BAYNESPRUIT REHABILITATION

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In fulfillment of the terms and conditions of the Memorandum of Understanding to facilitate the successful implementation of the uMngeni Ecological Infrastructure Partnership (UIEP) Strategy

1st Draft: To Rehabilitate the Baynespruit River for Increased Water Supply of Improved Water Quality.

Executive Summary

The Baynespruit is classified as one of the most highly polluted rivers in the region, currently consistently ranked in the top six most polluted rivers in South Africa and is most commonly associated with poor ecological health and its related impacts on local communities and the environment. Due to the high pollutant loads introduced into the Umgeni system by the Baynespruit, interventions which would result in even low to moderate improvements in water quality of the Baynespruit is likely to contribute significantly to improvements in the overall water quality of the Umgeni catchment.

It is thus appropriate that with Msunduzi Municipality being a signatory to the Memorandum of Understanding (MoU) would undertake the rehabilitation of the Baynespruit as its contribution in improving water quality and quantity within the Umgeni catchment area. This project builds on the Msunduzi Municipality‟s existing Environmental Management Framework (EMF), Environmental Management Framework – Status Quo Report, Strategic Environmental Management Plan (SEMP) and the Final Draft Strategic Environmental Assessment (SEA) and aims to rehabilitate ecological infrastructure of the Baynespruit which will result in the improved quality of water entering the Msunduzi River.

In order to achieve these desired goals of improved water quality and quantity; key constraints and opportunities along the length of the Baynespruit would have to be identified and mapped so that mitigation strategies, action plans and projects can be developed. Water quality sampling is also being undertaken by Umgeni water to locate problem areas with the support of the miniSASS and Index of Habitat Integrity tools to monitor water quality. The miniSASS tool will be incorporated into the schools life science or life orientation curriculum such that local schools are mobilised in the initiative to promote the on-going monitoring of water quality and to encourage custodianship of the environment through education and awareness. Wetland condition and functionality would be determined through WET-Health and WET-EcoServices assessments which would enable rehabilitation plans to be drafted. Alien Invasive Species (AIS) are to be removed and monitored whilst river embankments are replanted and re-vegetated with riparian forests. This may reduce erosion and sediment build up and may also assist with minimising the impact of associated stormwater events. Other stormwater management controls explored in this project were the use of Floating Wetlands; however, these were determined to be inappropriate due to the Baynespruit not containing the

relevant water depth needed to implement them. Key role players and ward councillors in the surrounding communities of Northdale, Willowton and Sobantu would have to be identified to assist in developing mitigation strategies, plans and programmes together with them. Constructive engagement will not only be undertaken with communities but also with commerce and industry. This is an important component of the project as we will work together with industries to develop strategies/ programmes to reduce/ prevent littering and the illegal discharge/ disposal of effluent waste rather than enforce issues of non-compliance.

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Acronyms:

ABM	Area Based Management
AIS	Alien Invasive Species
BBBEE	Broad Based Black Economic Empowerment
CARA	Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983)
DAEA	Department of Agriculture and Environmental Affairs
DUCT	Duzi uMngeni Conservation Trust
DWA	Department of Water Affairs
EGS	Ecosystems Goods and Services
EKZNW	Ezemvelo KwaZulu-Natal Wildlife
IWMP	Integrated Waste Management Plan
NEMA	National Environmental Management Act, 1998 (Act 107 of 1998)
NEM:BA	National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004)
NEM:WA	National Environmental Management: Waste Act, 2008 (Act 59 of 2008)
NWA	National Water Act, 1998 (Act 36 of 1998)
SALGA	South African Local Government Association
SANBI	South African National Biodiversity Institute
SASS	South African Scoring System
SMME	Small, Medium and Micro Enterprises
UW	Umgeni Water
WESSA	Wildlife and Environment Society of South Africa
WCT	Wildlands Conservation Trust
WfW	Working for Water
WRC	Water Research Commission
WSA	Water Services Act

Glossary:

Alien Invasive Species (IAS)	Plant or animal species that does not occur naturally in the area. Has the capacity to out-compete and dominate the naturally occurring species (Macfarlane *et al*., 2008).
Biodiversity	The variety of life in an area, including the number of different species, the genetic wealth within each species, and the natural areas where they are found.
Biotope	It is an area of uniform environmental conditions providing a living place for a specific assemblage of plants and animals. Biotope is almost synonymous with the term habitat (Newson and Newson, 2011).
Community	Consists of people of a district or country considered collectively, especially in the context of social values and responsibilities, having a particular characteristic in common, practising common ownership being unified by common interests (Oxford Dictionary of English, 2014).
Ecological Infrastructure	„Naturally functioning ecosystems that provide valuable services to people such as freshwater, climate regulation, soil formulation and disaster risk reduction. It is commonly described as being the nature-based equivalent of built or hard infrastructure, as is just as important for providing services and underpinning socio-economic development“

	SANBI (2013:1).
Ecosystems Services	The direct and indirect benefits that people obtain from ecosystems. These benefits may derive from outputs that can be consumed directly; indirect uses which arise from the functions or attributes occurring within the ecosystem; or possible future direct outputs or indirect uses. Synonymous with ecosystem "goods and services" (Royal HaskoningDHV, 2013).
Erosion	Physical and chemical processes that remove and transport soil and weathered rock (Macfarlane *et al*., 2008).
Fauna	A collective term for the animal life characteristic of a particular region (Macfarlane *et al*., 2008).
Fiscal capacity	"Fiscal capacity can be defined as the ability of a government jurisdiction to translate economic activity" Chernick (1998:531).
Floating Wetland	"Artificially created floating wetlands have been used with varying success for a number of applications to date, such as water quality improvement, habitat enhancement and aesthetic purposes in ornamental ponds" Headley and Tanner (2012: 2267).
Flora	A collective term for the plant life characteristic of a particular region or environment (Macfarlane *et al*., 2008).
Geology	The study of the composition, structure and processes of the rock layers of the earth (Macfarlane *et al*., 2008).
Geomorphology	The distribution and retention patterns of sediment within the wetland (Macfarlane *et al*., 2008).
Hydrology	The distribution and movement of water through a wetland and its soils (Macfarlane *et al*., 2008).
MiniSASS (Stream Assessment Scoring System)	The miniSASS method is an easy to learn river health biomonitoring tool which is ideal as an environmental education tool for learners, but can even be used by non-technical, private persons to monitor the health of rivers in their communities (GroundTruth Water, Wetlands and Environmental Engineering, 2013).
Potable Water	Water reserved or suitable for drinking (Collins English Dictionary, 2003)
Rehabilitation (Wetlands)	The process of assisting in the recovery of a wetland that has been degraded or of maintaining a wetland that is in the process of degrading so as to improve the wetland"s capacity for providing services to society (Macfarlane *et al*., 2008).
Riparian	The physical structure and associated vegetation of areas associated with a water course commonly characterized by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas." (National Water Act). Riparian areas that are saturated or flooded for prolonged periods would be considered wetlands and could be described as riparian wetlands. However, some riparian areas are not wetlands (e.g. where alluvium is periodically deposited by a stream during floods but which is well drained).
Run-off	Total water yield from a catchment including surface and sub-surface flow (Macfarlane *et al*., 2008).
Sanitation	Sanitation generally refers to the provision of facilities and services for the safe disposal of human excrement (WHO: 2014).
Solid Waste	Solid waste means any garbage, refuse, sludge from a wastewater treatment plant, water supply treatment plant, or air pollution control facility and other discarded materials including solid, liquid, semi-solid,

	or contained gaseous material, resulting from industrial, commercial, mining and agricultural operations, and from community activities (New York State Department of Environmental Protection, 2014).
Subsistence Agriculture	Traditional, small scale, peasant, low income, resource poor, low input or low technology farming (Breuntrup and Heidheus, 2002).
Sustainable Development	NEMA. Section 1 (29) of NEMA states that: "1(29)…Sustainable development means the integration of social, economic and environmental factors into the planning, implementation and decision-making process so as to ensure that development serves present and future generations".
The Conservation of Agricultural Resources Act (CARA)	The Conservation of Agricultural Resources Act (CARA) is an Act of the National Department of Agriculture and Forestry (DAFF) and makes provision for the conservation of the natural agricultural resources of South Africa through: • Maintaining the production potential of land; • Combating and prevention of erosion; • Preventing the weakening or destruction of the water sources; • Protecting the vegetation; and • Combating weeds and invader plants.
The Constitution	The Constitution of the Republic of South Africa is the legal source for all law, including environmental law, in South Africa. The Bill of Rights is fundamental to the Constitution of the Republic of South Africa.
The National Environmental Management Act (NEMA)	The National Environmental Management Act (NEMA) is South Africa‟s overarching environmental legislation and has, as its primary objective to provide for co-operative governance by establishing principles for decision making on matters affecting the environment, institutions that will promote co-operative governance and procedures for co-ordinating environmental functions exercised by organs of state and to provide for matters connected therewith (Government Gazette, 1998).
Topography	Graphic representation of the surface features of a place or region on a map, indicating their relative positions and elevations (The American Heritage Dictionary of the English Language, 2003).
Watercourse	(a) a river or spring; (b) a natural channel or depression in which water flows regularly or intermittently; (c) a wetland, lake or dam into which, or from which, water flows; and (d) 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. National Environmental Management Act, 1998 (Act 107 of 1998) GNR 544.
WET-Health Tool	WET-Health assists in assessing the health of wetlands using indicators based on geomorphology, hydrology and vegetation (Macfarlane *et al*., 2008).
Wetlands	"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 in normal circumstances supports or would support vegetation typically adapted to life in saturated soils." (National Water Act). Land where an excess of water is the dominant factor determining the nature of the soil development and the types of

	plants and animals living at the soil surface (Cowardin *et al*., 1979); lands that are sometimes or always covered by shallow water or have saturated soils long enough to support plants adapted for life in wet conditions.

Chapter 1:

Introduction

1.1 Background

This project attempts to enhance water quality in the Baynespruit stream by implementing projects to improve ecological infrastructure. The Msunduzi municipality is a signatory to the Memorandum of Understanding arising from a regional initiative called the Umgeni Ecological Infrastructure Partnership and the Baynespruit project is the contribution of this Municipality to improving water quality and quantity within the Umgeni Catchment area.

With the prevailing water crisis which South Africa faces it is appropriate to focus efforts onto the conservation of natural water resources and maintenance of their ecological integrity. Subsequently it can be suggested that the alternative means by which potable water can be obtained, either through the process of desalinisation and/ or recycling water from sanitation processes can be socially unacceptable and prohibitively expensive. Thus the reasonable solution to address water and sanitation challenges is to restore and manage existing ecological infrastructure.

This Project builds on the Msunduzi Municipalities" existing Environmental Management Framework (EMF), Environmental Management Framework – Status Quo Report, Strategic Environmental Management Plan (SEMP) and Final Draft Strategic Environmental Assessment (SEA). The SEMP identifies various Action Plans to address the state of the rivers reporting as well as rehabilitation thereof to which this project will address by developing proposals, plans and mitigation strategies.

The Action Plans, which were developed to assist in the implementation of the Environmental policy and which will be specifically addressed in this project are indicated by Table 1. The Action Plans relevant to this project are; B1, 2, 3 and 7, S2, E2, DAEA & RD1 and 3 and DWA1 respectively.

Table 1: SEMP Action Plans

Action Plan	Issues Addressed	Tasks	Strategic Outcomes	Timing
B1: Alien Invasive Clearing Programme for Msunduzi Owned Land	▪ Alien Plant Infestation results in land degradation ▪ The loss of agriculturally productive land and natural resources ▪ The loss of ecosystem goods and services and associated biodiversity; which will result in a decline in social and economic conditions	○ Update Alien Plant Mapping	• Reduce land degradation • Increase water availability	➢ Short term
B2: Wetland Functionality Assessment	▪ Poor sewerage ▪ Solid waste ▪ Storm water management ▪ Water quality ▪ Loss in ecosystem goods and services and associated biodiversity; results in a decline in social and economic conditions	○ Undertake a Wetland Health Assessment ○ Undertake a Wetland Goods and Services Assessment	• Improve water quality and quantity; maintain biodiversity and associated ecosystem goods and services.	➢ Medium term ➢ Medium term ➢ Medium term
B3: Detailed Flood Risk Assessment	▪ Impact of Storm water management on water	○ Identify flood hazards, impacts and risks	• Reduce human vulnerability	➢ Short term

	quality	○ Recommend potential mitigation measures or interventions	• Reduce land degradation • Improve economic opportunities	
B7: Rehabilitation of land owned by Msunduzi	▪ The loss of agriculturally productive land and natural resources ▪ The loss of ecosystem goods and services and associated biodiversity; which results in a decline in social and economic conditions.	○ Implement soil erosion control measures including rehabilitation with local indigenous species	• Reduce land degradation • Maintain and Improve ecosystems goods and services and thereby create more opportunities for economic and social development.	➢ On going

Action Plan	Issues Addressed	Tasks	Strategic Outcomes	Timing
S2: Integrated Waste Management Plan	▪ Industrial effluent ▪ Land degradation ▪ Poor sewerage ▪ Solid waste and Storm water management impact on water and aquatic ecosystem quality ▪ The lack of basic services such as effective waste removal and the provision of appropriate sanitation and water services impact on human health and well-being and result in a deterioration of the quality of life.	○ Select a preferred alternative, including option for re-use and recycling ○ Public awareness campaign to support identified re-use and recycling initiative and education on correct waste disposal.	• Sustainable waste management that includes all aspects of the waste hierarchy	➢ Short term ➢ Short term

Action Plan	Issues Addressed	Tasks	Strategic Outcomes	Timing
E2: Ecosystems goods and services assessment	▪ The unequal distribution of wealth and resources, and resulting poverty, is resulting in environmentally harmful practices which are causing environmental and resource degradation ▪ The increased demand for development within the Msunduzi area, as a result of its strategic location within the primary Provincial development corridor and being established as the Provincial capital, is placing pressure on the optimal use of land and the provision of sustainable services and infrastructure	○ Identify priority systems for valuations such as wetlands and grasslands or alternatively the systems of open space identified in the environmental services plan ○ Identify goods and services associated with the systems ○ Collect necessary information and mapping i.e. extent of ecosystems, ecosystems function and condition	• Value of Ecosystem goods and services is included in development planning	➢ Short term ➢ Short term ➢ Medium term

