Royal HaskoningDHV
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Wetland Assessment Study:

In support of the

Basic Assessment Study

for the proposed Upgrade to the Eastbury Trunk Sewer Line Project, eThekwini Metropolitan Municipality, KwaZulu-Natal

June 2014

ETHEKWINI METROPOLITAN MUNICIPALITY

Document description

Client:

eThekwini Metropolitan Municipality

Project Name:

Wetland Assessment Study in support of the Basic Assessment Study for the Proposed Upgrade to the Eastbury Trunk Sewer Line Project, eThekwini Metropolitan Municipality, KwaZulu-Natal

Royal HaskoningDHV Reference Number:

T01.DUR.000343

Compiled by internal wetland specialist:

Paul da Cruz

Date:

June 2014

Location:

Woodmead

Internal r~~R~~eview and a~~A~~pproval by:

Bronwen Griffiths (PrSciNat – Environmental Science – 400169/11)

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Glossary of Terms

Alluvial Material / deposits	Sedimentary deposits resulting from the action of rivers, including those deposited within river channels, floodplains, etc.
Anaerobic	The absence of molecular oxygen
Anthropogenic	Originating in human activity
Baseflow	The component of river flow that is sustained from groundwater sources rather than from surface water runoff
Facultative	Occurring optionally in response to circumstances rather than by nature; applied to wetland plants in this context – a facultative species is a species usually found in wetlands, but occasionally found in non-wetland areas
Gleying	The process by which a material (soil) has been or is becoming subject to intense reduction as a result of prolonged saturation by water. Gleyed soils are characterised by grey (due to an absence of iron compounds), blue and green colours (due to an absence of ferrous compounds)
Herb	A small non woody plant in which the aerial parts die back at the end of every growing season
Herbaceous	A plant having little or no woody tissue and persisting usually for a single growing season
Hydric / Hydromorphic Soils	Soils formed under conditions of saturation, flooding or ponding for sufficient periods of time for the development of anaerobic conditions and thus favouring the growth of hydrophytic vegetation
Hydrology surface	The scientific study of the distribution and properties of water on the earth's
Hydromorphy	A process of gleying and mottling resulting from intermittent or permanent presence of free water in soil. Results in hydromorphic soils
Hydroperiod	The term hydroperiod describes the different variations in water input and output that form a wetland, characterising its ecology – i.e. the water balance of the wetland
Hydrophyte	A plant that grows in water or in conditions that are at least periodically deficient in oxygen as a result of saturation by water – these are typically wetland plants
Illuviation	The movement of soil material (soluble or insoluble) downwards into an underlying soil layer which has been removed by the action of percolating water
Indurated	Rendered hard by processes such as heat, pressure or cementation.

Intertropical Convergence Zone (ITCZ)	An area where the Northern and Southern Hemispheric trade winds converge, usually located between 10 degrees North and South of the equator. It is a broad area of low pressure where both the Coriolis force and the low-level pressure gradient are weak, occasionally allowing tropical disturbances to form. It fluctuates in location, following the sun's rays, so that during the Southern Hemisphere summer, the ITCZ moves southward over southern Africa
Macrophyte	An aquatic plant that grows in or near water. Macrophytic plants can be emergent, submerged, or floating
Marginal	Plants and habitat on the edge of waterbodies
Obligate Hydrophyte	A plant species that almost always occurs in wetlands (>99% of the time)
Pediment(ation)	A gentle slope, cut into bedrock, occurring below a much steeper slope, extending at a flatter gradient down to a valley bottom.
Perched water table / aquifer	A water table caused by the presence of water above an isolated relatively impermeable underlying layer, some height above the normal aquifer level
Reach	A portion / stretch of a river
Redoximorphic	Features within soil that are a result of the reduction, translocation and oxidation (precipitation) of Fe (iron) and Mn (manganese) oxides that occur when soils are saturated for sufficiently long periods of time to become anaerobic
Riparian Zone	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

Abbreviations and Acronyms

DWA	Department of Water Affairs
EMPr	Environmental Management Programme
HGM	Hydrogeomorphic
RoW	Right of Way
VEGRAI	Riparian Vegetation Response Assessment Index
WWTW	Wastewater Treatment Works

Specialist Declaration

I, Paul da Cruz, declare that I –

- act as a specialist consultant in the field of surface water assessment
- do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2010;
- have and will not have any vested interest in the proposed activity proceeding;
- have no, and will not engage in, conflicting interests in the undertaking of the activity;
- undertake to disclose, to the competent authority, any material information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the Environmental Impact Assessment Regulations, 2010; and
- will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not.

PAUL DA CRUZ

1 Introduction

The eThekwini Metropolitan Municipality has appointed Royal HaskoningDHV (RHDHV) to undertake a Basic Assessment Study for a proposed sewer upgrading in Phoenix, Durban. As part of the environmental studies for the proposed sewer upgrading, Royal HaskoningDHV was tasked with investigating whether the proposed development would affect any wetlands.

Surface water features (including wetlands and rivers) are a very important component of the natural environment, as they are ~~typically~~ often characterised by high levels of biodiversity, perform critical ecological and hydrological functions and are often~~are~~ ~~critical~~ vital for ~~the~~ sustaining ~~of~~ human livelihoods through the provision of water for drinking and other human uses. As such, surface water resources and wetlands are specifically protected under the National Water Act, 1998 (Act No. 36 of 1998) and generally under the National Environmental Management Act, 1998 (Act No. 107 of 1998, ~~) (~~as amended). It is in this context that the potential impact of the proposed development on surface water features has been assessed.

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1.1 Aims of the Study

The aims of the study are to:

- identify all surface water features in the vicinity of the proposed sewer upgrading;
- assess the impact of the proposed sewer upgrading on identified surface water resources in the vicinity of the development; and
- recommend suitable mitigation measures, if relevant, to ameliorate or remove predicted impacts.

1.2 Assumptions and Limitations

As discussed in section 1.3 below, a definition of wetlands that is slightly different to that provided by the National Water Act has been provided in this report. The definition used is based primarily on the presence of hydric soils, rather than on the hydroperiod of the surface water body.

Only surface water features within the immediate surrounds of the proposed development were assessed in the field as part of this study; the study does not include an assessment of the wider catchment within which the surface water resources on the development site are located.

The wetland study is being undertaken as part of a B~~b~~asic A~~a~~ssessment A~~a~~pplication. At the time of writing, no Water Use Licenc~~s~~e~~ing~~ Studies, which are required for water use that ~~(~~ is broadly described in~~under~~ Section 21 of the National Water Act, ~~)~~ are being undertaken for the proposed project, and thus this study has not included component studies of the state and functionality of wetlands and other surface water resources in the wider area that may need to be undertaken as part of a water use application.

