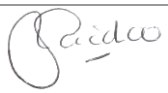
UMGENI WATER

PROPOSED DARVILL CONSTRUCTED WETLAND EIA

DRAFT ENVIRONMENTAL IMPACT REPORT

Issue Date: March 2017
Revision No.: 1
Project No.: 13396

Date:	March 2017
Document Title:	**DARVILL CONSTRUCTED WETLAND EIA**
Author:	Shivani Naidoo
Signature:	
Revision Number:	1
Checked by:	Tarryn Curtis
Approved:	Tarryn Curtis
Signature:	
For: **Umgeni Water**	
"Copyright is vested in SiVEST in terms of the Copyright Act, 1978 (Act No. 97 of 1978) and no use or reproduction or duplication thereof may occur without the written consent of the author"	

UMGENI WATER

PROPOSED DARVILL CONSTRUCTED WETLAND EIA

FINAL ENVIRONMENTAL SCOPING REPORT

Contents Page

1 INTRODUCTION 1
2 DETAILS OF THE ENVIRONMENTAL ASSESSMENT PRACTIONER (EAP) 3
3 DESCRIPTION OF THE PROPOSED ACTIVITY AND ALTERNATIVES 3
3.1 Brief Overview 3
3.2 Detailed Activity Description 3
3.2.1 Principal Design Data 4
3.2.2 Dams 5
3.2.3 Channels, Gates and Sluice 5
3.2.4 Spillway 6
3.2.5 Drop Inlet Tower Structures and Emergency Overflow Spillways 6
3.2.6 Proposed Surface Flow Wetlands/Attenuation Wet Ponds 6
3.3 Need and Desirability 7
3.4 Description of identified feasible and reasonable alternatives 7
3.4.1 Alternative sites 8
3.4.2 The "No Go" Option 12
3.5 Layout 12
4 A DESCRIPTION OF THE PROPERTY ON WHICH THE ACTIVITY IS TO BE UNDERTAKEN 12
4.1 Regional Locality 12
4.2 Site Description 13
4.3 Climate 13
4.4 Topography and Geology 14
4.5 Surface water and Wetlands 14
4.6 Biodiversity (Fauna and Flora) 14
4.7 Visual Environment 15
4.8 Heritage and Cultural Aspects 15
4.9 Social and Economic Aspects 15
5 SPECIALIST STUDIES 15
5.1 Vegetation Impact Assessment 16
5.2 Aquatic Ecosystem Assessment 18
5.3 Avi-Faunal Impact Assessment 20
5.4 Heritage Impact Assessment 22
5.5 Geo-hydro & Geo-technical impact Assessment 22
5.5.1 Aquifer Characterisation 22
5.5.2 Groundwater Quality 23
5.5.3 Hydro-census 24
5.5.4 Potential Pollution Source Identification 24
6 MACRO PERSPECTIVE OF THE LEGAL ENVIRONMENT AND ASSESSMENT FRAMEWORK 26
6.1 Legislative considerations 26
6.1.1 Constitution of the Republic of South Africa Act (Act No 108 of 1996) as amended by the Constitution of the Republic of South Africa, Amendment Act (Act No 35 of 1997) 26
6.1.2 National Environmental Management Act (Act No 107 of 1998) as amended June 2010 27
6.1.3 National Environmental Management: Waste Act (Act No. 59 of 2008) 28
6.1.4 Hazardous Materials and Installation Management 29
6.1.5 National Water Act (Act No 36 of 1998) 29
6.1.6 National Heritage Resources Act (Act No 25 of 1999) 30
6.1.7 Conservation of Agricultural Resources Act (Act No. 43 of 1983) 30
6.1.8 National Environmental Management: Biodiversity Act (Act No 10 of 2004) 31
6.1.9 Conservancies 31
6.1.10 Other National, Provincial and Local legislation of potential relevance 31
7 APPROACH AND METHODOLOGY 32
7.1 Introduction to the Scoping and EIA Process 32
7.1.1 Process in Terms of the NEMA EIA Regulations 32
7.2 Scoping Phase 33
7.2.1 Objectives 33
7.2.2 Scoping Report Requirements as per the NEMA EIA Regulations 33
7.2.3 Compilation and Public Review of the Final Scoping Report 34
7.2.4 Compilation of the Final Scoping Report 34
7.2.5 Assessment Phase 34

7.2.6 Public Participation Process *34*
8 PUBLIC PARTICIPATION **34**
8.1 Objectives of Public Participation 35
8.2 Identification and Involvement of Interested and Affected Parties 36
8.2.1 Registration of Interested and Affected Parties *37*
8.2.2 Notification of Key Stakeholders *37*
8.2.3 Landowner Notification *37*
8.2.4 Media Notices *37*
8.2.5 Notice Boards *37*
8.2.6 Background Information Document *38*
8.2.7 Public Information Sharing Meeting *38*
8.2.8 Solicitation of Comments *38*
8.2.9 Comments and Response Report *38*
9 ENVIRONMENTAL ISSUES & POTENTIAL IMPACTS **39**
9.1 Rating System Used to Classify Impacts 39
9.1.1 Assessing impacts on the biophysical environment *39*
9.1.2 Environmental Value *39*
9.1.3 Ecosystem Goods & Services Value *40*
9.1.4 Conservation Status *40*
9.1.5 Impact Magnitude *41*
9.1.6 Degree of Disturbance *41*
9.1.7 Impact Extent *42*
9.1.8 Impact Duration *42*
9.1.9 Impact Probability *42*
9.1.10 Assessing impacts on the social and socio-economic environment *43*
9.1.11 Social Value *43*
9.1.12 Impact Magnitude *44*
9.1.13 Degree of Disturbance *44*
9.1.14 Impact Extent *46*
9.1.15 Impact Probability *47*
9.1.16 Determining Impact Significance *47*
9.2 Construction phase Impacts 48
9.2.1 Topography and Geology *48*
9.2.2 Potential soil and water pollution *50*
9.2.3 Surface Water *52*
Medium *54*
9.2.4 Biodiversity (Flora) *54*
Medium *55*
9.2.5 Impact on Avi-Faunal *55*
Medium *56*
9.2.6 Temporary above ground storage of fuel *57*
9.2.7 Dust *58*
9.2.8 Noise *58*
9.3 Potential Impacts on the Socio-Economic Environment 59
9.3.1 Impact on the surrounding residents as a result of air pollution during the construction phase. *59*
9.3.2 Impact on the surrounding residents as a result of noise pollution during the construction phase. *60*
9.3.3 Disruption caused to surrounding residents from traffic impacts *61*
9.3.4 Heritage and Cultural Aspects *62*
9.3.5 Visual Impact *63*
9.3.6 Employment and Job Creation *63*
9.3.7 Skills Development *64*
9.4 Operational Phase Impacts: 64
9.4.1 Stormwater runoff along the hardened surfaces of the constructed wetland (Soil Wash) *64*
9.4.2 Disturbance of the linear flow channel *66*
9.4.3 Change in subsurface water movement *67*
9.4.4 Increase in pollution or contamination risk *67*
9.4.5 Decline in downstream wetland integrity *68*
9.4.6 Noise *69*
9.4.7 Effective functioning of the Darvill WWTW during a high storm event *70*
9.4.8 Boost in Local Economic Growth and Development *70*
9.5 Cumulative Impacts 71
9.5.1 Boost to Local Economic Growth and Business Development *71*
9.5.2 Opportunity for new processes to be explored *71*
Medium *71*
9.6 No-Go Option 71
9.6.1 Impacts on the Socio-Economic environment *71*
9.6.2 Increased pressure on current Darvill WWTW Plant *72*
9.6.3 Activated sludge entering the Msunduzi River system after high flow events *72*
9.7 Decommissioning Phase 72
10 ENVIRONMENTAL IMPACT STATEMENT SUMMARY **73**
10.1 Significant Impacts before Mitigation 73
10.2 Significant Impacts Post Mitigation Measures 76
11 ENVIRONMENTAL IMPACT STATEMENT **78**

12 CONCLUSION AND RECOMMENDATIONS 78

List of Tables

Table 1: Listed Activities 1
Table 2: Environmental and SiVEST specialist consultants 3
Table 3: Summary of climatic conditions of the proposed site 13
Table 4: Ecosystem goods & services value rating categories 40
Table 5: Conservation status rating categories 41
Table 6: Degree of Disturbance rating categories for biophysical/ecological systems 41
Table 7: Extent rating categories 42
Table 8: Duration rating categories 42
Table 9: Probability rating categories 43
Table 10: Social value rating categories 43
Table 11: Degree of Disturbance rating categories for the 'determinants of quality of life' 45
Table 12: Relative Contribution and Importance rating categories for the 'determinants of quality of life' 45
Table 13: Degree of Disturbance rating categories for human health and safety 46
Table 14: Degree of Disturbance rating categories for agricultural resources 46
Table 15: Degree of Disturbance rating categories for cultural heritage resources 46
Table 16: Extent rating categories 47
Table 17: Duration rating categories 47
Table 18: Probability rating categories 47
Table 19: Significance score rating categories 48
Table 20: Impacts before mitigation for the Preferred Option 73
Table 21: Impacts after mitigation 76

List of Figures

List of Annexures

Annexure A: Expertise of Environmental Consultants
Annexure B: Locality Plan and Layout Plan (including designs)
Annexure C: Public Participation Report

Glossary of terms

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.

Environmental Impact Assessment: In relation to an application, to which Scoping must be applied, means the process of collecting, organising, analysing, interpreting and communicating information that is relevant to the consideration of the application.

Environmental Impact Report: In-depth assessment of impacts associated with a proposed development. This forms the second phase of an Environmental Impact Assessment and follows on from the Scoping Report.

Environmental Management Programme: A legally binding working document, which stipulates environmental and socio-economic mitigation measures that must be implemented by several responsible parties throughout the duration of the proposed project.

Precipitation: Any form of water, such as rain, snow, sleet, or hail that falls to the earth's surface.

Red Data Species: All those species included in the categories of endangered, vulnerable or rare, as defined by the International Union for the Conservation of Nature and Natural Resources.

Riparian: The area of land adjacent to a stream or river that is influenced by the stream or induced through related processes.

Scoping Report: A report that identifies issues, potential impacts and alternatives which forms the first phase of an Environmental Impact Assessment process.

List of Abbreviations

AMAFA	– *Amafa aKwaZulu-Natali* Heritage Council
BID	– Background Information Document
DEA	– Department of Environmental Affairs (National)
EDTEA	– Department of Economic Development, Tourism and Environmental Affairs
DSR	– Draft Scoping Report
EA	– Environmental Authorisation
EIA	– Environmental Impact Assessment
EIR	– Environmental Impact Report
DEIR	– Draft Environmental Impact Report
EMPr	– Environmental Management Programme
ENPAT	– Environmental Potential Atlas
ESRI	– GIS and Mapping software
FSR	– Final Scoping Report
GIS	– Geographic Information System
HIA	– Heritage Impact Assessment
I&APs	– Interested and Affected Parties
IUCN	– International Union for the Conservation of Nature and Natural Resources
NEMA	– National Environmental Management Act, 1998 (Act No. 107 of 1998)
NEMBA	– National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004)
NFA	– National Forests Act, 1998 (Act No. 84 of 1998)
NHRA	– National Heritage Resources Act, 1999 (Act No. 25 of 1999)
NWA	– National Water Act, 1998 (Act No. 36 of 1998)
PM	– Public Meeting
PPP	– Public Participation Process
SANBI	– South African National Biodiversity Institute
WWTW	- Waste Water Treatment Works

UMGENI WATER
PROPOSED DARVILL CONSTRUCTED WETLAND EIA

DRAFT ENVIRONMENTAL IMPACT REPORT

1 INTRODUCTION

SiVEST Environmental Division has been appointed by **UMGENI WATER** to conduct an Environmental Impact Assessment (EIA) in terms of the National Environmental Management Act, 1998 (Act 107 of 1998) as amended in 2014, for the proposed Darvill Constructed Wetland EIA.

In terms of the Environmental Regulations promulgated under the National Environmental Management Act (NEMA) an EIA must be conducted for any development or activity that requires an Environmental Authorisation. Government Notice (GN) No. R. 983 and 984 (4 December 2014): Listing Notice 1 and 2 stipulates that a Full Scoping and EIA Assessment is required for the following listed activities, some or all of which may be triggered by the proposed development: The relevant listed activities contained in NEMA that trigger the need for Environmental Authorisation are listed below:

Table 1: Listed Activities

Indicate the number and date of the relevant notice:	**Activity No.(s) (in terms of the relevant or notice):**	**Describe each listed activity as per the detailed project description (and not as per wording of the relevant Government Notice):**
GNR 983 of 4 December 2014	**12**	The proposed constructed wetland will include development of the surface flow wetland cells infrastructure that will exceed 100 square metres for the bulk transportation of sewage or storm water.
GNR 983 of 4 December 2014	**19**	Construction of the proposed constructed wetland will involve excavation and removal and/or moving of more than 5 cubic metres of soil.
GNR 983 of 4 December 2014	**27**	The proposed surface area to be cleared for the constructed wetland is approximately 8.6ha
GNR 983 of 4 December 2014	**48**	A canal will be constructed from the final wetland cell to the existing maturation river outfall structure into the Msunduzi River
GNR 984 of 4 December 2014	**6**	The proposed constructed wetland will require a Water Use Licence in terms of the National Water Act, 1998 (Act No. 36 of 1998) (NWA). The following water uses will be triggered under Section 21 of the NWA for the proposed constructed wetland:

Indicate the number and date of the relevant notice:	Activity No.(s) (in terms of the relevant or notice):	Describe each listed activity as per the detailed project description (and not as per wording of the relevant Government Notice):
		• (c) Impeding or diverting the flow of water in a watercourse; • (i) Altering the bed, banks, course or characteristics of a watercourse; • (g) disposing of waste in a manner that may detrimentally impact of a watercourse The proposed constructed wetland will also require a Waste Management Licence as the development would trigger GNR 921 - Category A - activity no 5, the treatment of hazardous waste in lagoons.
GNR 984 of 4 December 2014	**11**	The proposed constructed wetland cells will "treat" the overflow from the storm dam and the final effluent from the wetland will gravitate to the Msunduzi river.
GNR 984 of 4 December 2014	**16**	The constructed wetland will comprise of a series of three wetland/attenuation ponds.
GNR 984 of 4 December 2014	**25**	The proposed constructed wetland will have a capacity to hold/process 140ML of polish/ naturally treated wastewater.

Any construction within 500 m to a watercourse (including wetlands) requires a Water Use Authorisation from the Department of Water and Sanitation (DWS) according to the National Water Act (NWA) (Act No. 36 of 1998). The project will trigger impacts on surrounding water resources (Msunduzi River) and thus requires a water use licence application. This process will run concurrently with the EIA process. **N.B.** Note that wastewater effluents are not defined as waste as they are regulated and controlled by the Water Act, 1956 (Act 54 of 1956) (refer to Section 1 paragraph 1.1). Sewage sludge from sewage works and building rubble contaminated by other waste or not used for fill would fall under the definition of waste.

This project will be registered with the National Department of Environmental Affairs (DEA).

In addition to the EIR phase of the Environmental process, various specialist studies, identified as part of the Scoping Phase of the project, have been be undertaken.

These specialist studies have been be used to address the potential issues that are raised during the Scoping Phase. Further, these studies will respond and provide supporting information to issues raised through the Public Participation Process.

2 DETAILS OF THE ENVIRONMENTAL ASSESSMENT PRACTIONER (EAP)

SiVEST has considerable experience in the undertaking of EIAs. Staff and specialists who have worked on this project and contributed to the compilation of this Scoping Report are detailed in **Table 2** below.

Table 2: Environmental and SiVEST specialist consultants

SKILL	NAME	QUALIFICATIONS	YRS EXP
Project Manager	Tarryn Curtis	B.Sc. (Hons) Geography and Environmental Management	10
Project Consultant and Public Participation Specialist	Shivani Naidoo	B.Sc. (Hons) Geography and Environmental Management	4

*Please refer to attached CV's for more information (See **Appendix A**).

3 DESCRIPTION OF THE PROPOSED ACTIVITY AND ALTERNATIVES

3.1 Brief Overview

Darvill Wastewater Works was constructed in the mid-1950s and commissioned in 1958. It has been owned and operated by Umgeni Water since 1992 and is currently undergoing an upgrade to increase its capacity by an additional 35Ml/day. Part of the upgrade includes the construction of an artificial wetland that will assist in attenuating storm water run-off and thus preventing overflow of activated sludge in to the Msunduzi River. The upgrade of the WWTW will still be unable to accommodate the erratic high storm flow volumes and to ease the impacts associated with these storm flow events, Umgeni Water (UW) have considered the use of wetland habitat to partially treat the overflows (effluent) from the storm flow storage dam before entering the Msunduzi River. A **surface flow** wetland is proposed.

Aim:

The wetland creation aims to provide additional attenuation capacity for the effluent originating from the storage dam during the high flow events and potentially enhance the provision of wetland ecosystem services within a substantially transformed landscape.

Objective:

The primary objective of the wetland creation is to establish and maintain a wetland ecosystem in a desired state (a system dominated by *Phragmites australis* and/or *Typha capensis*) to promote ecosystem services associated with water quality enhancement. During high storm flow events, the created wetland habitat will also provide additional attenuation capacity serving to increase the retention time of flows through the system, potentially enhancing the water quality, although the efficacy of the system to 'polish' the water during these events would be largely reduced.

3.2 Detailed Activity Description

The bulk infrastructural elements for the above mentioned approach are to include the following:

- Storm and base flow off take structure from the existing storm dam outlet channel (An appropriate off-take channel and structure will be installed along a portion of the storm water attenuation dam canal to allow storm flows into the constructed system)

- Rectangular canal, which becomes a trapezoidal canal to deposit effluent from existing storm dam outlet channel to wetlands
- A weir as part of the offtake structure from the existing storm dam outlet channel
- Relocation of the exiting chlorinated effluent outlet (The existing chlorine treatment outlet should be relocated downstream of the wetland off-take, ideally situated between the wetland off-take and the discharge from the maturation river)
- Three discrete wetlands (Construct a series of wetland/attenuation ponds. These wetland systems are similar to natural systems, and are not reliant on gravel beds for purification, and therefore are less expensive to install and maintain)
- Outlet structures for each of the wetlands
- Base Flow pipe connections between ponds and final outlet
- Emergency Spillways between ponds and final outlet
- By-pass channel
- Outlet channel from the third cell to the cascade portion of the maturation river
- Monitoring station at the end of the outlet channel.
- The effluent from the constructed systems will be discharged into the existing maturation river outfall on the Msunduzi River via a vegetated channel. An inlet will be constructed into the outfall, to allow the water to be aerated prior to being discharged into the Msunduzi River.

3.2.1 Principal Design Data

The principal design data and criteria which was utilised in the wetland habitat creation for the Darvill WWTW as per the design report is listed below:

- Area for wetlands = 8.6 ha
- Depth for wetland = 1.0 m to spillway, 0.6 m in wetlands
- Effluent should be less than or equal to 2.5 Ml/day (2500 m3/day)
- Site is beyond 1:100 year flood line
- Wetland attenuation capacity = 80 Ml (at spillway level) 45Ml (at base flow level)

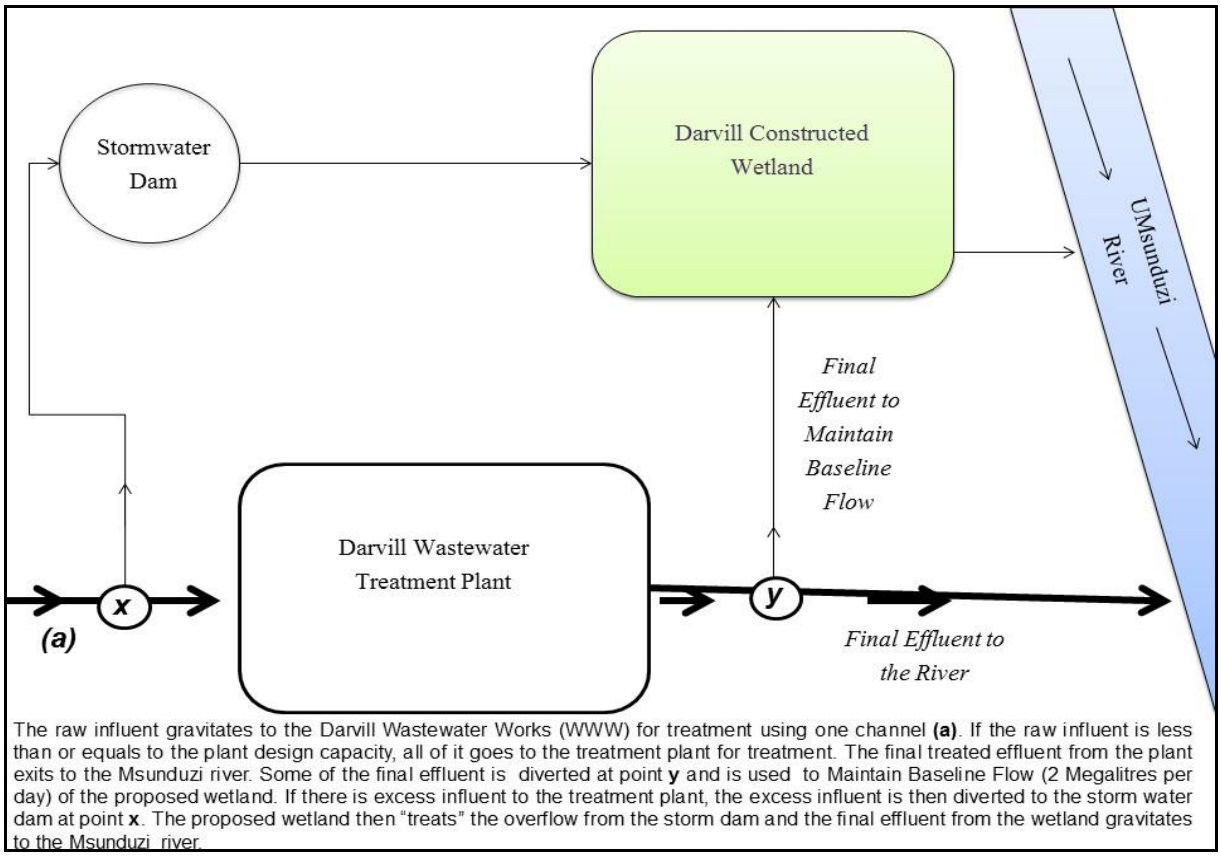


Figure 1: Diagrammatic representation of how the constructed wetland will operate

The above process is further briefly discussed below:

3.2.2 Dams

An impermeable layer is not required for the ponds since it is assumed that the substrate is impermeable. A 3m berm will be constructed around the outer edge of the constructed wetlands in order to prevent Msunduzi River flood waters entering the system. The objective of these earthen berms would be to increase the flow path of the effluent within the base of the ponds and in so doing, increase the contact time of the effluent with the wetland vegetation. Internal berms of 2m and 0,5m will be constructed for the bird watchers. When constructing the ponds both cut and fill will be done. The slope used for the berms during the design phase of the wetland was 1:2.5. A base flow pipe should be incorporated between each of the wetland systems to maintain flows to sustain the vegetation during the low flow months. There will be a monitoring station at the end of the outlet channel to monitor the discharge rates exiting the wetland habitat when the effluent from the constructed wetland habitat is discharged into the Msunduzi River.

