WETLAND DELINEATION & ASSESSMENT REPORT- KWA-THEMA TO GRUNDLIGH WWTW BULK OUTFALL
PROPONENT: CITY OF EKURHULENI
PROJECT NUMBER: PS-WS 36-2016

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LIST OF ABBREVIATIONS USED IN THIS ASSESSMENT

CARA	Conservation of Agricultural Resources Act (Act. No 34 of 1983)
CBA	Critical Biodiversity Areas
DAFF	Department of Forestry and Fisheries
DWS	Department of Water and Sanitation
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMPr	Environmental Management Programme
GIS	Geographical Information Systems
GPS	Global Positioning System
HGM	Hydrogeomorphic Unit
IAPs	Invasive Alien Plant species
IDP	Integrated Development Plan
MAP	Mean Annual Precipitation
NEMA	National Environmental Management Act (Act No. 107 of 1998)
NFEPA	National Freshwater Ecosystems Priority Areas
NWA	National Water Act (Act 36 of 1998)
PES	Present Ecological State
SANBI	South African National Biodiversity Institute
SWMA	Sub Water Management Area
VEGRAI	Riparian Vegetation Response Assessment Index

WMA	Water Management Area
WULA	Water Use Licence Application

1. INTRODUCTION & BACKGROUND

1.1. Introduction

With South Africa being a contracting party to the Ramsar Convention on Wetlands, the South African government has taken a keen interest in the conservation, sustainable utilisation and rehabilitation of wetlands in South Africa. This aspect is also reflected in various pieces of legislation controlling development in and around wetlands and other water resources, of which the most prominent may be the National Water Act, Act 36 of 1998. As South Africa is an arid country, with a mean annual rainfall of only 450mm in relation to the world average of 860mm (DWAF, 2003), water resources and the protection thereof becomes critical to ensure their sustainable utilisation. Wetlands perform various important functions related to water quality, flood attenuation, stream flow augmentation, erosion control, biodiversity, harvesting of natural resources, and others, highlighting their importance as an irreplaceable habitat type. Determining the location and extend of existing wetlands, as well as evaluating the full scope of their ecosystem services, form an essential part in striving towards sustainable development and protection of water resources.

1.2. Rationale for this wetland assessment

An ecosystem is a complex, self-sustaining natural system centred on the interaction between the structural components of the system (biotic and abiotic). Functional aspects of an ecosystem include productivity and energy flow, cycling of nutrients and limiting factors. Effective conservation of biodiversity is paramount for the provision of ecosystem services including clean water, food and medicinal properties. South Africa is an extremely biologically diverse country and provides important basis for economic growth and development. Ecosystems are particularly susceptible to anthropogenic activities such as urban and infrastructural developments. Due to their susceptibility, a holistic approach is required in order to effectively integrate the activity and the receiving environment in a sustainable and progressive way. This includes the incorporation of the natural system into the layout and design of the development.

The implementation of legal frameworks coupled with wetland functionality and health assessments, facilitates the implementation of conservation initiatives. Appropriate management recommendations to lower the significance of the existing impacts to water resources will be provided in this assessment. This is achieved through a detailed wetland delineation process within the study site augmented by data and previous studies conducted within the region.

1.3. Scope of the assessment

As all wetlands are automatically designated as ecologically sensitive areas, they have to be delineated so as to enable appropriate conservation buffers to be allocated to each wetland associated with a proposed development area. This is to be done in accordance to DWAF guidelines for the delineation of wetlands and riparian zones (2005) by looking at terrain, soil form, soil wetness and vegetation unit indicators to delineate permanent, seasonal and temporary zones of the wetlands. An obligatory conservation buffer is then to be allocated from the outer edge of the temporary zones of the wetlands.

The terms of reference for the current study were as follows:

- Identify and delineate any wetland areas and/or watercourses within a 500m boundary around proposed sewer pipeline development site according to the Department of Water Affairs "Practical field procedure for the identification and delineation of wetlands and riparian areas".
- Determine the Present Ecological Status (PES) and Functional Integrity of identified wetlands using the WET-Health and Wet-EcoServices approach.
- Determine the Ecological Importance and Sensitivity (EIS) of identified wetlands using the latest applicable approach as supported by the DWS.
- Identify possible impacts to wetlands or watercourses within the study area as well as recommend mitigation measures and rehabilitation measures for the proposed development.

Typically surface water attributed to wetland systems, rivers and riparian habitats comprise an important component of natural landscapes. These systems are often characterised by high levels of biodiversity and fulfil various ecosystems functions. As a result, these systems are protected under various legislation including the National Water Act, 1998 (Act No. 36 of 1998), National Biodiversity Act (10 of 2004) and the National Environmental Management Act, 1998 (Act No. 107 of 1998).

1.4. Assumptions and Limitations

It is difficult to apply pure scientific methods within a natural environment without limitations or assumptions. The following apply to this study:

- The findings, results, observations, conclusions and recommendations provided in this report are based on the author's best scientific and professional knowledge as well as available information regarding the perceived impacts on wetland and watercourse.
- Wetland boundaries are essentially based on GPS coordinate waypoints taken onsite of wetland indicator features. The accuracy of the GPS device therefore affects the

accuracy of the maps produced. A hand- held Garmin Montana 680 was used to delineate the wetland boundaries.

- The assessment of the present ecological state (PES), the provision of ecosystem goods and services, and the ecological importance and sensitivity of the identified wetland systems was based on a one- day field investigation conducted on the 20th of August 2018. Site visits should ideally be conducted over differing seasons in order to better understand the hydrological and geomorphologic processes driving the characteristics of the water resource and the functional integrity of the wetland system. Once-off assessments such as this may potentially miss certain ecological information, thus limiting accuracy, detail and confidence.
- The assessment of impacts and recommendation of mitigation measures was informed by the site-specific ecological issues arising from the field survey and based on the assessor's working knowledge and experience with similar development projects. No construction work methodology was provided.

1.5 Project Description & Locality

Project Description

The South East Sewerage System is in the East Rand, on the south eastern section of Ekurhuleni Metropolitan Municipality. The system consists of a series of gravity trunk sewers draining to the CE Grundlingh WWTW. The sewer drainage system's_ _challenges are compounded by aging infrastructure, vandalism, theft (of exposed steel pipes) and limited hydraulic capacity of the existing out falls. The sewer outfall drains areas that constitute of low, middle and high-income households and industrial sites. (See Figure 1 below).
Currently, the CoE spends huge sums of money on the operation and maintenance of its sewerage infrastructure at the expense of other competing needs. As a result, the CoE intends to improve the efficiency of sewage drainage and disposal service delivery by implementing measures that would reduce the operational and maintenance costs and improve the efficiency of the whole sewerage out-fall system. CoE intends to undertake refurbishment and/or upgrade works of the existing sewerage drainage infrastructure aimed at improving their functionality and operation and maintenance, efficiency. Broadly, it is intended that these measures will bring about a balance between efficiency and cost of operation and maintenance of the overall sewerage service delivery system.

Route 1

Two possible routes were considered for the upgrades of the system. The drainage area slopes from the north southwards. However, the sewer drainage basin has local high and low points, thus posing challenges in attempts to drain the whole area via gravity pipelines. A possible pipeline route was identified, one that would traverse parallel to the existing sewer pipelines from Sharon Park and divert to follow the servitude of the Dunnottar Aerodrome Road towards the east, facing the army base. At the intersection of Nigel-Springs Road and

Dunnottar Aerodrome Road, the proposed pipelines would then follow the servitude Nigel-Springs Road towards the south till the CE Grundlingh WWTW.

Important to note is that along the section between the intersection of Nigel-Springs Road and Dunnottar Aerodrome Road and the WWTW, there is a railway line crossing, stream crossing, two road crossings and local high and low points. This means that along this part of the pipeline, there would be manholes as deep as 7m and expected pipe supports up to 5m high. For this reason, this pipeline route was ruled out.

Route 2

An alternative pipeline route was considered for the gravity outfall sewer lines. However, it would follow low lying areas which are sensitive in terms of environmental considerations. This pipeline route will run parallel to the existing gravity sewer trunk mains. The existing rising main draining the existing suburbs of Sharon Park and Dunnottar was accepted as the ideal route for the proposed new gravity sewer outfalls since it follows a designated route through existing servitudes and road reserves and may present less difficulties in the installation of pipes. A locality plan of the proposed pipeline routes is attached in presented below.

Project Location

The proposed pipeline mining development is located on farm Grootfontein 165, situated in Kwa-Thema, in Gauteng Province.

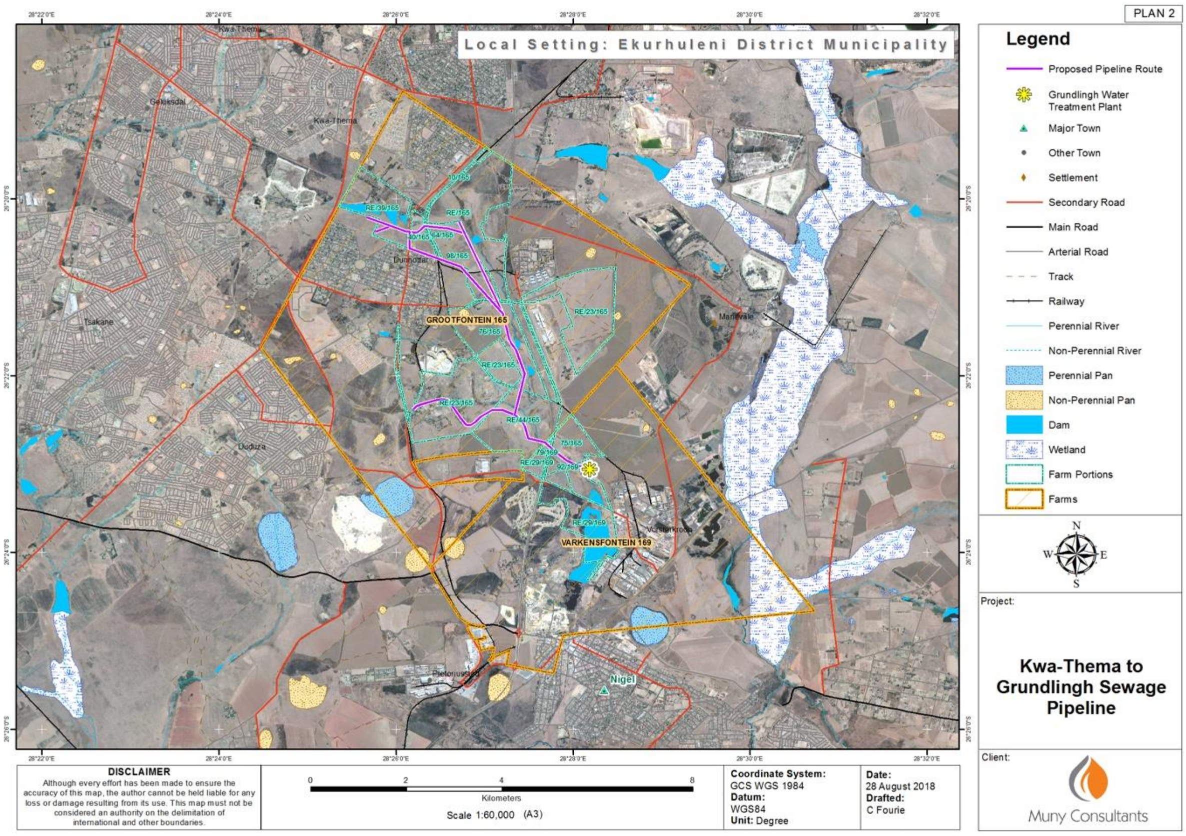


Figure 1 : Locality Map

2. LEGISLATIVE & CONSERVATIONAL PLANNING REQUIREMENTS

This section outlines the definitions, key legislative requirements and guiding principles of wetland studies and the Water Use Authorisation process.

The National Water Act, 1998 (Act No. 36 of 1998) [NWA] provides for Constitutional water demands including pollution prevention, ecological and resource conservation and sustainable utilisation. In terms of this Act, all water resources are the property of the State and are regulated by the Department of Water Affairs (DWA). The NWA sets out a range of water use related principles that are to be applied by DWA when taking decisions that significantly affect a water resource. The NWA defines a water resource as including a watercourse, surface water, estuary or aquifer. A watercourse includes a river or spring; a natural channel in which water flows regularly or intermittently; a wetland, lake, pan or dam, into which or from which water flows; any collection of water that the Minister may declare to be a watercourse; and were relevant its beds and banks.

The NWA defines a wetland as "land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil." In addition to water at or near the surface, other distinguishing indicators of wetlands include hydromorphic soils and vegetation adapted to or tolerant of saturated soils (DWA, 2005).

Riparian habitat often times perform the important ecological and hydrological functions, some similar to those performed by wetlands (DWA, 2005). Riparian habitat is also the accepted indicator used to delineate the extent of a river's footprint (DWAF, 2005). It is defined by the NWA as follows: "Riparian habitat includes the physical structure and associated vegetation of the areas associated with a watercourse, which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas".

Water uses for which authorisation must be obtained from DWA are indicated in Section 21 of the NWA. Section 21 (c) and (i) is applicable to any activity related to a wetland:

Section 21(c): Impeding or diverting the flow of water in a watercourse; and

Section 21(i): Altering the bed, banks, course or characteristics of a watercourse.