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1.3 Definition of Surface Water Features, Wetlands, Hydric Soils and Riparian Zones

1.3.1 Surface Water Features

In order to set out a framework in which to assess surface water features, it is useful to ~~set out~~establish what this report defines as surface water resources. In this context the National Water Act is used as a guideline. The Act includes a number of features under the definition of water resources, i.e., watercourses, surface waters, estuaries and aquifers. The latter two do not apply in the context of this study as estuaries are marine features and this report does not consider groundwater, thus surface waters and water-courses are applicable in this context. The Act defines a watercourse as, (inter alia):

- a river or spring;
- a natural channel in which water flows regularly or intermittently;
- a wetland, lake or dam into which, or from which, water flows.

The definition of a water-course as used in the Act is taken to describe surface water features in this report. It is important to note that the Act makes it clear that reference to a watercourse includes, where relevant, its bed and banks and other possible associated channel morphology (DWAF 2005).

It is important to note that the Act does not discriminate on the basis of being perennial, and any natural channel, however ephemeral, is included within the ambit of water resources. This definition is applied in this report.

1.3.2 Wetlands

The National Water Act 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."*

This definition alludes to a number of physical characteristics of wetlands, including wetland hydrology, vegetation and soil. The reference to saturated soil is very important, as this is the most important factor by which wetlands are defined.

Another widely used definition of wetlands is the one used under the Ramsar Convention; wetlands are defined as:

> *"areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres"*

However the presence / absence of hydric soils is the primary determining factor used to define a surface water feature as a wetland. This determining factor has been utilised in this assessment. Wetland soils can be termed hydric or hydromorphic soils. Hydric soils are defined by the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS) as being "soils that formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the upper part". These anaerobic conditions would typically support the growth of hydromorphic vegetation (vegetation adapted to grow in soils that are saturated and starved of oxygen) and are typified by the presence of redoximorphic features. The presence of hydric (wetland) soils on the site of a proposed development is significant, as the alteration or destruction of these areas, or development within a certain radius of these areas would require authorisation in terms of the National Water Act (36 of 1998) and in terms of the Environmental Impact Assessment Regulations promulgated under the National Environmental Management Act, 1998 (Act No. 107 of 1998).

1.3.3 Riparian Habitat and Riparian Zones

The National Water Act defines riparian habitat as:

> *"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"*

As detailed in the then Department of Water Affairs and Forestry (DWAF, now DWA) 2005 guidelines for the delineation of wetlands and riparian areas, riparian areas typically perform important ecological and hydrological functions, some of which are the same as those performed by wetlands. It is thus important that both wetlands and riparian areas be taken into consideration when making mandatory management decisions affecting water resources and biodiversity (DWAF, 2005).

1.4 Legislative Context

The following section briefly examines the legislation that is relevant to the scope of the surface water assessment. The stipulations / contents of the legislation and policy that is relevant to the study are explored.

1.4.1 The National Water Act

It is important to note that water resources, including wetlands are protected under the National Water Act (Act No. 36 of 1998) (NWA). 'Protection' of a water resource, as defined in the Act entails:

- "m~~M~~aintenance of the quality ~~of the quality~~ of the water resource to the extent that the water ~~use~~ resource may be used in an ecologically sustainable way;
- p~~P~~revention of the degradation of the water resource; and
- t~~T~~he rehabilitation of the water resource;".

Comment [NW1]: The original content here is taken from "Definitions and interpretation" in the National Water Act. Quotation marks should be used to indicate if bulleted points are being taken directly from the source, so that the reader knows when quoted passages are being used or otherwise. This suggestion applies to all bulleted points in the document.

In the context of the current study and the identification of potential threats to the surface water features posed by the proposed development of the road, the definition of pollution and pollution prevention contained within the Act is relevant. 'Pollution', as described by the Act is "the direct or indirect alteration of the physical, chemical or biological properties of a water resource, so as to make it", ~~(~~inter alia~~)~~:~~-~~

- "less fit for any beneficial purpose for which it may reasonably be expected to be used; or
- harmful or potentially harmful to the welfare" "of~~r~~ human beings, to any aquatic or non-aquatic organisms, or to the resource quality."

The inclusion of physical properties of a water resource within the definition of pollution entails that any physical alterations to a water body, for example the excavation of a wetland or changes to the morphology of a water body can be considered to be pollution. Activities which cause alteration of the biological properties of a watercourse, i.e., the fauna and flora contained within that watercourse are also considered pollution.

In terms of S~~s~~ection 19 of the Act owners / managers / people occupying land on which any activity or process undertaken ~~which~~ that causes, or is likely to cause pollution of a water resource, must take all reasonable measures to prevent any such pollution from occurring, continuing or recurring. These measures may include measures to, ~~(~~inter alia~~)~~:

- "cease, modify, or control any act or process causing the pollution;
- comply with any prescribed waste standard or management practice;
- contain or prevent the movement of pollutants;
- remedy the effects of the pollution; and

- remedy the effects of any disturbance to the bed and banks of a watercourse."

These general stipulations of the Act have ramifications for the proposed development as impacts on surface water associated with the proposed development would be relevant in terms of the above sections.

1.4.1.1 The National Water Act and Riparian Areas

Riparian habitat is afforded protection under the National Water Act in a number of ways. Firstly reference in the National Water Act to a watercourse includes its banks, on which riparian habitat is encountered. Riparian areas are thus afforded the same degree of protection as the river beds and channels alongside which they occur.

Riparian habitat is also important in the context of resource quality objectives that are a critical part of the Act. In terms of Section 13(1) of the Act resource quality objectives must be determined for every significant water resource, and are a central part of data type specifications relating to national monitoring systems and national information systems as determined in Section 137(2) and Section 139(2) of the Act respectively. Under Section 27 of the Act resource quality objectives must be taken into account in the issuing of any licence or general authorisation, and form a critical part of the duties of catchment management agencies. The purpose of resource quality objectives in the Act is to establish clear goals relating to the quality of the water resources. Resource quality is important in the context of riparian habitat as resource quality as defined in the Act means the quality of all aspects of a water resource and includes the character and condition of the riparian habitat. In terms of Section 26(4) of the Act, the need for the conservation and protection of riparian habitat must be taken into account in the determination and promulgation of regulations under the Act.

The above stipulations of the Act have implications for the proposed development; as identified further on in this report the proposed development may be associated with certain direct or indirect impacts on surface water features in the area, some of which may affect the physical characteristics of the feature. The activities that result in these impacts are likely to be needed to be licensed under the Act. The National Water Act also stipulates requirements for permitting which would need to be followed.

2 Project Description

2.1 Project Technical Description

A portion of the trunk sewer along the alignment of Eastbury Drive in Phoenix, linking portions of Phoenix, Mount Edgecombe and Cornubia to the KwaMashu Wastewater Treatment Works (WWTW), has been found to be below the required capacity and thus requires an upgrade. The proposed upgrade involves the installation of approximately 1.1 km of sewer line with a diameter of approximately 750 mm, adjacent to the existing pipeline alongside Eastbury Drive.

Alternatives relate to the method of upgrading the existing pipeline and would include:

- replacement of the existing pipeline piping;
- installing a larger diameter pipe and attaching this to the existing pipe within the larger pipe;
- placing a new pipe on top of the existing pipe; or
- placing a new pipe alongside the existing pipe.