3.2.3 Channels, Gates and Sluice

An appropriate off-take structure will be installed along a portion of the storm water attenuation dam canal to allow storm flows into the constructed system. This structure will include an adjustable weir on a rectangular canal which becomes a trapezoidal canal. A flow diversion structure will be constructed downstream of the offtake structure to make allowance for the diversion of effluent into the trapezoidal bypass, when required, by means of a manual stop lock system. This trapezoidal bypass allows flows

to bypass either of the first two wetland cells allowing maintenance activities to be carried out in either of these cells. This bypass will only be utilised during emergency situations. Construction of a canal from the final wetland cell to the existing maturation river outfall structure into the Msunduzi River. Tower drop inlet structures (TDIs) will make allowances for base flows (by means of an opening with manual stop lock system 600mm above the level of the wetlands) to ensure that the wetland habitat within the base of the ponds remains wet at all times of the year.

3.2.4 Spillway

Emergency spillways will be incorporated into the design of the wetland berms (in the vicinity of the TDIs) to cater for extremely high flows, as well as in cases where maintenance is required on the TDIs and associated outlet pipes. The emergency spillway should be lined with concrete gabions and be in the form of a chute on the downstream side.

3.2.5 Drop Inlet Tower Structures and Emergency Overflow Spillways

In order to maximise the attenuation capacity within the wetland systems, it is recommended that tower drop inlet structures be constructed at the outlets of each of the wetland systems. The TDIs should make allowance for base flows (by means of an opening with a sluice located 200mm above the level of the wetlands) to ensure that the wetland habitat within the base of the ponds remains wet at all times of the year. The rate of flows through the base flow openings should be controlled by means of sluice gates that will control:

- The volumes of base flows that enter each of the wetland systems; and
- The rate at which the wetland ponds drain to ensure that the vegetation is not inundated for extended periods during high and extended rainfall events.

The base flows, which will comprise of treated effluent from the existing maturation river during the winter months, should at least match the water demand from the wetlands which is anticipated to include minor seepage and evapotranspiration. The energy of the water discharging from the TDI outlet pipes should be controlled with appropriate structures on the downstream outlets. The outlet structures should include energy breakers and a stilling basin that would also be utilised as a spreader canal to promote diffuse flows (when discharging into a wetland system). A spreader canal will not be required on the final structure as it will be discharging into the return channel to the existing outfall into the Msunduzi River.

3.2.6 Proposed Surface Flow Wetlands/Attenuation Wet Ponds

The effluent from the off-take channel will discharge into a series of constructed wetlands/attenuation wet ponds. It is proposed that a series of three wetland/attenuation wet pond systems be constructed within the available area. Surface flow wetland habitats were considered to be more desirable in comparison to sub-surface flow wetlands to avoid the need for gravel substrate. Although these gravel systems are effective, the establishment and on-going maintenance requirements of these systems are substantially more than the surface flow systems.

Wet ponds have been recommended, to assist in the removal of sediments from the effluent, increase retention time, and provide attenuation capacity.) Wet ponds are suitable mechanisms for the removal

of suspended pollutants including among others, metals, nutrients, sediments and organics. The contaminants are removed through a combined process namely:

- Physical adsorption of bottom sediments and suspended fine sediments,
- Natural chemical flocculation,
- Bacterial decomposition, and
- Uptake by aquatic plants and algae

The efficacy of the system to remove the contaminants from the effluent is dependent on the retention time of the water within the pond, i.e. the longer the water is retained within these systems the greater the removal rate of the contaminants, both solid and soluble pollutants. As with the majority of natural treatment mechanisms, the efficacy of these systems is reduced during the colder winter months, as low temperatures decrease the rate of biological activity.

3.3 Need and Desirability

The Darvill Waste Water Treatment Works in Pietermaritzburg, KwaZulu-Natal, is due to be upgraded. However, the upgrade of the WWTW will still be unable to accommodate the erratic high storm flow volumes and to ease the impacts associated with these storm flow events, Umgeni Water (UW) have considered the use of wetland habitat to partially treat the overflows (effluent) from the storm flow storage dam.

The contribution of wetland habitat towards improving the quality of water flowing through a wetland system has been well documented in various literature and have shown to contribute towards water quality comprising five of the fifteen ecosystem services identified by Kotze et al. (2007) in the Wet-Eco-Services assessment framework. In addition to water quality, wetlands provide rich habitat for various organisms, contributing towards the maintenance of biodiversity within the landscape.

Thus it can be seen how the construction of this artificial wetland will contribute to the long-term efficient operation of the Darvill WWTW's especially during high storm flow events and overall water quality of the water entering the immediate river systems.

3.4 Description of identified feasible and reasonable alternatives

The EIA Regulations stipulate that the Scoping Process must investigate alternatives to the proposed project. The EIA Regulations define "Alternatives", in relation to a proposed activity, as "*different means of meeting the general purpose and requirements of the activity, which may include alternatives to:*

(a) The property on which or location where it is proposed to undertake the activity;
(b) The type of activity to be undertaken;
(c) The design or layout of the activity;
(d) The technology to be used in the activity; and
(e) *The operational aspects of the activity*."

The identification and examination of alternatives is fundamental to environmental assessment. It provides decision-makers with information that enables them to properly consider optimal solutions to

development proposals. Alternatives illustrate and contrast the environmental implications and consequences of different options available to achieve the same end. In this way, both the proponent and the authorities who must consider the authorisation, are put in a position where all involved are able to make informed choices or decisions.

Alternatives are considered as a means of reaching the same need and purpose as the originally proposed project in a way that minimises its negative and maximises its positive impacts. Alternatives that are considered must be reasonable and feasible.

Three other sites were investigated as alternatives to the current proposed development site. However, due to various factors these alternatives were found to not be suitable in comparison to the proposed development site.

Hence the alternatives for investigation at this stage of the project are:

- Alternative sites;
- The “No-Go” Option.

Alternatives within these categories were identified by the EIA Team and the proponent and are discussed below:

3.4.1 Alternative sites

The requirements for the proposed artificial wetland can be summarised as the following:

- To accommodate the erratic high storm flow volumes and to ease the impacts associated with these storm flow events, the use of wetland habitat can help to partially treat these overflows
- During power cuts, the proposed artificial wetland will still be able to operate as the downward gravity pull will allow any excess water to still filter through the system
- Partial treatment of the storm flow volumes can be viewed as better than no treatment at all

In light of the above summary, there were three other alternative sites that were considered and discussed during the feasibility stage of the proposed development (see Figure 2 below).

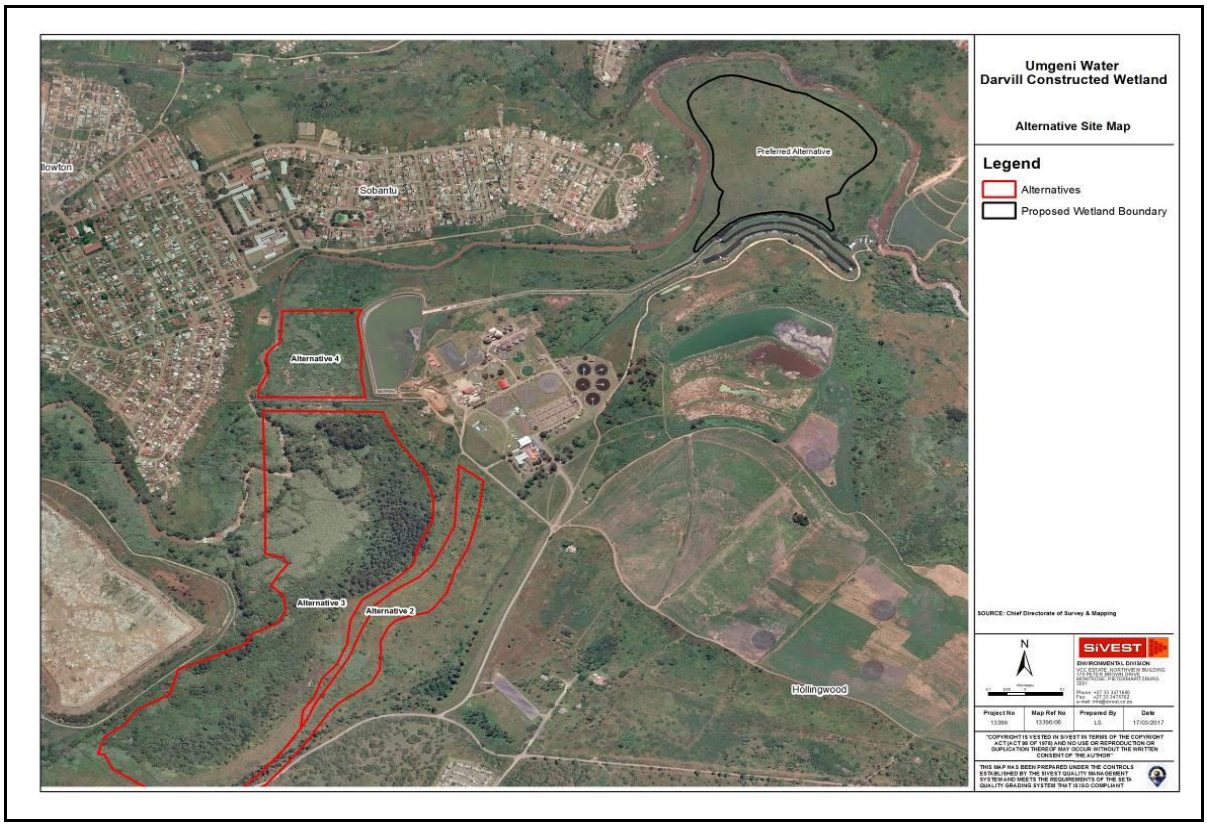


Figure 2: Map showing the alternatives that were considered for the Darvill Constructed Wetland Project

However, each of these alternatives (Site 2, 3 and 4), included different factors which deemed them unsuitable as an alternative including the following reasons:

- Positioned in the floodplain
- Size/extent of proposed area (smaller surface area, therefore less retention time through the system for natural treatment of effluent)
- Elevation
- Location of site at higher point than the influent
- Alternative pumping would be required
- Secondary discharge point (the proposed wetland will use an existing discharge point)
- Distance from the main WWTW for maintenance purposes

Each of the three alternative sites is discussed below:

3.4.1.1 Site 2- Hybrid Modular System

The area to the south of the WWTW was been identified for Site 2 and Site 3. Site 2 and 3 cover a greater area than Site 1, specifically 4.2ha and 30.4ha, respectively. The substantially greater area available is beneficial as greater volumes of effluent may be treated. Site 2 would comprise a hybrid modular system, with the created wetland habitat to follow in Site 3. Due to the extensive area available in Site 3 for the creation of wetland habitat, a greater area for the "pre-polishing" treatment is required. The shape and extent of Site 2 is defined by the topography of the site. The site is located on the side of a hill with the area being defined by the contours. Ideally the entire hillside below the Darvil WWTW access road would be utilised for the proposed modular system, however, topographically this

area is unavailable as it is located above the WWTW elevation, hindering the opportunity for the effluent to reach Site 2 through a gravity fed system. Therefore, the location of Site 2 on the hillside is defined by the height of WWTW.

The decision to incorporate the modular system within the proposed Site 2 is due to the following:

- The proposed location of Site 2 is beyond the 1:100 year floodline. Due to the nature of this system, comprising of constructed systems, it is considered essential that the system be located beyond the 1:100 floodline preventing any damages to the system associated with flood events.
- The additional area provides for the additional "pre-treatment" services to be incorporated into the design that is attenuation capacity, sediment removal, UV radiation, percolation etc., partially improving the effluent entering the created wetland habitat.

Due to the limited available area for the proposed modular system, the site only allows for limited volumes of storm water storage dam overflow to be treated. However, it should be noted that provisions have been made for additional storm flows to enter Site 3, bypassing Site 2, except the litter trap. This will greatly reduce the efficacy of Site 3 to 'polish' the effluent as the effluent will have bypassed Site 2.

The effluent that enters Site 2 will go through a similar modular system as described for the preferred site. The objective of the modular system is to remove the majority of the solids from the effluent prior to entering Site 3, in addition to partially removing the sediments within the water column, and therefore, partially removing some of the contaminants. The limited extent of the site, would limit the effectiveness of the system in terms of treating flows greater than 90ℓ/s, and thus highlights that the proposed systems would serve to polish the effluent rather than form an integral part of the treatment process.

The design and location of the interventions for Site 2 have been determined based on the linear nature of the site. The proximity of the local communities to the proposed modular system influenced the design and materials used for Site 2. However; should Site 2 be considered that it is appropriately cordoned off preventing any access from persons and/or livestock, in addition to reduce the likelihood of vandalism or theft.

The following components would be required to create the hybrid modular system for Site 2:

- Sluice gate to regulate the maximum volume of effluent entering the off-take canal;
- Litter trap (similar to the litter trap within the WWTW);
- Concrete-lined off-take canal;
- Litter/solids trap pond:
  - Concrete-lined canal;
  - Screens;
- Wet ponds:
  - Concrete weir;
  - Decant pipe;
- UV and fines pond:

- Concrete panel walls;
- Concrete-lined;

- Percolation pond:
  - Impermeable liner;
  - Mulch layer;
  - Plant soil bed (growing medium for vegetation);
  - Sand bed;
  - Gravel bed;
  - Decant pipes'
- Concrete-lined cascading decant into Site 3.

3.4.1.2 Site 3 and 4 – Created Wetland Habitat

The large area to the south of the WWTW was identified as a suitable site for the creation of wetland habitat, referred to as Site 3. The approximate extent of Site 3 is 30.4ha, which is a substantial area for the creation of wetland habitat and therefore greater volumes of effluent may be treated. Currently the site is dominated by alien invasive plant species, and is not providing limited ecosystem services. The creation of wetland habitat within the 'relic' floodplain would allow for ecosystem services associated with wetland habitats to be provided. Should additional area be required and/or should the construction of wetland habitat beyond the sewage pipeline be feasible, Site 4 provides an additional 4.44ha for the creation of wetland habitat. Although Site 4 is located to the west of the storage dam, it would serve as a continuation to Site 3.

Should the modular system along Site 3 be used, the proposed approach would be the following:

- The location of the site within the 'relic' floodplain has limited the types of interventions proposed for the creation of wetland habitat. In the event that there is a severe flood, interventions that would be less likely be affected have been proposed, and therefore options such a gravel bed wetlands or other hard engineered structures/solutions have been avoided as far as possible.
- The location of the municipal landfill site and its adjacent streams, will influence the design of the created wetland habitat. These landscape features are considered to potentially carry their own suite of issues and/or contamination. Therefore, the proposed wetland habitat will have to remain a safe distance from these features, to avoid 'carrying' any additional problems / contaminants originating from the adjacent area.
- The outer edge of the proposed wetland habitat will be defined by an earthen berm. The berm will run alongside the landfill stream and the Msunduzi River, similar to a levee.
- Reshaping of the site including the creation of hummocks across the system.
- The flows will be discharged into the Msunduzi River via an existing channel.

The design and location of the interventions will be largely dictated by the nature of the site, i.e. forming part of the 'relic' floodplain. The creation of wetland habitat and the close proximity of housing and/or local communities will influence the design.

Based on the above-mentioned approach, it is anticipated that the following components would be required to create the wetland habitat:

- Spreader canal to evenly distribute flows across the wetland habitat;

- Earthen berms;
- Hummocks;
- Discharge via the existing channel;
- Alien vegetation clearing;
- Active re-vegetation.

3.4.2 The "No Go" Option

The "No-Go" alternative assumes that the proposed activity does not go-ahead, implying a continuation of the current situation or the *status quo*. The "No-Go" or "No-Action" alternative is regarded as a type of alternative that provides the means to compare the impacts of project alternatives with the scenario of a project not going ahead. In evaluating the "No-Go" alternative it is important to take into account the implications of foregoing the potential benefits of the proposed project.

For this project, the "No-Go" option would result in Umgeni Water not constructing the proposed Constructed wetland. This in turn would continue to impose a strain on the current Wastewater treatment works and the proposed wetland system would be unable to assist with partially treating the overflow effluent from the storage dam. Furthermore the proposed constructed wetland would be unable to support the additional attenuation capacity within the landscape. Thus the 'no-go' option will result in a continued strain to be placed on the WWTW.

This DEIR provides a more detailed comparative analysis of the potential impacts against the "No-Go" alternative, which will provide the baseline against which all alternatives will be considered.

3.5 Layout

The layout designs for the Darvill Constructed Wetland are included in **Appendix B** of this DEIR.

4 A DESCRIPTION OF THE PROPERTY ON WHICH THE ACTIVITY IS TO BE UNDERTAKEN

A general description of the site is provided below; however more detailed findings are described in **Section 5**.

4.1 Regional Locality

The Darvill Waste Water Works (WWW) is located in New England, Pietermaritzburg and serves the Msunduzi Municipality. The site is surrounded by Glenwood to the north, Lincoln Meade to the south, and Sobantu to the west. The town of Sobantu and the WWTW is separated by the Msunduzi River.
The Maritzburg Golf course and the New England Road Landfill site are also nearby to the Darvill Waste Water Works. The plant treats all domestic and industrial sewage from the city of Pietermaritzburg and now, due to the growing demand on the capacity of Darvill Wastewater Works, Umgeni Water is proposing to upgrade the Head of Works, the biological process, sludge digestion and disposal and tertiary treatment facilities.

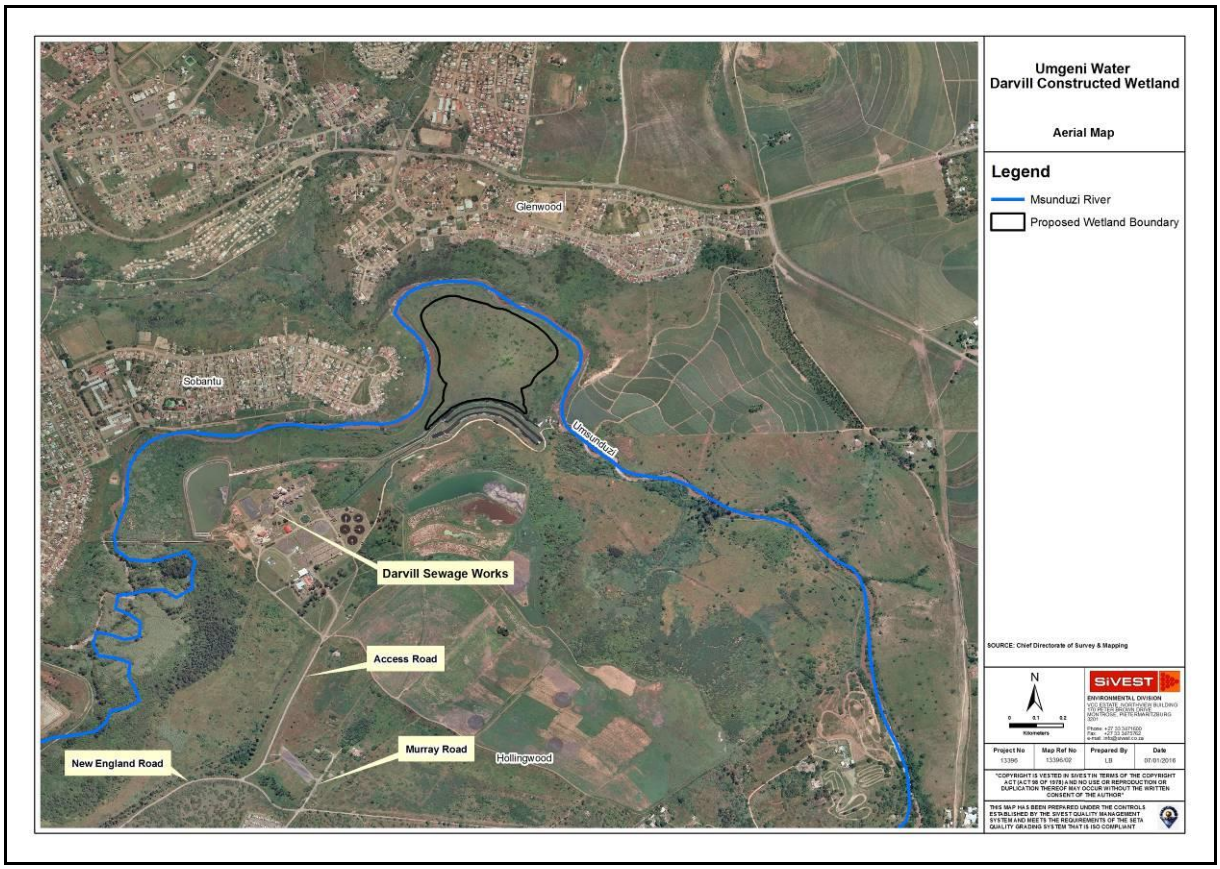


Figure 3: Aerial Map showing location for the proposed constructed wetland

4.2 Site Description

With reference to Appendix B, Site 1 (the preferred site) can be seen below the maturation river of the WWTW and was identified as the preferred site for the creation of wetland habitat. The extent of the site covers an area of approximately 8.6ha, and is characterised by disturbed veld. Although the site is adjacent to the Msunduzi River, it is beyond the 1:100 year floodline. The site is easily accessible via the road around the existing storage dam and alongside the concrete canal. The status quo of the site has been assessed through a number of specialist studies and is described in the section below.

4.3 Climate

The development area is located in Pietermaritzburg, KwaZulu-Natal. This area has a warm climate with wet summers and dry, cold winters. The area has moderate rainfall of approximately 738 mm annually. Frost does not pose a hazard or restriction to the growing season. **Table 3** below summarises the rainfall, temperature and evaporation pattern, which comprises of two main Bio Resource Units (BRU).

Table 3: Summary of climatic conditions of the proposed site

	Annual	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
RAINFALL													
Median rainfall (mm)	640	101	92	87	36	17	6	6	17	33	68	84	93
Mean rainfall (mm)	738	116	98	92	48	27	10	10	30	51	67	90	99
Median rainfall (mm)	756	124	113	102	42	16	7	6	19	37	81	98	111

Mean rainfall (mm)	786	145	112	99	44	23	9	11	27	48	75	87	106
TEMPERATURE													
Mean (^{0}C)	18.4	21.9	22.1	21.4	18.8	16.2	13.9	14.0	15.6	17.8	18.4	19.7	21.2
Minimum (^{0}C)	12.3	16.9	17.1	16.0	12.9	9.4	6.4	6.5	8.3	11.2	12.7	14.4	15.9
Maximum (^{0}C)	24.5	26.9	27.2	26.8	24.6	22.9	21.3	21.5	22.9	24.5	24.1	24.9	26.5
Mean (^{0}C)	18.2	21.9	22.1	21.2	18.7	15.8	13.2	13.4	15.2	17.4	18.4	19.6	21.3
Minimum (^{0}C)	11.8	16.8	16.9	15.7	12.5	8.5	5.3	5.4	7.4	10.5	12.4	14.3	15.8
Maximum (^{0}C)	24.6	27.1	27.3	26.8	24.8	23.0	21.2	21.5	22.8	24.4	24.3	25.1	26.8
EVAPORATION													
A-pan (mm)	1661	177	155	150	119	103	91	98	125	143	157	162	181
A-pan (mm)	1682	179	158	152	121	103	91	98	126	145	161	164	184
SUNSHINE													
Hours/day (Oct-Mar)	6.8												
Mean annual (hours)	7.2												
Hours/day (Oct-Mar)	6.4												
Mean annual (hours)	6.9												

4.4 Topography and Geology

In terms of the terrain of the receiving environment, the site can be described generally as presenting rolling and partly broken hills with restricted moderate to steep slopes. The soils on site are described as shallow, duplex soils and soils of moderate to poor drainage. They may present an erosion hazard if not managed correctly. The exact underlying geological conditions of the site will be assessed through a geotechnical study.