GN R.1198: Any activity in a wetland for the rehabilitation of a wetland for conservation purposes.

GN R.1199: Any activity within 500 m from the boundary of a wetland.

These regulations also stipulate that these water uses must the registered with the responsible authority. Any activity that is not related to the rehabilitation of a wetland and which takes place within 500 m of a wetland are excluded from a GA under either of these regulations. Wetlands situated within 500 m of proposed activities should be regarded as sensitive features potentially affected by the proposed development (GN 1199). Such an activity requires a Water Use Licence (WUL) from the relevant authority.

In addition to the above, the proponent must also comply with the provisions of the following relevant national legislation, conventions and regulations applicable to wetlands and riparian zones:

- Convention on Wetlands of International Importance - the Ramsar Convention and the South African Wetlands Conservation Programme (SAWCP).
- National Environmental Management Act, 1998 (Act No. 107 of 1998) [NEMA]. National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004).
- National Environment Management Protected Areas Act, 2003 (Act No. 57 of 2003).

- Regulations GN R.982, R.983, R. 984 and R.985 of 2014, promulgated under NEMA. Conservation of Agriculture Resources Act, 1983 (Act 43 of 1983).
- Regulations and Guidelines on Water Use under the NWA.
- South African Water Quality Guidelines under the NWA. Mineral and Petroleum Resources Development Act, 2002 (Act No. 287 of 2002).

3.0 STUDY METHODOLOGY

The following techniques and tools were used in the assessment:

3.1 Baseline data / Desktop Assessment

The desktop study conducted for the proposed development involved the examination of aerial photography, GIS databases including the NFEPA and South African National Wetland maps as well as literature reviews of the study site, to determine the likelihood of wetland systems within the area. The study made use of the following data sources:

- Google imagery was used at the desktop level.

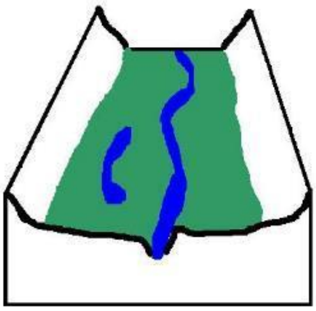
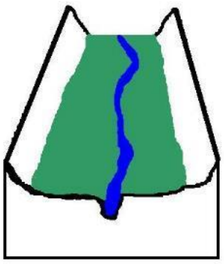
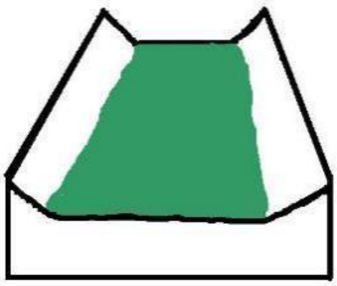
- Relief dataset from the Surveyor General was used to calculate slope and the desktop mapping of watercourses.
- The NFEPA dataset from (Driver, et al., 2011) was used in determining any priority wetlands.
- Geology dataset was obtained from AGIS,
- Vegetation type dataset from (Mucina & Rutherford, 2006) was used in determining the vegetation type of the study area.
- In field data collection was taken on the 24th of May2018.

3.2 Wetland Delineation and Identification

In accordance with the DWAF guidelines (DWAF 2005) the wetland delineation procedure considers four attributes to determine the limitations of the wetland. These attributes are discussed according to the DWAF guidelines in further detail later on in this section. Further descriptions on the four attributes are presented in Appendix B. The four attributes are:

- Terrain Unit Indicator - helps to identify those parts of the landscape where wetlands are more likely to occur;
- Soil Form Indicator - identifies the soil forms, which are associated with prolonged and frequent saturation;
- Soil Wetness Indicator - identifies the morphological “signatures” developed in the soil profile as a result of prolonged and frequent saturation; and
- Vegetation Indicator - identifies hydrophilic vegetation associated with frequently saturated soils.

In accordance with the definition of a wetland in the NWA, vegetation is the primary indicator of a wetland, which must be present under normal circumstances; however, the soil wetness indicator tends to be the most important in practice. The remaining three indicators are then used in a confirmatory role. The reason for this, is that the response of vegetation to changes in the soil moisture regime or management are relatively quick and may be transformed, whereas the morphological indicators in the soil are significantly more permanent and will hold the indications of frequent and prolonged saturation long after a wetland has been drained (perhaps several centuries) (DWAF 2005).

Hydro-geomorphic Settings	Description
Reparian Habitat	Linear fluvial, eroded landforms which carry channelized flow on a permanent, seasonal or ephemeral/episodic basis. The river channel flows within a confined valley (gorge) or within an incised macro-channel. The "river" includes both the active channel (the portion which carries the water) as well as the riparian zone.
Floodplain 	Valley bottom areas with a well-defined stream channel stream channel, gently sloped and characterised by floodplain features such as oxbow depression and natural levees and the alluvial (by water) transport and deposition of sediment, usually leading to a net accumulation of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.
Valley Bottom with a Channel 	Valley bottom areas with a well-defined stream channel but lacking characteristic floodplain features. May be gently sloped and characterized by the net accumulation of alluvial deposits or may have steeper slopes and be characterised by the net loss of sediment. Water inputs from the main channel (when channel banks overspill) and from adjacent slopes.
Valley bottom without a channel 	Valley bottom areas with no clearly defined stream channel, usually gently sloped and characterised by alluvial sediment deposition, generally leading to a net accumulation of sediment. Water inputs are mainly from the channel entering the wetland and also from adjacent slopes. The valley floor is a depositional environment composed of fluvial or colluvial deposited sediment. These systems tend to be found in the upper catchment areas, or at tributary junctions where the sediment from the tributary smothers the main drainage line.

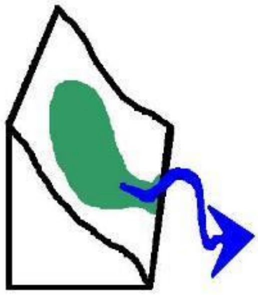
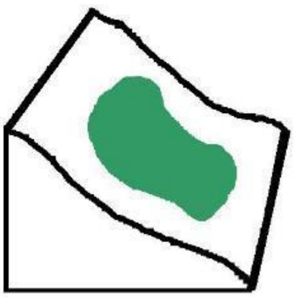
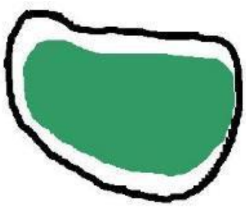
Hydro-geomorphic Settings	Description
Hillslope seepage linked to a stream channel 	Slopes on hillsides, which are characterised by colluvial (transported by gravity) movement of materials. Water inputs are mainly from sub-surface flow and outflow is usually via a well-defined stream channel connecting the area directly to a stream channel.
Depressional Pans	Small (deflationary) depressions which are circular or oval in shape; usually found on the crest positions in the landscape. The topographic catchment area can usually be well-defined (i.e. a small catchment area following the surrounding watershed). Although often apparently endorheic (inward draining), many pans are “leaky” in the sense that they are hydrologically connected to adjacent valley bottoms through subsurface diffuse flow paths
Isolated hillslope seepage 	Slopes on hillsides that are characterised by colluvial transport (transported by gravity) movement of materials. Water inputs are from sub-surface flow and outflow either very limited or through diffuse sub-surface flow but with no direct link to a surface water channel.
Pan/Depression 	In areas with weakly developed drainage patterns and flat topography, rainfall may not drain off the landscape very quickly, if at all, due to the low relief. In such areas (commonly characterized by aeolian deposits or recent sea floor exposures) the wet season water table may rise close to, or above, the soil surface, creating extensive areas of shallow inundation or saturated soils. In these circumstances the seasonal or permanently high groundwater table creates the conditions for wetland formation.

Table 1 Classification of wetland and riparian areas (adapted from Brinson, 1993; Kotze, 1999; Marneweck and Batchelor, 2002 and DWAF, 2005).

3.3 Wetland Functionality, Status and Sensitivity

Wetland functionality is defined as a measure of the deviation of wetland structure and function from its natural reference condition. In the current assessment the hydrological, geomorphological and vegetation integrity was assessed for the offset wetland unit associated with the study site, to provide a Present Ecological Status (PES) score (Macfarlane et al, 2007) and an Environmental Importance and Sensitivity category (EIS) (DWAF, 1999).The functional assessment methodologies presented below take into consideration these recorded impacts in various ways to determine the scores attributed to each functional Hydro geomorphic (HGM) wetland unit. The aspect of wetland functionality and integrity that is predominantly addressed includes hydrological and geomorphological function and the integrity of the biodiversity component (mainly based on the intactness of natural vegetation).

Currently, no single integrity assessment methodology exists which can be used to determine the Present Ecological State of all the various HGM types for the construction period. Therefore, each HGM type should be evaluated by using the functional assessment best suited to its particular characteristics. In the current study the offset wetland found adjacent to the study site was assessed using WetEco Services (Kotze et al 2005), WET-Health (Macfarlane et al, 2007) and the Ecological Importance and Sensitivity (DWAF, 1999).

3.4 Present Ecological Status (PES)

WET-Health (Macfarlane et al, 2007) provides an appropriate framework for assessing the Present Ecological State (PES) of wetland systems. The assessment helps to identify specific impacts which can be addressed through rehabilitation activities. All the information gathered as well as hydrology-, hydraulic/geomorphic-, biological criteria and water quality is used to assign a Present Ecological Status (PES) for the offset wetland features. Table 3 below lists the attributes as well as criteria assessed during the PES assessment.

Table 2 Criteria and Attributes

Criteria and attributes	
Hydrologic	**Hydraulic/Geomorphic**
Flow modification	Canalisation
Permanent Inundation	Topographic Alteration
Water Quality	**Biota**
Water Quality Modification	Terrestrial Encroachment
Sediment load modification	Indigenous vegetation removal
	Invasive plant encroachment

	Alien fauna
	Over utilisation of biota

Each of the attributes were given a score according to ecological state observed during the site visit, as well as a confidence score to indicate areas of uncertainty

3.4.1 Quantification of the Present State of the Wetland

WET-Health is a tool designed to assess the health (present state) or integrity of a wetland. Wetland health is defined as a measure of the deviation of wetland structure and function from the wetland's natural reference condition (Macfarlane et al. 2009). This tool is utilised to assess hydrological, geomorphological and vegetation health in three separate modules.

Hydrology is defined in this context as the distribution and movement of water through a wetland and its soils. This module focuses on changes in water inputs as a result of changes in catchment activities and characteristics that affect water supply and its timing, as well as on modifications within the wetland that alter the water distribution and retention patterns within the wetland. Geomorphology is defined in this context as the distribution and retention patterns of sediment within the wetland. This assessment focuses on evaluating current geomorphic health through the presence of indicators of excessive sediment inputs and/or losses for clastic (minerogenic) and organic sediment (peat). Vegetation is defined in this context as the vegetation structural and compositional state. This module evaluates changes in vegetation composition and structure because of current and historic onsite transformation and/or disturbance.

The overall approach is to quantify the impacts of human activity or clearly visible impacts on wetland health, and then to convert the impact scores to a Present State score. The tool attempts to standardise the way that impacts are calculated and presented across each of the modules. This takes the form of assessing the spatial extent of impact of individual activities and then separately assessing the intensity of impact of each activity in the affected area. The extent and intensity are then combined to determine an overall magnitude of impact.

Impact scores obtained for each of the modules reflect the degree of change from natural reference conditions. Resultant health scores fall into one of six health categories (A-F) on a gradient from "unmodified/natural" (Category A) to "severe/complete deviation from natural" (Category F) as depicted in Table 3

Table 3: Quantification of the Present State of the Wetland

Impact Category	Description	Impact Score Range	Present State Category
None	Unmodified, natural	**0-0.9**	**A**
Small	Largely natural with few modifications. A slight change in ecosystem processes is disceminable and a small loss of natural habitats and biota might have taken place	**1-1.9**	**B**
Moderate	Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitats remains predominantly intact	**2-3.9**	**C**
Large	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred	**4-5.9**	**D**
Serious	The change in ecosystem proceses and loss of natural habitat and biota is great but some remaining natural habitats features are still recognisable	**6-7.9**	**E**
Critical	Modifications have reched a critical level and the ecosystem processes have been modified completely with an almost loss of natural habitat and biota	**8-10**	**F**

An overall wetland health score is calculated by weighting the scores obtained for each module and combining them to give an overall combined score using the following formula: Overall health rating = [(Hydrology∗3) + (Geomorphology∗2) + (Vegetation∗2)] / 7. This overall score assists in providing an overall indication of wetland health/functionality, which can in turn be used for recommending appropriate management measures.

Table 4 Scoring guidelines

Scoring guideline		**Relative confidence score**	
Natural, unmodified	5	Very high	4
Largely natural	4	High	3
Moderately modified	3	Moderate	2
Largely modified	2	Low	1
Seriously modified	1		
Critically modified	0		

A mean score for all attributes were then calculated and the final score was then used in the PES category determination as indicated in the Table 5.