Site and activity alternatives are not an option as this is enhancement and upgrading of existing bulk infrastructure in a built-up area, with no land-use or servitude control changes thus required. The upgrade and installation will occur within the existing road reserve of Eastbury Drive

2.2 Site Location and Description

The development site is located within Phoenix, within the northern part of the eThekwini Metropolitan Municipality. The development site is located along Eastbury Drive which links the circular Phoenix Highway that traverses Phoenix and which provides links to the R102 and M41 arterial roads. The section of Eastbury Drive along which the proposed sewer upgrade is located traverses a vacant area (open space) located between the residential areas of Clayfield to the east, Rydalvale to the west, and the Phoenix Industrial area to the south-west. Rydalvale to the west is located on higher-lying ground that slopes up steeply from the valley bottom along which Eastbury Drive runs. This sloping ground occurs as a series of spurs containing residual natural thicket / forest vegetation (the steep topography has precluded development of this local area). The surrounding area is thus largely developed, with the open space running along Eastbury Drive and associated park to the south-west being the only non-developed areas. A railway line runs ~~in~~ parallel to the road ~~(~~to the east~~)~~. The Phoenix Railway Station is located along this railway to the east of the sewer line. A stream runs through the valley bottom within the open space to the west of, ~~(~~ and roughly parallel to~~)~~ the road. This stream is a tributary of the Piesang River which is a tributary of the Umngeni River to the south.

Comment [NW2]: Is this DMOSS or just an open space? I so, please state that it is.

Comment [NW3]: Same question as above.

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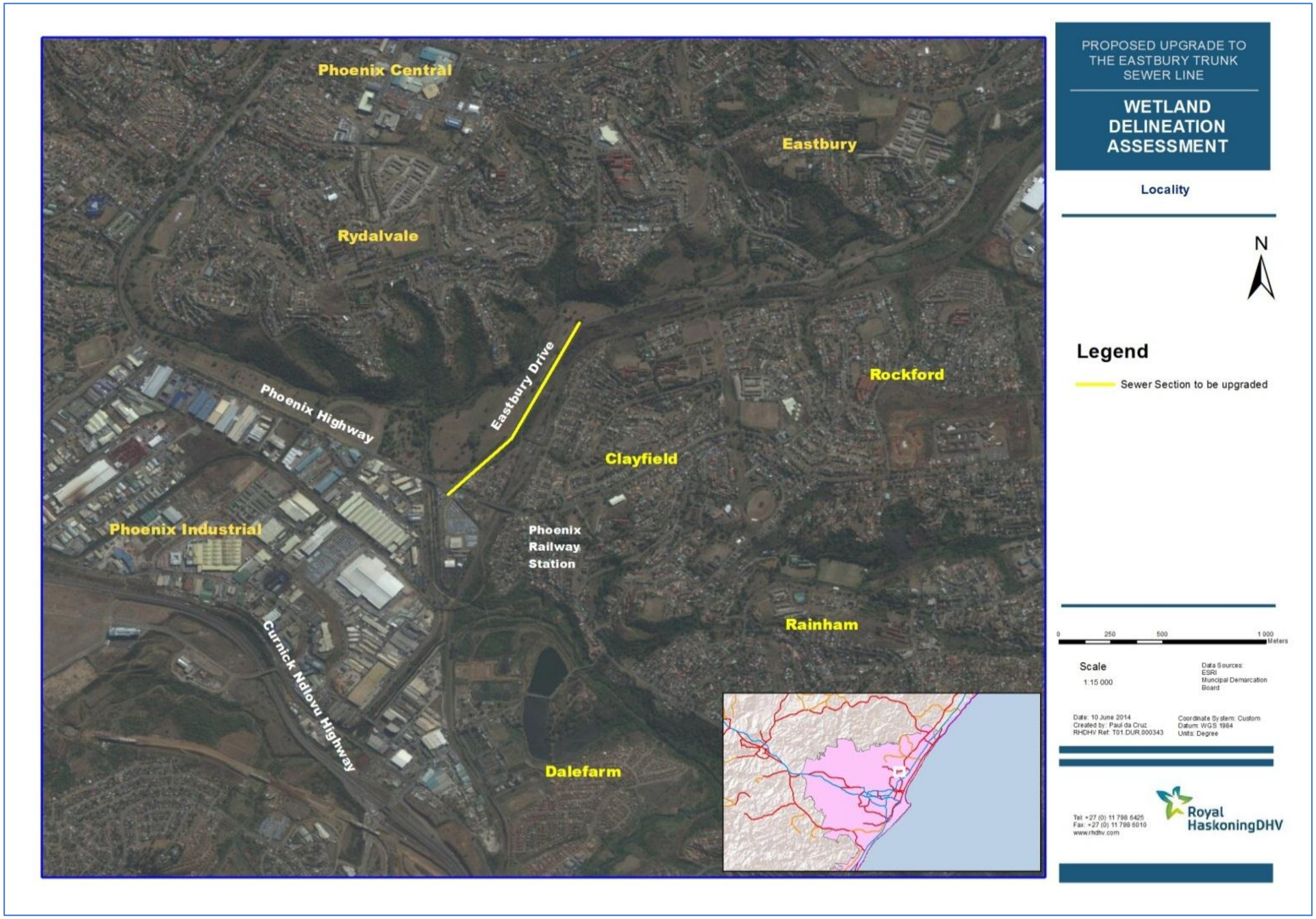

Figure 1 – Study Area Map.

Comment [NW4]: The d[…] Fig. 1 (10 June 2014) is th[…] the figure was created. The[…] image however is unlikely […] same. When was the satel[…] taken as this is useful infor[…] the reader when interpretin[…] in relation to the proposed […] development?

3 Methodology for Assessment

3.1 Site Assessment (Wetland Delineation)

A site visit was conducted in April 2014. The alignment of the proposed sewer upgrade was investigated and soils and vegetation were sampled at a number of locations along and close to the route of the proposed sewer upgrade. The primary aim of the site assessment was to determine the presence of hydric soils, i.e., wetland habitat, in the vicinity of the proposed sewer upgrade.

Typically the presence of wetlands is determined through wetland delineation. The accepted procedure for wetland delineation in South Africa is based upon the DWA(F) guidelines 'A practical field procedure for the identification and delineation of wetlands and riparian areas' (DWAF, 2005), which stipulates that consideration be given to four specific wetland indicators to determine the boundary of a wetland.

The four wetland indicators are:

- terrain unit - helps to identify those parts of the landscape where wetlands are more likely to occur.
- soil form - identifies the soil forms, as defined by the Soil Classification Working Group (1991), which are associated with prolonged and frequent saturation.
- soil wetness - identifies the morphological "signatures" developed in the soil profile as a result of prolonged and frequent saturation.
- vegetation - identifies hydrophilic vegetation associated with frequently saturated soils.

The guidelines do mention hydrology, although it is not listed as being one of the four indicators above. However the guidelines state that the delineation procedure is substantially facilitated by an understanding of the broad hydrological processes that drive the frequency of saturation (DWAF, 2005).