4.5 Surface water and Wetlands

The main river system located in close proximity to the site is the Msunduzi River, and can be found to the North of the site. There are no Wetlands recorded for the proposed development site. The nature of the surface water and ground water on site has been assessed during the Impact Assessment Phase, and a detailed wetland and geo-hydro assessment has been undertaken.

4.6 Biodiversity (Fauna and Flora)

The majority of the site is degraded (98% alien plant composition) due to a lack of veld management (burning / mowing regimes, exclusion of fire), illegal dumping of waste material and some subsistence grazing has further degraded the floristic composition and potential of this landscape. The dominant vegetation that currently occurs on site is degraded grassland and predominantly alien vegetation. The presence of the sewer treatment works results in considerable leaching of nitrogen and phosphorus into the soil, both essential for plant growth. The high availability of nitrogen and phosphorus may also explain the prevalence of alien plants, which have very easily established and invaded the area.

Although the terrestrial faunal species found on the site will be limited to small mammals and rodents, large numbers of avi-faunal species are present on the site and it has been listed as an International Birding Area. Some of these species include a variety of waterfowl and waders, fish-eagle, black

sparrowhawk, peregrine falcon, long-crested eagle and jackal buzzard.

Natural vegetation found on site will fall into the category of KwaZulu-Natal Hinterland Thornveld. The vegetation biome is primarily bushed grassland and bushland. Indicator species include *Aristida junciformis (Ngongoni Three-awn), Panicum maximum (Guinea Grass), Acacia karroo (Sweet Thorn), Acacia nilotica (Thorn mimosa), Acacia sieberiana (Paperbark Thorn), Lantana camara (Lantana)*; and various other species types which comprise this particular Bio-resource group.

4.7 Visual Environment

The overall visual appearance of the proposed development site consists mainly of degraded and disturbed grasslands and thornveld dominated by Acacia sieberana and other exotic trees and shrubs. The Msunduzi river system surrounds the proposed site with the communities of Sobantu, Hayfields, Glenwood and Lincoln Meade nearby.

The fact that the site is currently degraded and already disturbed ultimately means that there will not be a major change element as the construction of the artificial wetland would not impact the visual amenity and character.

4.8 Heritage and Cultural Aspects

For the proposed Darvill Constructed Wetland site development, a Heritage Impact Assessment was undertaken for the site to investigate any potential aspects related to heritage or culture. The findings have been discussed further down in this Draft EIR Report.

4.9 Social and Economic Aspects

The proposed project is situated within the Msunduzi Municipality which has a total population of approximately 618,536 people. Of the 229 672 economically active (employed or unemployed but looking for work) people in the municipality, 33% are unemployed. The proposed constructed wetland will provide work opportunities for the surrounding communities. This will result in the creation of new short term construction jobs during the construction phase of the project, thus assisting to boost the local economy. The construction of the artificial wetland will also result in the effluent reaching the Msunduzi River system to be more 'polished'. This in turn will mean an improvement in the quality of water entering the river system, which in turn means a cleaner, safer living environment for the surrounding communities.

5 SPECIALIST STUDIES

A number of specialist studies were undertaken for the proposed Darvil Constructed Wetland EIA. These specialist studies included the following:

- Vegetation Impact Assessment
- Aquatic Impact Assessment
- Avi-Faunal Impact Assessment
- Heritage Impact Assessment
- Geo-hydro & Geo-technical impact Assessment

The findings of the above studies are summarised in the sub sections below:

5.1 Vegetation Impact Assessment

The Bioresource Unit within the project is classified as "Vb 14 – Pietermaritzburg, Dry Coast Hinterland". The vegetation pattern is comprised entirely of Grassland. The dominant vegetation that currently occurs on site is degraded grassland. It is evident from the alien species composition and indigenous pioneer herbaceous species present that the site is degraded, most notably due to a lack of environmental management (burning / mowing regimes, exclusion of fire, alien plant control), illegal dumping of waste material and some subsistence grazing. Furthermore, the presence of the sewer treatment works results in substantial leaching of nitrogen and phosphorus into the soil, both essential for plant growth. Consequently, the existing vegetation is highly productive, and in the absence of burning, results in excess moribund material. The high availability of Nitrogen and Phosphorus may also explain the prevalence of alien plants, which have very easily established and invaded the area.

The majority of the site is comprised of degraded grassland with a small patch of woodland at the east boundary of the site, comprised almost entirely of alien vegetation. The woodland patch is almost exclusively comprised of Mulberry trees, *Morus alba,* which are in turn smothered by the alien invasive vine, *Cardiospermum grandiflorum.* The Mulberries show evidence of bush clearing as there are a number of dead individuals that have been ring-barked and poisoned (**Figure 2 in the Vegetation report**). There are significant patches of *Cannabis sativa* in the understorey, along with a number of other invasive alien plants. There are a few Paintbrush lilies, *Scadoxus puniceus,* (which are protected) growing in the understorey. The grassland is comprised predominantly of *Chloris gayana* and *Digitaria* spp. which make up the majority of the graminoid layer, while there are a number of alien and pioneer indigenous woody species, shrubs and herbaceous plants **(Figure 3 in the Vegetation report)** scattered within the grassland, such as *Acacia* spp*., Melia azedarach, Populus* spp., *Lantana camara, Asparagus* spp*., Berkheya* spp*., Cirsium vulgare* and *Verbena aristigera* to mention a few (**Figure 4 in the Vegetation report**). While species such as *Asparagus* spp. are considered protected in terms of the KZN 1974 Ordinance, it is noted that in this instance such species appear to be indigenous invaders and are of limited importance.

The riparian boundary is dominated by the cosmopolitan giant reed grass, *Phragmites australis,* while towards the water's edge are a number of sedge species and fruit-bearing Gooseberries, *Physalis viscosa*. A list of plant species recorded during the survey are provided in **Appendix 4 in the Vegetation report**.

The species that occur within the site are predominantly alien and indigenous pioneer forms, considered to be secondary successional communities. The indication is that most of the woody vegetation appears to have established and proliferated as a possible consequence of the exclusion of fire due to the proximity of the site to the sewage works, rubbish dump, farm lands and the

communities of Sobantu and Glenwood. Increased soil fertility due to the sewage works has also lead to more favourable conditions for alien plant establishment.

Of the indigenous species that were present on site, the most prevalent were the *Acacia* species (Appendix 4 in the Vegetation report). These species, even though indigenous, are able to establish themselves and dominate the species assemblage, hence they are similar in ecological terms to an invasive species. Several emerging individuals of *Scadoxus puniceus* **(Figure 4 below)** were observed around the site which are protected plant species under the KZN Ordinance of 1974.

Figure 4: Emerging individuals of Scadoxus puniceus were observed on site

This protected species will be required to be relocated out of the footprint of the proposed constructed wetland. This species is small and has underground storage organs (bulbs). These bulbs sustain the plant and store energy reserves, so their relocation should be relatively simple. Relocation should take place early in spring.

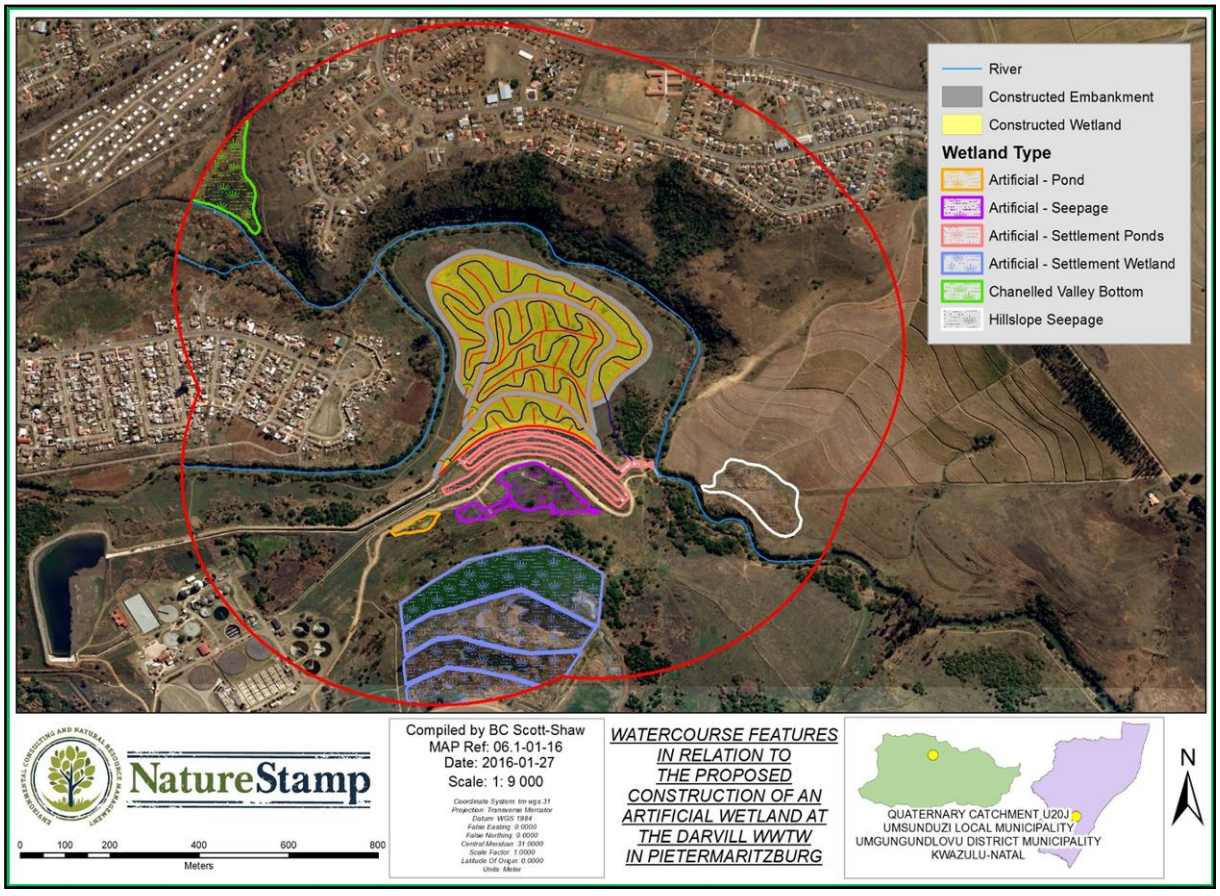
The biodiversity noteworthiness of the combined vegetation has a score of **1.4,** this is deemed to be **moderately low**. The future integrity and viability value that the combined vegetation is considered **moderately low**, with a score of **1.4**. The final condition score of this site is **1** which indicates that the site is functioning at a **moderately low** level. The alien species composition and indigenous pioneer herbaceous species present, most notably due to a lack of veld management (burning / mowing regimes, exclusion of fire), illegal dumping of waste material and some subsistence grazing, has resulted in the severe reduction of indigenous cover and loss of historical grassland.

5.2 Aquatic Ecosystem Assessment

The proposed development site consists of areas of hydrological interest and these areas have been tabulated (Table 11 of the Wetland report) and is described in detail in the wetland report. There were no wetlands identified within the development footprint. Any wetlands that the proposed wetland did not intersect were not assessed for wetland health or functionality as they would not be disturbed by the development. These areas were considered when checking the connectivity of the systems and potential impacts from the roads; as well as to show 'No-Go' areas. Watercourse systems that would be affected by the development were assessed.

The delineation of the wetland and riparian areas identified the following and is illustrated in **Figure 5** below as per the aquatic specialist report:

- One riverine system (Msunduzi river linked to the Bayne's Spruit stream);
- Riparian habitat associated with the linear system;
- One Hillslope Seepage Wetland on the opposite bank;
- Numerous artificial systems and associated seeps forming part of the WWTW remediation process; and
- One channelled valley bottom wetland linked to the Bayne's Spruit.



A WET-Health assessment was undertaken for the wetland systems found within 500m of the development. The present hydrological state of the HS (seepage wetlands) and the CVB (channelled valley bottom wetland) were given a score of C, meaning that the impact of the modifications on the

hydrological integrity is clearly identifiable, but limited. The present state of wetland vegetation of the channelled wetland was given a symbol B as the vegetation composition has been partly transformed but not that the state of the wetland has been altered. The seepage wetland is completely surrounded by sugarcane which has encroached into the original extent and has resulted in the reduction of characteristic indigenous wetland species

In accordance with the NFEPA guidelines, the relevant reach of the Bayne's Spruit stream (and its associated riparian area) has not been classified as a river FEPA, which indicates that these river systems are not a national freshwater conservation priority. However, the Msunduzi River, which has numerous conservation organizations working on it (such as Duzi-Umgeni Conservation Trust, DUCT) has been classified as a Class D (Largely Modified) river. The NFEPA project highlights the Msunduzi, associated sub-quaternary catchments, associated sub-quaternary catchments and Upstream Management Areas as a Freshwater Ecosystem Priority Areas (FEPAs) and Fish Support Area. As there is much focus on the Msunduzi River, the same considerations should be applied to its tributaries which cumulatively impact on this system. NFEPA wetlands were identified north of the Bayne's Spruit bordering on the edge of the project footprint. These were not considered in detail during the Wetland Impact Assessment, as would not be affected by the development.

The results from the water quality assessment indicate that most of the parameters measured are within the DWS effluent standards. However, the E. coli count was unusual. The upstream point had a very high concentration while the downstream point (which has been mixed with the WWTW outlet) was very low. As the outlet is treated it is not likely to have a high count but unlikely to have 0 colonies per 100 ml. This parameter should be used with precaution as the laboratory took a long period to produce the results over the festive season. This preliminary finding suggests a poor quality drinking water upstream of the WWTW as is notorious with this river system. This parameter is known to fluctuate seasonally and, as such, should be considered during and after the development (especially as the measurements were taken in the midst of a severe drought). Presence of ablutions during construction may influence this parameter. The oil and grease component (which is relevant for any development where construction activities occur near water resources) did not meet standard at the upstream and downstream point. In similar vein, the upstream values were much higher than downstream. The treatment chemicals from the WWTW may cause oil & grease to flocculate out of the flowing channel. The oil and grease should not exceed 2.5 mg.l-1 or the known level prior to construction. Dissolved manganese is very high from the WWTW outlet and subsequently at the downstream point. Manganese is a common metal found in foods and water and, although not highly toxic, can lead to some health implications. The water should also be monitored for other heavy metals or dangerous chemicals that could be increased during and after construction.

The aquatic specialist concludes that the surrounding wetlands have been lost over the years resulting in a shortage of wetland habitat in the area. Given the excess water from the WWTW, the elevation, the fact that the soils are not particularly good for agriculture and the potential to improve water quality which is the biggest problem for the system, this is a suitable area for the wetland. As it will form a part of the WWTW remediation plans, it will have to be well maintained. Given the shallow depth of the wetland and that the water will already be partly treated, the risk of contamination of the river is low. On observation of the artificial wetland above the site, it is clear that the wetland will provide a habitat for important flora and fauna.

5.3 Avi-Faunal Impact Assessment

The avi-faunal investigation re-emphasizes that it is the wetland habitats at Darvill that are most important from an avifaunal perspective. The bird populations of greatest interest and conservation value, including relevant to the Red Data species present, are waterbirds.

The maturation ponds and surrounding area at Darvill Waste Water Treatment Works have long supported an avifauna attractive to birdwatchers. In particular, the site serves as a significant refuge for waterbirds. Indeed the site is widely known as 'Darvill Bird Sanctuary' amongst such hobbyists. In addition, Darvill has served as a long-term bird-ringing (or 'bird-banding') site of significant scientific and student-training value, especially for the local university: the University of KwaZulu-Natal (UKZN). From an avifaunal perspective, Darvil's recreational, scientific, teaching and conservation value now stretches back over many decades.

The information on the general avifauna at Darvill coming from the Birds in Reserves Project (BIRP) dataset can be considered relatively comprehensive and reliable. The total of 165 checklists is relatively large and coverage is fairly even throughout the year (11-18 checklists per month).

The 165 bird checklists from the BIRP database provide a total list of 255 bird species as having been recorded at Darvill during the course of that project. Of these, 88 species (35%) can be classified as 'waterbirds'. In addition, 71 species have been confirmed breeding at Darvill. Appendix 1 of the Avi-Faunal report provides a list of the common and scientific names of these 255 species, as well as the reporting rate, a measure of relative abundance, for each species. Appendix 1 of the Avi-Faunal report also identifies which of these species are waterbirds and also identifies species confirmed breeding during the BIRP (and Co-ordinated Waterbird Counts Project [CWAC]) projects.

A total of 151 bird species were recorded at Darvill on the seven checklists compiled during the same number of field surveys made during this survey. Only four of these species (Black Cuckoo, Green Sandpiper, Black Heron and Olive Thrush) do not occur on the BIRP list for Darvill; two of these are waterbirds: Green Sandpiper and Black Heron. A total of 24 species were recorded as breeding or possibly breeding at Darvill during this survey. Of these, two species (Grey Crowned Crane and Goliath Heron) were not confirmed breeding during the BIRP project. The behaviour of two Grey Crowned Cranes in the area of maturation Ponds 1 and 2 suggested that they may have attempted breeding in Pond 2. A pair of adult Goliath Herons accompanied by three flying juveniles at Pond 4 suggested that the species had bred in the area.

A total of 46 waterbird species have been counted at Darvill during the CWAC counts at an average of 25 species per count (range 7-34 species; Appendix 2 and Table 1). The average total number of waterbirds counted per CWAC count is 591 (Range 191-917 birds). It should be noted that the 13 February 2015 count was particularly low (191 individuals of only 7 species compared with 516-917 individuals of 27-34 species on the other five counts).

A total of 56 waterbird species were counted at Darvill during the counts made as part of the constructed wetland survey at an average of 35 species per count (range 28-40 species; Appendices 3-9 and Table 1). The average total number of waterbirds counted during these counts is 843 (Range 350-1263 birds). Not surprisingly the least complete count (20 November 2015) was the lowest (only

350 individuals of 28 species compared with 570-1263 individuals of 28-40 species on the other six counts). Overall, a total of 61 waterbird species have been counted at Darvill during all these counts combined at an average of 31 species per count (range 7-40 species; Appendices 2-9 and Table 1 of Avi-faunal report). The average total number of waterbirds counted during these counts is 729 (Range 191-1263 birds).

In summary, the data from BIRP (and CWAC) and this study provide a list of 259 bird species as having been recorded at Darvill. Of these, 90 species, or over a third (35%), can be considered as waterbirds. A total of 71 species have been confirmed breeding at the site and 31 of these (44%) are waterbirds.

During the course of the constructed wetland survey, the presence of Red-billed Quelea and especially Green Sandpiper **(Figure 6 below)** were noted to draw fairly large numbers of birdwatchers to Darvill over the summer periods.

Figure 6: A Green Sandpiper, a rare vagrant to Darvill and South Africa generally, photographed along the lower canals during the Avi-Faunal assessment

The number of Red Data species (nine) recorded at Darvill is relatively low and the site is clearly not a major refuge for formally threatened bird species. In addition, only the Grey Crowned Crane and African Marsh Harrier, both wetland species, show any indication of being regularly recorded at Darvill.

Darvill has long been popular with birdwatchers. This popularity is still current today and is based, at least partially, on the proximity of the site to the large city of Pietermaritzburg. At present, however, there are several factors that limit the value of Darvill to birdwatchers. The heavily overgrown vegetation along the entire lengths of the berm walls between the maturation ponds currently limits and indeed even denies access to this key birdwatching area. The Avi-faunal specialist recommends that consideration should also be given to enhancing the diversity of wetland habitats and waterbirds

present at the maturation ponds by controlling the growth of emergent vegetation and increasing the extent of exposed mudflats and shorelines. The absence of hides or viewing platforms is another limiting factor to the popularity of the site. There are various other potential initiatives that could also be considered relevant to enhancing the attractiveness of the site to birdwatchers, including signage, pamphlets and annotated bird lists or trained bird guides.

Darvill supports a long established bird-ringing site of scientific and teaching importance, especially to the local university. The avi-faunal specialist further recommends that any future developments at Darvill should endeavour to accommodate this ongoing ringing effort such that its long-term value is not threatened or compromised in any way.

5.4 Heritage Impact Assessment

A desktop study was conducted of the archaeological databases housed in the KwaZulu-Natal Museum. The SAHRIS website was consulted for data relating to the distribution and significance of heritage sites in the greater Pietermaritzburg. In addition, the available heritage literature covering the study area was also consulted.

A ground survey, following standard and accepted archaeological procedures, was conducted. A cultural heritage survey of the proposed development of an artificial wetland at the Darvill Wastewater Works, Pietermaritzburg, identified no heritage sites or features. The Water Works and related office buildings are all younger than 60 years. No archaeological and other heritage sites were observed in the existing bird sanctuary, the area earmarked for wetland rehabilitation and the surrounding areas. The study area is not part of any known cultural landscape

There is no known archaeological reason why development may not proceed as planned. However, attention is drawn to the South African Heritage Resources Act, 1999 (Act No. 25 of 1999) and the KwaZulu-Natal Heritage Act (Act no 4 of 2008) which, requires that operations that expose archaeological or historical remains should cease immediately, pending evaluation by the provincial heritage agency.

5.5 Geo-hydro & Geo-technical impact Assessment

The findings of this investigation are detailed below:

5.5.1 Aquifer Characterisation

The Karoo Supergroup sedimentary units are essentially secondary or fractured rock aquifers with negligible primary storage and permeability. Groundwater storage and movement is generally confined to fractures, joints and bedding planes within the rock mass. The Tillite and shales of the Dwyka Group and Pietermaritzburg Formation respectively are generally classified as moderate-

yielding fractured rock aquifers, with borehole yields typically ranging from > 0.5 l/sec – 3.0 l/sec according to the information as contained in the "Characterisation and Mapping of the Groundwater Resources KwaZulu-Natal Province Mapping Unit 2" April 1995, which was prepared for the former Department of Water Affairs and Forestry (DWAF) by Groundwater Consulting Services. Higher yielding boreholes, where yields of > 3.0 l/sec have been recorded, were likely drilled to intersect faults and fracture zones associated with dolerite intrusion emplacement, particularly on the lip of sills and in the contact zones of dykes. The groundwater development potential increases due to the enhancement of the porosity and permeability within these discreet zones.

The Dwyka Group is generally considered to be a poor aquifer due to its massive nature and elevated electrical conductivity (EC) values of the groundwater intersected. This is attributable to high concentrations of dissolved solids, mainly sodium (Na) and chloride (Cl), which frequently renders the water brackish. Groundwater circulating in the shales of the Pietermaritzburg Formation in this area generally has a median EC value of 18 mS/m, whilst the typical hydrochemical facies is said to be Ca/Na-HCO3.

5.5.2 Groundwater Quality

During the hydro-census, two accessible boreholes, were further assessed. These boreholes were chosen as their locations are spatially diverse around the proposed site, and they appear to tap the deep and shallow / perched aquifers respectively. Refer to Table 2 on page 9 of the specialist report to observe data acquired during the field assessment for the above mentioned boreholes.

It was seen, when comparing historic and current SWLs in the Deep Aquifer, it was clear that, at least in the deep aquifer in proximity to this borehole, depth to groundwater levels have almost doubled. This has in all likeliness as a result of the current drought conditions.

Groundwater samples were collected from each of these boreholes, and were submitted to the SANAS-accredited Talbot Laboratories for analysis according to the SANS 241: 2015 abbreviated suite of determinants to allow for the assessment of baseline water quality within the study area. The attained results are summarised in Appendix B of the specialist report, where they have been compared to the SANS 241: 2015 Standards for Drinking Water, given that there are groundwater supply boreholes in the general area.