Action Plan	Issues Addressed	Tasks	Strategic Outcomes	Timing
DAEA & RD1: Land rehabilitation	▪ Inappropriate land use results inland degradation ▪ The loss of agriculturally productive land and natural resources ▪ The loss of ecosystems goods and services and associated biodiversity which results in a decline in social and economic conditions	○ Identify and map areas of degraded land ○ Implement soil erosion control measures	• Reduce land degradation • Maintain and improve ecosystems goods and services and thereby create more opportunities for economic and social development	➢ Medium term ➢ On going
DAEA & RD3: Alien Invasive Clearing Programme for land within Msunduzi not owned by the municipality	▪ Alien plant infestation results in land degradation ▪ The loss of agriculturally productive land and natural resources ▪ The loss of ecosystems goods and services and associated biodiversity which results in a decline in social and economic conditions	○ Undertake alien plant mapping ○ Prioritise areas in terms of extent and the role the area plays in ecological functioning ○ Devise and implement a strategy for alien plant control ○ Carry out follow up inspections to ensure reinvasion does not occur	• Reduce land degradation • Increase water availability	➢ Short term ➢ Short term ➢ On going ➢ On going

Action Plan	Issues Addressed	Tasks	Strategic Outcomes	Timing
DWA1: Refined state of the rivers reporting	▪ Industrial effluent ▪ Land degradation ▪ Poor sewerage ▪ Solid waste and Storm water management impact on water and aquatic ecosystem quality	○ Identify goods and services provided by surface water resources ○ Identify suitable management units (sub-catchments) ○ Assess the surface water in terms of: ❖ Biological data from literature review such as vegetation maps ❖ Land cover or land use within the (sub-catchment) ❖ Habitat Integrity ❖ Ecological importance and sensitivity ○ Identify representative sampling points and undertake sampling for the following pollutants: ❖ *E-Coli* ❖ Conductivity ❖ Dissolved Oxygen ❖ Chemical Oxygen Demand ❖ Ammonia ❖ Nitrate ❖ Soluble Reactive Phosphate	• Improved Water Quality	➢ Short term ➢ Short term ➢ Medium term ➢ Medium term ➢ Medium term

		❖ Total Phosphorus ❖ Sulphate o Produce a management framework to include: ❖ Eco specs for each river reach ❖ Recommendations to meet targets ❖ A monitoring Programme		

1.2 Purpose of Study

The Baynespruit stream is approximately nine kilometres in length – all of which will be assessed for the purpose of this project. Its headwaters can be found in the residential area of Northdale and joining the Msunduzi River east of the residential suburb of Sobantu. The Baynespruit is regarded as a small tributary of the Msunduzi River and forms part of the Pietermaritzburg urban catchment, however, this small tributary does contribute significantly to the provision and quality of water within the catchment. The Msunduzi River is itself, one of the main tributaries of the uMgeni River, which flows into Inanda Dam being Durban‟s primary water supply.

The Baynespruit is in notably poor condition due to surrounding contributors of pollution and industrial effluent as well as damaged built and ecological infrastructure and solid waste. The water which is sampled and tested by Umgeni Water, on an on-going basis has yielded results which have deemed the water to be highly toxic and severely polluted. It is thus unusable to surrounding communities including the residents of Sobantu who previously used the stream for fishing, swimming and for irrigation purposes.

It was thus determined, that the degraded Baynespruit catchment is a relevant site in need of ecological infrastructural rehabilitation. It is a key area which will contribute to the overall improvement of water quality results for the Msunduzi River and the Umgeni catchment.

The key purpose of this project is to enhance water quality entering the Msunduzi River through the rehabilitation, implementation and improvement of ecological infrastructure to the extent at which it is able to provide surrounding communities with water safe enough for irrigation of their agricultural crops, for fishing and recreational purposes. The integration of the restoration and management of ecological infrastructure with respect to the water reconciliation strategy for the Greater uMgeni River Catchment will allow for the overall significant improvement of the catchment and for water services to deliver water and sanitation services more effectively and efficiently.

In compliance with local government mandates and NEMA, all tiers of government must engage in holistic sustainable development where economic and social development is promoted but not at the expense of environmental conservation of resources for future generations.

Economic production contributes significantly to sustainable livelihoods which are crucial to the economy of KwaZulu-Natal and in addition, ecological infrastructure contributes significantly to the livelihoods of the people dependant on the environment for their livelihood resources. These environmental resources being linked so closely to sustainable development are referred to as „ecological infrastructure". Ecological infrastructure refers to „naturally functioning ecosystems that provide valuable services to people such as freshwater, climate regulation, soil formulation and disaster risk reduction. It is commonly described as being the nature-based equivalent of built or hard infrastructure and is just as important for providing services and underpinning socio-economic development" SANBI (2013:1). Ecological infrastructure enhances sustainable economic production and therefore needs to be restored and managed in such a manner so as to deliver critical Ecosystems goods and Services to the economy of the province.

1.3 Aim and objectives

Aim: To rehabilitate ecological infrastructure of the Baynespruit stream which will result in improved quality of water entering the Msunduzi River which the Sobantu community may utilise for recreational activities, fishing and irrigation of their agricultural lands.

Objectives:

1. To identify and map the key constraints and opportunities along the length of the Baynespruit stream in order to identify mitigation strategies, develop action plans and projects and to suggest best practice with regards to proposed development strategies.
2. To conduct water quality sampling along the Baynespruit stream at fixed locations and compare trends against historic data which will be used to locate problem areas.

3. To determine wetland condition and functionality by undertaking a wetland health and ecosystem services assessments in order to determine water quality constraints, identify opportunities in the provision of water services and develop rehabilitation plans.

4. To conduct mini SASS assessments along various reaches of the Baynespruit Stream to determine water quality and the health of the riverine system.

5. To identify key role players in communities through field work and assist in developing mitigation strategies, plans and programmes with them.

6. To identify and mobilise local schools within the communities alongside the Baynespruit stream to conduct mini SASS assessments to promote the ongoing monitoring of water quality and to encourage custodianship of the environment through education and awareness

7. To remove and monitor Alien Invasive Species identified within the Catchment.

8. To develop and construct storm water management controls through ecological infrastructure such as the creation of floating wetlands.

9. To reduce erosion and sediment build-up by stabilising river embankments by means of planting Riparian forests and Vetiver grass as well as possible gabion structures.

10. To undertake constructive engagement with Communities and Commerce and Industry to develop strategies/ programmes to reduce/ prevent littering and the illegal discharge/ disposal of effluent waste.

1.4 Location and Spatial extent of the Baynespruit stream

The Baynespruit stream traverses the Northdale, Willowton and Sobantu communities. The approximate length of 9km will be assessed for the purpose of this project extending from the top of the catchment at Otto‟s Bluff Road (30. 37945°E -29. 55316°S) to the confluence with the Msunduzi River (30. 433487 °E -29.593367 °S) (Figure 1). The Baynespruit is contained within the U20J quaternary catchment. The Northdale area is predominantly zoned as residential, while Willowton is partially residential and Industrial. The Sobantu Area is also residential with certain areas comprised of agriculture.

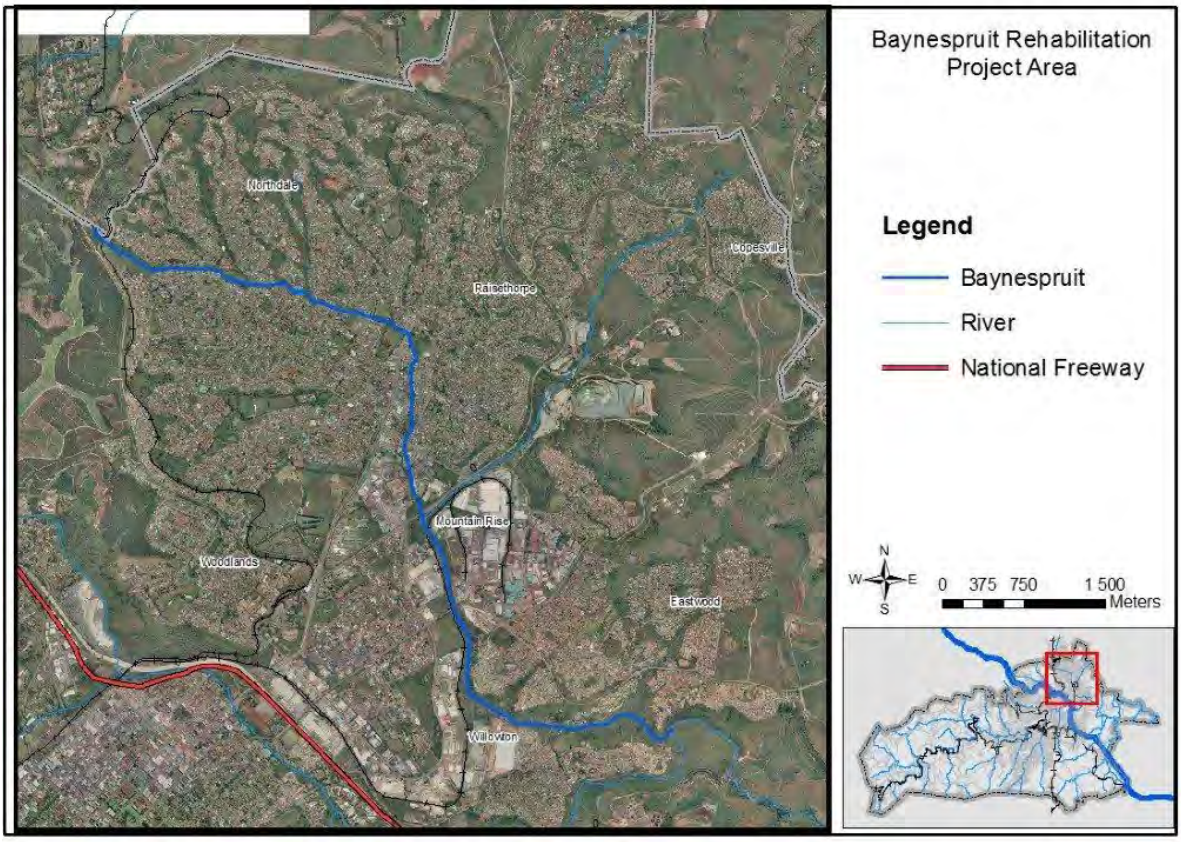


Figure 1: Location and Extent of the Baynespruit stream.

1.4.1 Associated Problems and Strategies

There are many causes of environmental degradation from anthropogenic contributors within this area which has raised much concern from both the government and public sectors. The anthropogenic contributors to the poor quality of river health and minimised flows of water into the Msunduzi River and mitigation strategies of them thereof are outlined in Tables 2, 3 and 4 below.

Table 2: Ecological attributes associated with problems along the Baynespruit Stream and mitigation strategies thereof.

Causes of the Problems	Nature and Severity of Impacts associated with the Problems	Mitigation Strategies
➢ Incorrect methods of solid waste disposal combined with old infrastructure.	❖ Impact on storm water infrastructure. ❖ Decline in water quality and river health in the Msunduzi.	✓ Sewer maintenance at 5 „Hot Spot" areas: Commencement of sewer infrastructure upgrades at Baijoo and New Greytown Roads. ✓ Blockages in drainage systems can be cleaned on a regular schedule ✓ Floating wetlands for enhanced stormwater treatment
➢ The lack of or inadequate sewage infrastructure ➢ Maintenance of sewage infrastructure ➢ Poor operation of waste water treatment works.	❖ Highly contaminated water with high levels of *E.coli* ❖ Increase in the level of nitrification causing algae blooms ❖ Negatively impact ecosystem functioning.	
➢ Influx of storm water into sewerage systems	❖ Surcharging sewer lines and over loading of the Darvill Waste Water Treatment Works	
➢ The transformation of riparian areas. ➢ The transformation of wetland areas ➢ Wetlands being drained	❖ Impacts on catchment hydrology, water quality, biodiversity and flood regimes. ❖ Reduction in riverine health ❖ Inability of wetlands to act as Ecological Infrastructure and provide ecosystem goods and services.	✓ Removal of solid waste and litter ✓ Clearing and monitoring of invasive alien species ✓ The replacement of alien species with indigenous vegetation ✓ River embankment stabilisation by means of a combination of Vetiver grass, riparian forests and gabion structures.
➢ Industrial pollution in riparian zones ➢ Illegal dumping of	❖ Affects the suitability of habitat for a range of flora and fauna.	

waste.		
➢ Alien plant species encroachment and infestation ➢ Increased nutrient loads and Erosion ➢ Disturbance in the ecosystem	❖ Rapid encroachment of Invasive Alien Species ❖ Loss of biodiversity and species diversity through competition and succession. ❖ Affects the production of Ecosystems Goods and Services	
➢ Illegal discharges of effluent from industrial sources	❖ Water quality is negatively affected ❖ Ecosystem integrity and human health are threatened.	✓ Create awareness about wetlands and riparian areas ✓ Find alternative methods for industries to dispose of industrial waste or repurpose the waste for re-use or recycling ✓ Floating wetlands also reduce chemicals such as copper, zinc and fine particulates
➢ Urbanisation and other developments	❖ Increases the amount of hardened surfaces within the catchment ❖ Increases storm water runoff which enables the excessive increase of erosion	✓ Rehabilitate wetland and riparian areas through off set and mitigation projects ✓ Develop a Storm Water Management Policy ✓ Ensure Storm water attenuation facilities are implemented for new developments.

Table 3: Social attributes associated with problems along the Baynespruit Stream and mitigation strategies thereof.