Under most circumstances the most important indicator of the presence of hydric soils is the soil wetness indicator, i.e., examination of redoximorphic features within the soil. The reason for this is that vegetation, the primary factor as defined under the National Water Act, can easily respond to changes in hydrology, e.g., the draining of a wetland, while the soil morphological signatures remain even if the wetland hydrology is altered.

In terms of the soil form indicator, the guidelines list a number of soil forms that are associated with the permanent zone of the wetland and the seasonal / temporary zones.

For an area to be considered a wetland, redoximorphic features must be present within the upper 500 mm of the soil profile (Collins, 2005). Redoximorphic features are the result of the reduction, translocation and oxidation, i.e., precipitation of Fe (iron) and Mn (manganese) oxides that occur when soils are saturated for sufficiently long periods of time to become anaerobic. Only once soils within 500 mm of the surface display these redoximorphic features can the soils be considered to be hydric (wetland) soils. 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 Fe^{3+} ions which are characterised by "grey" colours of the soil matrix.
- Redox depletions - the "grey" or 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, which are also called mottles. These can occur as:

Comment [NW5]: 99.99% of consultants use this word which actually means "the science of method; a treatise or dissertation on method." OED. I would prefer to use in the case of this report, "Method/s for Assessment". This may seem pedantic, but it is not.

Comment [NW6]: What date in April as this may affect flowering plants which may not be able to be identified because of an absence of flowers in late April compared to early April?

Comment [NW7]: It would have been a good idea to GPS these locations and show them on the most recent and clear satellite image to obtain an good idea about soil and vegetation sampling locations compared to the vegetation, wetland and terrain evident in the high quality satellite image.

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- 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.
- 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 recognized as high chroma colours that follow the route of plant roots, and are also referred to as oxidised rhizospheres.

Under most circumstances the presence or absence of redoximorphic features within the upper 500 mm of the soil profile alone is sufficient to identify the soil as being hydric, i.e., ~~(~~a wetland soil,~~)~~ or non-hydric, i.e., a ~~(~~non-wetland soil~~)~~ (Collins, 2005; DWAF, 2005).

Vegetation in an untransformed state is a very useful way to support the delineation of a wetland, due to plant community transition from the middle of the wetland to the adjacent terrestrial area. The guidelines specify that when using vegetation indicators, that focus be placed on the plant communities, rather than individual indicator species. The dominant species in the area being assessed (hydrophytes or not) must be assessed to determine the presence of a wetland. The DWA guidelines make reference to vegetation types typically found within the classical zones of a wetland (permanent, seasonal, temporary), but also make~~s~~ reference to the classification methodology developed by Kotze and Marneweck (1999) as part of the Resource Directed Measures for Protection of Water Resources for Wetland Ecosystems which is based on the identification of obligate and facultative wetland species, and the relative coverage of these species in terms of whether the area being assessed is likely to display hydric conditions, possibly~~e~~ display hydric conditions, or not at all.

Lastly, the hydrological framework for wetlands is covered in an appendix of the guidelines. This is based on the longitudinal classification of river channels into three different zones based on their hydrological activation:

- A Section – baseflow never occurs, and the water table never occurs at the surface (typically headward channels).
- B Section – channels within the zone of a fluctuating water table, only being characterised by baseflow when the saturated zone is in contact with the channel bed.
- C Section – channels that are always in contact with the zone of saturation, and thus always experiencing baseflow (i.e., being perennial in nature).

Typically, wetland habitat will never occur in the A section due to the insufficient period of saturation, while Section B and C channels will contain wetland habitat due to a sufficient period of saturation. In terms of the classical zonation of a wetland, the permanent wetland zone will typically only be found in the C Section, while the B section is only characterised by the presence of seasonal and temporary zones.

Use was made of a GPS to record sample locations and other important points as visited in the field. These GPS points were later converted into a GIS shapefile to allow these points to be mapped and to facilitate the delineation of hydric soils on the site.

3.2 Identification of Surface Water Impacts and Mitigation Measures

All potential impacts on surface water that could be associated with the proposed sewer upgrading have been identified. Mitigation measures to either ensure that the identified impact does not materialise, or to ameliorate / limit the impact to acceptable levels have been stipulated.

Comment [NW8]: Keep the formatting of your bulleted points consistent with previous bulleting.

Comment [NW9]: You make use of typical a lot which is not bad, but find some other words in the thesaurus that provide variation to the reader.

Comment [NW10]: I don't see this map in the document I am reviewing. Please include this important map and reference it here, e.g., Fig. 2, and then change the numbering of subsequent figures.

4 Findings of Assessment

As described above, the alignment of the proposed sewer upgrade was investigated in the field, and adjacent areas were investigated to determine the presence of wetland habitat and ~~(~~hydric soil occurrence~~)~~ on the site.

4.1 Description of Site Terrain and Hydrology

As described above Eastbury Drive and the sewer line that runs alongside it are located within a valley bottom drained by a stream with steeply sloping ground rising up to the west of the stream. The road runs closely parallel to a railway for most of its length. In the northern stretch of the ~~sewer to be upgraded~~proposed sewer upgrade area, ~~-~~the railway and road are located close to one another, and the intervening area between the two servitudes is a narrow strip of vacant land characterised by ~~an area characterised by~~ infilling of construction material. The vacant land ~~that~~ has since been colonised by vegetation and an open area of grassy vegetation that is mowed on a regular basis. This open grassy area is slightly lower-lying than either of the adjacent two servitudes and extends to a point approximately 100 m to the south of the alignment's northern end ~~of the alignment~~. The area to the north-east of the sewer pipeline section, i.e., ~~(~~ to the north-east of where the sewer alignment crosses Eastbury Drive, ~~)~~ is characterised by the presence of a thin band of wetland habitat running parallel to the road. This area of wetland does not visibly drain under the road and there is no visible wetland habitat to the west of Eastbury Drive at this point, thus it appears unlikely that this wetland area to the north-east of the alignment naturally formed part of a channel that drained into the valley bottom and ~~(~~stream~~)~~ to the west. Rather, the wetland area appears to be effectively 'impounded' by the raised area of infilling immediately to the south and was possibly part of the wider valley bottom wetland.

Comment [NW11]: Both are important or did you just check for hydric soils?

Comment [NW12]: Either use or don't use a space between dimensions and their units in the whole document, but be consistent.

Comment [NW13]: I have deleted the second "of the". This tip should be employed through the whole document with similar passages or phrases, as it shortens the document and makes for easier reading, NOT that your report is difficult to read in any way, as generally it is well written and composed.

Figure 2 – Ditch located between the road and rail servitudes, extensively ~~invaded~~ colonised by alien invasive vegetation.

To the south of the infilled area and lower-lying southern vacant strip of land ~~to the south~~, a drain / ditch runs parallel to the road for a distance of approximately 300 m (Fig. 2). This ditch, which appears to be fed by stormwater from the rail servitude and the adjacent road, has been colonised by a mix of alien invasive vegetation species forming a band of dense thicket-like vegetation. The~~is~~ ditch contains areas of standing water and has an outlet under the road, extending west of the road to the stream to the south-west.