The following was determined by the specialist:

- Levels / concentrations of turbidity, iron (Fe), manganese (Mn) and standard plate count in the deep aquifer sample exceed the chosen water quality standards, with the Fe and Mn concentrations, being highly elevated, this is however typical of groundwater quality in the study area.
- Levels / concentrations of turbidity, EC, nitrate (NO3), sodium (Na), total coliforms and standard plate count in the shallow/perched aquifer sample exceed the chosen water

quality standards. It is thought that the measured NO3 concentrations and total coliforms levels in this shallow aquifer are attributable to the fact that processed effluent from the Darvill Sewage Works is land-farmed in the area in proximity to the site, by an independent grass-grower.

- Interestingly, the concentrations of calcium (Ca), Cl, magnesium (Mg), sulphate (SO4), total hardness and lead (Pb) are appreciably higher in the sample collected from second borehole, which taps the shallow / perched aquifer.

The water quality data, although likely reflecting the impacts of anthropogenic sources, further suggests that there are two (2) distinct aquifers below the area, with the shallow / perched aquifer not necessarily recharging the deep aquifer over a short time scale.

5.5.3 Hydro-census

A desktop hydro-census was undertaken within 2 km of the site. The Department of Water and Sanitation's (DWS) KwaZulu-Natal Groundwater Resource Information Database (GRIP) and Geomeasure's in-house (Geom) borehole database was utilised to assist in undertaking this task. Refer to the tables on pages 7 and 8 in the attached Specialist Geo-hydro study (See Appendix E) for the Hydro-census Information. The following was determined from the Hydro-census information obtained as per the specialist report:

- Boreholes of various depths have been installed in the areas surrounding the proposed Darvill Constructed Wetland.
- During drilling, water strikes were encountered at inconsistent depths, which is typical of a weathered and fractured rock aquifer.
- A shallow / perched (<10 m bgl) and deep (>10 m bgl) aquifer appear to be in existence in the general study area.
- Monitoring boreholes C2, C3 and C4, located closest to the proposed Darvill Constructed Wetland, have a historic static water levels (SWL) averaging 4.0 m bgl.
- Only two (2) of the fifteen (15) boreholes drilled to depth (>10 m) within a 2 km radius of the proposed Darvill Constructed Wetland had measureable groundwater yields, with these averaging 3.0 l/sec.

Further to this, during the hydro-census, two accessible boreholes, were further assessed. These boreholes were chosen as their locations are spatially diverse around the proposed site, and they appear to tap the deep and shallow / perched aquifers respectively.

5.5.4 Potential Pollution Source Identification

An existing point-source pollution source assessment was undertaken in proximity to the proposed site, with the findings detailed below (in order of possible severity):

- Darvill Sewage Works:

    - Any uncontained or incorrectly discharged Wastes from the Darvill Sewage Works may impact upon soil and groundwater, with a possible increase in NO3, ammonia (NH3), phosphate (PO4), total coliforms, E. Coli and standard plate count occurring.

- Proximal grass-growing operation:

    - The land-farming of sewage from the Darvill Sewage Works, if undertaken incorrectly or in too great a quantity, might result in an increase in NO3, NH3 and PO4 concentrations, and total coliforms, E. Coli and standard plate count, in the soil and groundwater environment.

- New England Road Landfill Site:

    - Any uncontained leachate, or other waste streams as resulting from the New England Road Landfill site, would likely result in an increase in numerous determinant concentrations in the groundwater environment.

- Hollingwood Cemetery:

    - Should this cemetery site ultimately be utilised, then an increase in various determinant concentrations (as linked to human body decomposition), would possibly be evident in the soil and groundwater environment.

During the geotechnical investigation, it was noted that the soils underlying the site in question were easily excavatable through mechanical means (TLB). Should the base of each cell not extend to competent bedrock, then the bulk earthworks involved as part of the construction of the wetland should progress relatively easily. However, should soft weathered rock (or possibly competent bedrock) be encountered during excavations, then the use of an excavator, or possibly ripping, may be required to reach the required depth. Note that said mechanical means may only be required across part of the site, where shallow depths to refusal were encountered.

When considering the thickness of the soil cover on-site, it becomes apparent that a surface flow wetland is preferable, as subsurface flow wetlands generally extend to greater depths.

The results gathered from the Geotechnical study recommend that the following should be undertaken as a part of groundwater monitoring:

A detailed geotechnical investigation should be undertaken once environmental authorisation has been received, prior to construction commencing, under the guidance of the project civil / design engineer.

As a form of best practice, it is recommended that the water resources in the vicinity of the Darvill Constructed Wetland be monitored once it is built. This will include installing and monitoring both shallow (< 10 m deep) and deep (>30 m deep) monitoring boreholes.

Further to this, at least one (1) up-gradient and one (1) down-gradient deep (> 30 m deep) monitoring borehole should be installed to monitor the deep aquifer underlying the site. It is imperative that the design and installation of the shallow and deep monitoring boreholes be undertaken by, and supervised by, a qualified and experienced geohydrologists, so that cross-contamination of the shallow and deep aquifers does not occur.

The installed shallow monitoring wells should be subjected to slug tests, whilst the deep monitoring wells should be subjected to either a slug test or a pump test (depending on their yield) under the supervision of a qualified and experienced geohydrologist. This will allow for the acquisition of hydraulic conductivity values for the shallow and deep aquifers underlying the site, which can in turn be utilised to determine groundwater travel times in shallow and deep aquifers underlying the site.

Baseline groundwater samples should be collected before the wetland is built, and every six (6) months thereafter, for submission to a SANAS-accredited laboratory for analysis according to the SANS 241: 2015 suite of determinants. This will aid in determining whether or not the shallow aquifer is being impacted upon by the wetland (once built).

6 MACRO PERSPECTIVE OF THE LEGAL ENVIRONMENT AND ASSESSMENT FRAMEWORK

6.1 Legislative considerations

For a development such as the proposed Darvill Constructed Wetland and the associated infrastructure, there are a host of legal requirements (National, Provincial and Local Government) to which the development proponent must adhere. This section includes legislation and policy guidelines that have been identified and considered as key to the Scoping and EIA Process for the proposed Project. It must be noted that other legislation may also be applicable to this project and would need to be considered by the proponent.

6.1.1 Constitution of the Republic of South Africa Act (Act No 108 of 1996) as amended by the Constitution of the Republic of South Africa, Amendment Act (Act No 35 of 1997)

The legal reference source for environmental law in South Africa is found in the Constitution of the Republic of South Africa (Act No. 108 of 1996). All environmental aspects should be interpreted within the context of the Constitution. The Constitution has enhanced the status of the environment by virtue of the fact that environmental rights have been established. This is enhanced by **Section 24** of the Bill of Rights, which provides that:

"*Everyone has the right*

(a). to an environment that is not harmful to their health or well-being; and

(b). to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that

(i) prevent pollution and ecological degradation;

(ii) promote conservation; and

(iii) secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development".

An objective of local government is to provide a safe and healthy environment (**Section 152**) and (**Section 195(1)(e)** to **(g)**) states that public administration must be accountable, transparent and encourage participation in defining that:

"(1) Public administration must be governed by the democratic values and principles enshrined in the Constitution, including the following principles: (a). (b). (c). (d).

(e). People's needs must be responded to, and the public must be encouraged to participate in policy- making.

(f). Public administration must be accountable

(g). Transparency must be fostered by providing the public with timely, accessible and accurate information".

The right of the public to information and to transparent administrative processes underpins the public participation process that is implicit in the conducting of an EIA.

6.1.2 National Environmental Management Act (Act No 107 of 1998) as amended June 2010

The National Environmental Management Act (NEMA) is South Africa's overarching framework for environmental legislation. The primary objective of NEMA is to provide for operative environmental 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.

It sets out a number of principles that aim to implement the environmental policy of South Africa. These principles are designed, amongst other purposes, to serve as a general framework for environmental planning, as guidelines by reference to which organs of state must exercise their functions and to guide other law concerned with the protection or management of the environment.

The principles include a number of internationally recognised environmental law norms and some principles specific to South Africa, namely, the:

- Preventive principle
- Precautionary principle
- Polluter pays principle
- Equitable access for the previously disadvantaged to ensure human well-being.

Chapter 3 of NEMA is designed to promote integrated environmental management. Environmental

management must place people and their needs at the forefront of its concerns, and serve their physical, psychological, developmental, cultural and social interests equitably. Development must be socially, environmentally and economically sustainable. Sustainable development therefore requires the consideration of all relevant factors including the following:

- The disturbance of ecosystems and loss of biological diversity is avoided, or, minimised and remedied
- The pollution and degradation of the environment are avoided, or, minimised and remedied
- The disturbance of landscapes and sites that constitute the nation's cultural heritage is avoided, or, minimised and remedied
- That waste is avoided, or, minimised and re-used or recycled where possible and otherwise disposed of in a responsible manner
- The use and exploitation of non-renewable natural resources should be utilised responsibly and equitably
- The development, use and exploitation of renewable resources and the ecosystem of which they are part of do not exceed the level beyond which their integrity is jeopardised
- A risk-averse and cautious approach is applied
- Negative impacts on the environment and on the people's environmental rights be anticipated and prevented, and where they cannot be altogether prevented, are minimised and remedied.

NEMA empowers the Minister to identify activities for which Authorisation is necessary and to make regulations for the conduct of applications for such authorisation. No person may undertake activities listed by the Minister in **GNR 983, 984** and **GNR 985** unless such authorisation is obtained.

6.1.3 National Environmental Management: Waste Act (Act No. 59 of 2008)

The National Environmental Management: Waste Act, Act No. 59 of 2008, (Waste Act), which was promulgated on 10 March 2009, and for the most part was brought into effect on 1 July 2009, now constitutes South Africa's overarching primary waste legislation. The Waste Act gives effect to the White Paper on Integrated Pollution and Waste Management; and addresses the current fragmentation in waste legislation in South Africa.

The Waste Act regulates waste management in order to protect health and the environment.

More specifically, the objectives of the Waste Act are to:

- Protect health, well-being and the environment by providing reasonable measures for:
  - Minimisation of the consumption of natural resources
  - Avoidance and minimisation of the generation of waste
  - Recovery, re-use and recycling of waste
  - Treatment and safe disposal of waste as a last resort
  - Prevention of pollution and ecological degradation
  - Securing ecologically sustainable development while promoting justifiable economic and social development
  - Promoting and ensuring the effective delivery of waste services
  - Remediating land where contamination presents, or may present, a significant risk of harm

- Achieving integrated waste management reporting and planning.

- Ensure that people are aware of the impacts of waste on health and the environment.
- Provide for compliance with the measures set out in paragraph (a) (first bullet)
- Generally give effect to section 24 of the Constitution in order to secure an environment that is not harmful to the health and well-being of people.
- It is important to note that the Waste Act, replace **Sections 19,19A, 20, 24, 24A 24B**, and **24C** of the ECA[1].

6.1.4 Hazardous Materials and Installation Management

Hazardous Substances Act (Act No. 15 of 1973)

The Hazardous Substances Act (Act No. 15 of 1973) governs the control of substances that may cause ill health or death in humans by reason of their toxic, corrosive, irritant, flammability or pressure effects. The Act provides for the regulation of the storage, handling, labelling and sale of Group I, II, and III hazardous substances. A license is required for an operation that stores, handles and sells Group I substances. **Section 29 (1)** of the Act regulates the disposal of the empty containers, which previously held Group I substances.

No national, local provincial or local municipal regulations have been promulgated under the Act for the on-site management of Group II hazardous substances. The protection of environmental impacts caused by on-site hazardous substances is therefore covered by South Africa's constitution and environmental framework legislation (i.e. the National Environmental Management Act (NEMA) and National Water Act), which protects the environmental rights of its citizens. Further protection is provided through the regulations for hazardous substances, promulgated under the Occupational Mine Health and Safety Act (Act No. 29 of 1996) and the Road National Road Traffic Act (Act No. 93 of 1996).

6.1.5 National Water Act (Act No 36 of 1998)

The NWA is the fundamental law for managing South Africa's water resources. The purpose of the Act is to ensure that water resources of the nation are appropriately protected, used, developed, conserved and controlled. This includes meeting the Reserve (basic human needs and environmental flow requirements); equitable access; redressing the result of past racial and gender discrimination; promoting the efficient, sustainable and beneficial use of water in the public interest; facilitating social and economic development; providing for growing demand for water use; protecting aquatic and associated ecosystems and their biological diversity; reducing and preventing pollution and degradation of water resources; and managing floods and droughts.

The Act deals with the development of strategies to facilitate the proper management of water resources, provides for the protection of the water resource, for the regulation of the use of water, for financial provision, catchment management agencies, water user associations, and other matters. GN1199 under NWA protects wetlands within 500 metres from a development through the requirement of a water use licence.

[1] **To provide for the effective protection and controlled utilization of the *environment* and for matters incidental thereto. Replaced by the National Environmental Management Act of 1998.**

Chapter 3 (Part 4) of the Act deals with pollution prevention and, in particular, a situation where pollution of a water resource occurs or might occur as a result of activities on land. The person who owns, controls, occupies, or uses the land in question is responsible for taking measures to prevent pollution of water resources. If these measures are not taken, the catchment management agency concerned may do whatever is necessary to prevent the pollution or to remedy its effects, and to recover all reasonable costs from the persons responsible for the pollution.

Chapter 4 of the Act deals with the regulation of the use of water and the requirements for controlled activities, general authorisations, and licenses. In general, a water use must be licensed unless it is listed in Schedule 1 of the Act, is an existing lawful water use, is permissible under a general authorisation, or if a responsible authority waives the need for a license.

6.1.6 National Heritage Resources Act (Act No 25 of 1999)

The National Heritage Resources Act aims to promote an integrated system for the identification, assessment, and management of the heritage resources of South Africa. Furthermore, it established the South African Heritage Resources Agency (SAHRA) to implement the Act.

The Act describes a process to be complied with by developers with respect to the identification, assessment, and management of cultural heritage resources that may be affected by a development. Provisions are made for alignment with other evaluation processes undertaken in terms of other legislation, for example, the Integrated Environmental Management Guidelines issued by DAEA or the Minerals and Petroleum Resources Development Act (Act No. 28 of 2002).

The National Heritage Resources Act (Act No. 25 of 1999) aims to promote the good management of the national estate of South Africa. The national estate can include:

- Places, buildings, structures and equipment of cultural significance
- Places to which oral traditions are attached or that are associated with living heritage
- Historical settlements and townscapes
- Geological sites of scientific or cultural importance
- Archaeological and paleontological sites
- Graves and burial grounds
- Other human remains not covered in terms of the Human Tissue Act (Act No 65 of 1983)
- Sites of significance relating to the history of slavery in South Africa.

In terms of **Section 38** of the Act, the South African Heritage Resources Agency (SAHRA) must be notified during the early planning phases of a project for any development that includes a number of activities. These include for example linear developments or barriers exceeding 300 m in length; any developments that change the character of a site exceeding 5 000 m^2 in extent; and the re-zoning of a site exceeding 10 000 m^2 in extent.

6.1.7 Conservation of Agricultural Resources Act (Act No. 43 of 1983)

The present legal mechanism regarding soil conservation and the control of alien invasive species (weeds) is contained in the Conservation of Agricultural Resources Act. The object of the Act is “To

provide for control over the utilisation of the natural agricultural resources in the Republic in order to promote the conservation of soil, the water resources, the vegetation and the combating of weeds and invader plants, and the matters connected therewith". Soil erosion is a natural process, which without disturbance would balance itself with the formation of new soil. Any development that destroys the natural protective canopy of vegetation, speeds up the process of soil erosion. Regulations applicable to the proposed project include:

Section 2 (2) (a) – *the provisions of this Act relating to weeds and invader plants shall also apply to land that is situated in an urban area.*

Section 6 (2) (e) – *the utilisation and protection of vleis, marshes, water sponges, watercourses and water resources[2].*

Section 6 (2) (I) – *the control of weeds and invader plants.*

6.1.8 National Environmental Management: Biodiversity Act (Act No 10 of 2004)

The purpose of the Biodiversity Act is to provide for the management and conservation of South Africa's biodiversity, to protect species and ecosystems, to ensure sustainable use of indigenous biological resources, to ensure fair and equitable sharing of benefits arising from the commercial use of these resources, and to establish a South African National Biodiversity Institute. The Act also covers alien and invasive species and genetically modified organisms that pose a threat to biodiversity.

6.1.9 Conservancies

A conservancy is the voluntary co-operative environmental management of an area, by its community or user groups, in respect of which registration has been granted by the relative provincial nature conservation authority. This means that a group of individuals, landowners, or businesses who are concerned with the state of their environment or who wish to monitor and enhance it, may do so by volunteering to be part of a committee that is registered with their local nature conservation agency. Co-operative management means that a conservancy manages an area in accordance with sound environmental principles, as prescribed by the various laws and policies of the nature conservation authorities in a particular area. In adopting the conservancy concept, the relevant authorities will be at hand to advise a conservancy as to the best environmental practices. A conservancy need not be a vast tract of land stocked with wild animals.

Although there are many rural conservancies that have followed this form, biodiversity can be found in the midst of most urban and even industrial areas. There is no set rule as to how large a conservancy has to be or where it must be. It may be rural, peri-urban, urban, marine, industrial, or in a township. Educational institutions and townhouse complexes can also register as a conservancy. Most conservancies have drawn up a constitution by which they abide.

6.1.10 Other National, Provincial and Local legislation of potential relevance

These include:

[2] Wetlands are inadequately protected in South Africa. The loss of wetlands is of international concern (in the last century more than 50% of wetlands have disappeared worldwide), hence, the Ramsar Convention, to which South Africa is a signatory.

- Hazardous Substances Act (Act No 15 of 1973).
- Land Survey Act (Act No 9 of 1921).
- Minerals and Petroleum Resources Development Act (Act No 28 of 2002).
- Municipal Structures Act (Act No 117 of 1998).
- National Forests Act (Act No 84 of 1998).
- National Veld and Forest Fire Act (Act No 101 of 1998).
- Occupational Health and Safety Act (Act No 85 of 1993).
- Restitution of Land Rights Act (Act No 22 of 1994).
- Land Reform (Labour Tenants) Act (Act 3 of 1996).
- Extension of Security of Tenure Act (Act 62 of 1997).
- National Environmental Management: Air Quality Act 39 of 2004

Although not discussed under this macro legislative framework, the proponent must also take cognisance of Provincial and Local Government Acts, Ordinances, and By-Laws, which may be applicable to the proposed development, for example, in the location and operation of construction camp sites.

7 APPROACH AND METHODOLOGY

7.1 Introduction to the Scoping and EIA Process

7.1.1 Process in Terms of the NEMA EIA Regulations

The NEMA EIA Regulations (**GNR 983, 984** & **985**) identify a number of "listed activities" for which authorisation is required. In order to obtain these authorisations, either a "Basic Assessment Process" or "Scoping and EIA Process" must be followed. Basic Assessments are typically required for activities which have a less detrimental impact on the receiving environment, whilst Scoping and EIA Process is required for larger projects which typically have a potentially significant detrimental impact on the environment. Both processes include some form of public participation.

The Environmental Authorisation for a Scoping and EIA Process, as required for the proposed Darvill Constructed Wetland, commences with an Environmental Scoping Phase (hereafter referred to as the 'Scoping Phase'). Following submission of a Scoping Report and associated Plan of Study for the Impact Assessment Phase, to and approval by the DEA, the Impact Assessment Phase will be initiated. A prescribed PPP runs concurrently with the Scoping and Impact Assessment Phases.

The aim of Scoping is to determine the issues, concerns and queries of Interested and Affected Parties (I&AP's), potential impacts, potential alternatives, specialist studies required (as necessary) and the scope of the Impact Assessment Phase.

The Impact Assessment Phase addresses the issues that have been raised during the Scoping Phase; assesses alternatives to the proposed activity in a comparative manner; assesses all identified impacts and determines the significance of each impact and formulates appropriate mitigation measures. The Impact Assessment Phase thus comprises the actual assessment of potential impacts and the compilation of a comprehensive Environmental Impact Report.

The Impact Assessment Phase may include specialist studies, which need to be included in the EIA

Report and must also include a Draft Environmental Management Programme (EMPr) for the planning, construction, operational and decommissioning phases of the project.

7.2 Scoping Phase

7.2.1 Objectives

The Environmental Scoping Phase has been undertaken in accordance with the requirements of Sections 24 and 24D of the NEMA, as read with GNR 983 (**Regulations 21-26**), 984 and 985 of the NEMA and the IEM Information Series (DEAT, 2002).

The objectives of the Scoping Phase are to:

- Ensure that the process is open and transparent and involves the Authorities, proponent, project team, stakeholders and general public
- Identify the important characteristics of the affected environment
- Ensure that feasible alternatives are identified and selected for further assessment
- Assess and determine possible impacts of the proposed project on the biophysical and socio-economic environment
- Ensure compliance with the relevant legislation
- An important aspect of the Scoping Phase is the PPP which aims to:
  - Ensure all relevant I&AP's have been identified and invited to engage in the scoping process;
  - Raise awareness, educate and increase understanding of I&AP's about the proposed project, the affected environment and the environmental process being undertaken;
  - Create open channels of communication between I&AP's and the project team;
  - Provide opportunities for I&AP's to identify issues or concerns and suggestions for enhancing potential benefits and to prevent or mitigate impacts;
  - Accurately document all opinions, concerns and queries raised by I&AP's regarding the project;
  - Ensure the identification of the significant alternatives and issues related to the project as proposed by I&AP's.

7.2.2 Scoping Report Requirements as per the NEMA EIA Regulations

This Scoping Report has been compiled in accordance with the NEMA EIA Regulations, which includes the following requirements:

- Provided the details and expertise of the EAP undertaking the EIA process;
- Described the proposed location for the activity along with all applicable alternatives;
- A baseline description of the environment that may be affected by the activity and the manner in which the physical, biological, social, economic and cultural aspects of the environment may be affected by the proposed project;
- Identifying all relevant legislation and guidelines that have been considered for the project;
- Include a motivation for the need and desirability for the proposed development including the need and desirability of the activity in the context of the preferred location
- A description of the environmental issues and potential impacts, including cumulative impacts that have been identified;
- Providing the methodology that will be adopted in assessing the potential impacts that have been identified, including any specialist studies that will be undertaken;

- Outlining the PPP that has been undertaken for the project to date, and;
- Provide a Plan of Study for EIA;
- Provide an undertaking under oath or affirmation by the EAP in relation to the correctness of all information provided in the report
- Provide an undertaking under oath or affirmation by the EAP in relation to the level of agreement between the EAP and interested and affected parties on the plan of study for undertaking the environment impact assessment

7.2.3 Compilation and Public Review of the Final Scoping Report

This Scoping Report was compiled in accordance with the requirements of the NEMA EIA Regulations (**DEA, 2014**).

The Draft Scoping Report (DSR) was published for public review and comment. Comments received on this DSR or any new comments or issues raised during discussions with I&AP's were recorded in the Comments and Response Report (CCR) and has been appended to, and addressed in, the Final Scoping Report (FSR).

7.2.4 Compilation of the Final Scoping Report

Comments received on the DSR and during and in response to the notification of key stakeholders and I&AP's of the proposed project has been recorded in the CCR and responded to. Where necessary, the appropriate amendments will be made to the Scoping Report for finalisation before submission to the DEA for review.