Causes of the Social Problems	**Nature and Severity of Impacts created from the Problems**	**Strategies to Address the Problem**
Health	Decrease in quality of Life	✓ Public awareness and Education ✓ Information Campaigns
Impacts on the Duzi Canoe Marathon	Recreational Function of the Duzi Lost	✓ Community / Environmental Champions ✓ Waste minimisation Clubs ✓ River Clean up
Highly polluted and contaminated water	Sobantu community cannot irrigate their subsistence agriculture	✓ Rehabilitate Ecological Infrastructure to improve water quality

Table 4: Economic attributes associated with problems along the Baynespruit Stream and mitigation strategies thereof.

Causes of the Economic Problems	**Nature and Severity of Impacts created from the Problems**	**Strategies to Address the Problem**
Risk to the Duzi Canoe Marathon	❖ Loss in sponsorship ❖ Decrease investment in the city	✓ Re-align existing resources with Department of Agriculture for Funding ✓ International and Local Industries Funding
Increase cost of cleaning water for potable use	Decrease in availability of Ecosystems goods and services for those dependent on them	✓ Job creation is key for granting funding
Lack of funds for upgrades	Inability to conduct maintenance and upgrade infrastructure	✓ Develop a plan with Budget of expecting costs and a proposal on how money can be spend ✓ Funding opportunities

1.5 Local Governments Legal Responsibilities

The role of local government is to govern, on its own initiative, the local government affairs of its community, subject to national and provincial legislation (Environmental Governance and Institutional Framework, 2008). As government which most closely impacts the people, they are first and foremost responsible for the provision of services and social and economic development. They are to engage with communities and give priority to their basic needs. They are also responsible for caring for the environment to ensure that the health and quality of living is protected and that citizens continue to benefit from their surrounding environment in the long term for which provisions are outlined accordingly in the National Environmental Management Act, Act 107 of 1998. In other words, local government needs to create a balance between the economic, social and environmental sectors with regards to development, which should be sustainably managed for both current and future generations. The roles and responsibilities of local government are outlined in Chapter 7 and Schedules 4 and 5 of the Constitution. Local government exercises functions that impact the environment and functions involving the management of the environment.

1.6 Key Role Players Involved in the Project

- Sobantu Farmers Association
- Ward committees
- Ward councilors for Wards 28, 30, 31 and 35; Nithia Govender, Jay Singh, Rooksana Ahmed and Thandi Matiwane respectively.
- Departments within Msunduzi Municipality
- Department of Agriculture and Environmental Affairs
- Wildlands Conservation Trust
- Msunduzi Catchment Management Forum
- Duzi Umgeni Conservation Trust
- Umgeni Water
- WESSA Eco-Schools and WESSA Share-net

- Community Based Organizations
- Commerce and Industry
- Pietermaritzburg Chamber of Business (PCB)
- UKZN
- GroundTruth Water, Wetlands and Environmental Engineers and the MiniSASS website

Chapter 2:

Study Area and Summary of Environmental Attributes

2.1 Locality and Extent

Msunduzi Municipality is located at the centre of the uMgungundlovu District Municipality. It is 640 square kilometres in extent and is located 80 km north west of Durban along the N3 (Final Draft EMF, 2010). Figure 2 provides an indication of the locality and extent of the Baynespruit stream, which for the intended purpose of this project, has been highlighted for rehabilitation within the Msunduzi Municipality.

Figure 2: Locality and extent of the Baynespruit within the Msunduzi Municipality

2.2 Sub-catchment divisions

The Baynespruit is contained within the U20J quaternary catchment. However the quaternary catchment was not used for the assessment of the Baynespruit as it was determined to be inappropriate for the nature of this project. The quaternary catchment was large and did not allow for any variation in land use zones along the Baynespruit to be determined. Therefore the

four surrounding Wards of the Baynespruit were used instead namely; 28, 30, 31 and 35 as indicated by Figure 3. From the utilisation of the Ward boundaries the predominant land use zone for each ward could be determined. The Northdale area is predominantly zoned as residential, while Willowton is partially residential and Industrial. The Sobantu Area is also residential with certain areas comprised of agriculture.

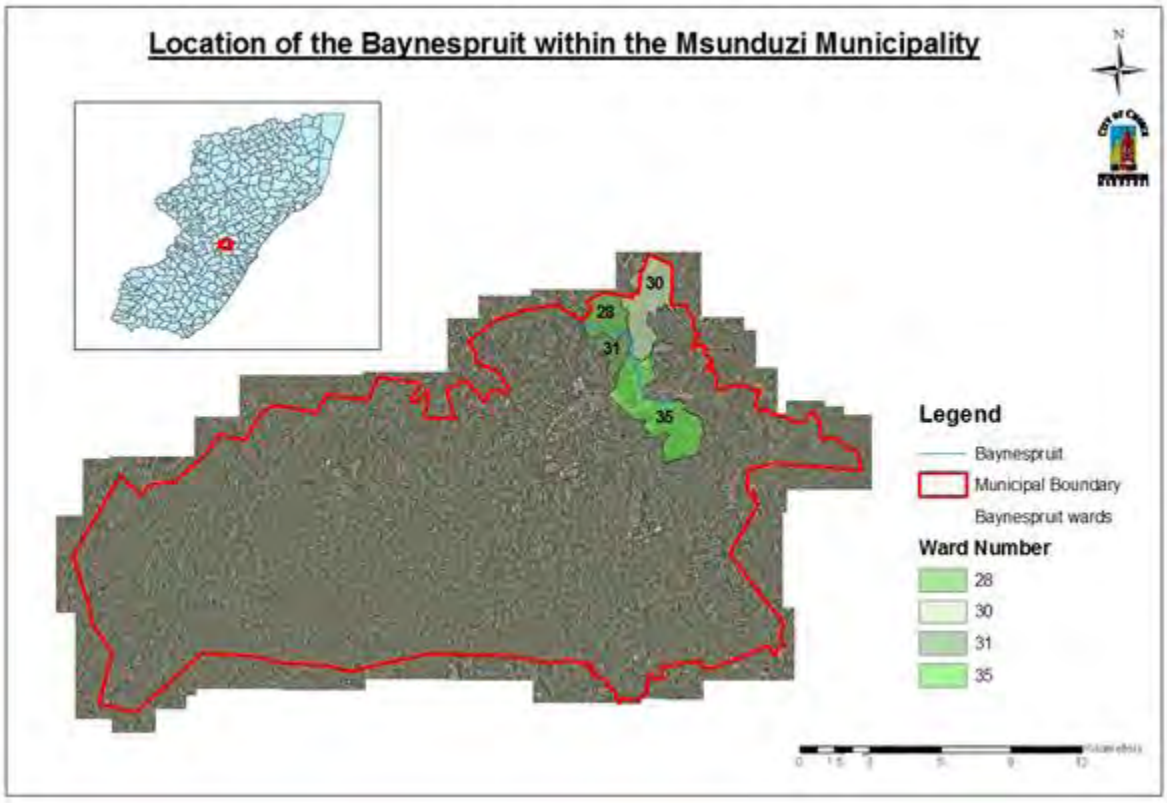


Figure 3: The Baynespruit stream within the extent of the Ward boundaries

2.3 Ecological Environment

2.3.1 Geology and Topography

Pietermaritzburg (the main economic hub within the District Municipality) is situated within the basin of the uMsunduzi River and its tributaries. An escarpment rises approximately 400m above the city to the West and North West. Altitude within the municipality ranges from 495 to 1795 metres above sea level and the municipality generally slopes from west to east (Final Draft SEA, 2010).

The Msunduzi municipal area is predominantly comprised of sedimentary rocks of the Ecca Group and Dwyka Formation which form part of the lower Karoo Supergroup. These sediments are extensively intruded by Jurassic post-Karoo dolerite sheets, dykes and sills that intermittently outcrop across the entire municipal area (Final Draft EMF, 2010).

The geology and geomorphology result in a very complex relationship between slope gradient. This supports a potentially unstable transportation of sediments and soils which could be further exacerbated by ineffective storm water mitigation controls.

2.3.2 Soils and Land capability

Soil within the Municipality varies significantly. The topography, rainfall patterns and geology have all resulted in a high agricultural potential for the area, however large portions of highly productive agricultural land has been developed for other uses and activities such as residential and industrial.

The Northdale, Willowton and Sobantu areas, through which the Baynespruit stream flows, indicates potential sites where land may be investigated for agricultural opportunity. The Sobantu community currently practices subsistence agriculture but cannot irrigate crops from the highly toxic water from the Baynespruit. Poor agricultural practices may contribute to the resultant poor water quality, however, this is minimal.

If the water quality of the Baynespruit were to be improved, the community could utilise the Ecosystems goods and services provided by this environmental resource to promote social and economic sustainability thus accomplishing sustainable development. There is therefore a direct linkage between environmental governance and management and the realisation of sustainable social and economic development goals.

Figure 4 below shows the distribution of bioresource groups (BRG‟s) as identified by the Department of Agriculture in the Final Draft Strategic Environmental Assessment, 2010. The BRG‟s provide further detail of the spatial distribution of both soil types and land capability. Northdale falls within the Moist Coast Hinterland Ngongoni Veld, Willowton within The Dry Coast Hinterland Ngongoni Veld and the Sobantu area falls within both The Dry Coast Hinterland Ngongoni Veld and The Coast Hinterland Thornveld bioresource groups.

The Moist Coast Hinterland Ngongoni Veld, indicated in dark red in Figure 4 below, suggests that the Northdale area is characterised by Soils which are acidic and leached with injudicious burning and selective overgrazing collectively results in very poor quality veld cover.

The Dry Coast Hinterland Ngongoni Veld bioresource group prevailing over the Willowton area and the upper portion of Sobantu has limited potential due to low rainfall. A previous history of early burning, and burning at any time of the year, coupled with selective overgrazing as the grass emerges, has resulted in a particularly poor quality veld condition.

The Coast Hinterland Thornveld is known for its floristic richness yet is also characterised by the drastic deterioration in the quality of the veld resulting from burning throughout the year and extreme overgrazing pressures. Under favourable soil and water conditions, the potential for sugar cane, maize and vegetables production are higher within this area. This suggests that there is great agricultural potential for the Sobantu community to conduct agricultural activities provided they are able to irrigate their crops from the Baynespruit.

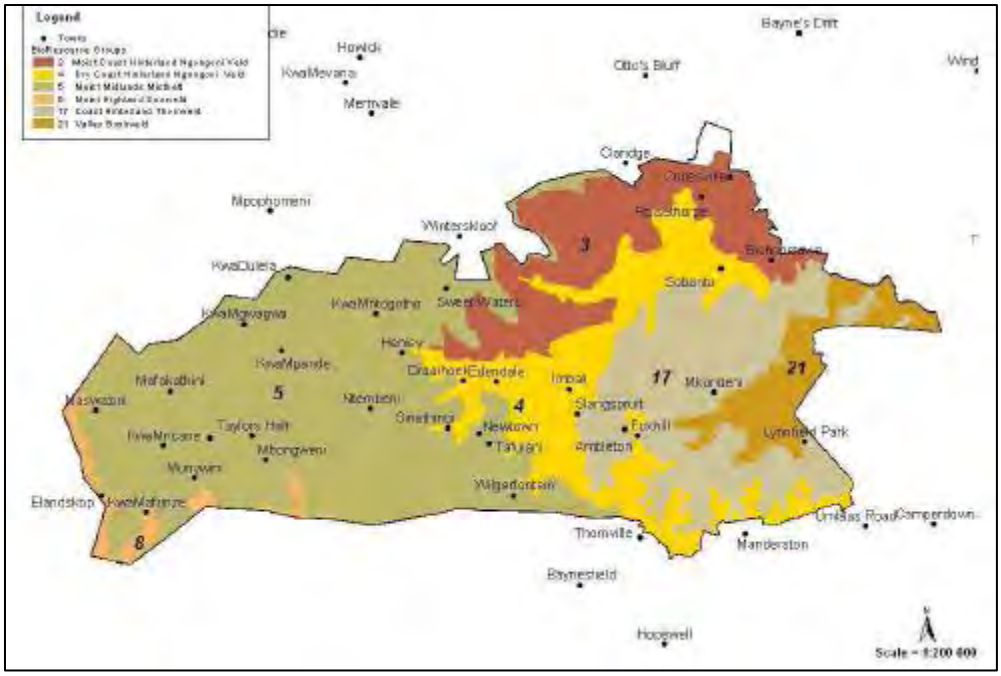


Figure 4: Bioresource groups (BRG's) as identified by the Department of Agriculture

2.3.3 Hydrology (Rivers and Wetlands)

Rivers within Msunduzi form part of the Catchment hydrology and constitute riparian corridors that may be vulnerable to flooding. Transformation of these areas will impact on biodiversity, catchment hydrology, flood vulnerability and water quality (Final Draft SEA, 2010). Any development within these areas is also likely to be damaged as a result of flooding. While the location of rivers is not negotiable it is possible to manage the impacts of flooding through appropriate land management, structural interventions and ecological infrastructure such as „floating wetlands".

The extent of wetlands has declined significantly, particularly in developed areas. Wetlands have been transformed and most of the remaining wetland areas are in a degraded state due to inappropriate land use and inadequate catchment management. There is a lack of ground level information regarding the functionality of most of the wetland habitats within Msunduzi. Therefore a wetland functionality assessment using

the WET-Health tool (level 1) will be undertaken on the 13 wetlands surrounding the Baynespruit. The range (in size) of wetlands along the Baynespruit is 0,18 to 2,89 Ha. The total size of these 13 wetlands along the Baynespruit combined are 13,24 Ha. These wetlands form part of the riverine system which generates various goods and services which are critical for the realisation of social and economic development goals.

2.3.4 Biodiversity

Msunduzi Municipality consists of diverse habitats and species richness. High levels of transformation with increasing future demand for urbanisation has resulted in a significant loss of natural habitat. A relatively low proportion of the Baynespruit can be regarded as "untransformed".

Within Msunduzi significant biodiversity features are said to include "a total of 56 animal species, 20 plant species and 8 vegetation types. At least 50 endemic species occur in the area. A high number of rare or threatened species occur within the Msunduzi Municipality and three species are thought to have become extinct" Final Draft SEA (2010: 16). Biodiversity features having been identified through field work will require conservation.