Table 5 Present Ecological Status Category Descriptions

Score	Class	Description
>4	A	Unmodified, natural
>3 and<=4	B	Largely natural with few modifications
>2 and<=3	C	Moderately modified
2	D	Largely modified
>0 and <2	E	Seriously modified
0	F	Critically modified

3.5 Overall Health of the Wetland

Once all HGM units have been assessed, a summary of health for the wetland as a whole needs to be calculated. This is achieved by calculating a combined score for each component by area-weighting the scores calculated for each HGM unit. Recording the health assessments for the hydrology, geomorphology and vegetation components provides a summary of impacts, Present State, Trajectory of Change and Health for individual HGM units and for the entire wetland.

3.5.1 Assessing the Anticipated Trajectory of Change

As is the case with the Present State, future threats to the state of the wetland may arise from activities in the catchment upstream of the unit or from within the wetland itself or from processes downstream of the wetland. In each of the individual sections for hydrology, geomorphology and vegetation, five potential situations exist depending upon the direction and likely extent of change (Table 4).

Table 6 : Assessing the Anticipated Trajectory of Change

Change Class	Description	HGM Change Score	Symbol
Substantial improvement	State is likely to improve substantially over the next 5 years	2	↑↑
Slight improvement	State is likely to improve slightly over the next 5 years	1	↑
Remain stable	State is likely to remain stable over the next 5 years	0	→
Slight deterioration	State is likely to deteriorate slightly over the next 5 years	-1	↓
Substantial deterioration	State is expected to deteriorate substantially over the next 5 years	-2	↓↓

3.6 Ecological Importance and Sensitivity (EIS)

The Ecological Importance and Sensitivity was determined by utilising a rapid scoring system. The system has been developed to provide a scoring approach for assessing the ecological/biological importance, hydrological functioning importance and the importance of direct human benefits of wetlands. These scoring assessments for these three aspects of wetland importance and sensitivity have been based on the requirements of the NWA, the original Ecological Importance and Sensitivity assessments developed for riverine assessments (DWAF, 1999), and the work conducted by Kotze et al. (2007) on the assessment of wetland ecological goods and services from the WET-EcoServices tool (Rountree, 2010). These aspects, which are assessed in terms of their importance/ sensitivity, are indicated in Table 5. A rating of zero (low sensitivity / low importance) to four (very high) is allocated to each aspect. An overall score is based on the highest score out of the three categories.

The method used for the Ecological Importance and Sensitivity (EIS) determination was adapted from the method as provided by DWA (1999) for floodplains. The method takes into consideration PES scores obtained for WET-Health as well as function and service provision to enable the assessor to determine the most representative EIS category for the wetland feature or group being assessed.

A series of determinants for EIS are assessed on a scale of 0 to 4, where 0 indicates no importance and 4 indicates very high importance. The median of the determinants is used to assign the EIS category. A confidence score is also provided on a scale of **0 to 4**, where **0** indicates low confidence and **4** high confidence.

Ecological / Biological	Hydrological /Functional Importance	Importance of Direct Human Benefits
Biodiversity support – Presence of Red Data species – Populations of unique species – Migration/breeding/feeding sites	**Regulating and supporting benefits** – Flood attenuation – Streamflow regulation Water	**Subsistence benefits** – Water for human use – Harvestable resources – Cultivated foods Cultural

Ecological / Biological	Hydrological /Functional Importance	Importance of Direct Human Benefits
Landscape scale – Protection status of the wetland – Protection status of the vegetation type – Regional context of the ecological integrity – Size and rarity of the wetland type/s present – Diversity of habitat types **Sensitivity of the wetland** – Sensitivity to changes in floods – Sensitivity to changes in low flows/dry season – Sensitivity to changes in water quality	**Quality Enhancement** – Sediment trapping – Phosphate assimilation – Nitrate assimilation – Toxicant assimilation – Erosion control Carbon Storage	benefits – Cultural heritage – Tourism and recreation – Education and research

OVERALL IMPORTANCE ***(highest of the three categories)***

Table 7 EIS Category Definitions

Ecological Importance and Sensitivity Categories (EISC)	Range of Median	Recommended Ecological Management Class (EMC)
Wetlands that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these wetlands is usually very sensitive to flow and habitat modifications. They play a major role in moderating the quantity and quality of water of major rivers.	Very high >3 and <=4	A
Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these wetlands may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers	High >2 and <=3	B
Wetland that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water of major rivers.	Moderate >1 and <=2	C
Wetlands that is not ecologically important and sensitive at any scale. The biodiversity of these wetlands is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water of major rivers.	Low/marginal >0 and <=1	D

3.7 Ecological Class and Management

Eco-Classification - the term used for the Ecological Classification process - refers to the determination and categorisation of the Present Ecological State (PES; health or integrity) of various biophysical attributes of wetland relative the natural or close to the natural reference condition. The purpose of the Eco-Classification process is to gain insight and understanding into the causes and sources of the deviation of the PES of biophysical attributes from the reference condition. This provides the information needed to derive desirable and attainable future ecological objectives for the wetland. The procedure of Eco-Classification describes the health of a water resource, and derives and formulates management targets / objectives / specifications for the resource.

The Recommended Ecological Category (REC) (i.e. management objectives) is a recommendation from an ecological viewpoint, which is considered within the decision-making process in the National Water Resource Classification System (NWRCS). This recommendation is based on either maintenance or improvement of the PES. The REC is based on ecological criteria only and considers the EIS, the restoration potential and attainability thereof. According to DWAF (2007), the PES and EIS of water resources must drive management objectives when there is no water resource classification (eco-classification) available. Therefore, for water resources that do not have a REC allocated for the system, information contained in Tables below may be utilise

Table 8 Description of EMC classes

Class	Description
A	Unmodified, natural
B	Largely natural with few modifications
C	Moderately modified
D	Largely modified

PES	Very High	High	Moderate	Low
A	Maintain	Maintain	Maintain	Maintain
B	Improve	Improve	Maintain	Maintain
C	Improve	Improve	Maintain	Maintain
D	Improve	Improve	Maintain	Maintain

3.8 Wetland Functional Assessment

"The importance of a water resource, in ecological social or economic terms, acts as a modifying or motivating determinant in the selection of the management class. The assessment of the ecosystem services supplied by the identified wetlands was conducted according to the guidelines as described by Kotze et al (2008). An assessment was undertaken that examines and rates the following services according to their degree of importance and the degree to which the service is provided:

- Flood attenuation
- Stream flow regulation
- Sediment trapping
- Phosphate trapping
- Nitrate removal
- Toxicant removal
- Erosion control
- Carbon storage
- Maintenance of biodiversity
- Water supply for human use
- Natural resources
- Cultivated foods
- Cultural significance
- Tourism and recreation
- Education and research

The characteristics were used to quantitatively determine the value, and by extension sensitivity, of the wetlands. Each characteristic was scored to give the likelihood that the service is being provided. The scores for each service were then averaged to give an overall score to the wetland.

Table 9 Classes for determine construction and the extent to which a benefit is being supplied

Score	Rating of the likely extent to which the benefit is being supplied
<0.5	Low
0.6-1.2	Moderately low
1.3-2	Intermediate
2.1-3	Moderately high
<3	High

3.8 Wetland Ecosystem Service

The supply of ecosystem goods and services of the offset wetland was assessed using approach based on the WET-Eco-services assessment tool (Kotze *et al.*, 2007). This approach relies on a combination of desktop and on-site indicators to assess the importance of a range of common offset wetland ecosystem services. A level 2 (detailed) assessment was conducted that assessed a host of benefits by assigning a score to each benefit based on a rating system that rates a range of pre-defined variables affecting the importance of benefits provided by the wetland system. The results are captured in tabular form as a list of benefits/goods with the level of supply and demand rated on a scale of 0 - 4. The rating shown in Table 9 is used to describe the level of importance of supply and demand:

Table 10 Rating table used to rate supply and demand scores

Score	Importance or level of supply/demand
<2	Low
2-3	Moderate
>3	High

3.9 Buffers as per GDARD guidelines

The Minimum requirements for Biodiversity Assessments, 2014 of the Gauteng Department of Agriculture and Rural Development (GDARD, 2014) state that different buffers must be applied to sites inside and outside the urban edge (Table 11).

Table 11 : Buffers as per GDARD guidelines

Project Area	Wetlands	Riparian areas
Inside urban edge	30 metres	32 metres
Outside urban edge	50 metres	100 metres

Buffer areas are seen as part of the aquatic ecosystem and may not be developed or affected in any way by the construction activities and is rated the same sensitivity as the system. Buffers are a strip of land surrounding a wetland or riparian area in which activities are controlled or restricted, in order to reduce the impact of adjacent land uses on the wetland or riparian area. Buffers are in essence a fabricated ecotone. This ensures the wetland functioning is kept at an optimum and the services provided by wetlands are maintained. To ensure the buffer is maintained it must be fenced off prior to the physical construction of the site and the building contractors of the site contractually bound to the conservation of the area.

4. RESULTS OF THE ASSESSMENT

4.1 Eco-Region & Quaternary Catchment

When assessing the ecology of any area (aquatic or terrestrial), it is important to know which ecoregion the study area is located within. This knowledge allows for improved interpretation of data to be made, since reference information and representative species lists are often available on this level of assessment to guide the assessment.

The study area located within farms Grootfontein 165 and Vakernsfontein 169 falls within the Tsakane Clay Grassland .This database was used as reference for the catchment of concern in order to define the EIS. Figure below indicate the aquatic ecoregion and quaternary catchments of the study area. The study area is located within the C21E quaternary catchment. The results of the assessment are summarised in the table and maps below.

Quaternary Catchment Number	River Name	Ecological Sensitivity	Confidence
C21E	Blesbokspruit	High	High