At the same time as submission of the FSR to the DEA for approval, I&AP's were informed of the submission and the availability of FSR, should they wish to review the document. Any further comments I&AP's may have on the FSR must be submitted directly to the DEA Assessing Officer, as well as the EAP for consideration in the review process.

7.2.5 Assessment Phase

The approach and methodology for the Assessment Phase was provided by way of the Plan of Study for EIA included in **Section 10 of the FSR**. Specialist studies that were identified during the Scoping Phase have been incorporated into the Plan of Study for EIA and have been undertaken as part of the Assessment Phase.

7.2.6 Public Participation Process

The approach adopted for the PPP shall be wholly based on the requirements stipulated in the NEMA EIA Regulations (GNR 984) and associated guidelines which DEAT published in May 2006 (DEA, 2014).

Section8 provides further details on the PPP undertaken to date as part of the Scoping Phase and how it continue into the Assessment Phase of the EIA.

8 PUBLIC PARTICIPATION

Public participation is the cornerstone of any EIA. The principles of NEMA as well as the EIA

Regulations govern the EIA process, including public participation. The Public Participation Process (PPP) following for the proposed Darvill Constructed Wetland has been conducted according to **Guideline 4** of the EIA Regulations No. 56(2). These include provision of sufficient and transparent information on an on-going basis to stakeholders to allow them to comment, and ensuring the participation of previously disadvantaged people, women and the youth.

The public participation process is primarily based on two factors; firstly, on-going interaction with the environmental specialists and the technical teams in order to achieve integration of technical assessment and public participation throughout. Secondly, to obtain the bulk of the issues to be addressed early on in the process, with the latter half of the process designed to provide environmental and technical evaluation of these issues. These findings are presented to stakeholders for verification that their issues have been captured for further comment.

Input into the public participation process by members of the public and stakeholders can be given at various stages of the EIA process. Registration on the project database can take place at any time during the EIA process up until the final EIA report is submitted to DEA. There are however set periods in which comments are required from interested and or affected parties (I&AP's) in order to ensure that these are captured in time for the submission of the various reports.

The EIA regulations emphasise the importance of public participation. In terms of the EIA regulations, registered interested and/or affected parties:

- may participate in the application process;
- may comment on any written communication submitted to the competent authority by the applicant or environmental consultant;
- must comment within the timeframes;
- must send a copy of any comments to the applicant or EAP if the comments were submitted directly to the competent authority; and
- must disclose any direct business, financial, personal or other interests that the person has in the application being granted or refused.

Further, in terms of the EIA regulations, the Environmental Assessment Practitioner (EAP):

- manages the application process;
- must be independent;
- must undertake the work objectively – even if this results in views and findings that are not favourable to the applicant;
- must disclose material information that may influence the decision; and
- must conduct a public participation process.

8.1 Objectives of Public Participation

The objectives of the Public Participation Process are to:

- Inform I&AP's about the proposed project and the Scoping and EIA Process

- Establish lines of communication between I&AP's and the project team to deal with potentially contentious issues
- Promote transparency and an understanding of the proposed project and its potential environmental impacts.
- Provide information used for decision-making.
- Provide ample opportunity to all parties to exchange information and express their views and raise issues and concerns
- Obtain contributions from I&AP's and ensure that all issues, concerns and queries raised are fully documented and carried forward in the EIA process
- Identify all the significant issues that need to be addressed in the EIA.
- Encourage co-regulation, shared responsibility and a sense of ownership.

It needs to be noted what Public Participation is and is not.

- Public Participation is:
  - A communication mechanism to inform I&APs regarding a proposed project.
  - A communication mechanism to record comments and/or concerns raised during the relevant phase of the EIA by I&APs regarding a proposed project.

- What Public Participation is not:
  - A marketing exercise.
  - A process to address grievances but rather to record comments raised.
  - One-on-one consultation with each I&AP during the EIA process.

In addition to the guidance of the PPP in the EIA Regulations every effort must also be made to conform to the requirements of the Promotion of Administrative Justice Act 2000 (Act 3 of 2000).

8.2 Identification and Involvement of Interested and Affected Parties

These periods were implemented according to **Guideline 4** of the NEMA (107/1998), Environmental Impact Assessment Regulations in terms of **Section 24(5)**, and where relevant, the comment periods were extended.

Section 41 of the NEMA EIA Regulations outlines the requirements for the notification and involvement of all potential Stakeholders and I&AP's. These requirements include to:

- Fix a notice board at a conspicuous place on all alternative sites
- Give written notice to:
  - The landowners and occupiers of the sites and those within 100 m of the alternative site or those directly influenced by the activity under consideration
  - The municipal councillor of the affected wards
  - The municipality which has jurisdiction in the area
  - Any organs of state having jurisdiction in respect of any aspect of the activity
- Place an advertisement in a local and provincial newspaper or official Gazette
- Place an advertisement in a national newspaper if the impact extends beyond 'local' boundaries
- Make information available containing all relevant facts in respect of the application to I&AP's

- Facilitate participation by I&AP's in such a manner that all are provided with a reasonable opportunity to comment on the application.

SiVEST adhered to these requirements as detailed in the sub-sections below.

8.2.1 Registration of Interested and Affected Parties

As part of the requirements for NEMA EIA Regulation 42, SiVEST has developed, maintained and is constantly updating an electronic I&AP register for the Darvill Constructed Wetland EIA. The register includes role players and stakeholders and registered public I&AP's.

8.2.2 Notification of Key Stakeholders

At the commencement of the Scoping and EIA Process, SiVEST identified key stakeholders such as Municipal Authorities, Government Departments and environmental groups that have jurisdiction over, or potential interest in, the activity and provided them with written notification **(Appendix C).** Stakeholders and I&AP's were also sent a Background Information Document (BID) detailing technical information about the Project and the EIA Process to be followed. Contact persons and details of these stakeholders are incorporated in the I&AP Register **(Appendix C).**

The key organisations and stakeholders identified through the PPP are:

- *Amafa* KwaZulu-Natal
- Department of Environmental Affairs
- Department of Economic Development, Tourism and Environmental Affairs.
- Department of Water and Sanitation
- *Ezemvelo* KZN Wildlife
- Local Ward Councillors
- Msunduzi Municipality
- WESSA
- Department of Transport
- Department of Agriculture, Forestry and Fisheries
- DUCT

8.2.3 Landowner Notification

As the site is owned by the Municipality, no landowners needed to be notified, however adjacent landowners to site have will be in regular communication with Umgeni Water and SiVEST.

8.2.4 Media Notices

The Scoping and EIA Process has been advertised in The Natal Witness newspaper 26th May 2016 - English advert) and the Isolezwe (25th May 2016 - Zulu Advert). The media notice provide brief information about the proposed Darvill Constructed Wetland Development and the EIA process that is currently in progress, as well as an invitation for the registration and participation of I&APs.

8.2.5 Notice Boards

Notice boards detailing information about the project and the Scoping and EIA Process, and inviting

I&AP's to register were be placed around the site on the 22nd of May 2016. These notice boards will be designed to the specification of **Section 41 (4)** of the NEMA EIA Regulations. Photographic proof of placement of these site notices can be found in **Appendix C** of this report.

8.2.6 Background Information Document

The BID was compiled in English and distributed to all registered I&AP's and authorities. The BID introduced the proposed project and contains background information on the project, the proponent, consultants, the proposed Scoping and EIA process and the associated PPP to be followed. It included an invitation to I&AP's to register and submit any comments to SiVEST in writing (**Appendix C**).

8.2.7 Public Information Sharing Meeting

A public meeting will be held if necessary. All I&AP's and key stakeholders will be invited to attend any planned meetings telephonically and via email. Any issues that will be raised will be documented in **(Appendix C).**

8.2.8 Solicitation of Comments

NEMA EIA **Regulation 43** entitles registered I&AP's to comment in writing, on all written submissions made to the Competent Authority as part of the environmental authorisation and to raise any issues or concerns which they believe may be of significance in the consideration of the application.

The DSR was published for a comment period of 30 days at the following locations:

- Msunduzi Local Library
- Sobantu Local Library
- Was available on SiVEST's website for download

IAP's were notified accordingly of the publication and invited to comment.

The review period for the impact phase of the EIA is proposed to be:

- Comment period for the Draft Environmental Impact Report (DEIR): 6 - 8 Calendar Weeks (30 working days)
- Comment on the Final EIR, should there be a significant change from the draft EIR an appropriate comment period will be liaised with DEA. This period may be seven (7) days, fourteen days (14), etc., as to be approved or set by DEA. Should there be no significant changes, then the final EIR will be submitted to DEA and registered I&AP's will be notified that the EIR has been submitted to DEA, that the EIR is available on SiVEST's website for review, and should an I&AP wish to submit comments on the EIR, to do so – in writing – to DEA. Contact details will be provided in the letter.

8.2.9 Comments and Response Report

All comments and issues raised to date have been consolidated into a Comments and Response Report (CCR), which summarises each comment received from any I&AP and provides a response from the EAP or member of the project team. This register is constantly updated and will include

comments and responses after publication of both the FSR and DEIR.

9 ENVIRONMENTAL ISSUES & POTENTIAL IMPACTS

In terms of **Regulation 29** of the EIA Regulations which describes the contents of a Scoping Report, sub-regulation (f) states that the Scoping Report must contain "*a description of environmental issues and potential impacts, including cumulative impacts that have been identified*."

The construction and operation of the proposed Darvill Constructed Wetland, as well as associated infrastructure, may result in a number of potential positive and/or negative impacts on the physical, biophysical and socio-economic environment associated with the proposed site, and any viable alternatives under consideration.

The purpose of this **Section** is to describe the potential impacts that may arise as a result of the project based on its context, knowledge of the area, issues raised and information provided during the PPP. An additional objective of the Scoping Phase is to identify any gaps in information that would require specific specialist studies to allow appropriate assessment of the identified impacts. This process has been undertaken and the identified specialist studies and their Terms of Reference are described in Plan of Study for EIA (refer to **Section 10**).

The potential impacts, as documented in this **Section,** were identified during the Scoping Process in conjunction with the project team and public interactions emanating from the PPP.

Issues for consideration have been identified by the following means:

- Inputs from relevant regulatory authorities;
- Inputs from I&AP's during the Public Participation Process in the Scoping Phase;
- Desktop studies and surveys;
- Compilation of the information relevant to the proposed development;
- Site visit and assessment by the consultants and relevant specialists;
- Evaluation of proposed design scope and potential impacts.

9.1 Rating System Used to Classify Impacts

9.1.1 Assessing impacts on the biophysical environment

The significance of an impact on a biophysical system or component is determined by multiplying the **environmental value** of the system or component affected by the **magnitude** of the impact on that system or component (**Environmental Value x Impact Magnitude**).

9.1.2 Environmental Value

For the purpose of this method, environmental value is defined as the value of an ecosystem, habitat or community to society in terms of the level of ecosystem goods and services provided by the system in question and current conservation status of the system or component. For individual populations and species, environmental value is defined according to the conservation status afforded to the specific population or species.

More specifically, the Environmental Value of ecosystems, habitats and communities is calculated as the average of the sum of its Ecosystem Goods and Services Value and its Conservation Status e.g. **Environmental Value = (Ecosystem Goods & Services Value + Conservation Status) / 2**. The Environmental Value of population and/or species is equal to the conservation status score only. E.g. **Environmental Value = Conservation Status.**

9.1.3 Ecosystem Goods & Services Value

Ecosystems are known to provide important goods and services to society. Ecosystem goods refer to the natural products harvested or used by humans such as water, fish, pastures for livestock, timber, firewood, crafts materials, medicinal plants and harvested wildlife such as game. Ecosystem services refer to a number life support services provided by ecosystems that contribute to human wellbeing and the production of the abovementioned ecosystem goods. Most ecosystem services can be grouped into the following general categories:

- Purification and detoxification: filtration, purification and detoxification of air, water and soils;
- Cycling processes: nutrient cycling, nitrogen fixation, carbon sequestration, oxygen production and soil formation and maintenance;
- Regulation and stabilization: pest and disease control, climate regulation, mitigation of storms and floods, erosion control, regulation of rainfall and water supply;
- Biodiversity maintenance: rare and/or diverse gene pools and/or habitats, storehouse of genetic material that is used in industrial, agricultural and pharmaceutical industries;
- Regeneration and production: production of biomass providing raw materials and food, pollination and seed dispersal; and
- Quality of life, fulfilment and knowledge: aesthetic, recreational, cultural and spiritual role, education and research.

At an ecosystem and community level, the Ecosystem Goods & Services Value expresses the relative importance of an ecosystem or community in terms of the provision of ecosystem goods and services to society as determined by specialists.

Table 4: Ecosystem goods & services value rating categories

	A: Community/Ecosystem (System)
1	**Low:** System provides a low/limited level of ecosystem goods and/or services to society and/or the goods are not valued or used by the local population in any way.
2	**Medium-Low:** System provides some (moderately low) level of ecosystem goods and/or services to society and/or the goods have some value the local population.
3	**Medium:** System provides an intermediate/moderate level of ecosystem goods and/or services to society and/or the goods are moderately valued by the local population.
4	**Medium-High:** System provides a moderately-high level of ecosystem goods and/or services to society and/or the goods are highly valued by the local population.
5	**High:** System provides a high level of ecosystem goods and/or services to society and/or the goods are essential to human activities (e.g. provides potable water).

9.1.4 Conservation Status

At the ecosystem and community level, the Conservation Status is an estimation of the current and future ability of an ecosystem and/or community to sustain ecological integrity and viability and adapt to environmental changes at the national, regional and local scales. Conservation status is based on

total habitat loss, habitat fragmentation, degree of degradation, degree of protection needed, degree of urgency for conservation needs, and types of conservation practiced or required. At the population and species level, conservation status refers to the likelihood of the survival of a species at present and into the future. The categories below have been adapted from **Golding (2002)**.

Table 5: Conservation status rating categories

	A: Community/Ecosystem (System)	B: Individual/Population (Component)
1	**Low:** System is not considered rare, endemic, near-threatened, vulnerable or endangered nationally, provincially or locally and/or does not provide core habitat for conservation worthy species.	**Low:** Component is not considered rare, endemic, near-threatened, vulnerable or endangered nationally, provincially or locally.
2	**Medium-Low:** System is near-threatened nationally, provincially and/or locally and/or provides core habitat for near-threatened species.	**Medium-Low:** Component is considered near-threatened nationally, provincially and/or locally.
3	**Medium:** System is considered rare, endemic and/or vulnerable nationally, provincially and/or locally and/or provides core habitat for rare, endemic and/or vulnerable species.	**Medium:** Component is considered rare, endemic and/or vulnerable nationally, provincially and/or locally.
4	**Medium-High:** System is considered endangered nationally, provincially and/or locally and/or provides core habitat for endangered species.	**Medium-High:** Component is considered endangered nationally and/or provincially and/or locally.
5	**High:** System is considered critically endangered nationally, provincially and/or locally and/or is the object of legislative and regulatory measures and/or provides core habitat for critically endangered species.	**High:** Component is considered critically endangered and/or critically endangered nationally, provincially and/or locally.

Once the ecosystem goods & services value and the conservation status of the biophysical system or component have been rated according to **Table 6** and **7** respectively, the combined average is calculated to give an indication of the overall environmental value rating of the biophysical system or component. The range of possible environmental value scores is from 1 to 5.

9.1.5 Impact Magnitude

The impact magnitude score for each identified impact is calculated by the addition of four criteria, namely 'degree of disturbance', 'extent', 'duration' and 'probability'. The range of possible impact magnitude scores is from 4 to 20.

9.1.6 Degree of Disturbance

The 'Degree of Disturbance' to biophysical systems and components expresses the change in the health, functioning and/or role of the system or component as a result of an activity. This criterion also includes possible downstream and/or cumulative impacts arising from the alteration of the system or component.

Table 6: Degree of Disturbance rating categories for biophysical/ecological systems

1	**Low:** Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	**Medium-Low:** Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a slightly modified way and maintains original integrity (no/limited impact on integrity).

3	**Medium:** Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity.
4	**Medium-High:** Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily ce:ase. High costs of rehabilitation and remediation.?
5	**High:** Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired (system collapse). Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.

9.1.7 Impact Extent

The Extent of the impact generally expresses the spatial influence of the effects produced by a disturbance to an environmental system or component.

Table 7: Extent rating categories

1	**Site:** Effects of an impact experienced within or in close proximity (100m) to the project site. However, the size of the site needs to be taken into account. A really large site may have to be scored according to category 2 below.
2	**Surrounding Area:** Effects of an impact experienced beyond the project site but within a 2km radius of the site.
3	**Local:** Effects of an impact experienced within the local area (e.g. between a 2km to 50km radius of the site).
4	**Regional:** Effects of an impact experienced within the local region (e.g. between a 50km to 200km radius of the site).
5	**Provincial:** Effects of an impact experienced within a large geographic area beyond a 200km radius of the site.

9.1.8 Impact Duration

The *Duration* of the impact describes the period of time during which an environmental system or component is changed by the impact.

Table 8: Duration rating categories

1	**Short-term:** The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	**Medium-Short:** The impact and its effects will continue or last for the period of a relatively long construction period and/or a limited recovery time after this construction period, thereafter it will be entirely negated (2 – 5 years).
3	**Medium-term:** The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (5 – 15 years).
4	**Long-term:** The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (15 – 50 years).
5	**Permanent:** The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient (Indefinite).

9.1.9 Impact Probability

The probability of the impact describes the likelihood of the impact actually occurring.

Table 9: Probability rating categories

1	**Unlikely:** The chance of the impact occurring is extremely low (Less than a 20% chance of occurrence).
2	**Fairly Unlikely:** The chance of the impact occurring is moderately low (Between a 20% to 40% chance of occurrence).
3	**Possible:** The impact may occur (Between a 40% to 60% chance of occurrence).
4	**Probable:** The impact will likely occur (Between a 60% to 80% chance of occurrence).
5	**Definite:** Impact will certainly occur (Greater than an 80% chance of occurrence).

9.1.10 Assessing impacts on the social and socio-economic environment

In contrast to the assessment of the impacts on biophysical systems and components, impacts on socio-economic systems and components are assessed in terms of impacts to the quality of life, health and safety of the people within the social and socio-economic systems affected. Thus, the significance of an impact on a social or socio-economic system or component is determined by multiplying the **social value** of the quality of life, health and safety of the people affected by the **magnitude** of the impact on the quality of life, health and safety of the affected people (**Social Value x Impact Magnitude**).

The assessment of impacts on agricultural and cultural resources is also included in this section.

9.1.11 Social Value

The Social Value expresses the relative importance attributed to an aspect of the social environment by the public, the various levels of government, or any other legislative or regulatory authority. Social Value indicates the public or political desire or will to conserve the integrity or original character of a social aspect. This will is expressed through the legal protection that the social aspect is accorded or by the concern of the local or regional public for the social aspect. The Social Value evaluation is based on information gathered during stakeholder engagement during the public participation process or a social impact assessment. Agricultural land value has been included due to the recent increased awareness of the loss of agricultural land occurring in South Africa.

Table 10: Social value rating categories

	Social/Socio-Economic Value	**Agricultural Land Value**
1	**Low:** Aspect or resource is of little or no concern to the local public and plays a limited role in the social health of communities.	**Low:** Agricultural land in question is of low agricultural potential as assessed by a qualified agricultural specialist.
2	**Medium-Low:** Aspect or resource is valued by a small portion of the concerned population and/or plays some role (mildly important) in the social health of communities.	**Medium-Low:** Agricultural land in question is of medium-low agricultural potential as assessed by a qualified agricultural specialist.
3	**Medium:** Aspect or resource is valued by an intermediate (moderate) portion of the concerned population and/or plays an intermediate (moderate) role in the social health of communities.	**Medium:** Agricultural land in question is of medium agricultural potential as assessed by a qualified agricultural specialist.
4	**Medium-High:** Aspect or resource is valued by a significant portion of the concerned population and/or plays a significant role in the social health of communities (but is not legally protected).	**Medium-High:** Agricultural land in question is of medium-high agricultural potential as assessed by a qualified agricultural specialist.
5	**High:** Aspect or resource is the object of legislative and regulatory measures and/or is critical to the	**High:** Agricultural land in question is of high agricultural potential as assessed by

	health of communities.	a qualified agricultural specialist.

According to these value categories, quality of life is of medium-high value as it plays a significant role in social health. Health and safety are of high value to society as they are integral to social function and the object of legislation.

9.1.12 Impact Magnitude

The impact magnitude score for each identified impact is calculated by the addition of four criteria, namely 'degree of disturbance', 'extent', 'duration' and 'probability'. The range of possible impact magnitude scores is from 4 to 20.

9.1.13 Degree of Disturbance

a. Degree of Disturbance to Social and Socio-Economic Systems/Components:

For the purposes of this study, the 'Degree of Disturbance' to social and socio-economic systems is assessed in terms of the impacts on the quality of life, health and safety of those within the social and economic systems that stand to be affected. This is because it is difficult to value social and socio-economic systems without reference to individual, communal and societal quality of life.
The 'Degree of Disturbance' to social and socio-economic systems and quality of life should be assessed by social scientists and economists. However, the public participation process does present an opportunity for the public to identify and describe impacts on their quality of life as well as to review the assessment of these impacts in the Environmental Impact Assessment Report.

Quality of life is generally defined as the measure of the social, psychological and physical well-being of individuals, communities, cities and societies in terms of the satisfaction and enjoyment derived from life. Quality of life is a complex measure to assess due to the complex ways in which different aspects influence overall quality of life for different individuals.

Fourteen (14) 'determinants of quality of life', based on the major aspects/dimensions of human life, have been identified to make the assessment of changes to quality of life easier and manageable for the purposes of this study. These are (but are not limited to):

1. Access to and quality of housing
2. Access to and quality of basic services e.g. potable water, sanitation, electricity & solid waste
3. Economic well-being and employment
4. Quality of employment
5. Physical and psychological health
6. Quality of family and social life
7. Quality of natural environment e.g. air quality
8. Safety and security
9. Quality of recreation and leisure
10. Access to and quality of education, learning and development
11. Access to and quality of social services
12. Community cohesion and involvement
13. Quality of transport and commuting
14. Individual and communal sense of place

It is a lot easier to assess the 'Degree of Disturbance' to one or many of the identified 'determinants of quality of life' above instead of overall quality of life, which is a complex interaction between all these determinants and their relative contribution and importance to overall quality of life.

For the purposes of this study, the 'Degree of Disturbance' to quality of life is calculated as the average of the sum of the 'Degree of Disturbance' to the 'determinants of quality of life' as shown in **Table 13** and the relative contribution and importance of the different determinants of quality of life to overall quality of life as shown in **Table 14** below.

The 'Degree of Disturbance' to the determinants of quality of life should be assessed using both qualitative and quantitative data from social and economic specialist studies. However, public statistics, the EIA public participation process and individual interviews may also be used if necessary. It is important that reasonable qualitative subjective data is given the same importance as quantitative objective data in the assessment as quantitative objective data often only gives an indication of the ability of people to meet their needs (potential quality of life) instead of giving an indication of whether the needs have actually been met (actual quality of life).

Table 11: Degree of Disturbance rating categories for the 'determinants of quality of life'

Determinants of Quality of Life	
1	**Low:** Impact alters one or many of the determinants of quality of life in a way that is barely perceptible by those being affected.
2	**Medium-Low:** Impact results in some (moderately low) deterioration or improvement in one or many of the determinants of quality of life.
3	**Medium:** Impact results in an intermediate (moderate) deterioration or improvement in one or many of the determinants of quality of life.
4	**Medium-High:** Impact results in a moderately-high deterioration or improvement in one or many of their determinants of quality of life.
5	**High:** Impact results in a highly significant (high to very high) deterioration or improvement in one or many of their determinants of quality of life.