2.4 Solid Waste and Sanitation

All solid waste collected by the Municipality is disposed of at the New England Road landfill site which has limited remaining capacity. Approximately 40% of the waste currently disposed of at the New England Road landfill site is of an industrial nature and with urban expansion occurring at a rapid rate, the amount of waste generated is increasing exponentially. The New England Road landfill site may soon reach its carrying capacity and alternative landfill sites will need to be investigated.

Illegal dumping of waste was identified as a key challenge in Msunduzi as this also affects the other service sectors, such as stormwater and sewer reticulation. According to SALGA (2013) a

long term solution to curb illegal dumping is proposed along with an outline of a clean-up initiative for the Msunduzi. The majority of waste as indicated in the Msunduzi EMF – Final Status Quo Report (2009: 24) is generated from the northern suburbs in which the Baynespruit is contained. Other initiatives such as the development of Msunduzi Municipality‟s Integrated Waste Management Plan (IWMP, 2014) are underway which will contribute significantly to the condition of the Baynespruit.

The Msunduzi Municipalities Water and Sanitation Section recently undertook a physical inspection of the structural integrity of the sanitation network with the use of Closed Circuit Television Camera‟s (CCTV). A total of approximately 800km was inspected where results showed that 48.9km needed to be replaced, 7 pump stations require upgrading and a total of 257 major point repairs were revealed; refer to figure 5. Two of the upgrade sites can be isolated along the Baynespruit and they are; the Baijoo and New Greytown Road sites (Figure 5).

Aurecon has since been appointed to commence with phase 1 of the project which involves:

- Replacement of 8.6km of a 150mm diameter sewer reticulation in the Northdale area;
- Laying a new 150mm diameter sewer in Northdale;
  Relaying of a 150mm diameter sewer across a culvert on Baijoo road (29°34'0.93"S; 30°24'31.80"E)
    - Baijoo Road– Repairs to broken 150mm diameter sewer crossing at stormwater outfall and bank erosion protection.
- Repairs to sewer stream crossing near New Greytown road (29°34'30.92"S; 30°24'36.11"E)
    - New Greytown Road sewer stream crossing – stream bank erosion rehabilitation and protection of sewer pipe through stream.

The capacity for sewage processing at Darvill Sewage Treatment Works (Darvill) has reached operational threshold and expansion of the existing works has commenced but will only be fully commissioned in 2016.

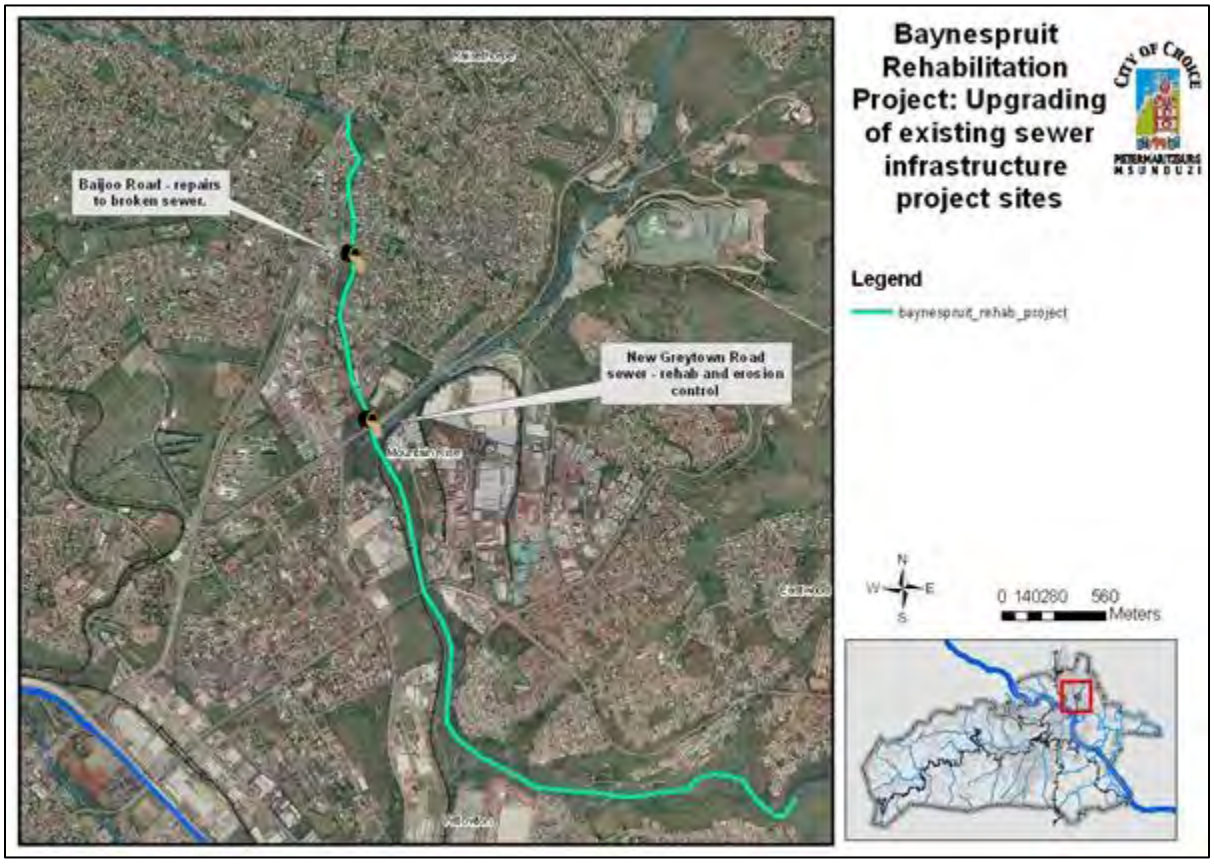


Figure 5: Sewer infrastructure upgrade sites

2.5 Storm water and Associated Flood Risk

The rapidly increasing density of settlement as well as the hardened surfaces created as a result, increases storm water run-off. This, combined with the destruction, degradation and reduction of wetlands and inappropriate use of floodplains, has significantly increased the risk of downstream flooding.

Communities living within or in close proximity to floodplains, such as Sobantu, are in danger of being affected by a river in flood which may place people and infrastructure in danger on-site, upstream or downstream. Damage to infrastructure, such as roads, bridges, culverts, sewers and

water pipelines is likely to occur if measures to protect floodplains and wetlands are not introduced and implemented. Flood zone areas can contain ecological features which help mitigate flooding potential.

Key challenges in the maintenance of stormwater infrastructure is the illegal dumping of waste, which results in stormwater systems becoming blocked, the need for constant upgrading of existing infrastructure to address higher demands caused by the increase in residential development and aging infrastructure. The Msunduzi Municipalities Water and Sanitation Section infrastructure upgrade and replacement project is essential in alleviating the pressures on stormwater facilities.

2.6 Social Environment

The rapid population growth within Msunduzi is resulting in inappropriate development and land degradation. For example, rapid population growth together with large housing backlogs results in high density informal settlements. Due to their density, service requirements in informal settlements are far greater than planned for and the Municipality has insufficient capacity to address these needs (Final Draft SEA, 2010). These perpetuate serious social problems. Land degradation through poorly planned or illegal development ultimately results in the loss of opportunities for agricultural production and ecosystem goods and services (such as grazing, medicinal plants, wood for fuel and building materials) (Final Draft SEA, 2010). This will significantly impact on rural livelihoods, which are considered to be the most vulnerable, and reduce opportunities to alleviate poverty.

High poverty levels coupled with the high prevalence of HIV/AIDS and TB, places further pressures on municipal services and infrastructure, job creation and natural resources. The challenges in service provision result in impacts to river health that increases the risk of waterborne diseases, which increases the demand for health services. For example, if communities do not have flush toilets but instead pit latrines and these become clogged; raw sewerage may be disposed of into a river or stream. This may result in waterborne diseases which would affect the communities nearby who are utilising the river for livelihood purposes such as bathing, washing clothes or recreation such as fishing or swimming and this will increase

the demand on health care services. A decrease in human health within the Municipality impacts on the provision of health services, productivity levels and the local economy (Final Draft SEA, 2010).

2.7 Economic Environment

Msunduzi‟s unique location between Johannesburg and Durban, allows for major economic development opportunities within the municipality. The ecosystem goods and services provided by the environment also provide various opportunities for economic development, as outlined in the Final Draft SEA 2010 to include:

- ✓ Water from the Msunduzi catchment can supply industry, domestic use, agriculture and livestock watering. Without suitable management of water resources and habitats responsible for water recycling, the demand for water will outweigh its supply.

- ✓ Goods and services provide tourism opportunities such as recreational sport. For example, the Dusi Canoe Marathon. In recent years however, the quality of water within Msunduzi has compromised the event. If the poor water quality continues to compromise the event which ultimately results in the loss of the Dusi Canoe Marathon there will be notable significant impacts on the local economy.

- ✓ Urban greening and the open spaces within the municipality provide a certain quality of life. If open spaces were drastically reduced, city marketing will be impacted and residents may choose to relocate to areas which offer a similar environment yet are still close enough for residents to commute.

- ✓ Untransformed areas of Msunduzi provide a range of grassland plants, indigenous animals and indigenous trees that are targeted by Traditional Healers and medicinal plant collectors for the informal trading and gardening of medicinal plants. The loss of medicinal species, and/ or the habitats that support them, will severely impact on these financial prospects.

- ✓ The natural environment currently provides natural stormwater attenuation. Development within the catchment increases hard surfaces which increases the flow of stormwater. This results in floodplain loss and increased erosion of river banks. The municipality is thus required to implement costly storm water management, canalisation or the installation of attenuation infrastructure.

It is critical to build an understanding that all development is dependent on ecosystem goods and services from natural resources and therefore the loss of these goods and services would result in the loss of development opportunities within the municipality.

Chapter 3:
Methods and Constraints

3.1 Ecological Assessments

The various ecological assessments undertaken in this project are; wetland functionality using the WET-Health tool and ecosystems goods and services using the WET-EcoServices tool. These two tools will both be completed on 13 wetlands along the Baynespruit at a level 1 assessment. Biodiversity assessments of fauna and flora and solid waste and sanitation facilities assessments were analysed from ground-truthing the approximated 9km extent of the Baynespruit. This involved demarcating the stream at every 200m interval. Within each 200m reach with a 32m buffer of the stream, the alien plants were identified and recorded. The same was done for the indigenous species within each reach. All faunal species encountered were also documented. Properties which fell within this buffer were recorded with regards to environmental, social and economic impacts (Appendices D andE).

The solid waste illegal dumping sites were noted and GPS co-ordinates were taken at these sites and input into GIS for spatial display. The sanitation infrastructure facilities such as sewers, manholes, pipe crossings as well as stormwater drains were recorded, GPS points taken at the features and input into GIS for mapping. Where industrial effluent was clearly visible within the stream the site was noted and described with GPS co-ordinates taken to record the incident which may lead to further investigation and linkages between surrounding industries through which the Baynespruit flows and the illegal discharge and disposal of waste into the stream. Water quality assessments are thus vital in determining the pollutants found in the water also allowing for conclusions to be drawn as to the sources of contamination into the stream by either industrial or residential means. Water quality samples have been collected over the past 5 years and are currently still being collected along 3 fixed locations along the Baynespruit. The streams water quality will not only be monitored by the water quality sampling but will also be assessed in terms of riverine health using the WET-IHI and miniSASS tools. Agricultural lands were recorded on field maps and GPS co-ordinates were taken to graphically represent their location and extent.

3.1.1 Wetland Assessments

To establish the current state of health of wetlands the WET-Health tool can be utilised. The WET-Health tool is comprised of three main components that require field verification: hydrology, geomorphology and vegetation analysis (Macfarlane *et al*., 2008). The first component, hydrology, is undertaken to determine the amount of water flowing through the wetland system, how much of that is captured and stored as groundwater and how much is lost by surface run-off. The evaluation of water volume input provides information regarding the distribution of water passing through the wetland. The geomorphology is important in understanding the underlying structure of the wetland and the nature thereof which can influence the water flow patterns and the ecology of the area. A vegetation assessment is necessary as it analyses the state of the environment with respect to land use change or disturbances for example, natural vegetation when compared to alien species serves as an indicator of the extent of alteration of the particular site.

Surrounding land use activities can play a role in altering the water flow regime; for example, residential areas with hardened surfaces may divert water movement into side drains away from a wetland. Land use types may cause disturbances in the water regime thus ensuring that water may change or alter its natural course of progression for example, commercial agriculture whereby drains may transport water out of the wetland for the irrigation of crops (Macfarlane *et al*., 2008).

The WET-EcoServices tool is used to assess the goods and services that individual wetlands provide. Understanding a wetland‟s ability to deliver ecosystem goods and services can assist in informing planning and decision making from a local to a global scale. Wetlands can be prioritised depending on the context in which they are found. For example, a wetland with water purification abilities situated upstream of a community that is reliant on the wetland for water can be considered important. This wetland can be managed so that pending developments are withheld or measures of impacts mitigated. Ecosystem goods and services include flood attenuation, streamflow regulation, sediment trapping, phosphate, nitrate and

toxicant assimilation, erosion control, carbon storage, biodiversity maintenance, provision of water for human use, provision of harvestable resources, provision of cultivated foods, cultural heritage, tourism and recreation and education and research (Kotze *et al*., 2008).