Source : www.dwa.gov.za/WAR/systems.html

PLAN 3

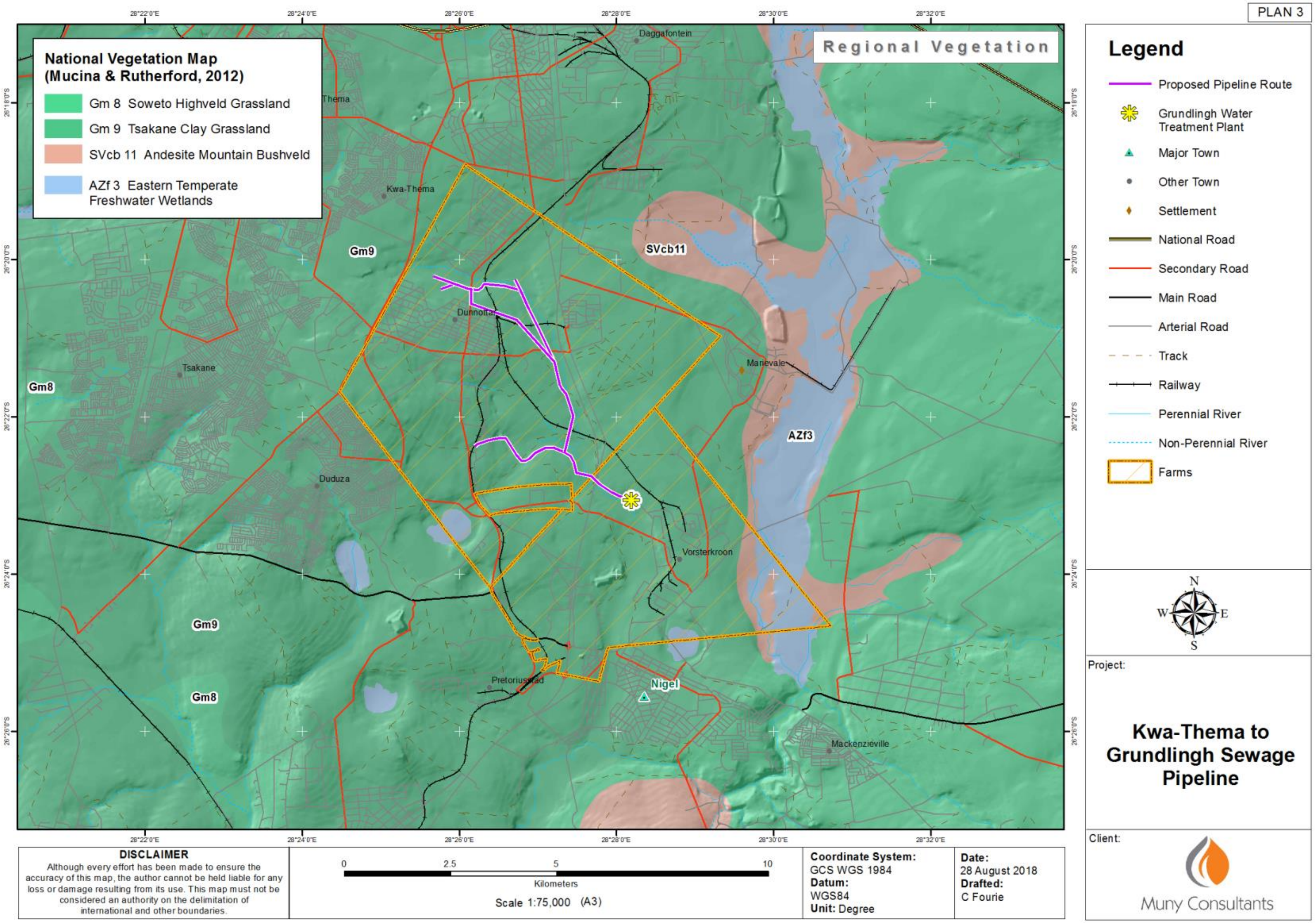


Figure 2 : Vegetation Type

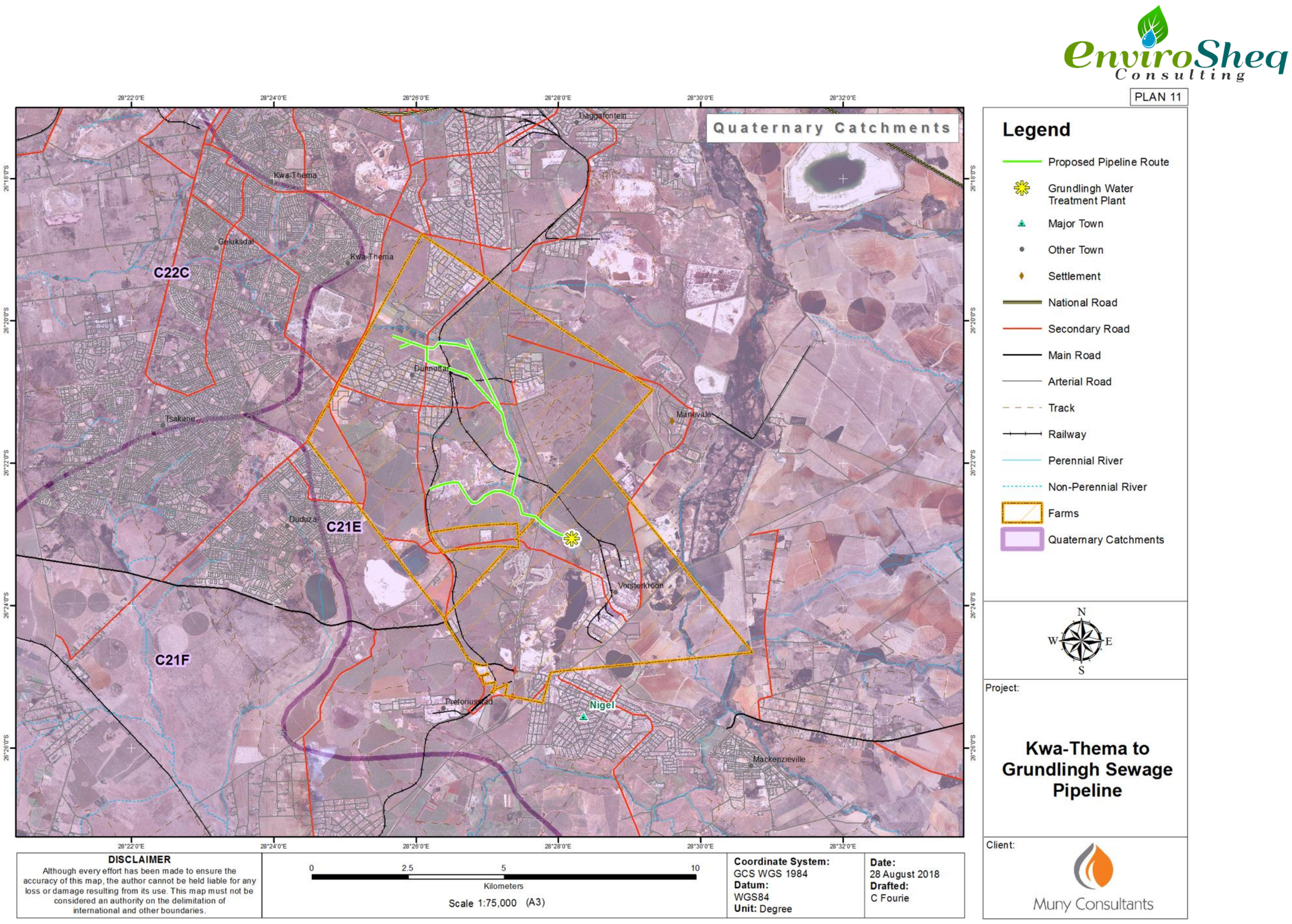


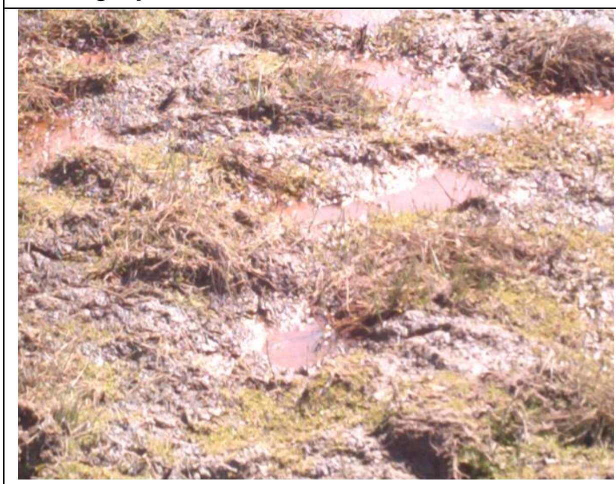
Figure 3 : Quaternary Catchment

4.2 Soil Wetness and Soil Form Indicator

According to DWAF (2005), the permanent zone of a wetland will always have either Champagne, Katspruit, Willowbrook or Rensburg soil forms present, as defined by the Soil Classification Working Group (1991). The seasonal and temporary zones of the wetlands will have one or more of the following soil forms present (signs of wetness incorporated at the form level): Kroonstad, Longlands, Wasbank, Lamotte, Estcourt, Klapmuts, Vilafontes, Kinkelbos, Cartref, Fernwood, Westleigh, Dresden, Avalon, Glencoe, Pinedene, Bainsvlei, Bloemdal, Witfontein, Sepane, Tukulu, Montagu. Alternatively, the seasonal and temporary zones will have one or more of the following soil forms present (signs of wetness incorporated at the family level): Inhoek, T sitsikamma, Houwhoek, Molopo, Kimberley, Jonkersberg, Groenkop, Etosha, Addo, Brandvlei, Glenrosa, Dundee (DWAF, 2005). The photographs below shows the saturated soils that were used as wetland indicators on the study site.

Photograph A

Photograph B



Photograph C

Photograph D

Figure 4 : Wetness Indicators Photograph A & B

Caption: Photographs above show the saturated soils used as delineation indicators of the wetland

Several redoximorphic features were also present on the surface of the soils of the study area, including mottles and rhizospheres. Redoximorphic features shown in the paragraphs are the result of the reduction, translocation and oxidation (precipitation) of iron and manganese oxides that occur when soils are saturated for sufficiently long periods of time to become anaerobic. Redoximorphic features typically occur in three types (Collins, 2005):

- A reduced matrix - i.e. an in situ low chroma (soil colour), resulting from the absence of Fe3+ ions which are characterised by "grey" colours of the soil matrix (See Photographs above).
- Redox depletions - the "grey" (low chroma) bodies within the soil where Fe- Mn oxides have been stripped out, or where both Fe-Mn oxides and clay have been stripped. Iron depletions and clay depletions can occur.
- Redox concentrations - Accumulation of iron and manganese oxides (also called mottles). These can occur as:
    - Concretions-harder, regular shaped bodies
    - Mottles - soft bodies of varying size, mostly within the matrix, with variable shape appearing as blotches or spots of high chroma colours; and,
- Pore linings – zones of accumulation that may be either coatings on a pore surface, or impregnations of the matrix adjacent to the pore. They are recognised as high chroma colours that follow the route of plant roots, and are also referred to as oxidised rhizospheres.

According to the DWAF (2005), soil wetness indicators (i.e. identification of redoximorphic features) are the most important indicator of wetland occurrence due to the fact that soil wetness indicators (redoximorphic features) remain in wetland soils, even if they are degraded or desiccated. It is important to note that redoximorphic features were present in the delineated wetland within the upper 500mm of the soil profile. The presence or absence of redoximorphic features within the upper 500mm of the soil profile alone is sufficient to identify the soil as being hydric (a wetland soil), or non- hydric (non-wetland soil) (Collins, 2005).

4.3 Wetland Vegetation Indicator

According to DWAF (2005), vegetation is regarded as a key component to be used in the delineation procedure for wetlands. Vegetation also forms a central part of the wetland definition in the National Water Act, Act 36 of 1998. Using vegetation as a primary wetland indicator however, requires undisturbed conditions (DWAF, 2005) This indicator was used to delineate the wetland as the site under investigation had minimum disturbances. A cautionary approach was taken as vegetation alone cannot be used to delineate a wetland, as several species, while common in wetlands, can occur extensively outside of wetlands. When examining plants within the wetland, a distinction between hydrophilic (vegetation adapted to life in saturated conditions) and upland species was kept in mind. The site showed a typically well-defined 'wetness' gradient that was found to occur along the river channel.

The following photographs shows the hydrophilic vegetation e.g bulrush that was found to dominate most of the NFEPA wetlands identified on site.

Photograph E **Photograph F**

Photograph G **Photograph H**

Figure 5 :Photographs G,H I J K -Riparian vegetation and the associated stream

Moist grasslands delineated in this wetland were classified as vegetation that typically grew in permanently to temporary saturated soils and was dominated by grass and / or sedge species. The moist grasslands were characterized as areas where permanent water was observed or where the soils supported plant species with an affinity to grow in permanent, temporary or seasonally saturated conditions.

4.4 Wetland Delineation Areas

According to the National Water Act (Act no 36 of 1998) a wetland is defined as, "*land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil*." Hydrophytes and hydric soils are used as the two main wetland indicators. The presence of these two indicators is symptomatic of an area that has sufficient saturation to classify the area as a wetland. The soil form indicator examines soil forms, as defined by the Soil Classification Working Group. Typically soil forms associated with prolonged and frequent saturation by water, where present, is a sign of wetland occurrence (DWAF, 2005). Terrain unit refers to the land unit in which the wetland is found. Wetlands can occur across all terrain units from the crest to valley bottom. Many wetlands occur within valley bottoms, but wetlands are not exclusively found within depressions. Terrain unit is a useful indicator in assessing the hydro-geomorphic form of the wetland.

In the delineation and assessment of the wetland all indicators were used and the presence of redoximorphic features was considered the most important, with the other indicators being confirmatory. An understanding of the hydrological processes active within the area was also considered important when undertaking the wetland assessment. These Indicators were then 'combined' to determine whether an area is a wetland and to delineate the boundary of a wetland. According to the DWS delineation guidelines, the more wetland indicators that are present the higher the confidence of the delineation. In assessing whether an area is a wetland, the boundary of a wetland or a non- wetland area should be considered to be the point where indicators are no longer present. As a result of the minimum disturbance of the study area, the confidence of the delineation was high, with a likelihood that wetland habitat were much more extensive historically.

The riparian zone and associated wetland features were delineated according to the guidelines advocated by DWA (2005). It should be noted that the identification of the outer boundary of the upper riparian zone and the temporary zone of wetland features did prove difficult in some areas as a result of general disturbance and agricultural activities. However, the delineation as presented in this report is regarded as a best estimate of the boundary of the riparian zone and temporary zone of wetlands based on the site conditions present at the time of assessment.

During the assessment, the following indicators were used to determine the boundary of the upper riparian zone:

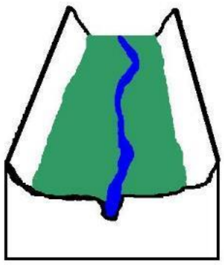
- Riparian vegetation proved to be the most indicative of the boundary of the riparian zone with a distinctive change in vegetation abundance, as well as diversity noted in the lower and upper zones of the riparian habitat compared to the surrounding terrestrial zones. The woody vegetation component increased significantly within these areas when compared to surrounding terrestrial areas;

- Terrain units were used in support of the vegetation or landscape characteristics;
- The presence of alluvial soils could be used to identify riparian zones;
- Surface water was mainly restricted to the active channel of the river. As a result, surface water and wet soils were of limited use as indicator during the riparian zone

Two hydro-geomorphic (HGM) type, a river floodplain was delineated and the map is presented in the figures and table below.

According to the DWS, riparian habitat includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas.

The majority of the wetlands associated with the watercourse system can be defined as a channelled valley bottom wetland due to the presence of a stream and the location of the HGM. The identified wetland systems are described in the table and figure below.

Valley Bottom with a Channel 	Valley bottom areas with a well-defined stream channel but lacking characteristic floodplain features. May be gently sloped and characterized by the net accumulation of alluvial deposits or may have steeper slopes and be characterised by the net loss of sediment. Water inputs from the main channel (when channel banks overspill) and from adjacent slopes.