As described above, the natural hydrology of the area appears to have been modified by the development of the road and rail servitudes which are both raised, with the development of these servitudes appearing to be associated with the creation of the artificial ditch alongside the southern parts of the alignment, into which stormwater appears to be fed. The analysis of soils on the site, as described (if you are referring to text) and shown (if you are referring to photos) below (see below) indicates the presence of hydric soils in the intervening area between the road and rail servitudes along parts of the length of the alignment (Fig. ?); however these soils appear to be relict areas of wetland habitat that once occurred in this area and which were significantly disturbed / transformed by the road and rail servitude developments. In spite of its presence as a linear feature, the ditch / drain located adjacent to the southern part of the alignment, was not noted to contain hydric soils and thus does not appear to be a natural wetland-related feature.

The stream to the west of the road is characterised by a relatively incised but wide primary channel in which macrophytes are located. The macro-~~-~~channel banks are characterised by woody riparian vegetation that has been extensively colonised by alien invasive vegetation. The riparian corridor thus runs along the stream, extending for a short distance beyond the top of the bank of the primary channel. The stream and associated riparian corridor run~~s~~ relatively close to the road, opposite the open grassy area to the north of the artificial ditch.

Comment [NW14]: Refer to your maps and photos as often as possible, as this increases the reader's graphic understanding of your report. I suggest that you go through the whole document quickly and add references to your figures in appropriate places.

Comment [NW15]: You need to be more specific here. Are you referring to text and /or photos in your reference "see below"?

Comment [NW16]: I have referred to this necessary new figure before, showing the GPS locations of all your sampling points.

Comment [NW17]: Is there more than one channel, e.g., with a mid-channel bar being present, and hence a primary and secondary channel? If not, and in any event, it is best to use the riparian terminology described in DWAF, 2005. Your "primary channel" sounds like the stream's active channel.

Comment [NW18]: You may need to change this to "active channel".

Closer to the southern part of the sewer upgrade alignment, the stream drains westwards to join the Ottawa Stream (Fig. ?), however a linear depressional area of wetland habitat that is likely to be inundated by spate flows when the channel overtops its banks, runs southwards back towards the Eastbury Drive / Phoenix Highway intersection, and thus runs close to the southern-most ~~section~~ part of the sewer upgrade section.

4.2 Investigation of Presence or Absence of Hydric Soils in areas adjacent to the sewer upgrading route

4.2.1 Wetland area to the north of the alignment

The wetland area to the north-east of the northern end of the sewer upgrade section, ~~(~~ where the sewer pipe crosses Eastbury Drive (Fig. ?)~~)~~, was investigated to determine if the presence of wetland vegetation in this area represents~~ed~~ naturally-occurring hydromorphic soils. This area, which is located approximately 125 m to the north-east of the likely construction footprint at its northern end, lies outside of the likely construction footprint of the sewer section, ~~being located approximately 125m to the north-east of its northern end~~. From the edge of the raised road servitude, a grassy intervening area grades to an area of marshland, characterised by the presence of reeds and rushes. This wetland area is a longitudinal feature that runs between the road and the railway servitude to the east (Fig. ?).

Comment [NW19]: Again, refer to figures frequently due to their graphic qualities. The human brain likes graphical representations!

Comment [NW20]: Name examples, such as possibly *Phragmites australis* and *Typha capensis.* This comment applies to above passages as well.

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Figure 3 – Southern edge of the wetland area to the north-east of the northern end of the sewer route, as viewed from the 'impounding' embankment ~~'impounding' it~~.

Soils investigated at the edge of the wetland revealed the presence of hydromorphy, primarily in the form of soft plinthic soil characteristics very close to the surface, as well as iron and manganese mottling and redox depletions within a grey (gleyed) matrix at a slightly greater depth below the surface (Fig. 4, Fig. ?). These soils along with the vegetation assemblage in this area were clear indicators of the presence of wetland habitat (Fig. 3?). The wetter part of the wetland consisted of *Typha capensis* ~~reed~~beds, along with a few specimens of ~~the species~~ *Cyperus dives* (Figs. ? & ?). Both these plant species are ~~*Typha capensis* is an~~ obligate hydrophytes, which are ~~that is~~ often~~almost always~~ associated with wetland soils (Marnewecke & Kotze, 1999). The periphery of the rushbeds and reedbeds graded to grassy vegetation on the edge of the road servitude. In this transitional area on the edge of the wetland, the predominant species noted was *Imperata cylindrica* (facultative species in wet climate conditions)~~,~~, with other grass species noted including *Hyparrhenia filipendula* (wide range of habitat), *Paspalum urvillei* (facultative wetland species), *Bothriochloa bladhii* (grows on riverbanks, in vleis, other wet places & often in road reserves where water collects) and *Sporobolus pyramidalis*. A number of sedge species were also encountered in including *Cyperus (Mariscus) congestus, Cyperus rotundus, Pycreus polystachyos Imperata cylindrica, Paspalum urvillei* and *Cyperus congestus* are hydrophyte species typically associated with wetland habitat, in particular the margins of wetland habitat. This vegetation assemblage and transition is typical of wetland margins and is generally reflective of an increasing degree of inundation of the soils from the area outside of the wetland into the wetland itself.

Comment [NW21]: Add figure showing the location of the soil sampling points.

Comment [NW22]: Provide a table of plant species that shows their wetland status, i.e., facultative & obligate wetland species, facultative species and facultative dryland species. Once you have done this, then you can just refer to Table 1 and mention important details in the body of the report.

Comment [NW23]: Indicate relevant photos & figure containing GPS sampling points.

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Comment [NW24]: Guide to Grasses of Southern Africa by Frits van Oudtshoorn, 1999, 1st edition, Briza Publications, Pretoria, South Africa.

Comment [NW25]: Do the same for this & other species, as mentioned above.

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Figure 4 – Gleyed soils and iron mottling from the periphery of the wetland area to the north-east of the alignment

As discussed above, no outlet or culvert for this wetland was noted at this point, and the wetland appears to rather be obstructed by the raised servitude and a raised embankment that runs between the road and the rail servitude. It should be reiterated that this wetland area is not located close to the section of sewer pipeline being upgraded and will thus be unlikely to be affected by the proposed development.

4.2.2 Area of Infilling

The area to the south of the narrow band of wetland habitat and the embankment flanking it to the south is characterised by undulating micro-terrain which appears to be the result of historic infilling of the area with rock and imported fill material. This area of infilling has also been colonised by a number of trees and other shrubs over time.

Depressions in this area have become reed-filled due to the localised collection of drainage between areas of fill. A soil sample was taken on the margin of one of these reedbeds as the presence of hydrophytes such as the obligate wetland hydrophytes *Leersia hexandra* and *Typha capensis* was noted. The substrate was noted to comprise of a mix of stony material / course gravel and organic matter, with hand held augering not able to penetrate into the substrate to a depth of greater than 15cm. No redoximorphic characteristics were noted in the substrate at this location and this area was concluded to not to be a natural wetland, rather an area of fill that has become waterlogged over time and thus colonised by hydrophytes.