The relative contribution and importance of each different 'determinants of quality of life' to the overall quality of life of individuals, communities and societies is largely a subjective measure and can only be assessed by collecting qualitative data from the individuals and communities that stand to be affected by the proposed project. However, at a general level, it can be assumed that the greater the value of a specific aspect of social life, the greater that aspect will contribute to overall quality of life. In the absence of qualitative data, quantitative data (e.g. community specific statistics) may be used but this data can only give an indication of the potential quality of life, not the actual quality of life experienced.

Table 12: Relative Contribution and Importance rating categories for the 'determinants of quality of life'

Relative Contribution/Importance to Quality of Life	
1	**Low:** The determinant of quality of life is of marginal importance (low contribution) to the overall quality life of those affected.
2	**Medium-Low:** The determinant of quality of life is of moderately-low importance (moderately-low contribution) to the overall quality life of those affected.
3	**Medium:** The determinant of quality of life is of intermediate (moderate contribution) importance to the overall quality life of those affected.
4	**Medium-High:** The determinant of quality of life is of moderately-high importance (moderately-high contribution) to the overall quality life of those affected.
5	**High:** The determinant of quality of life is of high to critical importance (high to very high contribution) to the overall quality life of those affected.

The 'Degree of Disturbance' to health and safety should be assessed using the findings of the health and safety risk assessment studies undertaken for the proposed project and site involved.

Table 13: Degree of Disturbance rating categories for human health and safety

1	**Low:** Impact results in the marginal increase or decrease in the incidences of near misses and/or has minimal effects on the health of humans who do not require medical treatment.
2	**Medium-Low:** Impact results in a moderate increase or decrease in the incidences of near misses and/or has some negative or positive effects on the health of humans BUT medical treatment or intervention is not required.
3	**Medium:** Impact results in the increase or decrease in the incidences of injury to humans requiring some medical treatment and/or some deterioration or improvement in health requiring or reducing the need for medicine/treatment.
4	**Medium-High:** Impact results in the increase or decrease in the incidences of serious and irreversible injury to humans and/or the deterioration in health of humans requiring hospitalization or the improvement in health reducing the need for hospitalization.
5	**High:** Impact results in the increase or decrease in the incidences of death to humans.

b. Degree of Disturbance to Agricultural Resources:

The 'Degree of Disturbance' to agricultural resources should be assessed using the findings of the agricultural specialist studies undertaken for the proposed project and site involved.

Table 14: Degree of Disturbance rating categories for agricultural resources

1	**Low:** Impact results in an impact on agricultural land that has a marginal/limited effect on the productivity of the land and/or ability of the farmer(s) to harvest land profitably.
2	**Medium-Low:** Impact results in an impact on agricultural land that has some effect on the productivity of the land and/or the ability of the farmer(s) to harvest the land profitably.
3	**Medium:** Impact results in an impact on agricultural land that has an intermediate effect on the productivity of the land and/or the ability of the farmer(s) to harvest the land profitably.
4	**Medium-High:** Impact results in an impact on agricultural land that has a serious effect on the productivity of the land and/or the ability of the farmer(s) to harvest the land profitably.
5	**High:** Impact results in the permanent loss of agricultural land to another land use making further farming of the land impossible.

c. Degree of Disturbance to Cultural Heritage Resources:

The 'Degree of Disturbance' to cultural heritage resources should be assessed using data from cultural heritage specialist studies undertaken for the proposed site involved.

Table 15: Degree of Disturbance rating categories for cultural heritage resources

1	**Low:** Impact affects the quality, use and integrity of cultural items in a way that is barely perceptible.
2	**Medium-Low:** Impact alters the quality, use and integrity of cultural items but the cultural items still continue to function in a slightly modified way and original integrity is maintained.
3	**Medium:** Impact alters the quality, use and integrity of cultural items but the cultural items still continue to function in a modified way and maintain most of integrity.
4	**Medium-High:** Impact results in serious damage to cultural items and the quality, use, and integrity of the cultural items temporarily cease.
5	**High:** Impact results in irreparable damage to cultural items and the quality, use, integrity of the cultural items permanently ceases and is irreversibly impaired.

9.1.14 Impact Extent

The Extent of the impact generally expresses the spatial influence of the effects produced by a disturbance to an environmental system or component. However, although this definition is

appropriate for an assessment of impacts of a biophysical nature, often the spatial extent in m^2 or km^2 is not appropriate for the assessment of impacts of a social and socio-economic nature. Rather the extent of social and socio-economic impacts is often better measured by the number of people that stand to be affected by a proposed activity as shown in **Table 18** below.

Table 16: Extent rating categories

	B: Socio-economic Impacts
1	**Low:** Less than 20 people stand to be affected by the impact.
2	**Medium-Low:** Between 20 and 50 people stand to be affected by the impact.
3	**Medium:** Between 50 and 100 people stand to be affected by the impact.
4	**Medium-High:** Between 100 and 1000 people stand to be affected by the impact.
5	**High:** Greater than 1000 people stand to be affected by the impact.

Impact Duration

The *Duration* of the impact describes the period of time during which an social/socio-economic system or component is changed by the impact.

Table 17: Duration rating categories

1	**Short-term:** The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	**Medium-Short:** The impact and its effects will continue or last for the period of a relatively long construction period and/or a limited recovery time after this construction period, thereafter it will be entirely negated (2 – 5 years).
3	**Medium-term:** The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (5 – 15 years).
4	**Long-term:** The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (15 – 50 years).
5	**Permanent:** The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient (Indefinite).

9.1.15 Impact Probability

The probability of the impact describes the likelihood of the impact actually occurring.

Table 18: Probability rating categories

1	**Unlikely:** The chance of the impact occurring is extremely low (Less than a 20% chance of occurrence).
2	**Fairly Unlikely:** The chance of the impact occurring is moderately low (Between a 20% to 40% chance of occurrence).
3	**Possible:** The impact may occur (Between a 40% to 60% chance of occurrence).
4	**Probable:** The impact will likely occur (Between a 60% to 80% chance of occurrence).
5	**Definite:** Impact will certainly occur (Greater than an 80% chance of occurrence).

9.1.16 Determining Impact Significance

The overall significance score for each identified impact is calculated by multiplying **impact**

magnitude by **environmental value or social value** (e.g. **Magnitude x Environmental Value**). The range of possible impact significance scores is from 4 to 100. The range of possible significance scores were classified into seven rating classes as shown in **Table 21** below.

For the purpose of this assessment, a significance score of 37 to 45 (**medium-low**) is considered 'acceptable but undesirable' to society. Undesirable impacts are not recommended and should be mitigated, but they may be offset by significant gains (>45+) in other aspects of the environment. A significance score of 46 to 55 (**medium**) and 56 to 63 (**medium-high**) is considered 'generally unacceptable' to society and only high gains (>63+) in other aspects of the environment can or should offset this impact. However, trade-offs between 'generally unacceptable' and 'highly beneficial' impacts should be avoided in line with the principles of sustainability. A significance score of over 63 (**high** to **very high**) is considered 'totally unacceptable' to society and no gains in other aspects of the environment can or should offset this impact.

It is important to note, however, that this rating system is not prescriptive and its aim is to aid and inform decision making. The method and ratings are there to guide the assessment of significance and all significance ratings will need to be interpreted realistically by the practitioner involved. In the end the decision to authorise this activity is the responsibility of the Department of Environmental Affairs (DEA).

Table 19: Significance score rating categories

Significance Score	Significance Rating	Significance Interpretation	
		Negative	Positive
4 – 22	Very Low	Acceptable / Not Serious	Marginally Positive
23 – 36	Low	Acceptable / Not Serious	Marginally Positive
37 – 45	Medium-Low	Acceptable But Undesirable / Mildly Serious	Moderately Positive
46 – 55	Medium	Generally Unacceptable / Serious	Beneficial/Important
56 – 63	Medium-High	Generally Unacceptable / Very Serious	Very Beneficial/Important
64 – 79	High	Totally Unacceptable / Highly Serious	Highly Beneficial/Important
80 – 100	Very High	Totally Unacceptable / Critically Serious	Critically Beneficial/Important

9.2 Construction phase Impacts

9.2.1 Topography and Geology

Description of Impact

Earth grading and soil stockpiling for site preparation, and the construction of the proposed Darvill Constructed Wetland, and associated infrastructure may facilitate erosion and resultant sedimentation. Excavation associated with this project will result in a large portion of soil being re-distributed over the site in the form of platforms, which could accelerate erosion and in turn lead to the sedimentation of nearby water resources. Due to the large area that will need to be developed the amount of cleared area and hence the potential for erosion to occur will be high.

There is the potential for impacts on the geology and topography during both the construction and operational phase of the development. However due to the levels of disturbance that are likely during the site clearing, bulk earthworks and construction, these possible impacts are likely to be more significant during the construction phase. During the operational phase erosion will decrease as the wetland will form a depression and collection point.

The aquatic study further outlines that the potential increase in slope and bank construction will enhance erosion potential (greater energy for sediment wash). The reduction in vegetation cover will open bare soil therefore reducing the surface roughness and increasing the erosive potential to the elements (wind and rain). Sheet wash, rill and gully erosion is likely and may lead to the collapse or slumping of wetland/stream bank areas that would bury marginal wetland habitat. An increase in compaction of the soils along the edge of the plot where heavy machinery traverses would also lead to an increase in the runoff.

A geotechnical investigation was undertaken to determine the area's susceptibility to erosion impacts and the extent to which they can be mitigated or not. In addition, the geotechnical investigation provides information on the suitability of the site in terms of founding requirements and potential geological hazards. The investigation undertaken indicates that the proposed design of a surface flow wetland is supported by the available data and information and that the geotechnical constraints must be adhered to. Drainage measures and storm-water management are essential as with any structural development.

Pre-Mitigation Measures

Assessment Criteria	Score	Rating
Ecosystem Value	3	Medium
Social Value	3	Medium
Environmental Value	**3**	**Medium**
Degree of Disturbance	3	Medium
Extent	2	Surrounding Area
Duration	4	Long-term
Probability	4	Probable
Impact Magnitude	**13**	**Medium**
Impact Significance	**39**	**Medium-Low**
Acceptability	**Acceptable but Undesirable**	

Proposed Mitigation Measures

- The time that stripped areas are left open to exposure should be minimised wherever possible.
- Care should be taken to ensure that lead times are not excessive. The stripping of vegetation directly preceding activities on site greatly reduce the risk of erosion.
- Wind screening and storm water control should be undertaken to prevent soil loss from the site.
- Procedures that are in place to conserve topsoil during the construction phase of the project are to be applied to the set up phase i.e. topsoil is to be conserved while providing access to the site and setting up the camp.
- No impediment to the natural water flow other than approved erosion control works is permitted, especially in the river or drainage lines located on the property.
- The site should be well-graded both during and after construction to prevent ponding of water on the ground surface.
- Soil erosion must be prevented at all times. Where evidence of soil erosion can be seen or is taking place, this should be reported by the Site Manager and the Environmental Control Officer
- To minimize the loss and damage to vegetation and to minimize compaction during construction, the construction camp should be kept to a minimum and all activities must be restricted to a demarcated servitude.
- To prevent erosion and sedimentation, construction activities should be undertaken during the dry season when flows will be substantially reduced.
- The construction camp should be located more than 100m from all watercourses.

- All stockpiles and spoil material should be located on even surfaces, and more than 100m from watercourses so as not to cause sediment wash into the system;
- Sediment controls measures (e.g. hay bales, silt fences, sedimentation ponds, etc) should be put in place should stockpiles show potential to wash away;
- The construction area should be clearly identified including access roads, stockpile or excavation areas, storage facilities and parking areas.
- Topsoil stripped from the construction footprint must not be spoiled but stockpiled and preserved for use in rehabilitation. Top-soil and sub-soil stockpiles and spoil sites to be placed on opposite sides of the entrance path as this is where they will cause the least impact.
- Vehicles should be parked out of the flood line and buffer when not in use in order to prevent compaction of the soil profile.
- Topsoil should be replaced in the correct order it was extracted and erosion prevention measures be put in place on areas with a steep gradient (such as geo-textiles).
- Any excess subsoil must be removed from the site and spoiled at an agreed spoil site.
- Excess flows from open surfaces and increased slope areas need to be controlled by an erosion control measure.

Impacts Post Mitigation Measures

Assessment Criteria	Score	Rating
Ecosystem Value	3	Medium
Social Value	3	Medium
Environmental Value	**3**	**Medium**
Degree of Disturbance	3	Medium
Extent	1	Site
Duration	4	Long term
Probability	2	Fairly Unlikely
Impact Magnitude	**10**	**Medium**
Impact Significance	**30**	**Low**
Acceptability	**Acceptable**	

9.2.2 Potential soil and water pollution

Description of Impact

In addition to sedimentation of water resources as discussed above, water and soil pollution may result from a number of construction-related activities. Soil may become contaminated as a result of improper management relating to the use and/ or disposal of hazardous substances such as fuel, oil and cement.

Aquatic environments, such as the Msunduzi River, may become subjected (directly and indirectly) to pollution from fuel/chemical spills that are associated with construction activities and vehicles. Physical-chemical pollution of the water resources and associated aquatic ecosystems may also occur through point source pollution discharge (e.g. treated and untreated sewage). In the case of the Darvill constructed wetland, the geohydrological report outlines four possible existing point-source pollution sources as follows;

- Darvill Sewage Works
- Proximal grass-growing operation
- New England Road Landfill Site
- Hollingwood Cemetery

Construction camps require services and infrastructure to handle the transport, treatment, and disposal of sewerage. If such services do not function correctly, the potential exists for aquatic ecosystems to become polluted. There will also be domestic waste and construction waste generated (such as containers, bags, rubble, etc.), which will need to be disposed of correctly to prevent pollution.

There is the potential for impacts on soil and water systems during both the construction and operational phase of the development, however pollution potential during the operational phase is highly unlikely as the wetland is not an operating facility and rather a natural structure.

The geotechnical and wetland investigation undertaken indicates that the site is suitable for the proposed development and that the geotechnical constraints must be adhered to as well as management and mitigation measures prescribed by the Wetland Specialist.

Pre-Mitigation Measures

Assessment Criteria	Score	Rating
Ecosystem Value	4	Medium-High
Social Value	4	Medium-High
Environmental Value	**4**	**Medium**
Degree of Disturbance	3	Medium
Extent	2	Local
Duration	5	Permanent
Probability	4	Probable
Impact Magnitude	**14**	**Medium**
Impact Significance	**56**	**Medium**
Acceptability	**Generally Unacceptable**	

Proposed Mitigation Measures

- Storage areas that are to contain hazardous substances must be bunded with an approved impermeable liner.
- A designated, bunded area is to be used for vehicles washing and maintenance – whether on-site or off-site at a commercial workshop. Materials caught in this bunded area must be treated to the required discharge standards or disposed of at a DWS licensed disposal site.
- If a batching plant is necessary, during the construction of the waste disposal site or any ancillary infrastructure, run-off should be managed effectively to avoid contamination of other areas of the site. Run-off from the batch plant must not be allowed to get into the storm water system.
- Although regular surface water monitoring already occurs as part of the operations of the Darvill Sewage Works, the geohydrological specialist further recommends that the Msunduzi River should be sampled regularly, both upstream and downstream of the proposed Darvill Constructed Wetland, with the collected samples analysed at a SANAS-accredited laboratory according to a suite as determined by a professional hydrologist
- The geohydrological specialist also recommends that baseline groundwater samples should be collected before the wetland is built, and every six (6) months thereafter, for submission to a SANAS-accredited laboratory for analysis according to the SANS 241: 2015 suite of determinants. This will aid in determining whether or not the shallow aquifer is being impacted upon by the wetland (once built).

Impacts Post Mitigation Measures

Assessment Criteria	Score	Rating
Ecosystem Value	3	Medium
Social Value	3	Medium
Environmental Value	**3**	**Medium**
Degree of Disturbance	3	Medium
Extent	2	Surrounding Area
Duration	4	Long Term
Probability	3	Possible
Impact Magnitude	**12**	**Medium**
Impact Significance	**36**	**Medium-Low**
Acceptability	**Acceptable**	

9.2.3 Surface Water

Description of Impact

Significant earthworks and construction activities can alter and impact significantly on the hydrological patterns and functions of an area. This is especially true during the construction phase when run off will increase from clearing of the currently vegetated land. The nature of the risk of developing the site potentially impacting on surface water resources is directly related to the proximity of the development to the water resources, placing the Msunduzi River at risk during the construction phase.

During the operational phase the proposed constructed wetland, will act as an overflow facility to assist with partially treating the overflow from the storm flow storage dam before it reaches the immediate river system. This in turn, will result in a depression of the proposed development site potentially protecting the river from both run off and pollution.

The Msunduzi River is a Freshwater Ecosystem Priority Area (FEPA) river which is classified as Category D: Largely Modified. Although there were no wetlands within the development footprint the aquatic specialist further points out that as a result of potential leaks of fuel, grease and oil from the heavy machinery, wash related to the above-mentioned changes during rainfall events will lead to the movement of these substances potentially entering the soil and watercourse systems. There will be a further decrease in water quality as a result of improper storage and handling of hazardous chemicals such as fuel and oil as well as chemicals relating to staff ablution facilities or as a result of any spills, such as concrete, during construction.

The wetland and geohydrological investigations undertaken indicate that the site is suitable for the proposed development.

Pre-Mitigation Measures

Assessment Criteria	Score	Rating
Ecosystem Value	4	Medium-High
Social Value	4	Medium-High
Environmental Value	**4**	**Medium-High**
Degree of Disturbance	4	Medium-High
Extent	2	Surrounding Area
Duration	5	Permanent
Probability	4	Probable
Impact Magnitude	**15**	**Medium**

Assessment Criteria	Score	Rating
Impact Significance	**60**	**Medium-High**
Acceptability	**Generally Unacceptable**	

Proposed Mitigation Measures

- To prevent storm water damage, the increase in storm water run-off resulting from construction activities must be estimated and the drainage system assessed accordingly. A drainage plan must be submitted for approval and must include the location and design criteria of any temporary stream crossings (siting, proposed measures etc.). Serious financial and environmental impacts can be caused by unmanaged storm water
- Appropriate locations on the property, away from wetlands, drainage lines and seepage areas, will be identified for the storage of hazardous substance.
- Spills must be contained and immediately cleaned up.
- An integrated drainage management system and oil trap system shall be constructed to ensure that runoff from the site will not result in significant off-site pollution.
- Ensure the planning undertaken by engineers appointed takes cognisance of the responsibility to preserve the natural environment
- Training and awareness of the workforce by an environmental practitioner is required
- Appropriate storage methods will be investigated and implemented for hydrocarbon substances that need to be kept on site during the construction phase of the project. These storage methods will need to comply with relevant legislation/guidelines which govern the storage of hazardous substances in South Africa i.e. in accordance to SABS 089 (1999) "Storage ... of petroleum products in above-ground installations".
- The extent of dewatering measures in poorly drained areas must be finalised by the designer in discussion with the geotechnical representative as deemed necessary during the construction programme.
- The EMPr should include a Spill Management Plan for the construction phase that addresses measures to prevent and mitigate the spillage of hazardous materials in the construction site (oil, petrol, diesel, detergents, etc), as even small spills and leakages can have major impacts when incorporated with water. A key issue comprises detergents, which have significant impacts on amphibians and fish; detergents interfere with their membranes, causing mortality.
- Regular vehicle and machinery maintenance must be carried out to ensure that accidental spills are avoided.
- No washing of construction equipment and vehicles should be allowed from the watercourses.
- To prevent spillages, no fuel or oil should be kept onsite or within the demarcated watercourse boundaries. Absorbent materials such as “Drizit” must be readily available in the event of any accidental spills, and all contaminated material including soil must be disposed of at a registered waste disposal site.
- In locations were cement is required to be used, cement must be mixed in lined containers to prevent contamination.
- All chemicals should be appropriately stored and handled. Storerooms must be more than 100m from watercourse zones and have appropriate concrete flooring and bunding.
- Any remnant rubbish, spoil, machinery and contaminants need to be removed from the development area.
- Vehicles or machinery must not be serviced or re-fuelled within 100m of the watercourse zones
- Appropriate ablution facilities need to be put in place more than 100m from a watercourse, with no effluent released into the soil or the river.
- Rubbish bins need to be placed on site so that no litter or food waste is left around the development.

Impacts Post-Mitigation Measures

Assessment Criteria	Score	Rating
Ecosystem Value	3	Medium
Social Value	3	Medium
Environmental Value	**3**	**Medium**
Degree of Disturbance	3	Medium
Extent	2	Surrounding Area
Duration	2	Medium-Short
Probability	3	Possible
Impact Magnitude	**10**	**Low**
Impact Significance	**30**	**Low**
Acceptability	**Acceptable**	

9.2.4 Biodiversity (Flora)

Description of Impact

Construction activities will result in vegetation clearance which, if the receiving environment is in excellent condition, can result in loss of species diversity as well as overall biodiversity.

As per the Vegetation Report, the study site is considered to be degraded based on the presence and abundance of alien and pioneer vegetation species, as a possible consequence of the exclusion of fire. In terms of the vegetation that was recorded, the majority of the species are common and not of conservation importance. Increased soil fertility due to the sewage works has also lead to more favourable conditions for alien plant establishment.

The impacts of the development on vegetation commence with construction and would generally be permanent in their effect. An additional consideration with vegetation and timing are the processes of rehabilitation, landscaping and ecological succession, which tend to increase the extent, and overall biomass of biodiversity over time, i.e. tend to improve the situation after the initial disturbances caused by construction are rehabilitated over time.

All remaining indigenous vegetation of conservation value has been accurately mapped. Protected plant species have been identified for protection, rescue and rehabilitation. Of the indigenous species that were present, the most prevalent were the Acacia species. These species, even though indigenous, are able to establish themselves and dominate the species assemblage, hence they are similar in ecological terms to an invasive species. Several emerging individuals of Scadoxus puniceus were observed by the vegetation specialist around the site (protected plant species under the KZN Ordinance of 1974). This protected species will be required to be relocated out of the footprint of the proposed constructed wetland.

Pre-Mitigation Measures

Assessment Criteria	Score	Rating
Ecosystem Value	4	Medium-High
Social Value	4	Medium-High
Environmental Value	**4**	**Medium-High**
Degree of Disturbance	4	Medium-High
Extent	2	Local
Duration	5	Permanent
Probability	4	Probable
Impact Magnitude	**15**	**Medium**
Impact Significance	**60**	**Medium-High**

Assessment Criteria	Score	Rating
Acceptability	**Generally Unacceptable**	

Proposed Mitigation Measures

- All remaining indigenous vegetation of conservation value will be accurately mapped and protected plant species will be identified for protection or rescue and rehabilitation.
- No vegetation may be cleared without prior permission from the relevant team members, one of which will be an Environmental Control Officer (ECO), whom will require appointment prior to construction commencing and will oversee the environmental aspects during the delivery of the proposed project
- Trees that are not to be cleared should be marked beforehand with danger tape. The ECO must be given a chance to mark vegetation that is to be conserved before the Contractor begins clearing the site. Failure to do this will result in a fine.
- Care must be taken to avoid the introduction of alien plant species to the site and surrounding areas. (Particular attention must be paid to imported material).
- Disturbance to birds, animals and reptiles and their habitats should be minimised wherever possible
- Areas which are identified as being ecologically sensitive and which are adjacent to any construction work are to be suitably demarcated to prevent damage by plant and labour. Temporary bonnox type fencing should be used and should be moved in phases as the construction progresses from one area to the next.
- The clearing of vegetation during construction, the operation of earth moving equipment, machines and vehicles in and next to the footprint, the creation of stockpiles and increased movement and activity by people (including possibly hand digging) creates opportunities for alien plant establishment. Alien plan management should be exercised to prevent further spread.
- Checks must be carried out at regular intervals to identify areas where erosion is occurring. Appropriate remedial action, including the rehabilitation of the eroded areas should be undertaken;
- If possible, the development footprint should avoid destroying the more favourable indigenous plants such as the *Scadoxus puniceus*. If they are required to be removed, they should be transplanted elsewhere on site so that they may re-establish.