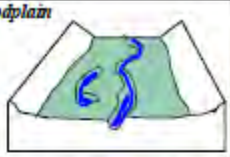
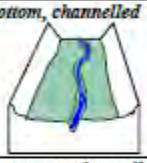
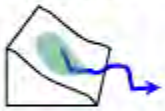
3.1.1.1 WET-Health Level 1 Hydrology, Geomorphology and Vegetation

A desktop evaluation prior to the commencement of fieldwork provided the following information: there are 13 wetlands along the Baynespruit with a range in size from the smallest being 0, 18 Ha to the largest being 2, 39 Ha. The total size of the 13 wetlands combined is 13, 24 Ha. Catchment boundary and catchment areas units (in hectares), wetland boundary and HGM unit boundaries and the area of each HGM unit (in hectares), the quaternary catchment and the Mean Annual Precipitation (MAP) in mm per annum, Potential Evapotranspiration (PET) in mm per annum, the MAP/PET ratio and the Median Annual Simulated Runoff in mm per annum, land uses in the catchment and the wetland and their approximate extent (in hectares) and the presence of any drains, dams, erosion features in the wetlands catchment and their extent (in hectares) (Macfarlane et al., 2008).

The WET-Health framework involves three primary components namely: hydrology, geomorphology and vegetation. For this research a level one WET-Health assessment was conducted.

WET-Health can be seen as a "deviation from the natural reference condition" (Macfarlane *et al*., 2008: 10). The tool was used to assess the extent of human activity on the wetland ecosystem and the magnitude of this impact indicates causes of deviation of wetland health from its natural condition. The WET-Health tool was used to provide best management practices with an understanding of wetland functions and inform decision makers such that the decisions made could ensure more effective functioning of the wetland ecosystem. The scoring system used for WET-Health is a scale from zero to ten with zero being the natural condition while ten indicates the most deviance away from the

natural state (Macfarlane *et al*., 2008). Within each individual hydro-geomorphic unit (see Figure 6) in the wetlands, the hydrological, geomorphological and vegetation health were assessed and scored to determine the overall current state of health of the wetland.

Hydrogeomorphic types	Description	Source of water maintaining the wetland	
		Surface	Sub-surface
Floodplain 	Valley-bottom areas with a well-defined stream channel gently sloped and characterised by floodplain features such as ox-bow depressions and natural levees and the alluvial transport and deposition of sediment, usually leading to a net accumulation of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.	***	*
Valley-bottom, channelled 	Valley-bottom areas with a well-defined stream channel but lacking characteristic floodplain features. May be gently sloped and characterised by the net accumulation of alluvial deposits or may have steeper slopes and be characterized by the net loss of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.	***	*/ ***
Valley-bottom, unchannelled 	Valley-bottom areas with no clearly defined stream channel, usually gently sloped and characterised by alluvial sediment deposition, generally leading to a net accumulation of sediment. Water inputs are mainly from the channel entering the wetland and also from adjacent slopes.	***	*/ ***
Hillslope seepage linked to a stream 	Slopes on hillsides, which are characterised by the colluvial (transported by gravity) movement of materials. Water inputs are mainly from sub-surface flow and outflow is usually via a well-defined stream channel connecting the area directly to a stream channel.	*	***
Isolated hillslope seepage 	Slopes on hillsides, which are characterised by the colluvial (transported by gravity) movement of materials. Water inputs mainly from sub-surface flow and outflow either very limited or through diffuse sub-surface and/or surface flow but with no direct surface water connection to a stream channel	*	***
Depression (includes Pans) 	A basin shaped area with a closed elevation contour that allows for the accumulation of surface water (i.e. it is inward draining). It may also receive sub-surface water. An outlet is usually absent, and therefore this type is usually isolated from the stream channel network.	*/ ***	*/ ***

Water source: * Contribution usually small
*** Contribution usually large

Wetland
*/ *** Contribution may be small or important depending on the local circumstances

Figure 6: Wetland hydrogeomorphic types (Table adapted from Macfarlane *et al*., 2008).

Hydrology

The hydrology assessment considers variation in amount of water that flows through the wetland system and the proportion captured and stored as groundwater or carried away as surface run-off. The evaluation of water volume input provides the distribution of water through the wetland. The surrounding land use activities play a role in altering water flow patterns. Land use types may cause disturbances in the water regime thus ensuring that the natural course of progression of water is altered resulting in water following another path. The barrier may not permit water to filter through thus the ground water table becomes saturated leading to water logging.

Components within a wetland‟s catchment such as infiltration rates, the presence of water bodies and areas of little ground vegetation cover, influence the amount of water that passes through the wetland and flood peaks. The relationship between infiltration rates is: the presence of water bodies, the lack of groundcover and flood peaks, a lack of water bodies and groundcover vegetation the higher the flood peaks (Macfarlane *et al*., 2008 and Love *et al.*, 2010). Having identified the HGM units, the alterations of water inputs and flow patterns can be determined (Macfarlane *et al*., 2008).

Each activity affecting water movement is assigned a relevant percentage score in terms of the degree to which it affects the wetland. An intensity score is approximated from zero to ten with zero being pristine and ten being critically altered. A magnitude score is calculated by multiplying the percentage by the intensity score, for example, if an activity affects ten percent of a HGM unit and the intensity of impact in the affected area is six, then the magnitude of impact is calculated as 10/100 x 6 = 0.6. This indicates the extent of alteration is minimal and the Present Ecological State (PES) category is an A, with the wetland being unmodified, natural (see Table 5). If an activity affects 90 percent of a HGM unit and the intensity of impact in the affected area is nine, then the magnitude of impact is calculated as: 90/100 x 9 = 8.1. This indicates an F PES as modification is critical with flow patterns severely altered. When the scores for different activities are added together, a combined impact magnitude score for the entire HGM unit is derived

(Macfarlane *et al*., 2008). A trajectory of change score is indicated to determine the conditions likely to occur within the wetland ecosystem over a five-year period: for example, if wetland conditions deteriorate slightly then a symbol of one downward facing arrow is indicated in the WET-Health assessment sheets (see Table 6).

Table 5: Present Ecological State categories

Description	Combined impact score	PES Category
Unmodified, natural.	0-0.9	A
Largely natural with few modifications. A slight change in ecosystem processes is discernable and a small loss of natural habitats and biota may have taken place.	1-1.9	B
Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact.	2-3.9	C
Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	4-5.9	D
The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognisable.	6-7.9	E
Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8-10	F

Table 6: Trajectory of Change Scores

Change Class	Description	HGM Score	Class Range	Symbol
Improve	condition is likely to improve over the over the next 5 years	1	0.3 to 1.0	(↑)
Remain stable	condition is likely to remain stable over the next 5 years	0	-0.2 to +0.2	(→)
Slowly deteriorate	condition is likely to deteriorate slightly over the next 5 years	-1	-0.3 to -1.0	(↓)
Rapidly deteriorate	substantial deterioration of condition is expected over the next 5 years	-2	-1.1 to -2.0	(↓↓)

Geomorphology

Geomorphic health is important to consider as a consequence of rates of erosion and deposition (Macfarlane *et al*., 2008). Geomorphic processes control and shape the

structure of a wetland affecting water distribution (Macfarlane *et al*., 2008). However it is essential to understand that geomorphology is linked to both the hydrology and ecology of the wetland and the interpretation of the results should show integration of hydrology, geomorphology and vegetation. Thus, the evaluation of geomorphological health of a wetland, present geomorphic state and trajectory of change must be assessed (Macfarlane *et al*., 2008).

Vegetation

Wetland vegetation is important as it serves to sustain local fauna and act as a break to water flowing through the wetland. By reducing the velocity of water, there is a greater opportunity for infiltration to occur thus allowing the groundwater table to store water as a reserve and reduce the amount of topsoil which could be removed by surface flow. Therefore it is important and appropriate to assess the health of wetland vegetation. To assess vegetation health, the assessor must have prior knowledge of the subject matter so that wetland vegetation can be identified and its composition under natural conditions in its native habitat be understood. This is important as there must be a template to compare the identified vegetation against vegetation under disturbed conditions.

3.1.1.2 Ecosystems Goods and Services Assessments Level 1

WET-EcoServices is a tool used to assess the goods and services that wetlands provide and is developed for a particular class of wetlands known as palustrine wetlands of which the following are considered: marshes, floodplains, vleis or seeps (Kotze *et al*., 2008). Ecosystems goods and services which wetlands can provide directly and indirectly are conveyed by Figure 7. Indirect benefits are that which "have worth, quality or importance to humans but does not require active use of wetlands by individuals in order for the benefits to be realized. Instead, the wider public benefits indirectly from the service that wetlands provide (e.g. purification of water)" Kotze *et al* (2008: 78) and Direct benefits are those which "have worth, quality or importance to humans and is realized by

individuals actively using a wetland (e.g. for recreation, or pasture production)" Kotze *et al* (2008: 77).

The first step in the process is to categorise the wetlands according to their hydro-geomorphic type. The level one assessment, conducted at desktop level is based on existing knowledge (Figure 8) and assesses indirect benefits namely: flood attenuation, streamflow regulation, erosion control, sediment trapping, phosphate, nitrate and toxicant assimilation and carbon storage. Direct benefits such as: biodiversity maintenance, provision of water for human use, provision of harvestable resources, provision of cultivated foods, cultural heritage, tourism and recreation and education and research are verified by limited fieldwork.

Ecosystem services supplied by wetlands	**Indirect benefits**	**Regulating and supporting benefits**	Flood attenuation		The spreading out and slowing down of floodwaters in the wetland, thereby reducing the severity of floods downstream
			Streamflow regulation		Sustaining streamflow during low flow periods
			Water quality enhancement benefits	Sediment trapping	The trapping and retention in the wetland of sediment carried by runoff waters
				Phosphate assimilation	Removal by the wetland of phosphates carried by runoff waters
				Nitrate assimilation	Removal by the wetland of nitrates carried by runoff waters
				Toxicant assimilation	Removal by the wetland of toxicants (e.g. metals, biocides and salts) carried by runoff waters
				Erosion control	Controlling of erosion at the wetland site, principally through the protection provided by vegetation.
			Carbon storage		The trapping of carbon by the wetland, principally as soil organic matter
	Direct benefits	**Biodiversity maintenance[2]**			Through the provision of habitat and maintenance of natural process by the wetland, a contribution is made to maintaining biodiversity
		Provisioning benefits	Provision of water for human use		The provision of water extracted directly from the wetland for domestic, agriculture or other purposes
			Provision of harvestable resources		The provision of natural resources from the wetland, including livestock grazing, craft plants, fish, etc.
			Provision of cultivated foods		The provision of areas in the wetland favourable for the cultivation of foods
		Cultural benefits	Cultural heritage		Places of special cultural significance in the wetland, e.g. for baptisms or gathering of culturally significant plants
			Tourism and recreation		Sites of value for tourism and recreation in the wetland, often associated with scenic beauty and abundant birdlife
			Education and research		Sites of value in the wetland for education or research

Figure 7: Ecosystems services included in and assessed using WET-EcoServices (Figure adapted from Kotze *et al*., 2008)

WETLAND HYDRO-GEO-MORPHIC TYPE	REGULATORY BENEFITS POTENTIALLY PROVIDED BY WETLAND							
	Flood attenuation		Stream flow regulation	Enhancement of water quality				
	Early wet season	Late wet season		Erosion control	Sediment trapping	Phos-phates	Nitrates	Toxicants[2]
1. Floodplain	++	+	0	++	++	++	+	+
2. Valley-bottom - channelled	+	0	0	++	+	+	+	+
3. Valley-bottom - unchannelled	+	+	+?	++	++	+	+	++
4. Hillslope seepage connected to a stream channel	+	0	+	++	0	0	++	++
5. Isolated hillslope seepage	+	0	0	++	0	0	++	+
6. Pan/ Depression	+	+	0	0	0	0	+	+

Notes: [1] The rationale for the rating of benefits is given in Section 3.6
[2] Toxicants are taken to include heavy metals and biocides.

Rating: 0 Benefit unlikely to be provided to any significant extent
+ Benefit likely to be present at least to some degree
++ Benefit very likely to be present (and often supplied to a high level)

Figure 8: Rating of hydrological benefits provided by a wetland based on HGM type (Figure adapted from Kotze *et al.*, 2008)

3.1.2 Biodiversity Assessments

3.1.2.1 Fauna Species List

The faunal or animal diversity was recorded upon field work by capturing the following information found below in table 7. Within each 200m reach, along the 9km Baynespruit, each reach was demarcated and the feature of interest assessed and evaluated. The method of evaluation in terms of the fauna found within the area meant that detailed descriptions with attached photographs would have to be attached if the animal was unknown off hand. Once the animal could be identified from literature, their sensitivity categories and protected statuses were added to the table. This would allow for the determination of a character profile of the Baynespruit to be developed which would include areas of high biodiversity and sensitive ecological areas. It would suggest key biodiversity areas of good grassland condition or wetlands which provide suitable habitats for a variety of animals.

Table 7: Faunal Species List

Reach	Co-Ordinates	Scientific or Common Name	Red Data Category	Vulnerability Category	Photo No.	Description
1						

3.1.2.2 Flora Species List

The flora or plant diversity was recorded upon field work by capturing the following information found in table 8 below. The same method for faunal species was adhered to for the plant biodiversity. Within each 200m reach, each reach was demarcated and the feature of interest assessed and evaluated. Detailed descriptions with attached photographs would have to be attached if the plant was unknown off hand. Once the plant could be identified from literature, their sensitivity categories and protected statuses were added to the table. This would allow for the determination of a character profile of the Baynespruit to be developed which would include areas of high biodiversity and sensitive ecological areas. It would also indicate problematic areas where rehabilitation interventions could commence or key biodiversity areas of good grassland condition or wetland species are occurring.

An alien plant clearing schedule will be drafted to ensure that 1 initial clearing with 4 follow-up activities will be completed every 4 months apart. Refer to the „Alien vegetation removal and rehabilitation" (Appendix A) and „Alien plant contract" (Appendiux B) documents for further information on alien vegetation removal and rehabilitation plan.

Table 8: Flora Species List

Reach	Co-Ordinates	Alien	Endemic	Scientific or Common Name	Category 1, 2 or 3	Photo No.	Property Description and Info
		✓ or ✗	✓ or ✗		(CARA)		
1		✓		Bugweed	1		
			✓	Acacia			
		✓		Lantana	1		

3.1.3 Mini Stream Assessment Scoring System (miniSASS) Assessment

The mini Stream Assessment Scoring System (miniSASS) is a rapid technique which is used to monitor the health of a river and measure the general quality of the water in that river (http://www.groundtruth.co.za/projects/minisass.html). The composition of macro invertebrates (small animals) living in rivers are used as indicators based on the sensitivity of the various animals to water quality. It is to be noted that miniSASS does not measure the contamination of the water by bacteria and viruses and thus does not determine if the river water is fit to drink.

