or retention catchment dams). The WTW will transfer the treated water into reservoirs as potable water;
- The only possible potential impact that could sprout from these conditions where dirty water could be mixed with clean water through leakage, spillage or leaching from the enclosed infrastructure on site. Furthermore, spillages from sludge lagoons may contaminate the receiving environment. This SWMP will address this issue to avoid this occurrence. It should be noted that any water that overflows from Bospoort WTW is captured downstream in the Vaalkop dam (approximately 30 km away), which is used by Magalies water as a source of raw water to produce potable water in the surrounding areas (See Figure 1-1).

The potential impacts and mitigation measures that may arise as a result of the proposed development are presented in Table 7-4, and are discussed below.

7.2.1 Construction Phase

Impact

Construction activities, such as the expansion of infrastructure, the installation of new pipelines and the demolition of redundant pipelines may cause soil disturbances and result in erosion and sedimentation.

Mitigation

- Construct silt traps to stop sediments from reaching nearby watercourses.
- Control erosion on the site using sand bags and geotextiles such as soil cells.

Impact:

Reduction of water quality resulting from hydrocarbon spills including grease, oils and other pollutants which are washed away by overland flow and cause pollution in nearby watercourses.

Mitigation:

- All waste generated during construction is to be disposed of in an approved manner;
- Minimise spills and keep vehicles away from the watercourse and conduct quick clean-ups when spills occur. Used oils and grease should be disposed of by accredited vendors.

7.2.2 Operational Phase

Impact

Dirty water could be mixed with clean water through leakage, spillage or leaching from the enclosed infrastructure on site. Furthermore, spillages from sludge lagoons may contaminate the receiving environment.

Mitigation

- Conduct regular inspection of infrastructure for effective process performance and ensure that leakages are fixed immediately and;
- Ensure that the sludge lagoons are adequately sized to contain sludge liquors emanating from the WTW site;
- Conduct continuous water quality monitoring to ensure that water discharged from the site is in accordance with the DWS guidelines.

Table 7-4: Surface water impact assessment and mitigation for the Bospoort water treatment works

POTENTIAL ENVIRONMENTAL IMPACT	APPLICABLE AREA	ACTIVITY	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION							RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION						
			M	D	S	P	TOTAL	STATUS	SP		M	D	S	P	TOTAL	STATUS	SP
CONSTRUCTION PHASE																	
Soil erosion and sedimentation	WTW construction site	**Top soil removal for construction of the proposed upgrades and the installation of new pipes**	2	1	2	3	15	-	L	•Use existing tracks and roads to gain access to site; •Erosion control measures must be implemented; •Install sediment barriers to prevent sediment flow into the watercourses.	0	1	1	2	4	-	L
Siltation of water courses	WTW construction site	**Top soil removal for construction of the proposed upgrades and the installation of new pipes**	2	2	2	3	18		L	•Erosion control measures must be implemented; •Install sediment barriers/silt traps to prevent sediment flow into the watercourses.	0	1	0	2	2	-	L
Pollution of water resources	WTW construction site	**Top soil removal for construction of the proposed upgrades and the installation of new pipes**	6	2	2	3	30	-	L	•All waste generated during construction is to be disposed of in an approved manner; •Contain and divert any spillages and hazardous chemicals from receiving water bodies.	2	2	1	2	10	-	L
OPERATIONAL PHASE																	
Leaks and spillages may contaminate clean water	Sludge lagoons and closed off infrastructure carrying contaminated water	**Spillages from sludge lagoons and leaks from infrastructure**	4	1	1	2	3	-	L	•Conduct regular inspection of infrastructure •Ensure adequate sizing of sludge lagoons to contain sludge liquors •Conduct continuous water quality monitoring	2	1	1	1	4	-	L

8 CONCLUSIONS

The CSWMP was designed to ensure compliance with the South African National Water Act (Act 36 of 1998) (NWA, 1998). The main conclusions from this study are as follows:

- The Bospoort site is situated in Quaternary catchments A22H and A22J and falls within the Crocodile West and Marico Management Area (WMA 3).
- The MAP of Quaternary catchment A22H is 662 mm, with an MAE of 1 700 mm and MAR of 14.43 mm.
- The MAP of Quaternary catchment A22J is 662 mm, with an MAE of 1 750 mm and MAR of 13.95 mm.
- The proposed activities were found to pose minimal pollution to receiving water bodies due to the limited infrastructure associated with the proposed development. Mitigation measure were recommended in order to mitigate the potential impacts during the construction phase and operational phases.

8.1 Recommendations

The following practices can assist in ensuring compliance:

- Employee training includes conduct training of personnel who are responsible of implementing activities identified above.
- The recommended mitigation measures must be implemented to ensure that receiving water bodies are not polluted during the construction and operational phases of the proposed pipeline.
- Flood line delineation should be included during the planning phase of the project to ensure the integrity of infrastructure during the operational phase.

9 REFERENCES

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APPENDIX A: THE EXISTING AND PROPOSED LAYOUT AT THE BOSPOORT WATER TREATMENT WORKS