Impacts Post-Mitigation Measures

Assessment Criteria	Score	Rating
Ecosystem Value	3	Medium
Social Value	2	Medium-Low
Environmental Value	**2.5**	**Medium**
Degree of Disturbance	2	Medium-Low
Extent	1	Site
Duration	2	Medium-Short
Probability	3	Possible
Impact Magnitude	**8**	**Medium-Low**
Impact Significance	**20**	**Low**
Acceptability	**Acceptable**	

9.2.5 Impact on Avi-Faunal

Description of Impact

The Darvill WWTW has served as a ringing station for approximately 30 years, making it the longest running monthly ringing station in South Africa. Thousands of birds of various species have been

ringed over the years at the Darvill WWTW and it has been classed as an International Birding Area (IBA) Some of the birds found on site include waterfowl, waders, fish-eagle, black sparrowhawk, peregrine falcon, long-crested eagle and jackal buzzard.

In turn, wildlife on the site would have specific habitat requirements, which if disturbed as a result of development of that habitat, could lead to the site not being able to sustain any populations of fauna, specifically habitat specific fauna.

Since construction is already occurring on the site and anthropogenic activities dominate the area, disturbance of bird species that visit the site is not an issue. The three main existing wetlands in which birds currently visit and are reliant on will not be decommissioned and hence the avi-faunal on the site will not be affected. In addition the introduction of a new wetland onto the site will provide a new habitat for such species.

The avi-faunal specialist identified the area for the proposed constructed wetland project as currently comprising open rank grassland with scattered trees and shrubs. The avi-faunal specialist further describes the area for the proposed constructed wetland as a fairly disturbed terrestrial area of less avifaunal importance compared with the other wetland habitats occurring at Darvill. The transformation of this area into additional wetland habitat would thus appear positive.

Proposed Mitigation Measures

- The heavily overgrown vegetation along the entire lengths of the berm walls between the current maturation ponds limits and denies access to this key birdwatching area. The Avi-faunal specialist recommends that consideration should be given to enhancing the diversity of wetland habitats and waterbirds present at the maturation ponds by controlling the growth of emergent vegetation and increasing the extent of exposed mudflats and shorelines.
- The absence of hides or viewing platforms is another limiting factor to the popularity of the site.
- There are various other potential initiatives that could also be considered relevant to enhancing the attractiveness of the site to birdwatchers, including signage, pamphlets and annotated bird lists or trained bird guides.
- The avi-faunal specialist further recommends that any future developments at Darvill should endeavour to accommodate the ongoing ringing effort such that its long-term value is not threatened or compromised in any way.

Impacts Post-Mitigation Measures

Assessment Criteria	Score	Rating
Ecosystem Value	3	Medium
Social Value	5	High
Environmental Value	**4**	**Medium**
Degree of Disturbance	1	Low
Extent	1	Site
Duration	4	Long Term
Probability	3	Possible

Assessment Criteria	Score	Rating
Impact Magnitude	**9**	**Medium-Low**
Impact Significance	**36**	**Medium-Low**
Acceptability	**Important**	

9.2.6 Temporary above ground storage of fuel

Temporary diesel storage will be required on the development site for use by construction machinery (plant), for the construction phase of the development. The incorrect storage of large quantities of fuels and oils has the potential to result in significant environmental impacts in the event of a major spill/leakage.

The following potential key issues are identified with regards to diesel storage:

- Accidental diesel spills could potentially result in contamination of soil, surface water and groundwater.
- Diesel storage areas have the potential to be a fire hazard.

Pre-Mitigation Measures

Assessment Criteria	Score	Rating
Ecosystem Value	4	Medium-High
Social Value	4	Medium-High
Environmental Value	**4**	**Medium-High**
Degree of Disturbance	3	Medium
Extent	3	Regional
Duration	2	Medium-Short
Probability	3	Possible
Impact Magnitude	**11**	**Medium**
Significance	**44**	**Medium-Low**
Acceptability	**Acceptable but Undesirable**	

Proposed Mitigation Measures

- Appropriate storage methods will be investigated and implemented for hydrocarbon substances that need to be kept on site during the construction phase of the project. These storage methods will need to comply with relevant legislation/guidelines which govern the storage of hazardous substances in South Africa i.e. in accordance to SABS 089 (1999) "Storage ... of petroleum products in above-ground installations";
- Appropriate locations on the property, away from wetlands, drainage lines and seepage areas, must be identified for the storage of hazardous substances.

Impacts Post-Mitigation Measures

Assessment Criteria	Score	Rating
Ecosystem Value	3	Medium
Social Value	3	Medium
Environmental Value	**3**	**Medium**
Disturbance	2	Low
Extent	2	Medium-Low
Duration	1	Short term
Probability	1	Unlikely
Impact Magnitude	**6**	**Low**

Significance	**18**	**Low**
Acceptability	**Acceptable**	

9.2.7 Dust

Excavations, bulk earthworks and vegetation removal on site will result in dust pollution and nuisance to neighbouring landowners and can be a potential hazard to motorists by reducing visibility.

Pre-Mitigation Measures

Assessment Criteria	Score	Rating
Social Value	**4**	**Medium-High**
Disturbance	3	Medium
Extent	3	Medium
Duration	2	Medium-Short
Probability	3	Low
Impact Magnitude	**11**	**Medium**
Significance	**44**	**Medium-Low**
Acceptability	**Acceptable but Undesirable**	

Proposed Mitigation Measures

- All road surfaces must be dampened on a regular basis to suppress dust;
- Stockpiles of soil must either be dampened on a regular basis or vegetated depending on the length of time the stockpile will exist;
- A staged approach must be adopted when stripping the areas to be developed, of vegetation.
- Vehicles entering and exiting the construction site should not exceed speed limits, thus avoiding excess dust

Impacts Post-Mitigation Measures

Assessment Criteria	Score	Rating
Social Value	**4**	**Medium-High**
Disturbance	2	Low
Extent	2	Medium-Low
Duration	1	Short term
Probability	1	Unlikely
Impact Magnitude	**7**	**Low**
Significance	**28**	**Low**
Acceptability	**Acceptable**	

9.2.8 Noise

Noise generated during the construction phase by delivery vehicles, earth moving machinery, piling works and the workforce may have a significant impact on people living in close proximity to the proposed development.

Pre-Mitigation Measures

Assessment Criteria	Score	Rating
Social Value	**4**	**Medium-High**
Disturbance	3	Low
Extent	3	Medium
Duration	2	Medium-Short
Probability	3	Possible
Impact Magnitude	**11**	**Medium**
Significance	**44**	**Medium-Low**

Assessment Criteria	Score	Rating
Social Value	**4**	**Medium-High**
Disturbance	3	Low
Extent	3	Medium
Duration	2	Medium-Short
Probability	3	Possible
Impact Magnitude	**11**	**Medium**
Significance	**44**	**Medium-Low**
Acceptability	**Acceptable but Undesirable**	

Certain measures will be investigated for implementation on the site in order to minimise the potential noise impacts. These are likely to include the following:

Proposed Mitigation Measures

- Standard mufflers being fitted to all construction vehicles;
- The labour force should be instructed to keep shouting, whistling, music etc. on the site to a minimum.

Impacts Post-Mitigation Measures

Assessment Criteria	Score	Rating
Social Value	**4**	**Medium-High**
Disturbance	2	Low
Extent	2	Medium-Low
Duration	1	Short term
Probability	1	Unlikely
Impact Magnitude	**7**	**Low**
Significance	**28**	**Low**
Acceptability	**Acceptable**	

9.3 Potential Impacts on the Socio-Economic Environment

Socio-economic impacts of the development are not necessarily as spatially based as the biophysical ones. Socio-economic impacts are related to both the construction process and, typically more significantly, to the long-term impacts of the development. These socio-economic impacts are discussed in detail below. For each of these potential impacts there is a discussion of the background and nature of the issue, followed by a brief description of the methodology to be adopted in assessing the potential impacts that have been identified. This includes any specialist studies or specialised processes that have/will be undertaken.

9.3.1 Impact on the surrounding residents as a result of air pollution during the construction phase.

Description of impact

Air pollution may occur in the vicinity of the site and the immediate surrounds during the construction phase as a result of:

- Exhaust fumes from heavy vehicles and machinery, in particular poorly serviced vehicles
- Dust from exposed surfaces and soil stockpiles picked up by wind
- Dust on haulage and access roads emitted into the air by construction vehicles
- Odours downstream of inappropriate and mismanaged chemical toilets

Pre-Mitigation Measures

Assessment Criteria	Score	Rating
Social Value	**4**	**Medium-High**
Disturbance	3	Low
Extent	3	Medium
Duration	2	Medium-Short
Probability	3	Possible
Impact Magnitude	**11**	**Medium**
Significance	**44**	**Medium-Low**
Acceptability	**Acceptable but Undesirable**	

Proposed Mitigation Measures

- Ensure compliance with the National Environment Management: Air Quality Act, Act No. 39 of 2004.
- Dust control measures must be considered as outlined in the EMPr for the construction phase.
- Dust generating construction activities should be avoided during strong winds.
- Management (including storage, transport, handling and disposal) of hazardous substances that have the potential to become airborne during construction should be carefully managed.
- A suitable dust palliative should be applied if dust levels rise above acceptable levels, either water or commercial dust suppressants.
- Soil loads in transit should be kept covered or wetted.
- Stockpiles of soil should be kept covered or have suitable dust palliative applied such as water or commercial dust suppressants.
- Servicing of vehicles must occur off site to limit gaseous emissions.
- Chemical toilets should be placed on site and must be maintained on a daily basis.

Impacts Post-Mitigation Measures

Assessment Criteria	Score	Rating
Social Value	**4**	**Medium-High**
Disturbance	2	Low
Extent	2	Medium-Low
Duration	1	Short term
Probability	1	Unlikely
Impact Magnitude	**7**	**Low**
Significance	**28**	**Low**
Acceptability	**Acceptable**	

9.3.2 Impact on the surrounding residents as a result of noise pollution during the construction phase.

Description of impact

Noise generated by delivery vehicles, earth moving machinery, piling works and the workforce have the potential to impact negatively on people living and/or working along the property boundaries and in relatively close proximity to the proposed development. The negative impacts could include an increase in stress and frustration and associated health implications

Pre-Mitigation Measures

Assessment Criteria	Score	Rating
Social Value	**4**	**Medium-High**
Disturbance	2	Low
Extent	2	Medium-Low
Duration	1	Short-term
Probability	3	Possible
Impact Magnitude	**8**	**Medium-Low**

Significance	**32**	**Low**
Acceptability	**Acceptable**	

Proposed Mitigation Measures

- Construction activities should only take place within standard working hours, namely from 7:00 AM to 5:00 PM, as per the Gazetted guidelines provided by the Department of Labour.
- Surrounding residents should be warned of particularly noisy activities (if any) by way of flyers or letters.
- A complaints register should be kept on site at all times.
- Construction staff should be provided with training regarding noise prevention and anti-social behaviour/conduct.

Impacts Post-Mitigation Measures

Assessment Criteria	Score	Rating
Social Value	**4**	**Medium-High**
Disturbance	2	Medium-Low
Extent	2	Low
Duration	1	Short term
Probability	1	Unlikely
Impact Magnitude	**6**	**Low**
Significance	**24**	**Low**
Acceptability	**Acceptable**	

9.3.3 Disruption caused to surrounding residents from traffic impacts

Description of Impact

During the construction phase there will be an influx of construction vehicles and vehicles transporting materials in the area. This, coupled with existing construction activities already taking place at Darvill (that is the current construction upgrade of the WTTW), is however unlikely to cause a disruption to traffic for the duration of the construction period, as traffic volumes will not be passing through a national road. The operational phase, however, will not have an impact on the roads.

Pre-Mitigation Measures

Assessment Criteria	Score	Rating
Social Value	**4**	**Medium-High**
Disturbance	2	Medium-Low
Extent	2	Medium-Low
Duration	1	Short term
Probability	3	Possible
Impact Magnitude	**8**	**Low**
Significance	**32**	**Low**
Acceptability	**Acceptable**	

Proposed Mitigation Measures

- All speed limits must be adhered to on site, and if no limits exist it would be recommended that a safe site speed for heavy machinery and plant of 25 kilometres per hour be imposed.
- Movement of construction vehicles potentially impacting on urban infrastructure should be mitigated through the use of appropriate warning signs, and not entering or leaving the site during peak traffic hours

- Movement of heavy-duty vehicles and vehicles not connected with work in progress must be restricted to the construction zone in order to control related impacts such as damage in the construction zone, compaction of soil, damage to vegetation and noise pollution.
- Relevant traffic signs should be erected in consultation with the local authority warning motorists of construction activities
- Construction traffic and deliveries must be scheduled to avoid peak – hour traffic and diverted to minimise the disturbance to other road users.

Impacts Post-Mitigation Measures

Assessment Criteria	Score	Rating
Social Value	**4**	**Medium-High**
Disturbance	1	Low
Extent	1	Low
Duration	1	Long
Probability	1	Unlikely
Impact Magnitude	**4**	**Low**
Significance	**16**	**Very Low**
Acceptability	**Acceptable**	

9.3.4 Heritage and Cultural Aspects

Description of the potential Impact

For the proposed Darvill Constructed Wetland Development, a heritage impact assessment was undertaken for the site to investigate any potential aspects related to heritage or culture. The findings revealed that no heritage sites or features were present within development area. The Heritage specialist further provides that there is no known archaeological reason why development may not proceed as planned.

However, attention is drawn to the South African Heritage Resources Act, 1999 (Act No. 25 of 1999) and the KwaZulu-Natal Heritage Act (Act no 4 of 2008) which, requires that operations that expose archaeological or historical remains should cease immediately, pending evaluation by the provincial heritage agency.

Correspondence regarding the heritage impact assessment report will be obtained from *Amafa aKwaZulu-Natali* (Heritage KwaZulu – Natal) now during the EIR phase, in which their views on the proposed development will be detailed.

Pre-Mitigation Measures

Assessment Criteria	Score	Rating
Ecosystem Value	3	Medium
Social Value	3	Medium
Environmental Value	**3**	**Medium**
Degree of Disturbance	2	Medium-Low
Extent	2	Surrounding Area
Duration	3	Medium-Term
Probability	1	Unlikely
Impact Magnitude	**8**	**Low**
Impact Significance	**24**	**Low**
Acceptability	**Acceptable**	

Proposed Mitigation Measures

- If any heritage artefacts are found during the construction work must be stopped and AMAFA contacted immediately.

Impacts Post-Mitigation Measures

Assessment Criteria	Score	Rating
Ecosystem Value	2	Medium-Low
Social Value	3	Medium
Environmental Value	**2.5**	**Medium**
Degree of Disturbance	3	Medium
Extent	1	Site
Duration	2	Medium-Short
Probability	3	Possible
Impact Magnitude	**9**	**Medium Low**
Impact Significance	**22.5**	**Low**
Acceptability	**Acceptable/Not Serious**	

9.3.5 Visual Impact

Description of the potential Impact

The site is currently disturbed and the development of a wetland structure on the land will not drastically change the existing visual nature and character of the environment.

Pre-Mitigation Measures

Assessment Criteria	Score	Rating
Social Value	**4**	**Medium-High**
Disturbance	2	Medium-Low
Extent	1	Low
Duration	1	Short term
Probability	1	Unlikely
Impact Magnitude	**5**	**Low**
Significance	**20**	**Low**
Acceptability	**Acceptable**	

Proposed Mitigation Measures

- Ensure the site camp and lay down areas are correctly screened
- Reduce the lead times between clearing and construction

Impacts Post-Mitigation Measures

Assessment Criteria	Score	Rating
Social Value	**4**	**Medium-High**
Disturbance	1	Low
Extent	1	Low
Duration	1	Short term
Probability	1	Unlikely
Impact Magnitude	**4**	**Low**
Significance	**16**	**Very Low**
Acceptability	**Acceptable**	

9.3.6 Employment and Job Creation

Description of potential impact

The construction and site preparation activities will produce a large number of temporary and permanent jobs throughout its life cycle.

Proposed Mitigation Measures:

As this is a positive impact no mitigation measures are required.

Impacts Post-Mitigation Measures

Assessment Criteria	Score	Rating
Social Value	**4**	**Medium-High**
Disturbance	4	Medium-High
Extent	2	Local
Duration	4	Medium-Long term
Probability	5	Definite
Impact Magnitude	**15**	**Medium-High**
Significance	**60**	**Medium-High**
Acceptability	**Very Beneficial**	

9.3.7 Skills Development

Description of potential impact

The development will provide employment opportunities for local people during construction. The training of unskilled or previously unemployed persons will add to the skills base of the area.

Proposed Mitigation Measures:

As this is a positive impact no mitigation measures are required.

Impacts Post-Mitigation Measures

Assessment Criteria	Score	Rating
Social Value	**4**	**Medium-High**
Disturbance	4	Medium-High
Extent	2	Local
Duration	4	Medium-Long term
Probability	5	Definite
Impact Magnitude	**15**	**Medium-High**
Significance	**60**	**Medium-High**
Acceptability	**Very Beneficial**	

9.4 Operational Phase Impacts:

Description of operations

The constructed wetland creation aims to provide additional attenuation capacity for the effluent originating from the storage dam during the high flow events and potentially enhance the provision of wetland ecosystem services within a substantially transformed landscape.

The primary objective of the wetland creation is to establish and maintain a wetland ecosystem in a desired state (a system dominated by *Phragmites australis* and/or *Typha capensis*) to promote ecosystem services associated with water quality enhancement. During high storm flow events, the created wetland habitat will also provide additional attenuation capacity serving to increase the retention time of flows through the system, potentially enhancing the water quality.

Operational impacts are classified as longer and more permanent impacts than construction impacts and are associated with the operation of the development.

9.4.1 Stormwater runoff along the hardened surfaces of the constructed wetland (Soil Wash)

Description of Impact

Development of the Darvil constructed wetland site will result in an appreciable volume of soil will have to be removed during the construction of the proposed wetland. This is likely to increase the run off from the site. Due to the proximity of the Msunduzi River to the proposed constructed wetland site, this could impact on this catchment area. Disturbance of the soil profile and vegetative cover may also prompt a change in flow path, with surface runoff running in rills along the concrete edges.

Pre-Mitigation Measures

Assessment Criteria	Score	Rating
Ecosystem Value	4	Medium-High
Social Value	4	Medium-High
Environmental Value	**4**	**Medium-High**
Degree of Disturbance	4	Medium-High
Extent	2	Surrounding Areas
Duration	4	Long Term
Probability	3	Possible
Impact Magnitude	**13**	**Medium**
Impact Significance	**52**	**Medium**
Acceptability	**Generally Unacceptable**	

Proposed Mitigation Measures

- Maintain adequate ground cover in all areas and at all times to negate the erosive forces of wind, water and all forms of traffic.
- Prevent concentration of stormwater flow at any point where the ground is susceptible to erosion.
- Reduce stormwater flows by the effective use of attenuating devices.
- Ensure that development does not increase the rate of stormwater flow above that which the natural ground can safely accommodate at any point.
- Ensure that all stormwater control works are constructed in a safe and aesthetic manner in keeping with the overall development.
- Prevent pollution of water ways and water features by suspended solids and dissolved solids in stormwater discharges.
- Contain soil erosion, whether induced by wind or water forces, by constructing protective works to trap sediment at appropriate locations. This applies particularly during construction.
- Avoid situations where natural or artificial slopes may become saturated and unstable, both during and after the construction process.
- Removal of vegetation cover must be carried out with care and attention to the effect, whether temporary or long term, that this removal will have an erosion potential.
- Precautions must be taken at all times on building sites to contain soil erosion and prevent any eroded material from being removed from the site.
- On-site stormwater control systems, such as swales, berms, soil fences and attenuation ponds must be constructed before any construction commences on the site. As construction progresses, the stormwater control measures must monitored and adjusted to ensure complete erosion and pollution control at all times.
- Earthworks on sites must be kept to a minimum. Where embankments have to be formed, stabilization and erosion control measures must be implemented immediately.
- As a form of best practice, the geotechnical specialist recommended that the water resources in the vicinity of the Darvill Constructed Wetland be monitored once it is built. This will include installing and monitoring both shallow (< 10 m deep) and deep (>30 m deep) monitoring boreholes.
- Ensure that a Water Use Licence (WUL) is obtained for all aspects of the project impacting on watercourses.

- Ensure that all water, including, storm water runoff, entering the wetland meets the DWS WUL requirements and that the flow is dissipated to mimic the natural situation as far as possible to prevent erosion downstream.
- Following completion of the construction activities and replacement of the stockpiled soil, removal of excess soil and re-vegetation of any bare areas must be undertaken.
- Compacted soil must be ripped or scarified and seeded with an appropriate vegetation species to stabilize the soil.
- If the alien species have become established during the construction period then these must be removed and indigenous species planted.

Impacts Post Mitigation Measures

Assessment Criteria	Score	Rating
Ecosystem Value	3	Medium
Social Value	3	Medium
Environmental Value	**3**	**Medium**
Degree of Disturbance	3	Medium
Extent	1	Site
Duration	2	Medium-Short
Probability	3	Possible
Impact Magnitude	**9**	**Medium-Low**
Impact Significance	**27**	**Low**
Acceptability	**Acceptable/Not Serious**	

9.4.2 Disturbance of the linear flow channel

A change in the flow regime due to the construction of supporting structures at the entrance of the constructed wetland may cause a change in the linear channel flow and channel bed. This, as well as rubble, may alter the watercourse bed and flow regimes.

Pre-Mitigation Measures

Assessment Criteria	Score	Rating
Ecosystem Value	4	Medium-High
Social Value	4	Medium-High
Environmental Value	**4**	**Medium-High**
Degree of Disturbance	4	Medium-High
Extent	2	Surrounding Areas
Duration	4	Long Term
Probability	3	Possible
Impact Magnitude	**13**	**Medium**
Impact Significance	**52**	**Medium**
Acceptability	**Generally Unacceptable**	

Proposed Mitigation Measures

- Regular maintenance of inlet structures should be undertaken.
- The banks of the wetland should be visually inspected every month for signs of excessive loss of riparian vegetation and bank collapse.

Impacts Post Mitigation Measures

Assessment Criteria	Score	Rating
Ecosystem Value	3	Medium
Social Value	3	Medium
Environmental Value	**3**	**Medium**
Degree of Disturbance	3	Medium
Extent	1	Site
Duration	2	Medium-Short

Assessment Criteria	Score	Rating
Probability	3	Possible
Impact Magnitude	**9**	**Medium-Low**
Impact Significance	**27**	**Low**
Acceptability	**Acceptable/Not Serious**	

9.4.3 Change in subsurface water movement

The development of the pathways deeper than the upper soil profile may cause sub-surface water movement to be diverted and potentially concentrated resulting in inundation areas.