Firstly the river is categorised into two types of habitats namely; rocky and sandy types. Although an ideal sample site has rocky, sandy, and vegetation habitats, not all habitats are always present at every site. Therefore, if a river does not have rocky habitats the sandy type category may be used to interpret the sensitivity scores.

The necessary equipment for the field work is; a net, white container / tray or ice-cream box, pencil, magnifying glass (optional), shoes/gumboots, hand wash or hygienic soap and the miniSASS methods pamphlet and dichotomous key. The following steps outline the miniSASS method for field work;

1. Whilst holding a small net in the current, **disturb** the stones, vegetation, sand etc. with your feet or hands.

2. You can also lift stones out of the current and **pick** insects off gently with your fingers or forceps.

3. Do this for about **5 minutes** whilst ranging across the river to **different habitats (biotopes)**.

4. Rinse the net and turn the contents into a plastic tray and **identify** each group using the identification guide (start with the dichotomous key and then use the identification guide for more information).

5. **Mark** the identified insects off on the identification guide.

6. Fill in the site information and **Add up** the sensitivity scores to determine the average score (see scoring sheet on the back page of the methods pamphlet).

7. **WASH** your hands when done!

From points 5 and 6 above, the scoring of the macro invertebrates can be completed by using Figure 9 as a guideline to identify which of them are present in the water sample and then associating sensitivity scores to each group can be determined from Table 9. The ecological category or condition can then be derived from Table 10. For example, if there were the following groups of macro invertebrates such as stoneflies, other mayflies and caddisflies present in the sample of water, then a sensitivity score of 17, 11 and 9 can be allocated to these respectively. These values will be added together to provide a total score of 37 in this instance. The average score can then be calculated by the total score of 37 divided by the number of groups which in this instance is 3 (stoneflies, other mayflies and caddisflies) which would equal 12, 3. This value of 12, 3 for both the rocky and sandy types of rivers suggest that the river being assessed is in an unmodified state or natural condition.

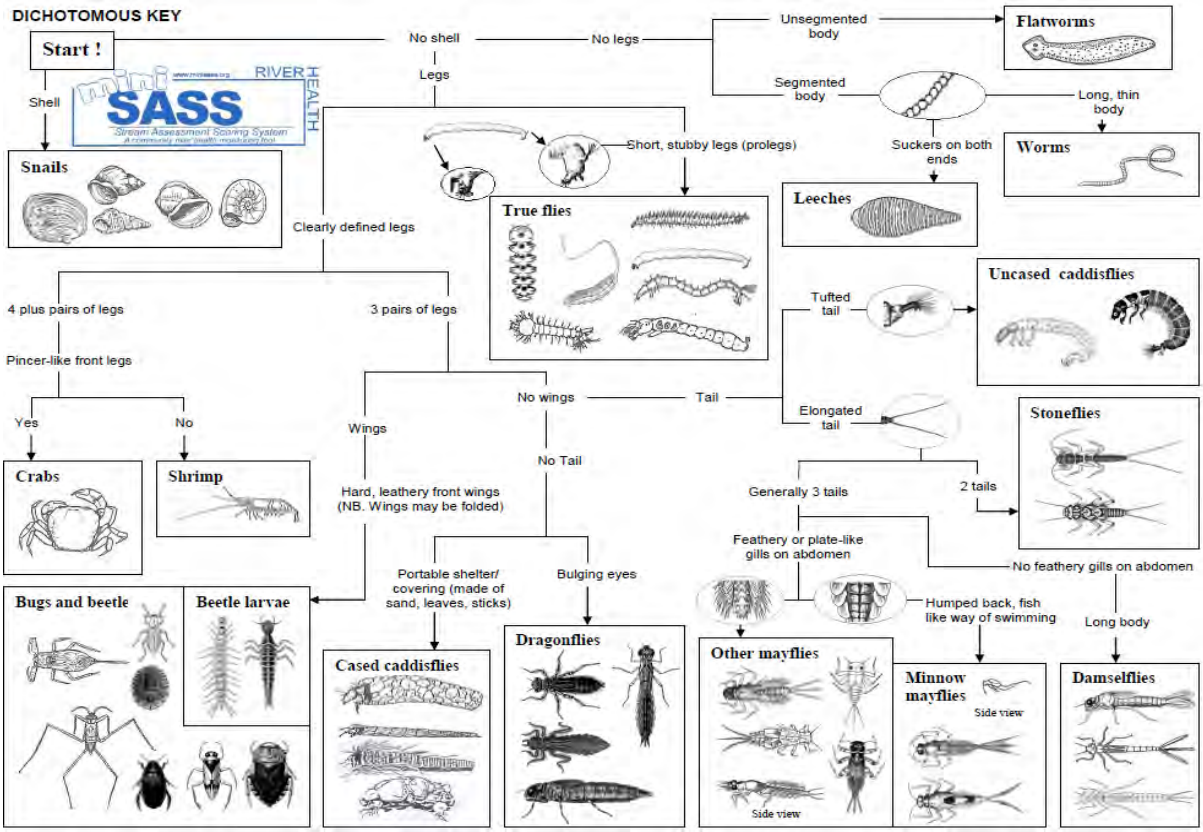


Figure 9: Dichotomous key to identify macro invertebrates

Table 9: Groups of macro invertebrates with their associated sensitivity score

GROUPS	SENSITIVITY SCORE
Flat worms	3
Worms	2
Leeches	2
Crabs or shrimps	6
Stoneflies	17
Minnow mayflies	5
Other mayflies	11
Damselflies	4
Dragonflies	6
Bugs or beetles	5
Caddisflies (cased & uncased)	9
True flies	2
Snails	4
TOTAL SCORE	
NUMBER OF GROUPS	
AVERAGE SCORE	
Average Score = Total Score ÷ Number of groups	

Table 10: Ecological Condition of the River based on the average score

Ecological category (Condition)	River category	
	Sandy Type	Rocky Type
Unmodified (NATURAL condition)	> 6.9	> 7.9
Largely natural/few modifications (GOOD condition)	5.8 to 6.9	6.8 to 7.9
Moderately modified (FAIR condition)	4.9 to 5.8	6.1 to 6.8
Largely modified (POOR condition)	4.3 to 4.9	5.1 to 6.1
Seriously/critically modified (VERY POOR condition)	< 4.3	< 5.1

Five local schools (Figure 10) will be asked to participate in the monitoring of river health and involvement in creating environmental awareness regarding water quality issues through environmental education. Their participation in this initiative will entail each school conducting River Health Assessments on a 200m reach of the Baynespruit stream using the miniSASS technique. Various educational materials will be made available to all schools involved. These educational materials include; lesson plans from grade R to grade 10, educational activities for primary school grade 5 and 7 and high school grade 9 and 11. Field work booklets such as the miniSASS methods pamphlet and dichotomous key will also be included. A miniSASS „Community River Health Assessment Guideline Video" will be made available as a training initiative before assessments are attempted. Duzi Umgeni Conservation Trust (DUCT) has also provided posters on wetlands, rivers, alien plants, indigenous trees and shrubs and waste management. A Science Honour"s student by the name of Adwoa Awuah from the University of KwaZulu-Natal Pietermaritzburg Campus will be undertaking the miniSASS and Water Quality Assessment (R-IHI) components in fulfilment of her Honour"s degree. She will not however, assist in the incorporation of miniSASS into the school curriculum and school participation with this regard.

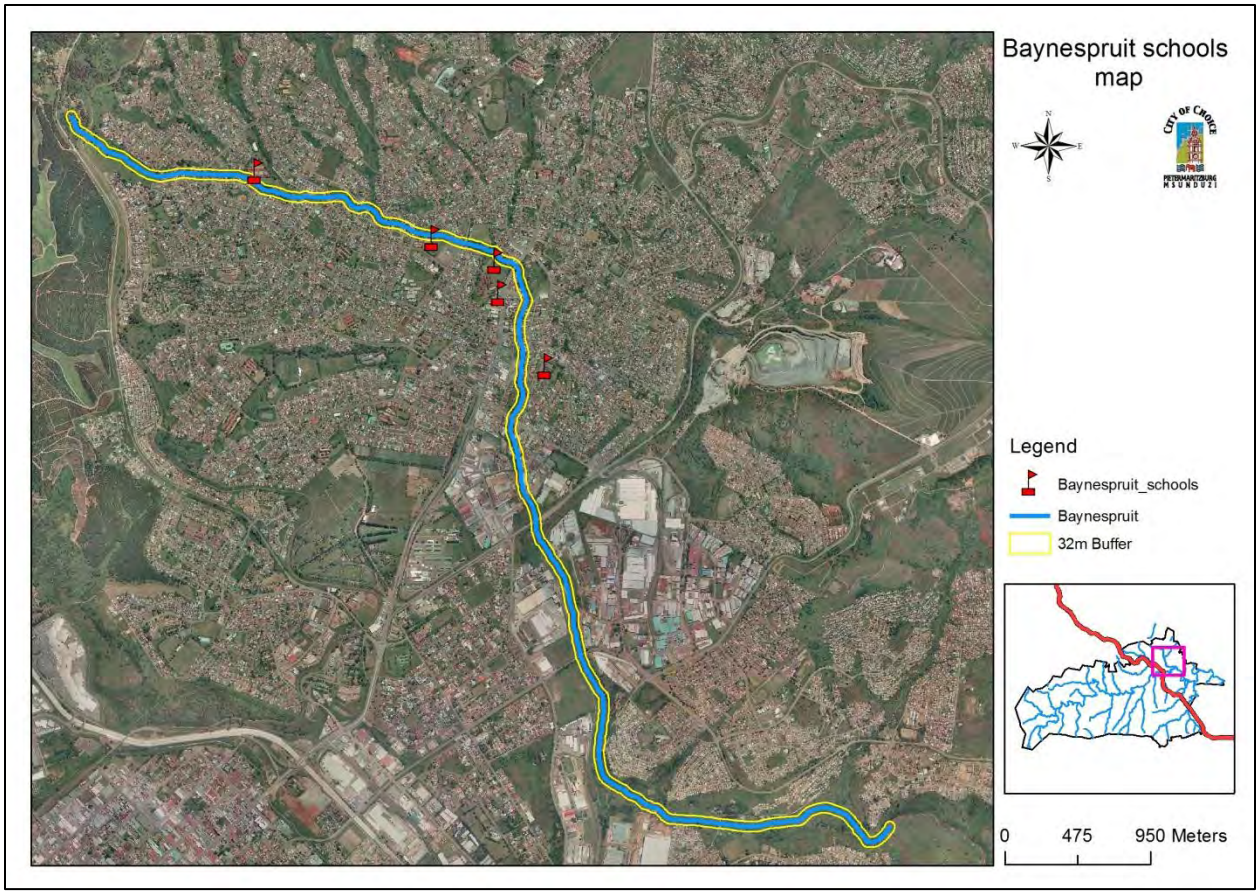


Figure 10: Schools along the Baynespruit

3.1.4 Solid Waste and Sanitation Facilities Assessment

The solid waste illegal dumping sites were noted and GPS co-ordinates were taken at these sites and input into GIS for spatial display. The sanitation infrastructure facilities such as sewers, manholes, pipe crossings and stormwater drains were recorded by GPS points being taken at the features and input into GIS for mapping. Any new illegal dumping sites, surcharging sewers or malfunctioning infrastructure were reported to the necessary departments for further investigation and remedial measures to be implemented.

3.1.5 Stormwater Assessment

The Baynespruit is surrounded by various land-use activities which in correspondence with the land use zones, indicate distinct areas of predominately residential, industrial and agriculture. This large amount of increased hardened surface exacerbates the impacts of storm activity initiating a host of environmental issues which generally negatively affects downstream users the most.

These environmental issues are an increased amount of erosion from unstable river embankments which may increase the scouring effect causing river channels to become further incised. This alteration to the hydrological flow regime may cause flooding in areas which may be densly populated which could impact livelihoods, human safety, economic security and hard built infrastructure. Stormwater control amenities may not be able to accommodate the effective management to minimise flood events due to the perpetuation of insufficient capacity to contain stormwater created from the blockages from solid waste and illegal dumping.

There are mitigation strategies which could reduce the impacts of stormwater to potentially minimise flood events. These strategies would include addressing the reduction of excessive soil erosion and the implementation of floating wetlands in the enhanced treatment of stromwater.

3.1.5.1 Erosion Control

Increasing surface roughness by replacing alien vegetation with indigenous species and revegetating stream banks will cause the movement of water from hardened surfaces to be slowed down. This will reduce excessive erosion from occuring and control the sediment transportation and build up from not being deposited into the stream channel. Stream banks will be vegetated by rehabilitating riparian vegetation, establishing riaprian forrests and the use of vetiver grass species. Before the revegetation and rehabilitation can be undertaken, the removal of alien vegetation must be completed refer to the „Alien vegetation removal and rehabilitation document" for a breakdown of the alien control component.

3.1.5.2 Floating Wetlands

Floating wetlands have also been identified as an essential and innovative solution to stormwater quality applications (figure 11) such as habitat enhancement, aesthetic value and water quality improvement (Headley and Tanner, 2006). Floating wetlands have been known to successfully remove coarse suspended sediments and also remove fine particulates of zinc and copper contaminants to a slightly lesser degree (Headley and Tanner, 2007). They are also pertinent for the regulation of combined stormwater-sewer

flow, sewage treatment, treatment of acid mine drainage effluent, piggery effluent, poultry processing water and the water filtering through these wetlands can supply reservoirs (Headley and Tanner, 2008). Headley and Tanner (2008) also suggest that the recommended water depth which must be maintained in order for successful implementation of the floating wetlands by establishment of the macrophyte roots is 0.8 – 1 meter. A constraint with regards to this initiative was determined as there is said to be no portion of the Baynespruit consisting of such a depth of which could support the implementation of a floating wetlands system and therefore this method was deemed innapropriate for undertaking with regards to the nature of this project.