This wider area of infilling extends for approximately 100m to the south, to a point where an open grassy area of slightly lower elevation is located.

4.2.3 Grassy area between the road and railway

A grassy area of slightly lower elevation than the road and railway servitudes is located adjacent to the edge of the road servitude between the infilled area to the north and the drainage ditch to the south. The grass in in this area appears to be mowed (especially closer to the road servitude), but the primary grass species in this area were noted to be *Sporobolus africanus, S. pyramidalis, Chloris gayana* and *Bothriochloa bladii*, grass species that are not typically hydrophytes, but which can be associated with damp areas on the peripheries of wetlands. In parts of this area located within the very shallow depression and closer to the rail servitude, a few hydrophyte species more typically encountered in wetlands were identified. Specimens of the species *Ischaemum fasciculatum, Imperata cylindrica* and even *Leersia hexandra* were encountered in the southern part of this area. Although not forming extensive communities of hydrophytes, the presence of these species (esp. *Leersia hexandra* which is an obligate hydrophyte and which typically grows in permanently waterlogged conditions) does accord with the presence of hydromorphic soils in this location as discussed below.

Soils in this area were noted to be highly clayey in character, showing expansive (swelling and shrinking) properties in certain locations (as indicated by surface cracking). Certain soil samples along this stretch of the intervening area between the two servitudes along this part of the alignment showed no signs of hydromorphy, however in a number other sample locations along this stretch, hydric soils were located. Redoximorphism was noted primarily in the form of soft plinthic characteristics. Soils with plinthic characteristics are characterised by localisation and accumulation of iron and manganese oxides under conditions of a fluctuating water table, with soft plinthic soils being non-indurated and hard plinthic being indurated. Hard plinthic horizons are also known as ferricrete or hardpan. The Westleigh (Orthic A→Soft plinthic B) wetland soil form was encountered within certain sample points in this area. The presence of soft plinthic soils in a number of the samples indicated that under natural conditions a degree of soil saturation sufficient for the development of anaerobic conditions and thus hydric soils would have been present in this area, but no evidence of a current perched water table was noted on the site. Within the soft plinthic matrix a number of redoximorphic characteristics were present, in particular large iron (bright orange and red) and manganese (black) oxides (mottles), as well as adjacent areas of clay and redox depletions (greyer areas within the matrix). The location of oxides and depletions in an alternating pattern within the matrix in certain of the soils sampled is representative of processes of the reduction of translocation of Fe ions and subsequent re-oxidisation of ions, a process that typically occurs within a root canal.

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Figure 5 – Soft plinthic soils from a sample point

Figure 6 – Alternating pattern of redox concentrations and redox depletions

From a terrain perspective, such hydromorphic soils were not only found in the lowest point (shallow depression) in this intervening area between the two servitudes, but on sloping ground of slightly higher elevation closer to the railway servitude. In addition these plinthic soils were found at the surface of the ground in certain of the sample locations, which is unusual in that under natural conditions, soft plinthic soil horizons are only encountered as secondary or sub-soil horizons. These two observations suggest that the substrate in this area between the road and rail servitudes has historically been subject to physical disturbance, with the alteration of both soils and hydrology. Due to the presence of the road and rail servitudes, topsoil may have been removed and gradients may have been altered to ensure drainage off the road and rail servitudes. In addition a fuel pipeline appears to run through this area, running adjacent to the road, as indicated by the presence of white pipeline markers in this area. These activities have clearly resulted in the alteration of the natural ground level in these servitude areas and the alteration of the natural hydrology of the area. The location of hydromorphic soils on a slightly higher gradient could possibly suggest the historical (natural) presence of a seepage wetland in this location, but may also reflect a natural extension of the valley bottom wetland with an associated degree of inundation. However due to the physical transformation of this area, the origin of these areas of hydric soils is very difficult to determine. The presence of hydric soils in this area, but with no visible indications of vegetative wetland habitat indicate that these soils are residual hydric soils.

Figure 7 – Open grassy area between the Eastbury Drive and the railway servitude in which residual areas of hydromorphic soils are located. Note the white fuel pipeline marker in the foreground

4.2.4 Ditch in the southern part of the sewer alignment

As described above a ditch runs immediately adjacent to the road shoulder along the southern part of the alignment of the sewer upgrade. The ditch is relatively incised being approximately 2m below the road surface. The ditch appears to be fed at its northern end by stormwater from the railway servitude. The ditch extends for approximately 300m and is thickly overgrown with alien invasive shrubs and trees. It appears to be culverted under the road, extending westward to join the stream to the south-west. The ditch was noted to contain standing water which has allowed the development of certain hydrophytes, in particular the large rush *Cyperus dives*. The soils in the ditch were sampled in two locations along its length. At the more northerly sample location soils on the margin of the standing water were noted to be a dark grey colour and thus possibly gleyed, but with no indication of redoximorphic features. Evidence of foreign / artificial material, possibly having been washed into this location, and organic material was present in the soils sampled. At the more southerly location close to the Phoenix Railway Station (to the east) the material within the ditch was noted to be mostly gravelly in nature with the presence of foreign material and similarly some traces of organic material. This material is likely to have been washed into or deposited into this location, and does not represent hydric soil. The ditch is highly likely to have been constructed in order to attenuate stormwater from the adjacent road and rail servitudes, and this feature *is not a natural drainage feature containing hydric soils.*

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4.3 Implications for Development (Surface Water Sensitivity)

The above analysis has shown that the area adjacent to the sewer servitude that runs within the Eastbury Drive road servitude has been extensively physically modified by the development of a road and railway servitude, as well as by the presence of a buried fuel pipeline and the dumping of large amounts of fill material. It should be noted that the sewer servitude *does not contain any hydromorphic soils* as the sewer is located within the road servitude which has been raised above the naturally-occurring ground level with material thus being likely to have been imported. An area of relatively intact wetland habitat lies to the north-east of the section of sewer pipeline that is proposed to be upgraded. This narrow band of wetland habitat is unlikely to be affected by the proposed sewer upgrading as it is located away from the sewer alignment. The analysis of the area adjacent to the sewer alignment to the south revealed that a similar narrow band of residual hydromorphic soils existed immediately adjacent to the road and sewer alignment. This area did not visibly constitute wetland habitat as it did not contain the presence of a community / assemblage of hydrophytes or visibly saturated soils that would normally exist along with the presence of hydromorphic soils exist. This factor along with the location of this area between the two servitudes suggests that these hydromorphic soils once formed part of a wider area of wetland habitat, which has now been transformed. Due to the degree of physical transformation of this area (as discussed above) it is very difficult to accurately identify the extent and natural wetland hydrology of the wetland in this part of the site. Analysis of aerial photographs of the development site indicate that this area of residual hydromorphic soils and the band of wetland habitat are most closely located to outer bends of the stream that runs to the west of the road, therefore possibly suggesting that these areas of wetland habitat / hydromorphic soils once existed as part of the wetland habitat that would have existed as part of the wider valley bottom, being seasonally inundated. The presence of a raised road servitude and intervening pipeline would however have altered the natural hydrology, resulting in the effective destruction of wetland habitat in this area. Although the band of wetland habitat to the north of the sewer section proposed to be upgraded retains much of its natural characteristics, especially in terms of vegetative composition, the area of residual hydromorphic soils to the south has effectively ceased to function as a wetland, with only the presence of hydromorphic soils (in a dried state) indicating that this area once comprised of wetland habitat. In spite of this transformation, the area is still technically a wetland as it contains hydric soils, but has retained no wetland characteristics per se.