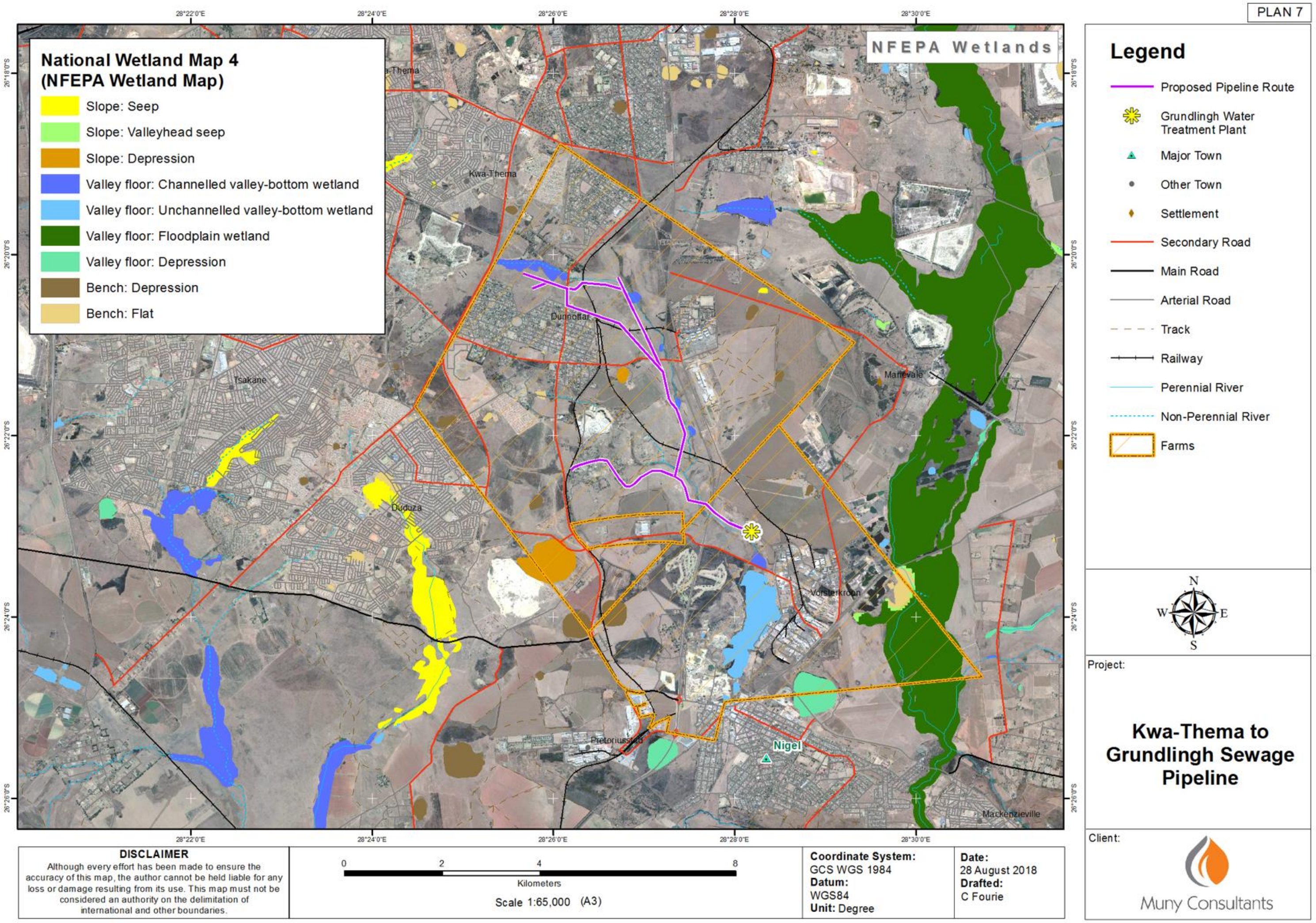


Figure 6 : NFEPA Wetlands Map

4.5 Wetland Functionality

The function and service provision provided by all wetland features associated with the stream is likely to be similar and was therefore assessed in a single assessment. It should be noted that wetland characteristics utilised during the calculation of function and service provision varied slightly from feature to feature. However, the use of the average condition is deemed sufficient to determine the overall importance of each of the features and guide decision making on utilisation of the resources in the vicinity of these areas and in order to determine management and mitigation measures to protect these resources. The results are presented in the table that follows.

Table 12 : Functionality & PES

Function	Aspect
Water balance	Streamflow regulation
	Flood attenuation
	Groundwater recharge
Water purification	Nitrogen removal
	Phosphate removal
	Toxicant removal
	Water quality
Sediment Trapping	Particle assimilation
Harvesting of natural resources	Reeds, Hunting etc.
Livestock usage	Water for livestock
	Grazing for livestock
Crop Farming	Irrigation

Hydro-geomorphic units are inherently associated with hydrological characteristics related to their form, structure and particularly their position in the landscape. This, together with the biotic and abiotic character (or biophysical environment) of wetlands in the study area, means that these wetlands are able to contribute better to some ecosystem services than to others (Kotze et al. 2005) (Table 3).

Each wetland's ability to contribute to ecosystem services within the study area is further dependant on the particular wetland's Present Ecological State (PES) in relation to a benchmark or reference condition. Present Ecological State scores were assigned for various wetlands within the study area using WET-Health Level 2 assessment. Through the use of a scoring system, the perceived departure of elements of each particular system from the "natural-state" was determined. The following elements were considered in the assessment:

- Hydrologic: Flow modification (has the flow, rates, volume of run-off or the periodicity changed);

- Geomorphic (Canalisation, impounding, topographic alteration and modification of key drivers); and
- Biota (Changes in species composition and richness, Invasive plant encroachment, over utilisation of biota and land-use modification).

Table 13 : Wetland Hydrological Benefits

WETLAND HYDRO-GEOMORPHIC TYPE	HYDROLOGICAL BENEFITS POTENTIALLY PROVIDED BY THE WETLAND							
	FLOOD ATTENUATION		Stream flow regulation	Erosion Control	ENHANCEMENT OF WATER QUALITY			
	Early wet season	Late wet Season			Sediment trapping	Phosphates	Nitrates	Toxicants
	++	++	++	+	+	+	+	+

Toxicants are taken to include heavy metals and biocides

Rating of Benefit unlikely to be provided to any significant extent

+ Benefit likely to be present at least to some degree

++ Benefit very likely to be present (and often supplied to a high level

From the results of the assessment it is evident that wetland features associated with the stream can be considered of intermediate importance in terms of function and service provision. Wetland features are likely to play a moderate role in the attenuation of floodwater entering into the system. Sediment trapping and erosion control are also considered important services provided by the wetlands and watercourse system.

Wetland features associated with the watercourse are likely to trap sediment carried in stormwater. Furthermore, water which is spread across wetland features is slowed down and the erosive capability is therefore decreased. Assimilation of nitrates, phosphates and toxicants calculated moderately high scores. The majority of wetland features are located in close proximity to disturbed areas and are therefore likely to play a role in the sediment trapping and toxic assimilation before these substances enters into the river.

4.6 Present Ecological State (PES)

A summary of the Present Ecological Status (PES) based on results from the WET-Health Tool is provided in table below. The health assessment of the wetland units within the project site indicates that the wetland unit is largely natural owing to the minimum past and current land uses, and activities.

Table 14 : Present Ecological Status (PES)

Criteria and attributes	Relevance	Section A		Section B		Section C	
		S	C	S	C	S	C
Hydrologic							
Flow modification	Consequence of abstraction, regulation by impoundments or increased runoff from human settlements or agricultural land. Changes in flow regime (timing, duration, frequency), volumes, velocity which affect inundation of wetland habitats resulting in floristic changes or incorrect cues to biota. Abstraction of groundwater flows to the wetland.	**3**	3	**3**	3	**4**	3
Permanent Inundation	Consequence of impoundment resulting in destruction of natural wetland habitat and cues for wetland biota.	**3**	3	**3**	3	**3**	3
Water Quality							
Water Quality Modification	From point or diffuse sources. Measure directly by laboratory analysis or assessed indirectly from upstream agricultural activities, human settlements and industrial activities. Aggravated by volumetric decrease in flow delivered to the wetland	**4**	3	**4**	3	**4**	3
Sediment load modification	Consequence of reduction due to entrapment by impoundments or increase due to land use practices such as overgrazing. Cause of unnatural rates of erosion, accretion or infilling of wetlands and change in habitats.	**3**	3	**3**	3	**3**	3
Hydraulic/Geomorphic							
Canalisation	Results in desiccation or changes to inundation patterns of wetland and thus changes in habitats. River diversions or drainage.	**4**	3	**4**	3	**4**	3
Topographic Alteration	Consequence of infilling, ploughing, dykes, trampling, bridges, roads, railway lines and other substrate disruptive activities which reduces or changes wetland habitat directly or through changes in inundation patterns.	**3**	3	**3**	3	**3**	3
Biota							
Terrestrial Encroachment	Consequence of desiccation of wetland and encroachment of terrestrial plant species due to changes in hydrology or geomorphology. Change from wetland to terrestrial habitat and loss of wetland functions.	**4**	3	**4**	3	**4**	3
Indigenous Vegetation Removal	Direct destruction of habitat through farming activities, grazing or firewood collection affecting wildlife habitat and flow	**5**	4	**5**	4	**5**	4

Criteria and attributes	Relevance	Section A		Section B		Section C	
		S	C	S	C	S	C
	attenuation functions, organic matter inputs and increases potential for erosion.						
Invasive plant encroachment	Affect habitat characteristics through changes in community structure and water quality changes (oxygen reduction and shading).	**4**	3	**4**	3	**4**	3
Alien fauna	Presence of alien fauna affecting faunal community structure.	**5**	4	**5**	4	**5**	4
Over utilisation of biota	Overgrazing, Over-fishing, etc	**4**	3	**4**	3	**4**	3
TOTAL		**42**		**42**		**42**	
MEAN		**3.8**		**3.8**		**3.8**	
Present Ecological Class (PES) Category		B		B		B	

***S- Score & C- Confidence**

Scoring guidelines per attribute:

Natural, unmodified = 5; Largely natural = 4, Moderately modified = 3;
Largely modified = 2; Seriously modified = 1; Critically modified = 0.

Relative confidence of score:

Very high confidence = 4; High confidence = 3; Moderate confidence = 2; Marginal/low confidence = 1.

The wetland score for the PES shows that the delineated and assessed falls with class "B" reflecting that the modification within the wetland system are very small or minimum and as such showing that the wetland systems are largely natural with a few modifications.

4.7 Ecological Importance & Sensitivity (EIS)

All wetlands, rivers, their flood zones and their riparian areas are protected by law and no development is allowed to negatively impact on watercourses and associated vegetation. The vegetation in and around wetlands and drainage lines play an important role in water catchments, assimilation of phosphates, nitrates and toxins as well as flood attenuation. Quality, quantity and sustainability of water resources are fully dependent on good land management practices within the catchment.

4.7.1 Importance according to Gauteng Conservation Plan

The Gauteng C-Plan is intended to guide land-use planning, environmental assessments and land-use authorisations, as well as natural resource management, in order to promote the sustainable development agenda. The C-plan has been developed to further the awareness of the areas unique biodiversity, the value this biodiversity represents to people and to promote management mechanisms that can ensure the protection and sustainable utilization of the regions biodiversity.

The C-Plan of the study area has indicated that:

- The majority of the study area is located within an Important biodiversity area
- A small section of the pipeline in the northern portion of the study area falls under Irreplaceable biodiversity areas
- A small section of the pipeline that runs in the north-western direction falls within an Ecological Support Area (ESA)

NB: See attached map below

Ecological Support Areas are not essential for meeting biodiversity targets but play an important role in supporting the ecological functioning of Critical Biodiversity Areas and/or in delivering ecosystem services.