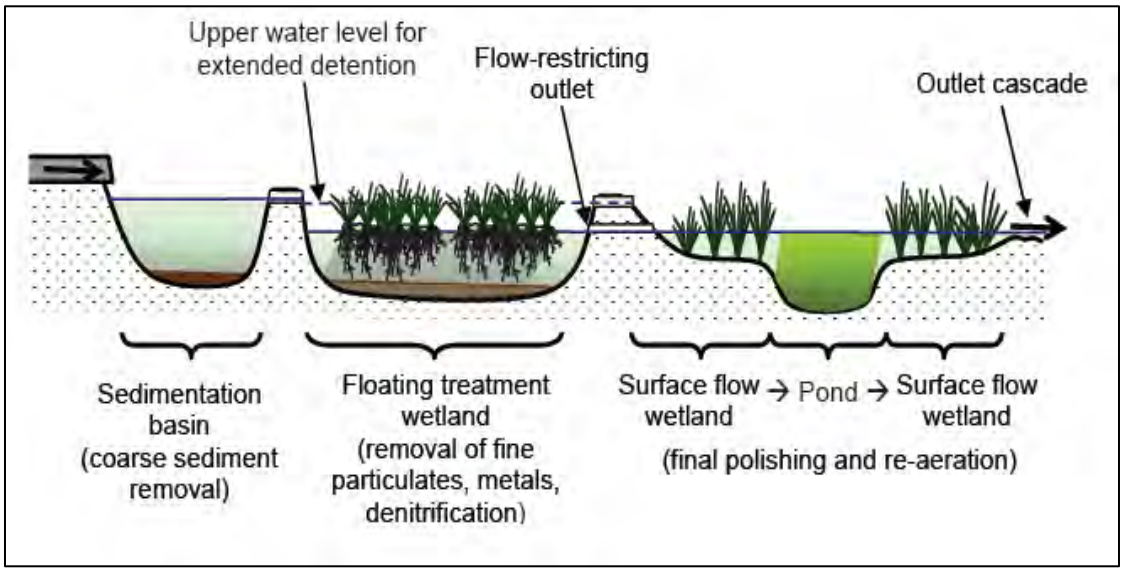


Figure 11: Conceptual longitudinal cross-section through a newly designed stormwater treatment system incorporating floating wetlands, ponds and surface flow wetlands (Adapted from Headley and Tanner, 2008: 1105).

3.1.6 Water Quality Assessment

The Index of Habitat Integrity (IHI) is a tool developed for use in the River Health Programme (RHP) and has been designed for the site specific rapid assessment and the monitoring of rivers and is to be incorporated into the national monitoring programme. This tool aims to "assess the number and severity of anthropogenic perturbations on a river and the damage they potentially

cause on the habitat integrity of the system" Dallas (2005: 4). These disturbances include abiotic factors, such as water abstraction, weirs, dams, pollution and dumping of rubble, and biotic factors, such as the presence of alien plants and aquatic animals which modify habitat.

The IHI emphasizes the field based site assessment with additional information such as aerial imagery or remotely sensed images, catchment study reports, Integrated Strategic Plans (ISPs) of DWAF per Water Management Area, Ecological Reserve Studies, the land cover database for South Africa (NLC 2000), together with local knowledge being used to supplement the data collected from the site. It should be noted that any site-based assessment will lack longitudinal continuity and therefore may not adequately reflect the habitat integrity of the river.

Aspects considered in the assessment are comprised of instream and riparian zone perturbations regarded as primary causes of degradation of a river ecosystem. The severity of each of these impacts is assessed, using scores as a measure of impact. The output scores from the IHI model are presented in the standard DWAF A-F ecological categories and provide a score of the Present Ecological State of the habitat integrity of the wetland system being examined (Table 11).

The assessor must assign a confidence level (high, medium or low) to each criterion (Table 12) based on his/her knowledge of the site and catchment. High confidence would be based on the assessor having a thorough knowledge and understanding of the site and area of at least 5 kilometers upstream. Low confidence would be based on the assessor having knowledge based on the site visit only and some supplementary information (e.g. land cover).

Table 11: Descriptions of the Habitat Integrity Classes

Ecological Category	PES % Score	Description
A	90-100%	Unmodified, natural.
B	80-90%	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.
C	60-80%	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.
D	40-60%	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.
E	20-40%	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.
F	0-20%	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.

Table 12: Descriptions of criteria used in the IHI assessment (Adapted from Dallas, 2005)

Criterion	Description
Water abstraction	Direct abstraction from within the specified river/river reach as well as upstream (including tributaries) must be considered (excludes indirect abstraction by for example exotic vegetation). The presence of any of the following can be used as an indication of abstraction: cultivated lands, water pumps, canals, pipelines, cities, towns, settlements, mines, impoundments, weirs, industries. Water abstraction has a direct impact on habitat type, abundance and size; is implicated in flow, bed, channel and water quality characteristics; and riparian vegetation may be influenced by a decrease in water quantity.
Extent of inundation	Destruction of instream habitat (e.g. riffle, rapid) and riparian zone habitat through submerging with water by, for example, construction of an in-channel impoundment such as a dam or weir. Leads to a reduction in habitat available to aquatic fauna and may obstruct movement of aquatic fauna; influences water quality and sediment transport.
Water quality	The following aspects should be considered; untreated sewage, urban and industrial runoff, agricultural runoff, mining effluent, effects of impoundments. Ranking may be based on direct measurements or indirectly via observation of agricultural activities, human settlements and industrial activities in the area. Water quality is aggravated by a decrease in the volume of water during low or no flow conditions.
Flow modification	This relates to the consequence of abstraction or regulation by impoundments. Changes in temporal and spatial characteristics of flow such as an increase in duration of low flow season can have an impact on habitat attributes, resulting in low availability of certain habitat types or water at the start of the breeding, flowering or growing season.
Bed modification	This is regarded as the result of increased input of sediment from the catchment or a decrease in the ability of the river to transport sediment. The effect is a reduction in the quality of habitat for biota. Indirect indications of sedimentation are stream bank and catchment erosion. Purposeful alteration of the stream bed, e.g. the removal of rapids for navigation is also included. Extensive algal growth is also considered to be bed medication.
Channel modification	This may be the result of a change in flow which alters channel characteristics causing a change in instream and riparian habitat. Purposeful channel modification to improve drainage is also included.
Presence of exotic aquatic fauna	The disturbance of the stream bottom during exotic fish feeding may influence, for example, the water quality and lead to increased turbidity. This leads to a change in habitat quality.
Presence of exotic macrophytes	Exotic macrophytes may alter habitat by obstruction of flow and may influence water quality. Consider the extent of infestation over instream area by exotic macrophytes, the species involved and its invasive abilities.
Solid waste disposal	The amount and type of waste present in and on the banks of a river (e.g. litter, building rubble) is an obvious indicator of external influences on stream and a general indication of the misuse and mismanagement of the river.
Decrease of indigenous vegetation from the riparian zone	This refers to physical removal of indigenous vegetation for farming, firewood and overgrazing. Impairment of the riparian buffer zone may lead to movement of sediment and other catchment runoff products (e.g. nutrients) into the river.
Exotic vegetation encroachment	This excludes natural vegetation due to vigorous growth, causing bank instability and decreasing the buffering function of the riparian zone. Encroachment of exotic vegetation leads to changes in the quality and proportion of natural allochthonous organic matter input and diversity of the riparian zone habitat is reduced.
Bank erosion	A decrease in bank stability will cause sedimentation and possible collapse of the river bank resulting in a loss or modification of both instream and riparian habitats. Increased erosion can be the result of natural vegetation removal, overgrazing or encroachment of exotic vegetation.

Once a score has been allocated to an impact, it is moderated by a weighting system. Assignment of weights is based on the relative threat of the impact to the habitat integrity of the riverine ecosystem. From Dallas (2005) the total score for each impact is said to be equal to the assigned score multiplied by the weight of that impact (Table 13). Based on the relative weights of the criteria, the impacts of each criterion are estimated as follows: rating for the criterion /maximum value (25) x the weight (percent). Example: for a criterion which receives a rating of 10 in the assessment, with a weighting of 14, the impact score is calculated as follows: 10/25 x 14 = 5.6

Table 13: Instream and riparian criteria used to develop the Index of Habitat Integrity (Adapted from Dallas, 2005).

Instream Criteria	Wgt	Riparian Zone Criteria	Wgt
Water abstraction	14	Water abstraction	13
Extent of inundation	10	Extent of inundation	11
Water quality	14	Water quality	13
Flow modification	7	Flow modification	7
Bed modification	13		
Channel modification	13	Channel modification	12
Presence of exotic macrophytes	9		
Presence of exotic fauna	8		
Solid waste disposal	6		
		Decrease of indigenous vegetation from the riparian zone	13
		Exotic vegetation encroachment	12
		Bank erosion	14

The estimated impacts of all criteria calculated in this way are summed, expressed as a percentage and subtracted from 100 to arrive at a present status score for the instream and riparian components, respectively. The Index of Habitat Integrity scores (%) for the instream and riparian zone components are then used to place these two components into a specific class. These classes are indicated in Table 11. IHI is an Excel spreadsheet based model which is used for the calculations.

3.2 Social Assessments

As with the Ecological assessment component contained herein, there are various social assessments which are vital for the success of the Baynespruit rehabilitation and water quality improvement.

People play both a dual role in society as they can either uplift society (may through protecting environmental services which provide ecosystems goods and services) and/or cause environmental degradation. In order to achieve sustainable development, public participation is instrumental in actively engaging with communities to manage and protect their resources. It is thus important to create awareness on problems causing environmental degradation along with peoples‟ rights and responsibilities so that communities can correct negative behaviour, police the problems, hold government accountable for provisions which are not functioning and ultimately improve the quality of their own livelihoods.

3.2.1 Creation of Partnerships for Potential Role Players

The scope of the project will allow for various partnerships amongst current role players to develop. With the progression of this project gaining momentum, there is definitely potential for the up scaling of this project to other rivers and increases the scope of work which may extend to inter basin transfer schemes. Other signatories of the MoU may become involved at a provincial and national scale to address and improve water quantity and quality issues. This may create interest from global organisations with regards to the prospect of co-operative governance achieving sustainable development. This in turn may attract international co-operation and financial resources.

3.2.1.1 Development of Steering Committee and Working Groups

The Steering Committee comprises representatives from each of the Partners and Role players as listed in section 1.6 of this document. Steering Committee members undertake to keep each other informed on relevant progress, in particular by provided information to other members related to; implementation of assessments and financial implications thereof, use of assessment reports, training planned and undertaken, the development of programmes, projects and policies and the planning of and findings from review/evaluation of partners' strategies, programs and projects with the purpose of supporting riverine systems improvement at country, regional and global levels (PEFA, 2014).

The Steering Committees responsibilities are to:

- Approve the objectives, targets and scope of activities for the Baynespruit Rehabilitation Project
- Mobilize the resources necessary to implement the Project
- Decide on operational strategies and procedures for the Project‟s activities
- Approve the budgets for the programmes and activities associated with the rehabilitation of the Baynespruit
- Decide the criteria for the use of the reports and assessments resulting from the Project
- Approve terms of reference for the Chair of the Steering Committee and for the Working Group
- Decide if and when any addition of Partners is desirable and the membership criteria that may apply.

Steering Committee meetings take place four times a year. Each meeting is hosted by one of the Partners on a rotational basis. The meeting is normally chaired by the host Partner. At the end of each meeting, the Steering Committee agrees on the host, location, and tentative timing of the next meeting. Between meetings, on-going consultation and coordination between the partners and with the Secretariat take place. The Secretariat is also responsible to ensure that resources are available to complete the tasks assigned to them in accordance with the Project‟s plans and budget approved by the Steering Committee. Decisions are reached through consensus by the Partners during the Steering Committees meetings or via email correspondence.

Working Groups work to create and write the standard. Standards are “published documents that establish specifications and procedures designed to maximize the reliability of the materials, products, methods, and/or services people use every day. Standards address a range of issues, including but not limited to various protocols to help maximize product functionality and compatibility, facilitate interoperability and support consumer safety and public health” (IEEE, 2014). Working Groups are thus a sub-committee of the Steering Committee for the purpose of technical development and maintenance of the Project Framework which comprises technical representatives from the Steering Committee Partners and the Secretariat.

Working Groups are open to anyone to participate. For individual standards projects membership is not required to participate. For corporate standards projects corporate membership is required. Overall, Working Groups strive for broad representation of all interested parties and encourage global participation. In the spirit of openness, agendas for Working Group meetings are distributed beforehand and the results of the group‟s deliberations are made publicly available, usually through meeting minutes. Working Groups have a chairperson who facilitates the group discussions and offers leadership and guidance to the Working Group. He/she also serves as the contact person for technical questions about the standard.