From a surface water sensitivity perspective, the area of residual environmental soils that is located adjacent to part of the stretch of the sewer line to be upgraded is thus regarded as having ***low sensitivity***. The stream and associated riparian corridor to the west, as well as the band of wetland habitat to the north of the sewer line to be upgraded are associated with a higher degree of sensitivity as, although degraded by a number of factors, these surface water features have a much higher degree of habitat integrity, and thus greater functionality than the transformed area of hydromorphic soils located between the road and rail servitudes that displays little to no habitat integrity and functionality. Accordingly these two areas have been assigned a buffer zone of 30m in which no construction activities should occur.

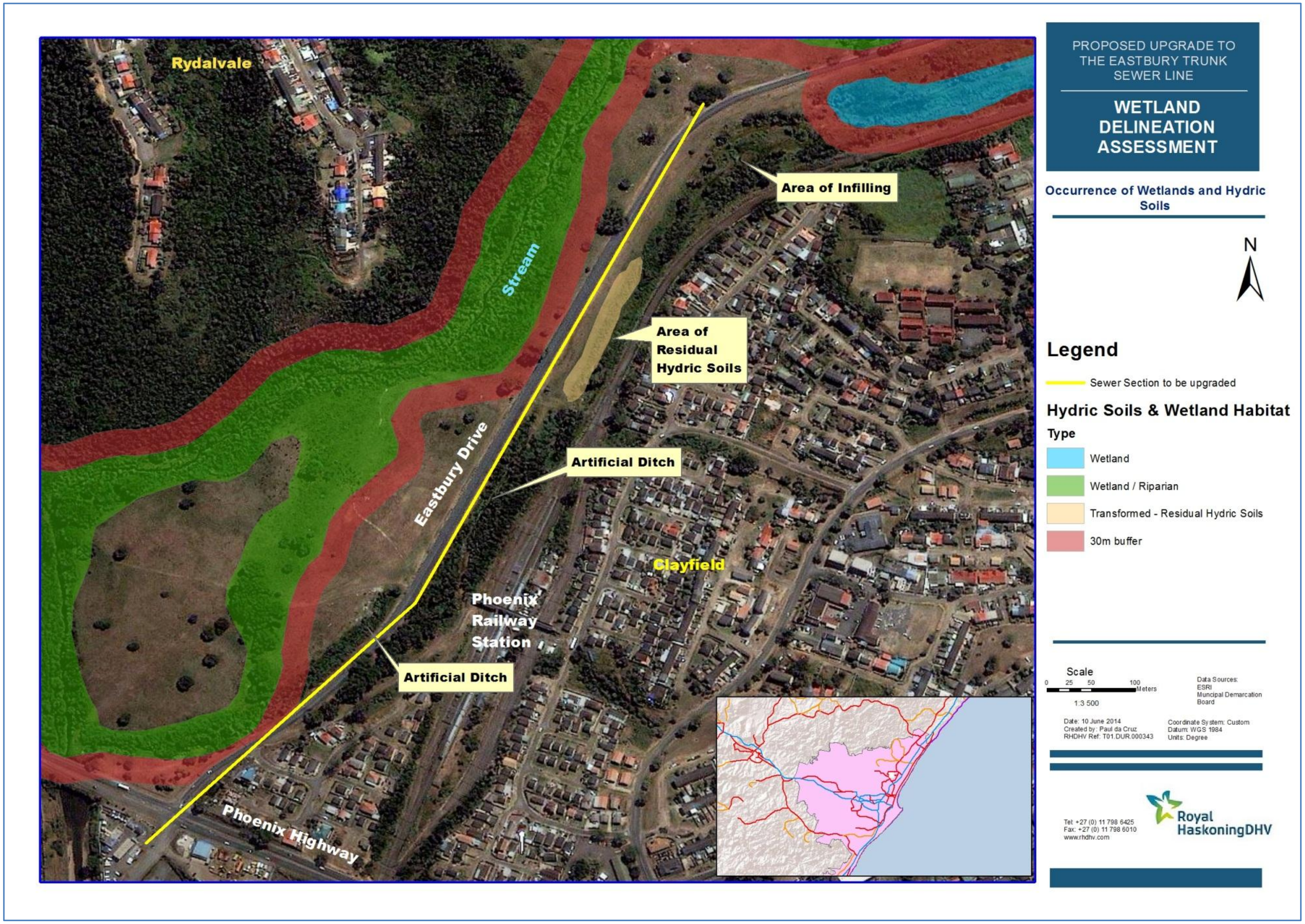

Figure 8 – Location of Wetland / Riparian Habitat and Residual Area of Hydric Soils.

5 Nature of the Potential Impacts Associated with the Proposed Development

As described above, the sewer section to be upgraded is located within the road reserve and is thus within a transformed area that does not contain any of the residual hydromorphic soils that are located adjacent to the road reserve. As the road reserve is likely to consist of foreign, imported material, the upgrading of the sewer pipeline within the road reserve is unlikely to physically affect any residual hydric soils. The main potential impact of the sewer upgrading relates to the potential expansion of the construction footprint of the sewer upgrading into the area of adjacent residual hydric soils along part of its length that could result in further disturbance and possible pollution of these soils. It should be noted that as this area of residual hydromorphic soils has effectively ceased to be a wetland, the sewer upgrading is unlikely to have any impact on current wetland functionality or health, unless impacts occur in the area to the west of the road.

Impacts can transpire within the area of hydromorphic soils in the case of disturbance of these soils through movement of machinery during periods of heavy rainfall when the soils would be saturated and prone to damage. Heavy machinery such as excavators can easily damage soils, causing compaction or altering the structural integrity of soils.

More importantly however (due to the existing disturbance factor), spills of hazardous materials may cause pollution of soils and could ultimately enter groundwater. Spills of oil or fuel from machinery would enter the soils adjacent to the construction area. Cement batching within the area of hydric soils could also result in polluted runoff water infiltrating the soils.

Any construction footprint occurring to the west of Eastbury Drive would be associated with a higher risk of potential impact on surface water resources, due to the presence of the stream and associated riparian corridor in this area. The stream and riparian corridor is located relatively close to the road in the area of residual hydromorphic soils (the edge of the riparian corridor is located about 50m from the edge of the road while the stream is located about 80m away). Thus activities occurring on the western side of the road could pose a risk to the integrity of the stream and riparian zone. The movement of machinery and the actions of construction workers in this area pose the greatest risk to the riparian corridor, as machinery movement into the riparian corridor could cause structural damage to vegetation and soils. Pollution of the stream and riparian area could be caused if construction material was dumped in this area, or in the case of an absence of provision of formal ablution facilities, construction workers were to use this area for the conducting of 'informal ablutions'.