Pre-Mitigation Measures

Assessment Criteria	Score	Rating
Ecosystem Value	4	Medium-High
Social Value	4	Medium-High
Environmental Value	**4**	**Medium-High**
Degree of Disturbance	4	Medium-High
Extent	2	Surrounding Areas
Duration	4	Long Term
Probability	3	Possible
Impact Magnitude	**13**	**Medium**
Impact Significance	**52**	**Medium**
Acceptability	**Generally Unacceptable**	

Proposed Mitigation Measures

- Inundation areas that occur above confining layers need to be managed.
- Precaution should be taken to avoid sub-surface seepage which may contaminate the groundwater reserves.

Impacts Post Mitigation Measures

Assessment Criteria	Score	Rating
Ecosystem Value	3	Medium
Social Value	3	Medium
Environmental Value	**3**	**Medium**
Degree of Disturbance	3	Medium
Extent	1	Site
Duration	2	Medium-Short
Probability	3	Possible
Impact Magnitude	**9**	**Medium-Low**
Impact Significance	**27**	**Low**
Acceptability	**Acceptable/Not Serious**	

9.4.4 Increase in pollution or contamination risk

Greater human/vehicle movement will take place through the site during the operational phase. This will lead to an increase of maintenance vehicles during operation, which in turn may lead to further pollution such as plastics, cans and glass.

Pre-Mitigation Measures

Assessment Criteria	**Score**	**Rating**
Ecosystem Value	4	Medium-High
Social Value	4	Medium-High
Environmental Value	**4**	**Medium-High**
Disturbance	4	Medium-High
Extent	2	Surrounding Areas

Assessment Criteria	Score	Rating
Duration	4	Long
Probability	4	Probable
Impact Magnitude	**14**	**Medium**
Significance	**56**	**Medium-High**
Acceptability	**Generally Unacceptable**	

Proposed Mitigation Measures

- The EMPr should include a Spill Management Plan for the operation phase that addresses measures to prevent and mitigate the spillage of hazardous materials in the operation of the site. A key issue comprises detergents, which have significant impacts on amphibians and fish; detergents interfere with their membranes, causing mortality.
- Regular water quality checks should be done in alignment with existing water quality monitoring strategies.

Impacts Post-Mitigation Measures

Assessment Criteria	Score	Rating
Ecosystem Value	4	Medium-High
Social Value	4	Medium-High
Environmental Value	**4**	**Medium-High**
Disturbance	1	Low
Extent	1	Low
Duration	4	Long
Probability	4	Probable
Impact Magnitude	**8**	**Low**
Significance	**32**	**Low**
Acceptability	**Acceptable**	

9.4.5 Decline in downstream wetland integrity

During the construction and operational phase of the constructed wetland, a number of impacts can be expected on the downstream wetlands. Change in wetland hydrology can occur due to the alteration of flow input into the wetlands, which could potentially increase due to hardened surfaces. Wetland geomorphology can be impacted by possible increased erosion and sedimentation within the wetland systems, which coupled with run off of pollutants could result in a decline in water quality. The possible disturbance of riparian environments, removal of vegetation species and infestation of alien species could have a knock on effect on the faunal dependent on these ecosystems.

Pre-Mitigation Measures

Assessment Criteria	Score	Rating
Ecosystem Value	4	Medium-High
Social Value	4	Medium-High
Environmental Value	**4**	**Medium-High**
Disturbance	4	Medium-High
Extent	2	Surrounding Areas
Duration	4	Long
Probability	4	Probable
Impact Magnitude	**14**	**Medium**
Significance	**56**	**Medium-High**
Acceptability	**Generally Unacceptable**	

Proposed Mitigation Measures

- As a form of best practice, the geotechnical specialist recommended that the water resources in the vicinity of the Darvill Constructed Wetland be monitored once it is built. This will include installing and monitoring both shallow (< 10 m deep) and deep (>30 m deep) monitoring boreholes.

- Ensure that a Water Use Licence (WUL) is obtained for all aspects of the project impacting on watercourses.
- Ensure that all water, including, storm water runoff, entering the wetland meets the DWS WUL requirements and that the flow is dissipated to mimic the natural situation as far as possible to prevent erosion downstream.
- No water is to be abstracted from the water resources for the construction or operational phase of the project.

Impacts Post-Mitigation Measures

Assessment Criteria	Score	Rating
Ecosystem Value	4	Medium-High
Social Value	4	Medium-High
Environmental Value	**4**	**Medium-High**
Disturbance	1	Low
Extent	1	Low
Duration	4	Long
Probability	4	Probable
Impact Magnitude	**8**	**Low**
Significance	**32**	**Low**
Acceptability	**Acceptable**	

9.4.6 Noise

Description of Impact

Noise generated by delivery vehicles and the workforce have the potential to impact negatively on people living and/or working along the property boundaries and in relatively close proximity to the proposed development.

Pre-Mitigation Measures

Assessment Criteria	Score	Rating
Social Value	**4**	**Medium-High**
Disturbance	2	Medium-Low
Extent	1	Low
Duration	4	Long
Probability	4	Probable
Impact Magnitude	**11**	**Low**
Significance	**44**	**Medium-Low**
Acceptability	**Acceptable**	

Proposed Mitigation Measures

- Activities should only take place within standard working hours, namely from 7:00 AM to 5:00 PM, as per the Gazetted guidelines provided by the Department of Labour.
- Surrounding residents should be warned of particularly noisy activities by way of flyers or letters.

Impacts Post-Mitigation Measures

Assessment Criteria	Score	Rating
Social Value	**4**	**Medium-High**
Disturbance	1	Low
Extent	1	Low
Duration	4	Long
Probability	1	Unlikely
Impact Magnitude	**7**	**Low**
Significance	**28**	**Low**

Assessment Criteria	Score	Rating
Acceptability	**Acceptable**	

9.4.7 Effective functioning of the Darvill WWTW during a high storm event

The wetland creation aims to provide additional attenuation capacity for the effluent originating from the storage dam during the high flow events. This will in turn take strain off the bigger WWTW, to handle more effluent from the storage dam during a high flow event. It will also reduce the risks of pollution to the Msunduzi River from overflows.

Pre-Mitigation Measures

Assessment Criteria	Score	Rating
Ecosystem Value	4	Medium-High
Social Value	4	Medium-High
Environmental Value	**4**	**Medium-High**
Disturbance	5	High
Extent	4	Regional
Duration	5	Permanent
Probability	5	Definite
Impact Magnitude	**19**	**High**
Significance	**76**	**High**
Acceptability	**Highly Important/ Beneficial**	

9.4.8 Boost in Local Economic Growth and Development

The development will result in job creation and provision of employment. Sense of place and community upliftment will improve due to improved economic development in the area. Further to this, Pietermaritzburg is a popular tourist attraction with regards to the Duzi Canoe Marathon which is the biggest canoeing event on the African continent, and one of the world's most popular river marathons, attracting between 1600 and 2000 paddlers each year. The water quality of the watercourse systems is currently very poor, namely the Msunduzi River. The proposed constructed wetland cells will "treat" the overflow from the storm dam during high storm events the final effluent from the wetland which will gravitate to the Msunduzi River. Partial treatment of the storm flow volumes can be viewed as better than no treatment at all. This can therefore add to tourist confidence to participate in such races, with regards to water quality enhancement.

The Darvill WWTW has also served as a ringing station for approximately 30 years, making it the longest running ringing station in South Africa. The construction of the wetland will increase the influx of potential bird watchers from around the country and even the world, consequently boosting the local economy of the area. Since the area has also served as a ringing station for many years and the research and data has proven to be vital for local university research and projects, the constructed wetland potentially will also attract more avi-faunal life, and potentially more financial investment for research purposes.

Proposed Mitigation Measures:

As this is a positive impact no mitigation measures are required.

Assessment Criteria	Score	Rating
Social Value	**5**	**High**
Disturbance	1	Low
Extent	1	Low
Duration	5	Long
Probability	5	Unlikely
Impact Magnitude	**15**	**High**
Significance	**75**	**High**

Assessment Criteria	Score	Rating
Acceptability	**Highly Beneficial**	

9.5 Cumulative Impacts

9.5.1 Boost to Local Economic Growth and Business Development

The development of the constructed wetland will in the medium to long term will be valuable to the local and regional economy due to an increase in job opportunities during the construction phase. The anticipated economic activity emanating from the proposed activities that the Darvill constructed wetland will attract can also add to the local economy of the area. The popularity of the site for both bird watching and canoeing, has the potential to attract more income from both the tourism and educational sector.

Assessment Criteria	Score	Rating
Social Value	**5**	**High**
Disturbance	4	Medium-High
Extent	4	Medium-High
Duration	5	Long
Probability	5	Definite
Impact Magnitude	**18**	**High**
Significance	**90**	**Very High**
Acceptability	**Critically Beneficial**	

9.5.2 Opportunity for new processes to be explored

The process of using a natural structure such as a wetland to partially treat sewerage is a fairly new concept for the Darvill Treatment Works. If the process is successful it may lead to similar projects being implemented at other treatment works.

Assessment Criteria	Score	Rating
Ecosystem Value	3	Medium
Social Value	5	High
Environmental Value	**4**	**Medium**
Degree of Disturbance	1	Low
Extent	1	Site
Duration	4	Long Term
Probability	3	Possible
Impact Magnitude	**9**	**Medium-Low**
Impact Significance	**36**	**Medium-Low**
Acceptability	**Important**	

9.6 No-Go Option

9.6.1 Impacts on the Socio-Economic environment

Description of impact

The proposed development will potentially have a direct impact on the quality of life of people in local settlements by improving the standard of living. This is mainly attributed to the anticipated impact of the constructed wetland development on employment and income levels in areas of high poverty.

From this it is evident that the constructed wetland has the potential to make a contribution to both job creation in the region through tourism efforts and also add to the local academic research outputs from the bird watching/ringing activities that can potentially take place at the constructed wetland area.

Assessment Criteria	Score	Rating

Assessment Criteria	Score	Rating
Ecosystem Value	3	Medium
Social Value	5	High
Environmental Value	**3.5**	**Medium**
Disturbance	5	High
Extent	5	Long
Duration	5	Permanent
Probability	5	Definite
Impact Magnitude	**20**	**High**
Impact Significance	**80**	**High**
Acceptability	**Totally Unacceptable**	

9.6.2 Increased pressure on current Darvill WWTW Plant

Part of the current upgrade taking place at Darvill WWTW includes the construction of the constructed wetland that will assist in attenuating storm water run-off and thus preventing overflow of activated sludge in to the Msunduzi River. The current upgrade of the WWTW will still be unable to accommodate the erratic high storm flow volumes and to ease the impacts associated with these storm flow events. The wetland creation aims to provide additional attenuation capacity for the effluent originating from the storage dam during the high flow events and potentially enhance the provision of wetland ecosystem services within a substantially transformed landscape. If the proposed constructed wetland development not take place, additional pressure will be placed on the current system during high storm events and the risk of pollution to the river will still be present.

Assessment Criteria	Score	Rating
Ecosystem Value	3	Medium
Social Value	5	High
Environmental Value	**3.5**	**Medium**
Disturbance	5	High
Extent	5	Long
Duration	5	Permanent
Probability	5	Definite
Impact Magnitude	**20**	**High**
Impact Significance	**80**	**High**
Acceptability	**Totally Unacceptable**	

9.6.3 Activated sludge entering the Msunduzi River system after high flow events

Since the proposed wetland aims in increasing the water retention time (attenuation capacity) of the overflow from the storage dam during high flow events, the final effluent that is to be released will be to some extent be less 'polished', than if it would go through the natural process/system of a wetland environment. This in essence means more activated sludge will be entering the nearby water system.

Assessment Criteria	Score	Rating
Ecosystem Value	3	Medium
Social Value	5	High
Environmental Value	**3.5**	**Medium**
Disturbance	5	High
Extent	5	Long
Duration	4	Permanent
Probability	5	Definite
Impact Magnitude	**19**	**High**
Impact Significance	**76**	**High**
Acceptability	**Totally Unacceptable**	

9.7 Decommissioning Phase

It is unlikely that the proposed development of the constructed wetland will be decommissioned in the foreseeable future. However, should the proposed development be decommissioned, a Decommissioning Plan should be prepared and implemented in order to mitigate and manage potential negative impacts on the receiving environment. This plan should be reviewed and approved by the competent environmental authority. Umgeni Water should appoint a suitably qualified Environmental Control Officer to oversee the decommissioning activities and to monitor compliance with the Decommissioning Plan.

10 ENVIRONMENTAL IMPACT STATEMENT SUMMARY

10.1 Significant Impacts before Mitigation

Table 20: Impacts before mitigation for the Preferred Option

System / Component	Potential Impacts	Score	Rating	Significance Interpretation
PROPOSED OPTION				
CONSTRUCTION PHASE				
Topography and Geology	Erosion of the site and sedimentation of the nearby watercourses.	**39**	Medium-Low	Acceptable but Undesirable
Soil and Water Pollution	Water and soil pollution may result from a number of construction-related activities	**56**	Medium	Generally Unacceptable
Surface Water	Significant earthworks and construction activities can alter and impact significantly on the hydrological patterns and functions of an area	**60**	Medium-High	Generally Unacceptable
Biodiversity	Loss of vegetation and faunal species through construction.	**60**	Medium-High	Generally Unacceptable
Temporary above ground storage of fuel	Accidental diesel spills could potentially result in contamination of soil, surface water and groundwater.	**44**	Medium-Low	Acceptable but Undesirable
Dust	Excavations, bulk earthworks and vegetation removal on site will result in dust pollution and nuisance to neighbouring landowners and can be a potential hazard to motorists by reducing visibility	**44**	Medium-Low	Acceptable but Undesirable
Noise	Noise generated during the construction phase by delivery vehicles, earth moving machinery, piling works and the workforce should not have a significant impact on people living in close proximity to the proposed development.	**44**	Medium-Low	Acceptable but Undesirable
Social Impacts	Impact on the surrounding residents as a result of air pollution from	**44**	Medium-Low	Acceptable but Undesirable

System / Component	Potential Impacts	Score	Rating	Significance Interpretation
	construction activities.			
	Impact on the surrounding residents as a result of noise pollution from construction activities.	**32**	Low	Acceptable
	Disruption caused to surrounding residents from traffic impacts	**32**	Low	Acceptable
	Impact on cultural resources.	**24**	Low	Acceptable
	Visual Impacts caused by the construction site and waste disposal site.	**20**	Low	Acceptable
OPERATIONAL PHASE				
Storm water run-off along the hardened surfaces of the wetland (soil Wash)	Development of the site may prompt a change in flow path, with surface run-off running in rills along the concrete edges.	**52**	Medium	Generally Unacceptable
Disturbance of the linear flow channel	A change in the flow regime due to the construction of supporting structures at the entrance of the constructed wetland may cause a change in the linear channel flow and channel bed	**52**	Medium	Generally Unacceptable
Change in sub-surface water movement	The development of pathways deeper than the upper soil profile may cause sub-surface water movement to be diverted and potentially concentrated resulting in inundation areas.	**52**	Medium	Generally Unacceptable
Pollution or contamination risk		**56**	Medium-High	Generally Unacceptable
Decline in downstream wetland integrity	Impacts of the development on downstream wetlands	**56**	Medium-High	Generally Unacceptable
Noise	Noise generated by delivery vehicles and the workforce have the potential to impact negatively on people living and/or working along the property boundaries and in relatively close proximity to the proposed development.	**44**	Medium-Low	Acceptable
Effective functioning of the Darvill WWTW during a high storm event	The wetland creation aims to provide additional attenuation capacity for the effluent originating from the storage dam during the high flow events. This will in turn take strain off the bigger WWTW, to handle more effluent from the storage dam during a high flow	**76**	High	Highly Important/Beneficial

System / Component	Potential Impacts	Score	Rating	Significance Interpretation
	event. It will also reduce the risks of pollution to the Msunduzi River from overflows.			
Boost in Local Economic Growth and Development	The development will contribute to economic growth locally.	**75**	High	Highly beneficial
CUMULATIVE IMPACTS				
Boost to Local Economic Growth and Business Development	The development will contribute to economic growth locally.	**90**	Very High	Critically Beneficial
Opportunity for new processes to be explored	The process of using a natural structure such as a wetland to partially treat sewerage is a fairly new concept for the Darvill Treatment Works. If the process is successful it may lead to similar projects being implemented at other treatment works, thus making it a benchmark for future similar projects.	**36**	Medium-Low	Important
NO GO OPTION				
Impacts on the socio-economic environment	It is estimated that following construction, many job opportunities will be established on site. Moreover, this activity will contribute to the establishment of further jobs off-site in related industries.	**70**	High	Totally Unacceptable
Increased pressure on current Darvill WWTW Plant	If the proposed constructed wetland development not take place, additional pressure will be placed on the current system during high storm events and the risk of pollution to the river will still be present.	**80**	High	Totally Unacceptable
Activated sludge entering the Msunduzi River system after high flow events	Since the proposed wetland aims in increasing the water retention time (attenuation capacity) of the overflow from the storage dam during high flow events, the final effluent that is to be released will be to some extent be less 'polished', than if it would go through the natural process/system of a wetland environment. This in essence means more activated sludge will be entering the nearby water system.	**76**	High	Totally Unaceptable

10.2 Significant Impacts Post Mitigation Measures

Table 21: Impacts after mitigation

System / Component	Potential Impacts	Score	Rating	Significance Interpretation
PROPOSED OPTION				
CONSTRUCTION PHASE				
Topography and Geology	Erosion of the site and sedimentation of the nearby watercourses.	**30**	Low	Acceptable
Soil and Water Pollution	Water and soil pollution may result from a number of construction-related activities	**36**	Medium - Low	Acceptable
Surface Water	Significant earthworks and construction activities can alter and impact significantly on the hydrological patterns and functions of an area	**30**	Low	Acceptable
Biodiversity	Loss of vegetation and faunal species through construction.	**20**	Low	Acceptable
Avi-Faunal	Impact on Avi-Faunal species	**32**	Medium-Low	Important
Temporary above ground storage of fuel	Accidental diesel spills could potentially result in contamination of soil, surface water and groundwater.	**18**	Low	Acceptable
Dust	Excavations, bulk earthworks and vegetation removal on site will result in dust pollution and nuisance to neighbouring landowners and can be a potential hazard to motorists by reducing visibility	**28**	Low	Acceptable
Noise	Noise generated during the construction phase by delivery vehicles, earth moving machinery, piling works and the workforce should not have a significant impact on people living in close proximity to the proposed development.	**28**	Low	Acceptable
Social Impacts	Impact on the surrounding residents as a result of air pollution from construction activities.	**28**	Low	Acceptable
	Impact on the surrounding residents as a result of noise pollution from construction activities.	**24**	Low	Acceptable
	Disruption caused to surrounding	**16**	Very Low	Acceptable

System / Component	Potential Impacts	Score	Rating	Significance Interpretation
	residents from traffic impacts			
	Impact on cultural resources.	**22.5**	Low	Acceptable/Not serious
	Visual Impacts caused by the construction site and waste disposal site.	**16**	Very Low	Acceptable
	Employment and Job Creation	**60**	Medium-High (+)	Very Beneficial
	Skills Development	**60**	Medium-High (+)	Very Beneficial
OPERATIONAL PHASE				
Storm water run-off along the hardened surfaces of the wetland (soil Wash)	Development of the site may prompt a change in flow path, with surface run-off running in rills along the concrete edges.	**27**	Low	Acceptable
Disturbance of the linear flow channel	A change in the flow regime due to the construction of supporting structures at the entrance of the constructed wetland may cause a change in the linear channel flow and channel bed	**27**	Low	Acceptable/Not serious
Change in sub-surface water movement	The development of pathways deeper than the upper soil profile may cause sub-surface water movement to be diverted and potentially concentrated resulting in inundation areas.	**27**	Low	Acceptable
Pollution or contamination risk	Greater human/vehicle movement will take place through the site during the operational phase. This will lead to an increase of maintenance vehicles during operation, which in turn may lead to further pollution such as plastics, cans and glass.	**32**	Low	Acceptable
Decline in downstream wetland integrity	Impacts of the development on downstream wetlands	**32**	Low	Acceptable
Noise	Noise generated by delivery vehicles and the workforce have the potential to impact negatively on people living and/or working along the property boundaries and in relatively close proximity to the proposed development.	**28**	Low	Acceptable
Boost in Local Economic Growth and Development	The development will contribute to economic growth locally.	**75**	High	Highly Beneficial
CUMULATIVE IMPACTS				
Boost in Local	The development will contribute to	**90**	Very High	Critically

System / Component	Potential Impacts	Score	Rating	Significance Interpretation
Economic Growth and Development	economic growth locally.			beneficial
Opportunity for new processes to be explored	The process of using a natural structure such as a wetland to partially treat sewerage is a fairly new concept for the Darvill Treatment Works. If the process is successful it may lead to similar projects being implemented at other treatment works, thus making it a benchmark for future similar projects.	**36**	Medium-Low	Important

11 ENVIRONMENTAL IMPACT STATEMENT

It is clear from **Table 20** above that the proposed development will have a number of highly significant positive and to a lesser degree negative impacts on the site and surrounding biophysical and social environment if mitigation measures are not implemented or adhered to. **Table 21** indicates that with appropriate mitigation, all of these impacts will be minimized. However, it is important to note that each of the mitigation measures will need to be accepted and adopted by the applicant, and the community to ensure that the significance of many of the impacts are minimized.

Table 21 indicates that the positive socio-economic impacts of the development would be extremely beneficial to both the local communities and the environment.

The only impact assessed as being of high significance and totally unacceptable to society was the impact on the proposed beneficiaries if the proposed development does not go ahead.

12 CONCLUSION AND RECOMMENDATIONS

The above report provides a detailed assessment of the issues that are pertinent to the development of the proposed Darvill Constructed Wetland Development

The Environmental Impact Phase has drawn on the above information and made use of the recommended specialist studies to reach an objective decision of the overall impact of the proposed development. The EIR Phase has culminated in the development of proposed mitigation measures to reduce impacts and identify sensitive areas within the development area which may require more specific management measures. The EIR Phase has also optimised and improved potential positive impacts that may result from the proposed development.

This Draft EIA Report provided the public and authorities with a second chance to comment and highlight any concerns or support they may have regarding the proposed development. SiVEST is of the opinion that if managed correctly, taking the comments into consideration, all impacts can be mitigated and managed.

As pointed out by the Aquatic specialist, the surrounding wetlands have been lost over the years resulting in a shortage of wetland habitat in the area. Given the excess water from the WWTW, the elevation, the fact that the soils are not particularly good for agriculture and the potential to improve water quality which is the biggest problem for the system, this is a suitable area for the wetland. As it will form a part of the WWTW remediation plans, it will have to be well maintained. Given the shallow depth of the wetland and that the water will already be partly treated, the risk of contamination of the river is low. On observation of the artificial wetland above the site, it is clear that the wetland will provide a habitat for important avi-fauna.

From the evidence provided in this report, it is clear that the constructed wetland has the potential to make a contribution to both job creation in the region through tourism efforts (Duzi Canoe Marathon) and also add to the local academic research outputs from the bird watching/ringing activities that can potentially take place at the proposed constructed wetland area. Water quality enhancement is also another lucrative positive impact for the currently poor/degraded water system.

Taking all the above into account, SiVEST recommends that the proposed constructed wetland development be granted a positive Environmental Authorisation with specific conditions to mitigate and manage any potential impacts associated with construction and implementation.

SiVEST Environmental Division
VCC Estate, North View Building, 170 Peter Brown Drive, Montrose
PO Box 707, Msunduzi, 3231
South Africa

Tel + 27 33 347 1600
Fax +27 33 347 5762
Email info@sivest.co.za
www.sivest.co.za

Contact Person: Tarryn Curtis
tarrync@sivest.co.za