EnviroSheq Consulting

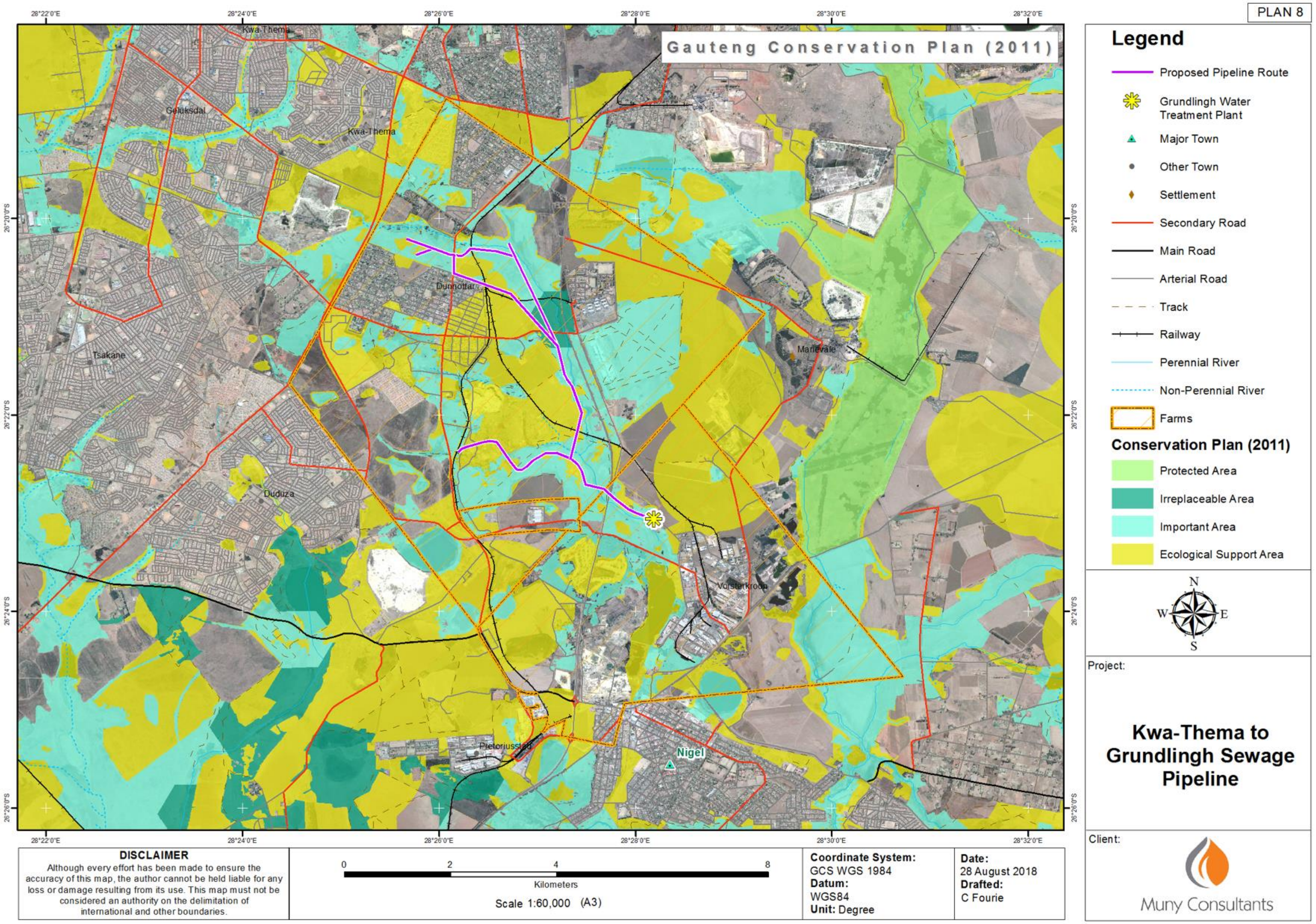


Figure 7 : Gauteng Conservation Plan

4.7.2 Ecological Importance & Sensitivity Rating

The Ecological Importance and Sensitivity (EIS) assessment was undertaken to rank water resources in terms of:

- Provision of goods and service or valuable ecosystem functions which benefit people;
- Biodiversity support and ecological value; and
- Reliance of subsistence users (especially basic human needs uses).

Water resources which have high values for one or more of these criteria may thus be prioritised and managed with greater care due to their ecological importance (for instance, due to biodiversity support for endangered species), hydrological functional importance (where water resources provide critical functions upon which people may be dependent, such as water quality improvement) or their role in providing direct human benefits (Rountree, 2010). Degradation of wetlands through impacts in catchments or in wetlands themselves is resulting in the reduction and loss of their functional effectiveness and ability to deliver ecosystem services or benefits to humans and the environment (Kotze et al., 2008).

Table 15 : Ecological Importance Sensitivity (EIS)

	Section A Wetlands		Section B Wetlands		Section C Wetlands	
PRIMARY DETERMINANTS	Score	Confidence	Score	Confidence	Score	Confidence
1. Rare & Endangered Species	2	3	2	3	2	3
2. Populations of Unique Species	3	3	3	3	3	3
3. Species/taxon Richness	4	3	3	3	3	3
4. Diversity of Habitat Types or Features	2	3	2	3	2	3
5. Migration route/breeding and feeding site for wetland species	2	2	1	2	1	2
6. Sensitivity to Changes in the Natural Hydrological Regime	2	2	3	2	3	2
7. Sensitivity to Water Quality Changes	3	2	3	2	3	2
8. Flood Storage, Energy Dissipation & Particulate/Element Removal	1	3	1	3	1	3
MODIFYING DETERMINANTS						
9. Protected Status according to NFEPA WetVeg	1	4	3	4	3	4
10. Ecological Integrity	2	4	2	4	2	4
TOTAL	22		23		23	
MEAN	2,2		2,3		2,3	
OVERALL Ecological Iportance & Sensitivity (EIS)	B		B		B	
Category B Wetlands Description--Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these wetlands may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers						

Score guideline: 4= Very High; 3=High;2= Moderate;1= Marginal/Low; 0=None
4=Very High Confidence;3= High Confidence;2= Moderate Confidence;1= Marginal/Low Confidence

The High Ecological Importance and Sensitivity (EIS) and Ecological Management Class of "B" Largely natural with a few modifications assigned to the identified wetlands can be attributed to the minimum disturbed nature of the wetlands and the study area and the classification of the study area to be an area of high conservation concern. The identified wetlands in study area " Section A & Section B" and associated river system has some sections mapped on the NFEPA wetland system and as such the Ecological Importance & Sensitivity (EIS) is generally regarded as high.

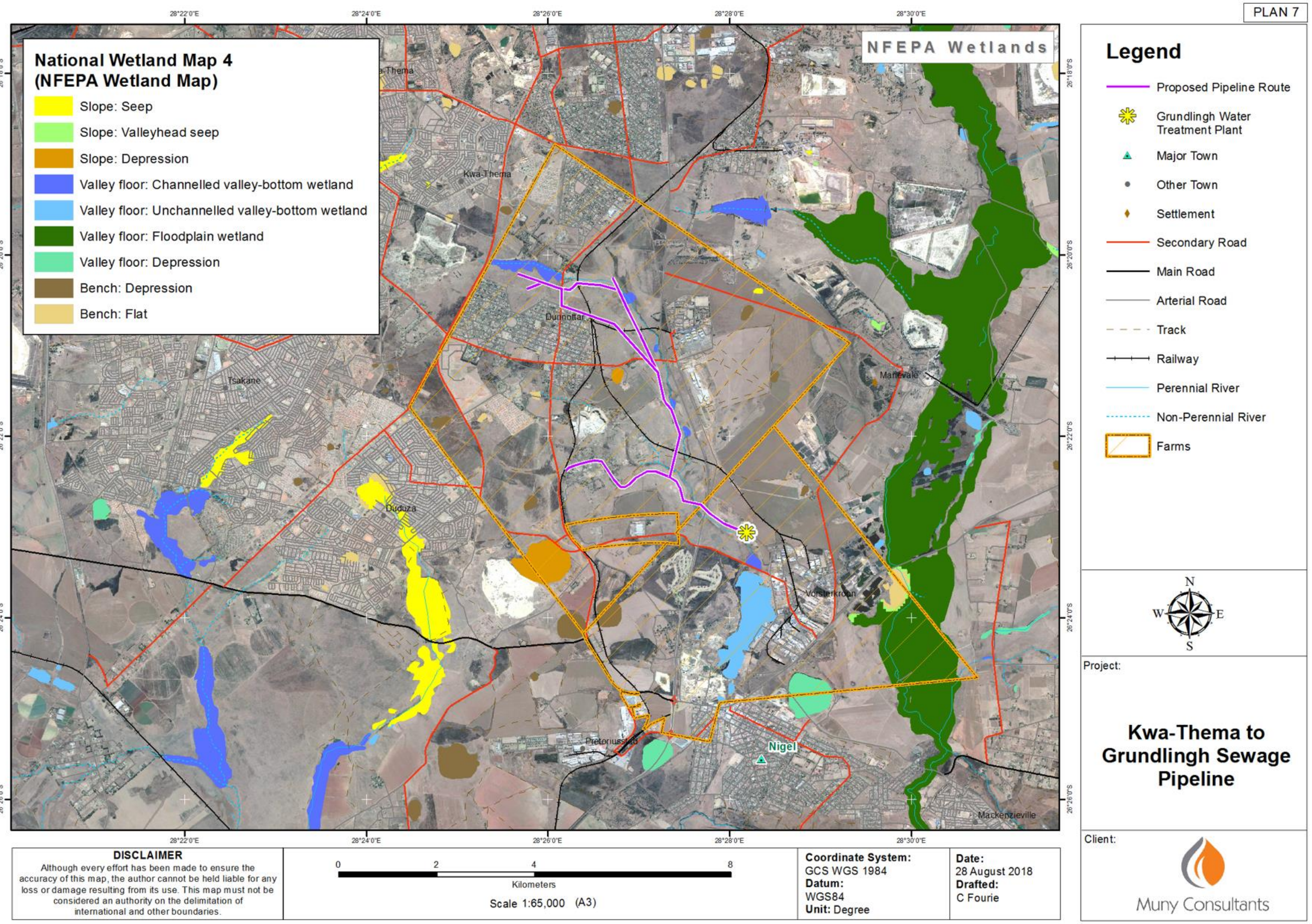


Figure 8 : NFEPA Wetlands

As previously discussed the hydrology and functionality of the wetland has been impacted though farming activities along the delineated wetland and hence contributing to the low ecological sensitivity.

4.8 Buffer allocation

The National Environmental Management Act (Act 107 of 1998) stipulates that no activity can take place within 32m of a wetland without the relevant authorisation. In addition, the National Water Act (Act 36 of 1998) states that no diversion, alteration of bed and banks or impeding of flow in watercourses (which includes wetlands) may occur without obtaining a Water Use Licence authorising the proponent to do so. This prescribed 32m buffer zone is deemed sufficient to maintain and improve the PES and limit any further impact of the proposed development on the local wetland resources.

The riparian zone/wetland areas and their associated buffer areas are presented in the figures to follow. Any activities occurring within the riparian zone/wetland areas or within a 32m buffer of the riparian zone/wetland areas must be authorised by the DWS in terms of Section 21 (c) & (i) of the NWA (Act 36 of 1998).

In this assessment the GDARD buffer allocation was methodology was utilised for the riparian areas Since the study area falls outside the urban edge, a 100m buffer zone was allocated although this can be reviewed subject to recommendations from the Department of Water & Sanitation.

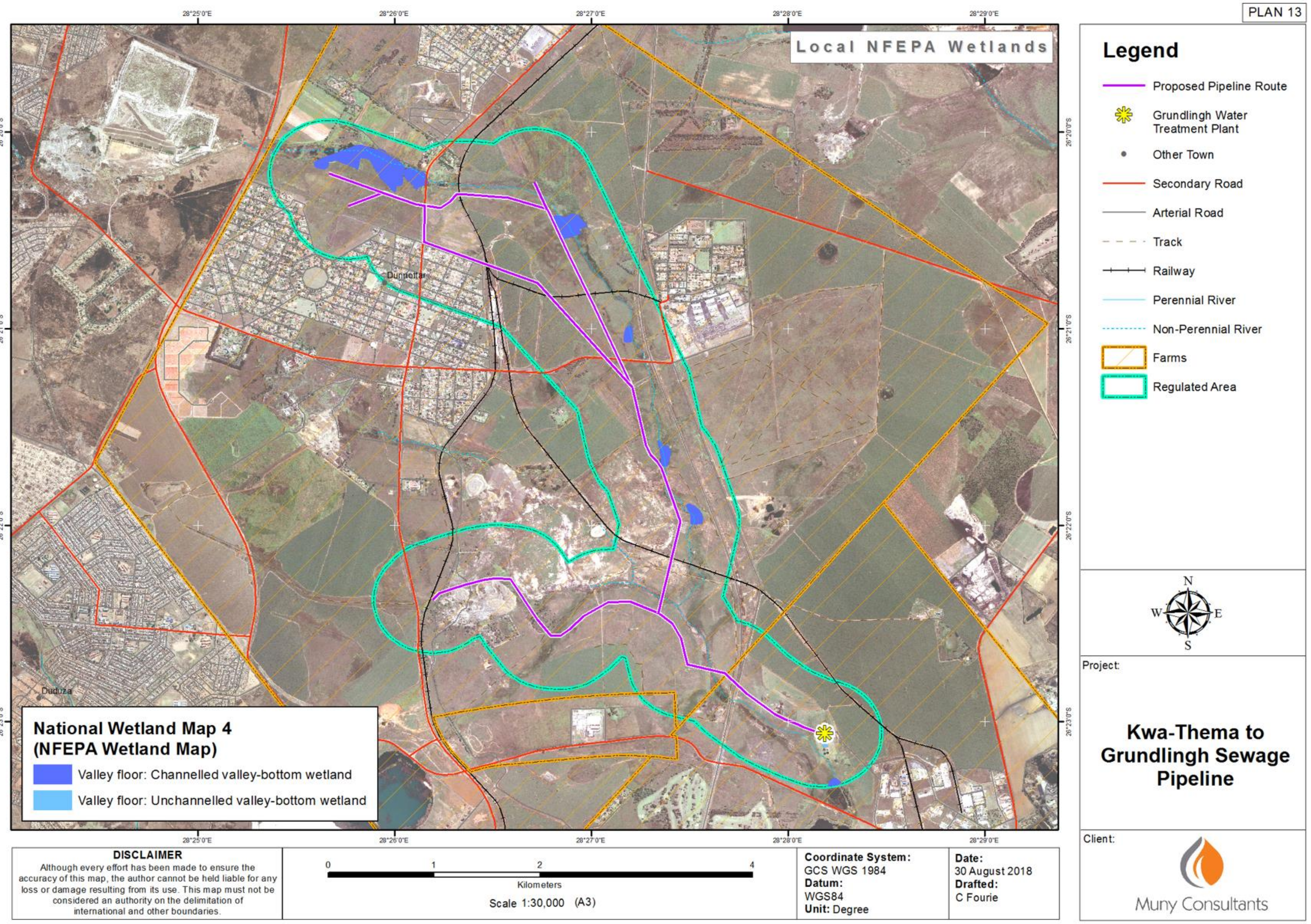


Figure 9 : 500m Regulated Area

5. SITE DESCRIPTION & IMPLICATIONS FOR THE DEVELOPMENT

For the purposes of this specific report, the sections are described as follows:

Section A-Section of the pipeline running from Grundligh Treatment Plant from the south eastern portion towards the north western portion of the study site . This section covers the 1st pipeline crossing in relation to the wetlands delineated and assessed.