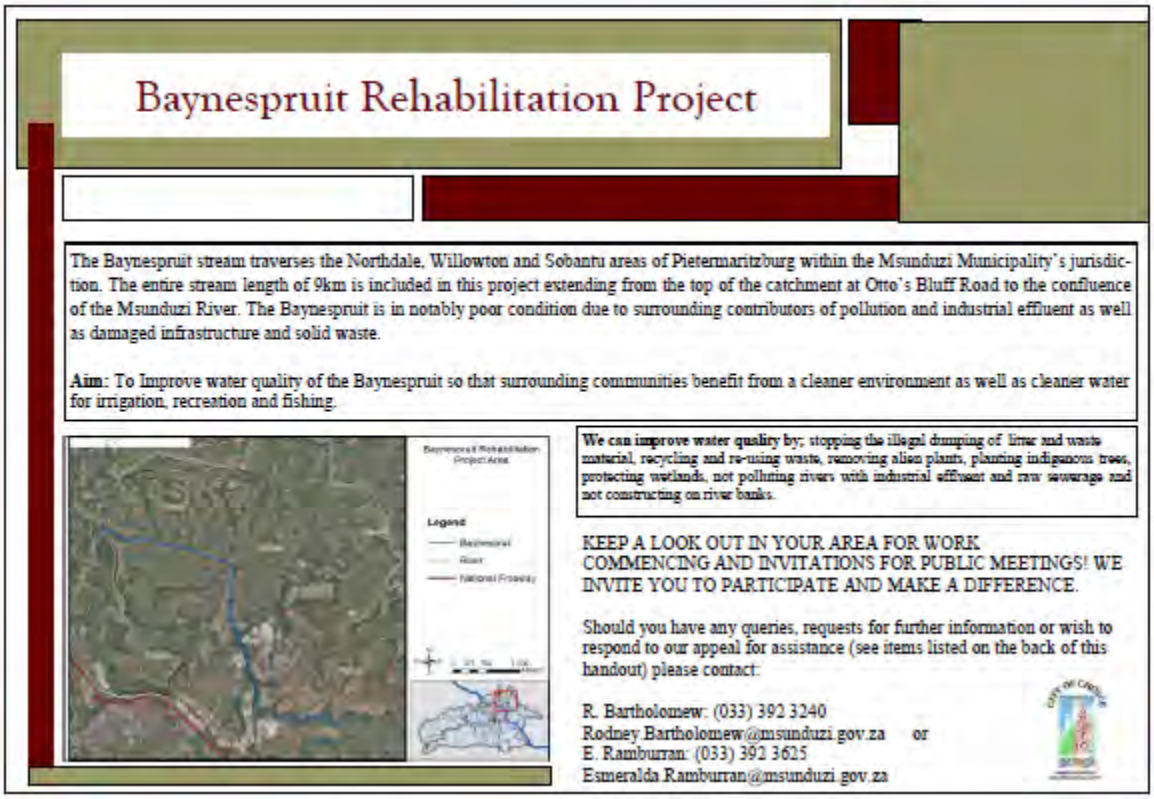
3.2.1.2 Organisational Partnerships

Willowton being predominantly zoned as industry with many industries currently occupying this area naturally lends itself to the perception that any industrial effluent discharged into and contained within the Baynespruit has originated from one of these sources. The intention behind this project is to engage with various industries to develop and implement more sustainable practices whereby alternative options for disposal of their waste products and by-products are explored. This would preferably be done with their co-operation instead of means of prosecution for non-compliance. By establishing economically and environmentally sound partnerships, more industries can be pressurised into becoming „greener‟. If green development is currently being practised by an industry, then financial sponsorship and donations can be allocated by them for the upgrading of current and implementation of new ecological infrastructure within other areas of the Msunduzi Municipality to improve water quality throughout the catchment.

3.2.2 Public Meetings and Community Engagement

In accordance with the Full Council Resolution dated the 26th of February 2014, a meeting with the Ward Councillors for Wards 28, 30, 31 and 35; Nithia Govender, Jay Singh, Rooksana Ahmed and Thandi Matiwane respectively was held prior to public engagement. The Baynespruit project and public consultative processes were discussed. This was necessary for the progression of various components of the project which requires public participation sessions with the Northdale, Willowton and Sobantu communities with regards to the illegal dumping of

waste, illegal sewer to stormwater connections, constructing on floodplains and the implications of these activities and the local schools therein to monitor water quality. The communities to be engaged with will receive invitations to participate (Figure 12). Dates will be stipulated closer to the commencement of the meeting.



Please indicate which area/s of interest below which you would be prepared to assist in or contribute to. In addition please inform us of any other initiatives you would be prepared to undertake or contribute to if it is not listed below.

1. The Sponsorship of 5 local schools to participate in miniSASS stream assessment training at R5400 per school. R5400 x 5 = R27 000
2. The Sponsorship of miniSASS stream assessment equipment for 5 local schools at R2245.80 per kit. R2245.80 x 5 = R11 229
3. The Sponsorship of funds towards hard built infrastructure such as Gabions for River Embankment Stabilisation
4. The Sponsorship of funds for obtaining Environmental Authorisation for any required built infrastructure
5. The Sponsorship of funds for weekly or monthly advertisement of water quality monitoring results in the Natal Witness
6. Litter Clean-up in your area
7. River Clean-up along the Baynespruit Stream
8. Monitoring and Reporting pollution, illegal disposal of waste or illegal dumping sites in your area
9. Monitoring and Reporting Sewer related problems for example, the illegal dumping of waste into sewers or surcharging (over-flowing) sewers
10. Alien Plant Removal
11. Donation of Indigenous plants
12. Planting of Indigenous plants
13. Recycling household materials such as paper, plastic and glass
14. Adopt a spot of the Baynespruit stream, key biodiversity areas which are habitats for sensitive fauna and flora

Please respond to Mr. Rodney Bartholomew or Miss Esmeralda Ramburran via email or telephone (Contact details provided on the first page of this handout).

Your involvement, contribution and participation is welcomed and most appreciated. We look forward to working with you.

THANK YOU

Figure 12: Public participation invitation

3.2.3 Local Schools' Custodianship of the Environment

Local schools located in the Baynespruit catchment will be contacted by our Environmental Management Unit to inform them of the Baynespruit Project and a formal request to participate will be disseminated to the schools and governing bodies [refer to the „School_Participation" (Appendix C) document]. Msunduzi Municipality will conduct in-field miniSASS assessments with the five schools together with GroundTruth Water, Wetlands and Environmental Engineers. These Schools will then be aligned with WESSA EcoSchools and Sharenet for follow-up management of water quality monitoring along the portion of the Baynespruit which they have adopted.

3.3 Economic Assessments

The economy is represented as the third pillar of sustainable development with the ecological and social components being the first and second pillars. According to the Municipal Structures Act, 1998 (Act 117 of 1998), the responsibility of local government is comprised of two elements; *"the first being concerned with macro level functions such as planning and promotion of integrated development planning, land, economic and environmental development; and the second with the sustainable provision of specific services such as health, housing, water and electricity"*. With regards to the economic assessment component of this project, the following needs to be understood; the role of local government in the provision of service delivery, the fiscal capacity and budget and the outsourcing of funds and sponsorships which may assist in the promotion of our economy in an environmentally sustainable manner. The Municipal Systems Act, 2000 (Act 32 of 2000) 4(2)(e) places a duty on the Council of a Municipality to "*strive to ensure that municipal services are provided to the local community in a financially and environmentally sustainable manner"*.

3.3.1 Local Government Service Delivery

Area Based Management (ABM) is about community facilitation, increasing participation, conflict resolution, community advocacy, relocation of communities, monitoring and speeding of services delivery through the decision tracker. It is one of the components under the Corporate Strategic Planning Business Unit. Area Based Management is the common ground for both the Communities and the Municipality. Msunduzi Municipality is required by the laws of the country to deliver services to the people and for Communities to participate in matters of Local Government. The White Paper on Local Government encourages Municipalities to pursue a role of a developmental Local Government. The following legislations/principles are relevant to the formulation, development and the implementation of Area Based Management.

The Constitution of South Africa (Act 108 of 1996);
The objects of Local Government are contained in the constitution Chapter 7, Section 152 sub-section 1:

- To provide democratic and accountable government for local Communities.
- *To ensure the provision of services to Communities in a sustainable manner.*
- *To promote social and economic development.*
- To promote a safe and healthy environment.
- *To encourage the involvement of Communities and Communities organisations in the matters of Local Government*

3.3.2 Fiscal Capacity and Budget

The Msunduzi Municipality lacks both human and financial capital to carry out the marketing functions properly as a result of being short staffed and having less budget to undertake huge marketing drives, It is not to say no work has been performed but points out to the fact that it poses a challenge in terms of investment attraction and the promotion of the City. The poor infrastructure, bad state of cleanliness and unreliable electricity supply, have also contributed negatively to the attraction of investors and tourists, and made it difficult to promote the City.

The other issue identified as one of the constraints regarding marketing tools was the poor Inter Governmental Relations with other spheres of Government and organizations. The marketing tools that needs further development is the website, brochures with marketing projects and drives, Magazines and Publications as well as other related marketing information.

This Section presents the Investment Development Framework and strategic interventions within which the Investment Strategy is developed. The vision and mission of the City's guide the framework in which the Investment Strategy is developed. A favourable investment environment is required for any type of development, regardless of sector or economic project. The success of economic initiatives, to a degree, is dependent on investment interventions to improve the investment environment. This section recommends strategic interventions required to improve the City environment in a manner that will facilitate investment. The strategy indicates that the role of the Msunduzi Municipality in investment promotion and facilitation should include the following:

- Creation of a package of local or regional incentives and concessions to attract and support business activities.
- Maintenance of a lobbying capacity for specific programmes, projects, offices, facilities and other services that may relocate to the area.
- Establishment and maintenance of a regional business inventory and database, including skills base, public owned land, commercial sites, rental rates, etc.
- Provision of relevant and up-to-date information and analysis on the local business environment.
- Creation of a "fast track process unit" in local government for handling planning, information and regulatory activities.
- Branding and promotion of the area as a centre of excellence in this regard.

3.3.3 Outsourced Funding and Sponsorships

The Marketing and Public relations Unit of Msunduzi Municipality has identified the need for a Marketing Strategy, aiming to be competitive and creating a vibrant brand identity for the city. With the development of marketing strategy and the incorporation with the LED strategy aims to synergize the Units efforts to attract investment and marketing Msunduzi Municipality on local and global environment (Msunduzi Municipality Draft Marketing Strategy, 2014). The focus will be on promoting sustainable and integrated development in local economy. The objective of marketing strategy is to formulate guidelines and implementation plan for retaining the existing industries and attraction of new and potential industries. In order to achieve this goal the following would be taken into consideration:

Market analysis: A review of local businesses data base and the relevant provincial departments such as Economic development, Integrated Development Plan, non-profit organizations, etc., as well as marketing data, promotional tools that will be cost effective, resources that will enable efficiency of the marketing strategy.

Marketing strategy: The development and formulation of vision, strategies and programmes, are required in order to be able to realize the vision. Target market, brand identity and market segment and marketing messages that are inward and external missions and mechanisms for public invitation and participation must be included.

Marketing materials: review of marketing communication information containing competitiveness of Msunduzi Municipality for the aim of potential investors. The marketing information contains the marketing investment environment of each sector with priority projects and potential investment opportunities. The investors will need to know key information is illustrated in the Table 14 below.

Table 14: Competitiveness of Msunduzi Municipality for the aim of attracting potential investors

MARKET ACCESS	INFRASTRUCTURE	ECONOMY	STRATEGIC RESOURCES
Potential Growth	Logistical platforms	Economic growth rate and responsiveness	Access to land
Place marketing	Infrastructure development	Economic stability and trends	Raw Materials
Tourism	Infrastructure Development	Local and International tourist spending.	Tourism sites.

Export marketing will be play a pivotal role income generation for Msunduzi Municipality. The local industries will have niche to compete successfully with the integration and efforts of develop the marketing strategy. With the creation of the Tourism Hub, it is another strong focus area and local industries will be encouraged to explore and utilize and market their unique attributes and invest to the local tourism sector. Efforts have been created and intensified to address unemployment with job creation and investment attraction. These plans are clearly marked out in the Integrated Development Plan which is five year strategic plan. The objectives are:

- To stimulate economic growth through job creation, promotion of BBBEE, development of SMME's, co-operatives and agri- industry.
- To promote sustainable tourism
- To promote and stimulate business investment, retention and expansion

The Msunduzi Municipality needs to highlight its range of attractions and activities as unique to it and different from other destinations by emphasizing the undiscovered, un-crowded quality of these attractions and activities in close proximity to all amenities and entertainment facilities that a tourist could want. It is true that the Msunduzi Municipality is set among the forested hills and rolling country side of the Natal Midlands, and is one of the best preserved Victorian Cities in the world boasting the largest brick building in the Southern Hemisphere, the City Hall.
The location of Pietermaritzburg has a strong influence on regional channels of investment, movement and structuring of the provincial spatial framework for growth and development. Pietermaritzburg has the following selling points:-

- Legislative and Administrative capital of the KwaZulu-Natal.
- Strategically located on South Africa's busiest highway, the N3.
- 45 minutes' drive from the Durban Port, and one hr. to King Shaka International Airport.
- One hour flight from O.R Tambo International Airport and Pietermaritzburg Airport.
- Excellent network of road, rail and air linkages.
- It is the sporting pulse point hosting such great events like the Comrades Marathon, Duzi Marathon, Royal Show and UCI BMX and MTB International Cycling Events.
- Some of the best schools in the Country are found in Pietermaritzburg
- Very unique and significant historical and heritage attractions.

It is recommended that these unique selling points be incorporated into the brand and positioning of Pietermaritzburg.

Chapter 4
Conclusion

The Baynespruit catchment is a relevant site in need of ecological infrastructural rehabilitation. It is a key area which will contribute to the overall improvement of water quality results for the Msunduzi River and the Umgeni catchment.

The water quality of the Baynespruit will be improved through the rehabilitation, implementation and improvement of ecological infrastructure to the extent at which it is able to provide surrounding communities with water safe enough for irrigation of their agricultural crops, for fishing and recreational purposes and ensure that water entering the Msunduzi River is of good condition. The integration of the restoration and management of ecological infrastructure with respect to the water reconciliation strategy for the Greater uMgeni River Catchment will allow for the overall significant improvement of the catchment and for water services to deliver water and sanitation services more effectively and efficiently.

In compliance with local government mandates and NEMA, all tiers of government must engage in holistic sustainable development where economic and social development is promoted but not at the expense of environmental conservation of resources for future generations.

Economic production contributes significantly to sustainable livelihoods which are crucial to the economy of KwaZulu-Natal and in addition, ecological infrastructure contributes significantly to the livelihoods of the people dependant on the environment for their livelihood resources. Therefore it is vital that ecological infrastructure is restored and managed in such a manner so as to deliver critical Ecosystems goods and Services to the economy of the province.

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