Section B- Section of the pipeline starting from the 2nd crossing of the wetland in the northern portion of the study site.

Section C- Refers to the pipeline section from the 3rd wetland crossing in the northen portion of the study site to the end of the proposed pipeline

Site Description

Section A photographs shows the existing 1st crossing point of the pipeline and the associated wetland. There is relatively no visible construction impacts that can be attributed to the construction activities at this point however there were some notable operational impacts that could be attributed to the leakages of pipeline. The pipeline is rusted and has several openings that could have led to spillages of sewer in the wetland area.. There were no NFEPA wetlands identified in this section of the study area.

Photograph I

Photograph J

 Photograph K	 Photograph L

Figure 10 : Section A Photographs

Section B photographs shows the existing 2nd crossing point of the pipeline and the associated wetland. There is relatively no visible construction impacts that can be attributed to the wetland at this point. It shows that over the years the wetland has managed to rehabilitate close to it pristine state. The photographs also shows the NFEPA wetlands that were identified and assessed s part of this study.

 Photograph M	 Photograph N
 Photograph O	 Photograph P

Figure 11 :Section B Photographs

Section C photographs shows the existing 3rd crossing point of the pipeline and the associated NFEPA wetland. As related to section B ,there is relatively no visible construction impacts that can be attributed to the construction activities at this point. It shows that over the years the wetland has managed to rehabilitate back to relatively its pristine state.

 Photograph Q	 Photograph R
 Photograph S	 Photograph T

Figure 12 : Section C Photographs

6. CONSIDERATION OF THE POTENTIAL IMPACTS ON THE WETLANDS AS A CONSEQUENCE OF THE PROPOSED PIPELINE UPGRADES AND CONSTRUCTION

Since there are already existing sewer pipelines in the ground along the entire pipeline route it is possible to consider the long term consequences of the previous construction operations by using the existing conditions as a guideline. In no instance was it possible to find impacts on wetland or stream crossings, or elsewhere, which could be attributed to the pipelines. Thus it is possible to state that, if the new construction work is done correctly, the impacts that will arise as a consequence of the proposed upgrades are likely to be minor or even negligible.

As a part of the impact assessment process, attention was given to the scores derived in the Ecological Importance & Sensitivity (EIS), the Present Ecological Status (PES) and the Ecological functionality in terms of service provision of the identified Channeled Valley Bottom Wetlands".

6.1 Impacts on Stream and Wetland Crossings

The key issue at the stream and wetland crossing sites is the need to undertake excavations within the various watercourses. The foreseen potential impacts associated with such work are as follows:

- Deposition of soil or other sediment into the watercourse where it will be washed downstream into either wetlands or the stream.
- Possible damage to the riparian surrounds.
- Possible spillage of wet cement/concrete into the watercourse.
- Deposition of solid waste such as plastics, scrap metal and the like into the watercourse.

Such impacts would be unacceptable without mitigation. Therefore, in order to minimise (mitigate) the impacts the following recommendations are put forward:

- Prior to the start of operations the contractor must produce a method statement indicating how the construction process will be undertaken. Most important in this statement will be consideration of the impacts on the watercourse crossings and the associated mitigation measures.
- The construction camp(s) may not be sited within 100 m of a wetland.
- Ideally, the construction work should be done in the dry season when plants are senescent and stream flows are at their lowest.
- If concrete or cement are to be mixed at the site then it must be done in a place where no uncured product can flow into a watercourse in an uncontrolled manner.
- Precautions are to be taken in regard to spillage of any hydrocarbon (fuels, oils, greases) on the site. Care must be taken in their use but spill clean-up facilities must also be on hand at all times
- The watercourses and their surrounds must be protected against inputs of soil or other sediment through proper use of stormwater management structures along the pipeline route

- Where sections of pipe are to be decommissioned they should be left in the ground unless the new pipe will be laid in the same place. The reason for this recommendation is that of avoiding opening unnecessary second trenches through the site.

6.2 General management and good housekeeping practices

Latent and general everyday impacts, which may affect the wetland ecology and biodiversity, will include any activities which take place in the vicinity of the proposed study area that may impact on the receiving environment. Mitigation measures for these impacts are highlighted below and are relevant to the wetland systems identified in this report:

Development footprint

- The development footprint area should remain as small as possible and should not encroach onto surrounding areas beyond the proposed route;
- Ensure that only essential activities must occur within the wetland features which are traversed by the proposed route, all other non-essential activities should occur outside of the freshwater features; the wetland areas not indicated within the linear developments footprint are off-limits to construction vehicles and personnel;
- Planning of temporary roads and access routes should avoid natural areas and be restricted to existing tarred and gravel roads where possible;
- Appropriate sanitary facilities must be provided for the life of the construction and all waste removed to an appropriate waste facility;
- All hazardous chemicals should be stored in designated area which are not located near freshwater feature areas;
- No fires should be permitted in or near the construction area;
- Restrict construction to the drier winter months if possible to avoid sedimentation of the wetland features and to minimise the severity of disturbance of the wetland habitat;
- Access to the construction site should be limited to a single entry point to minimise compaction of soils, loss of vegetation and increased erosion; and
- Ensure that an adequate number of litter bins are provided and ensure the proper disposal of waste and spills.

Vehicle access

- It must be ensured that all hazardous storage containers and storage areas comply with the relevant South African Bureau of Standards (SABS) standards to prevent leakage. All vehicles must be regularly inspected for leaks. Re-fueling must take place on a sealed surface area to prevent ingress of hydrocarbons into the topsoil;
- In the event of a vehicle breakdown, maintenance of vehicles must take place with care and the recollection of spillage should be practiced near the surface area to prevent ingress of hydrocarbons into topsoil and subsequent habitat loss; and
- All spills should they occur, should be immediately cleaned up and treated accordingly.

Soils

- As much vegetation growth should be encouraged to protect soils;
- Dumped soils should be removed and the area must be levelled to improve the flow of water;
- Reinforce banks where necessary with gabions and reno-mattresses; and
- Monitor all areas traversed by the development for erosion and incision, during site clearing in the preconstruction phase and throughout the construction phase.

Rehabilitation

- Bare areas that resulted from vegetation clearing during site preparation, must be revegetated with indigenous species to protect the soils;
- Construction rubble must be collected and dumped at a suitable landfill site; and
- All alien vegetation in the construction footprint areas as well as immediate vicinity should be removed upon completion of construction. Alien vegetation control should take place for a minimum period of two growing seasons after construction is completed.

Impact ratings on the wetland ecology

The tables below serve to summarise the anticipated impacts that might occur throughout the development phases, as well as the mitigations that must be implemented in order to maintain and enhance the wetland features conditions.

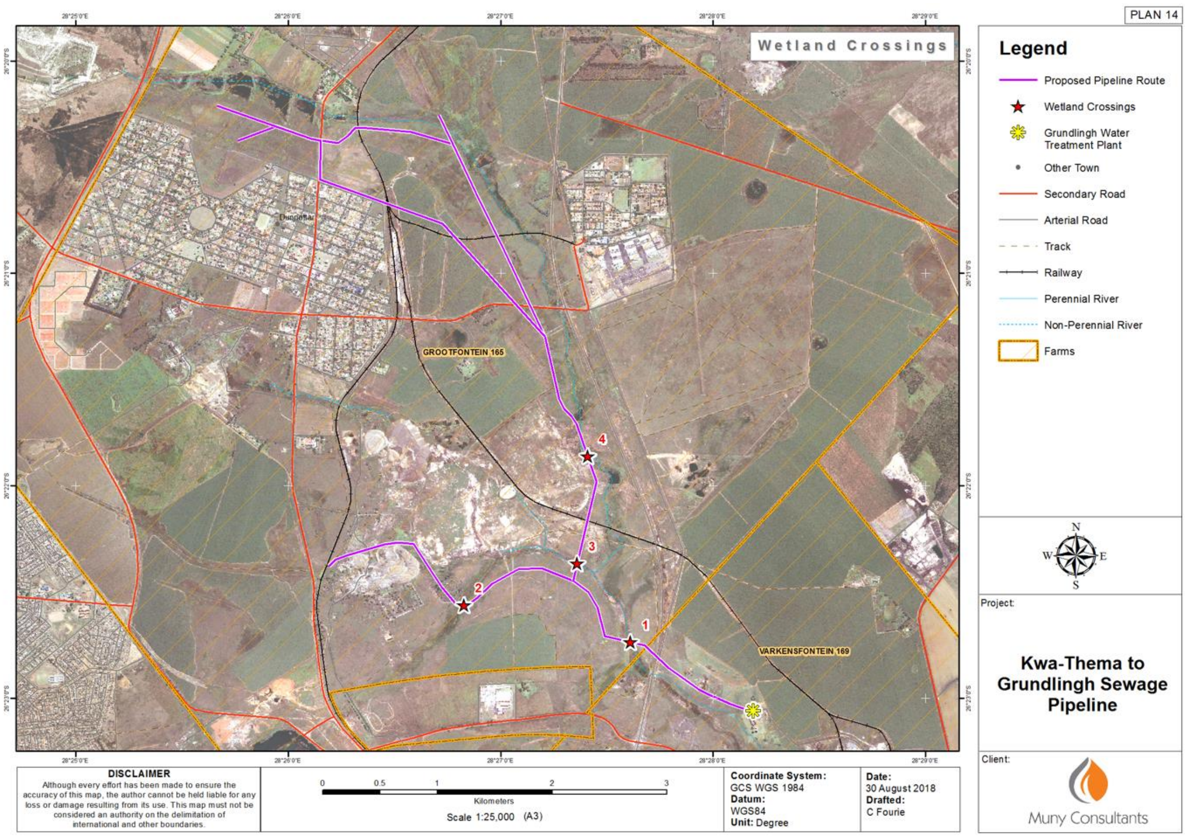


Figure 13 : Wetland/ Stream Crossing Points

6.3 Impact Identification & Assessment

Impact 1: Loss of wetland Features Habitat and Ecological Structure

Aspects & Activities Register

Pre-Construction

- Potential poor planning, resulting in the placement of the linear development within wetland habitat, leading to altered habitat
- Increased anthropogenic activity within the wetland feature

Construction

- Site clearing and the removal of vegetation leading to increased runoff and erosion during rainfall events
- Potential indiscriminate driving through wetland feature areas leading to soil compaction
- Earthworks in the vicinity of the wetland feature system leading to loss of wetland feature habitat, erosion and altered runoff patterns
- Spillage from construction vehicles and waste dumping leading to contamination of wetland feature soils
- Changes to the wetland feature vegetation community due to alien invasion resulting in altered wetland feature conditions

Operational

- Poor rehabilitation of wetland features resulting in alien plant proliferation and erosion of construction areas.
- Potential movement of vehicles through wetland features during follow up work to ensure adequate rehabilitation and the alien vegetation control is taking place

Before Mitigation

Phase	Severity/Intensity	Spatial Scale	Duration	Probability	Consequence	Significance
Construction	5	3	3	6	-11	-66
Operation	2	2	2	3	-6	-18

Essential mitigation measures for construction phase:

- Ensure that vegetation clearing and indiscriminate vehicle driving does not occur outside of the demarcated areas;
- Minimize construction footprints prior to commencement of the construction and control the edge effects from construction activities; and
- Implement alien vegetation control program within the wetland features.

Recommended mitigation measures for construction phase:

- Ensure that all activities impacting on the wetland features are managed according to the relevant DWS Licensing regulations (where applicable); and
- As far as possible, all construction activities should occur in the low flow season, during the drier winter months.

Essential mitigation measures for operational phase:

- Any areas where active erosion within the wetland features are observed must be immediately rehabilitated in such a way as to ensure that the hydrology of the area is reinstated to conditions which are as natural as possible;
- Cutting/ clearing of the herbaceous layer within the wetland areas along the linear development should be avoided so as to retain soil stability provided by the grass root structures

After mitigation

Phase	Severity/Intensity	Spatial Scale	Duration	Probability	Consequence	Significance
Construction	2	2	2	3	-6	-18
Operation	1	1	1	2	-3	-6

Impact 2 : Changes to Ecological and Socio-Cultural Services Provision

Aspects and activities register

Pre-Construction

- Potential poor planning, resulting in the placement of the linear development within wetland habitat, leading to altered habitat
- Increased anthropogenic activity within the wetland feature leading to an increased impact on the biological structure of the wetland features and the associated effects that this will have on service provision

Construction

- Loss of phosphate, nitrate and toxicant removal abilities due to vegetation clearing
- Inability to support biodiversity due to vegetation clearing and contamination of wetland feature soils and water as a result of waste rubble dumping, increased sedimentation and alteration of natural hydrological regimes
- Earthworks within the wetland features leading to loss of flood attenuation abilities and streamflow regulation capabilities
- Unmanaged oil leaks from construction vehicles leading to water quality deterioration
- Loss of vegetation resulting in a loss of breeding and foraging habitat and overall decreased biodiversity

Operational

- Decrease ability to assimilate toxicants, phosphates and nitrates due to loss of wetland vegetation and increased runoff
- Decrease in biodiversity as a result of loss of habitat and the introduction of alien plant species

Before Mitigation

Phase	Severity/Intensity	Spatial Scale	Duration	Probability	Consequence	Significance
Construction	4	3	2	5	-9	-45
Operation	2	2	2	5	-6	-30

Essential mitigation measures for the construction phase:

- During construction use techniques which support the hydrology and sediment control functions of the freshwater features; and normal as soon as possible after construction.
- Limit excavations to a limited extent to ensure that drainage patterns within the features returns to

Recommended mitigation measures for the construction phase:

- Restrict construction to the drier winter months if possible to avoid sedimentation of the freshwater feature and to minimize the severity of disturbance of the features and hydraulic function.

Essential mitigation measures for the operational phase:

- Monitor the wetland feature for erosion and incision;
- Maintain the REC for each of the wetland features, as stated within the report during the life of the development; and
- Implement an alien vegetation control program within the wetland features and ensure establishment of indigenous species within areas previously dominated by alien vegetation.

After Mitigation

Phase	Severity/Intensity	Spatial Scale	Duration	Probability	Consequence	Significance
Construction	2	2	2	3	-6	-30
Operation	2	2	1	2	-6	-12

Impact 3: Loss of hydrological function and sediment balance

Aspects and activities register

Pre-construction

- Potential poor planning, resulting in the placement of the linear development within wetland habitat, leading to altered habitat

Construction

- Site clearing and further removal of vegetation resulting in increased runoff which leads to erosion and alteration of the geomorphology of the wetland features
- Disturbance of soils, topsoil stockpiling adjacent to the wetland features and runoff from stockpiles leading to sedimentation of the system
- Earthworks in the vicinity of the wetland features leading to incision, erosion and altered runoff patterns
- Movement of construction vehicles within the wetland features resulting in soil compaction

Operational

- Increased runoff volumes due to compacted soils
- Disturbed soils may form erosional gulley's, leading altered hydrological flow patterns and increased sedimentation of downstream features

Before Mitigation

Phase	Severity/Intensity	Spatial Scale	Duration	Probability	Consequence	Significance
Construction	5	4	4	6	-13	-78
Operation	2	2	2	2	-6	-12

Essential mitigation measures for the construction phase:

- Any construction-related waste must not be placed in the vicinity of the wetland features; and
- Limit the footprint area of the construction activity to what is absolutely essential in order to minimize environmental damage.

Recommended mitigation measures for the construction phase:

- Stockpiled soil must be removed and the area must be levelled to avoid sedimentation of the wetland features from runoff; and
- As far as possible, all construction activities should occur in the low flow season, during the drier summer months.

Essential mitigation measures for the operational phase:

- Vehicles should not be driven indiscriminately within the wetland features during maintenance activities to prevent soil compaction.

After Mitigation

Phase	Severity/Intensity	Spatial Scale	Duration	Probability	Consequence	Significance
Construction	3	2	1	2	-6	-12
Operation	1	1	1	2	-3	-6

7. CONCLUSION

This study on the stream and wetland crossings along the designated pipeline routes has found no potential impacts that could be considered to be fatal flaws. Despite this, there is substantial environmental sensitivity, with the watercourses and their surrounds being the primary features of concern. The potential impacts on the systems have been assessed. Key concerns include damage to the wetland and riparian vegetation, and to the deposition of sediment and waste materials into the systems. It will be possible to mitigate against the impacts and recommendations in this regard have been put forward.. If the recommendations are adhered to then the pipeline upgrade project should have no long lasting effects at all.

The main wetland indicators used during the wetland delineation process included the terrain unit indicator, soil wetness indicator, and the presence or absence of hydric soils and hydrophytes. One hydro-geomorphic type, a channeled valley bottom was identified and delineated.

From a functional perspective, wetlands within the study area serve to improve habitat within and downstream of the study area through the provision of various ecosystem services such as streamflow regulation, flood attenuation, groundwater recharge, sediment trapping, toxicant removal, particle assimilation and provision of other natural resources. The Ecological Importance and Sensitivity (EIS) assessment was undertaken to rank water resources in terms of provision of goods and service or valuable ecosystem functions which benefit people, biodiversity support and ecological value, and reliance of subsistence users (especially basic human needs uses). The EIS was determined to be High ,the moderately low functionality, Moderate Present Ecological Status and relatively low Ecological Importance and Sensitivity assigned to the hydro-geomorphic unit can be attributed to the disturbed nature of the wetlands as a result of human activities surrounding the study area.

Based on the proposed activity and taking into consideration the present state of the wetlands and their associated functionality and biodiversity status the largest and most effective mitigation measure to mitigate the foreseen impacts is to ensure there is minimum disturbance by ensuring construction activities are limited within the route of the pipeline. It is also recommended that the designer utilise existing wetland crossing concrete structures in relation to the sections where the pipeline crosses the wetland so as to minimise the impact of dredging and excavation within the watercourse.

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APPENDIX A-IMPACT ASSESSMENT METHODOLOGY

The impact rating process is designed to provide a numerical rating of the various environmental impacts identified by use of the Input-Output model. The significance rating process follows the established impact/risk assessment formula given in figure 1 below:

***Significance* = *consequence* of an event x *probability* of the event occurring**

where

***Consequence* = *Type of impact* x (Intensity + Spatial Scale + Duration)**

and

Probability* = *Likelihood of an impact occurring

In the formula for calculating **consequence:**

Type of impact **= +1** (for positive impacts) ***or*** **-1** (for negative impacts)

Significance Rating Methodology

The matrix calculates the rating out of 147, whereby Severity, Spatial Scale, Duration and Probability is rated out of seven. Please refer to Table 1 for the parameter ratings which will be used to assign a weighting for both positive and negative impacts. The significance of an impact is determined and categorised into one of eight categories, as indicated in below

Table 1: Impact Assessment Parameter Ratings

Rating	Severity/Intensity		Spatial scale	Duration	Probability
	Environmental	Social, cultural and heritage			
7	Very significant impact on the environment. Irreparable damage to highly valued species, habitat or eco system. Persistent severe damage. The positive impact will result in a significant improvement to the initial/post disturbance environmental status and will benefit ecological and natural resources.	Irreparable damage to highly valued items of great cultural significance or complete breakdown of social order. The positive impact will be of high significance which will result the improvement of the socio-economic status of a greater area beyond the boundary of the directly affected of the community and/or promote archaeological and heritage awareness and contribute towards research and documentation of sites and artefacts through phase two assessments.	International The effect will occur across international borders	Permanent: No Mitigation No mitigation measures of natural process will reduce the impact after implementation.	Certain/ Definite. The impact will occur regardless of the implementation of any preventative or corrective actions.
6	Significant impact on highly valued species, habitat or ecosystem. The positive impact is of high significance which will result in a vast improvement to the environment such as ecological diversification and/or rehabilitation of endangered species	Irreparable damage to highly valued items of cultural significance or breakdown of social order. The positive impact will be of high significance and will result in the upliftment of the surrounding community and/or contribute towards research and documentation of sites and artefacts through phase two assessments	National Will affect the entire country	Permanent: Mitigation measures of natural process will reduce the impact.	Almost certain/Highly probable It is most likely that the impact will occur.

Rating	Severity/Intensity		Spatial scale	Duration	Probability
	Environmental	Social, cultural and heritage			
5	Very serious, long-term environmental impairment of ecosystem function that may take several years to rehabilitate The positive impact will be moderately high and will have a long term beneficial effect on the natural environment	Very serious widespread social impacts. Irreparable damage to highly valued items The positive impact will be moderately high and will result in visible improvements on the socio-economic environment of the local and regional community, and/or promote archaeological and heritage awareness through mitigation	Cercle/ Region Will affect the entire Cercle or region	Project Life The impact will cease after the operational life span of the project.	Likely The impact may occur.
4	Serious medium term environmental effects. Environmental damage can be reversed in less than a year The positive impact on the environment will be moderate with visible improvement to the natural resources and regional biodiversity	On-going serious social issues. Significant damage to structures / items of cultural significance The positive impact on the socio-economic environment will be of a moderate extent and benefits should be experience across the local extent and/or potential benefits for archaeological and heritage conservation	Commune Area Will affect the whole municipal area	Long term 6-15 years	Probable Has occurred here or elsewhere and could therefore occur.

Rating	Severity/Intensity		Spatial scale	Duration	Probability
	Environmental	Social, cultural and heritage			
3	Moderate, short-term effects but not affecting ecosystem function. Rehabilitation requires intervention of external specialists and can be done in less than a month. The positive impact will be moderately beneficial to the natural environment, but will be short lived.	Ongoing social issues. Damage to items of cultural significance. The positive impact will be moderately beneficial for some community members and/or employees, but will be short lived and/or there will be a moderate possibility for archaeological and heritage conservation	Local Local extending only as far as the development site area	Medium term 1-5 years	Unlikely Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur.
2	Minor effects on biological or physical environment. Environmental damage can be rehabilitated internally with/ without help of external consultants. The positive impacts will be minor and slight environmental improvement will be visible.	Minor medium-term social impacts on local population. Mostly repairable. Cultural functions and processes not affected. Minor positive impacts on the social/cultural and/ or economic environment	Limited Limited to the site and its immediate surroundings	Short term Less than 1 year	Rare/ improbable Conceivable, but only in extreme circumstances and/ or has not happened during lifetime of the project but has happened elsewhere. The possibility of the impact materialising is very low as a result of design, historic experience or implementation of adequate mitigation measures

Rating	Severity/Intensity		Spatial scale	Duration	Probability
	Environmental	Social, cultural and heritage			
1	Limited damage to minimal area of low significance, (e.g. ad hoc spills within plant area). Will have no impact on the environment. The positive impact on the environment will be insignificant and will not result in visible improvements.	Low-level repairable damage to commonplace structures. The positive impact on social and cultural aspects will be insignificant	Very limited Limited to specific isolated parts of the site.	Immediate Less than 1 month	Highly unlikely/None Expected never to happen.

Significance

Probability																																						
7	-147	-140	-133	-126	-119	-112	-105	-98	-91	-84	-77	-70	-63	-56	-49	-42	-35	-28	-21	21	28	35	42	49	56	63	70	77	84	91	98	105	112	119	126	133	140	147
6	-126	-120	-114	-108	-102	-96	-90	-84	-78	-72	-66	-60	-54	-48	-42	-36	-30	-24	-18	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120	126
5	-105	-100	-95	-90	-85	-80	-75	-70	-65	-60	-55	-50	-45	-40	-35	-30	-25	-20	-15	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105
4	-84	-80	-76	-72	-68	-64	-60	-56	-52	-48	-44	-40	-36	-32	-28	-24	-20	-16	-12	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	84
3	-63	-60	-57	-54	-51	-48	-45	-42	-39	-36	-33	-30	-27	-24	-21	-18	-15	-12	-9	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60	63
2	-42	-40	-38	-36	-34	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42
1	-21	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
	-21	**-20**	**-19**	**-18**	**-17**	**-16**	**-15**	**-14**	**-13**	**-12**	**-11**	**-10**	**-9**	**-8**	**-7**	**-6**	**-5**	**-4**	**-3**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**

Consequence

Relationship between Consequence, Probability and Significance Ratings

Significance Ratings

Score	Description	Rating
109 to 147	A very beneficial impact which may be sufficient by itself to justify implementation of the project. The impact may result in permanent positive change	Major (positive)
73 to 108	A beneficial impact which may help to justify the implementation of the project. These impacts would be considered by society as constituting a major and usually a long-term positive change to the (natural and / or social) environment	Moderate (positive)
36 to 72	An important positive impact. The impact is insufficient by itself to justify the implementation of the project. These impacts will usually result in positive medium to long-term effect on the social and/or natural environment	Minor (positive)
3 to 35	A small positive impact. The impact will result in medium to short term effects on the social and / or natural environment	Negligible (positive)
-3 to -35	An acceptable negative impact for which mitigation is desirable but not essential. The impact by itself is insufficient even in combination with other low impacts to prevent the development being approved. These impacts will result in negative medium to short term effects on the social and / or natural environment	Negligible (negative)
-36 to -72	An important negative impact which requires mitigation. The impact is insufficient by itself to prevent the implementation of the project but which in conjunction with other impacts may prevent its implementation. These impacts will usually result in negative medium to long-term effect on the social and / or natural environment	Minor (negative)
-73 to -108	A serious negative impact which may prevent the implementation of the project. These impacts would be considered by society as constituting a major and usually a long-term change to the (natural and / or social) environment and result in severe effects	Moderate (negative)
-109 to -147	A very serious negative impact which may be sufficient by itself to prevent implementation of the project. The impact may result in permanent change. Very often these impacts are immitigable and usually result in very severe effects	Major (negative)