5.1 Recommended Mitigation Measures

Due to the high degree of transformation of the area of residual hydromorphic soils and effective transformation of wetland habitat east of the road, the risk of impacts in this area is considered to be low ~~risk~~. Nonetheless a few precautionary measures are recommended:~~.~~

- It is understood that due to spatial~~ce~~ constraints, the construction activities may need to extend into the area of residual hydromorphic soils, however it is recommended that the construction servitude or ~~(~~ right of way~~)~~ be kept as narrow as possible along the stretch of the sewer line being upgraded that runs adjacent to the area of residual hydromorphic soils (Fig. ?).
- Heavy machinery must not be allowed to enter the area of residual hydromorphic soils, and this area must be designated on site as a no-go area (Fig. ?).
- No stockpiling of any material should occur in the area of residual hydromorphic soils; if this is unavoidable the ground underneath the stockpile should be lined with a geotextile or similar material.
- Measures must be put in place to ensure that no silt from any stockpiles placed adjacent to the area of residual hydromorphic soils can enter the area of hydromorphic soils, ~~(~~ e.g., soil berms, silt fences, etc.~~).~~

- No construction activities must take place within the 30 m buffer zone of the sensitive surface water features on the site (Fig. ?).
- No storage of any hazardous material must be placed within 50 m of the boundary of the area of residual hydromorphic soils, or within 50 m of the wetland area to the north of the sewer stretch to be upgraded. It is very important that no storage of any hazardous materials occur within 50 m of the edge of the riparian zone of the stream to the west of Eastbury Drive (Fig. ?).
- No cement batching activities must be conducted within 50 m of the boundary of the area of residual hydromorphic soils.
- If, due to spatial~~ce~~ constraints, stockpiling of soil or other material needs to occur to the west of Eastbury Drive, this must take place~~occur~~ as close to the road as possible. No stockpiling must occur within the 30 m buffer zone (Fig. ?). Methods to prevent material from being washed off the stockpiles and entering the riparian corridor of the river must be put in place, ~~(~~e.g., soil berms~~)~~.
- The riparian corridor of the stream to the west of Eastbury Drive must be maintained as a strict no-go area for construction workers and machinery (Fig. ?).
- Should water need to be abstracted from the stream for construction, this must only occur if authorised by the Department of Water Affairs, and as directed by the project EMPr.

6 Impact Ratings Matrix

The Impact rating matrix for the project appears below. Please refer to Appendix B for the Impact Rating Matrix scoring system.

Phase	Potential Aspect and or Impact	Significance rating of impacts before mitigation	Mitigation	Significance rating of impacts after mitigation
Construction	• Irresponsible construction practices could lead to the pollution of the area of residual hydromorphic soils, or of the stream and associated riparian corridor to the west of Eastbury Drive (e.g. faecal contamination, or pollution of surface water through hydrocarbons). • Poor stormwater management in the construction servitude, and in the context of soil stockpiles could lead to the siltation and/or pollution of the area of residual hydromorphic soils or of the stream and riparian corridor. • The movement of machinery within the area of residual hydromorphic soils could cause compaction or physical disturbance of these soils. • Temporary (illegal) construction access to the stream (riparian corridor) to abstract water could cause hydrological and morphological impacts (erosion, channel morphology changes, undercutting of riparian areas, etc.) and degrade the resource quality riparian corridor.	**Extent:** Local (-2) **Duration:** Medium-term (-2) **Intensity:** Moderate (-2) **Probability:** Possible (-2) **Significance: Medium (-8)**	• Construction to be guided by the EMPr and the mitigation measures stipulated in this report. • Construction to be monitored by an ECO according to the stipulations of the EMPr. • No batching or chemical / fuel storage areas to be located within 50m of the area of residual hydromorphic soils or the stream and associated riparian corridor. • Construction-phase stormwater controls to be implemented along the stretch of the construction servitude adjacent to the area of residual hydromorphic soils, and around all stockpiles, including those placed to the west of Eastbury Drive. • The narrow area of wetland habitat to the north of the upgraded section and the stream and associated riparian corridor must be strictly maintained as no-go areas. • No temporary construction accesses to be constructed into the riparian corridor of the stream, unless authorised by the Department of Water Affairs through any surface water feature and no machinery to enter any surface water feature or buffer	**Extent:** Site (-1) **Duration:** Medium-term (-2) **Intensity:** Low (-1) **Probability:** Possible (-2) **Significance: Low (-6)**
Operations	• Maintenance of the sewer pipeline which requires the pipeline to be accessed will require the excavation of overlying material, and the effective creation of a construction environment, resulting in the above construction-related impacts. • Leakage of sewage from the pipeline could pollute adjacent soils, and create faecal pollution of surrounding wetland / riverine habitats.	**Extent:** Local (-2) **Duration:** Medium term (-2) **Intensity:** High (-3) **Probability:** Possible (-2) **Significance: Medium (-9)**	• Any sewer maintenance activity that requires excavation of substrate adjacent to the area of residual hydromorphic soils must be conducted as a construction activity that is controlled by the same mitigation measures stipulated for construction above. • Any leakage of sewage from the pipeline must be immediately stopped and the pipeline repaired in order to prevent pollution of the area of residual hydromorphic soils and nearby watercourses and wetlands.	**Extent:** Local (-2) **Duration:** Medium term (-2) **Intensity:** Low (-1) **Probability:** Possible (-2) **Significance: Medium (-7)**

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Phase	Potential Aspect and or Impact	Significance rating of impacts before mitigation	Mitigation	Significance rating of impacts after mitigation
Decom-missioning	• Similar general impacts as detailed during construction due to irresponsible actions during decommissioning could occur, especially if the sewer pipeline was physically removed.	**Extent:** Local (-2) **Duration:** Medium-term (-2) **Intensity:** Moderate (-2) **Probability:** Possible (-2) **Significance: Medium (-8)**	• Decommissioning to be guided by and EMPr compiled for decommissioning • No temporary accesses to be constructed through any surface water feature and no machinery to the riparian corridor to the west • As decommissioning is similar in nature to construction, construction-related mitigation measures must be implemented.	**Extent:** Site (-1) **Duration:** Medium-term (-2) **Intensity:** Low (-1) **Probability:** Possible (-2) **Significance: Low (-6)**
Cumulative	• The upgrading of the sewer pipeline is unlikely to result in any further wetland loss in the local catchment and local area, as no intact wetland habitat is likely to be affected. • However construction-related (pollution) impacts on the stream or riparian corridor, if these occurred would constitute part of the wider cumulative impact acting on the stream and riparian corridor and that is acting to degrade this surface water feature. Current impacts on the riparian corridor include invasive alien vegetation, water quality impacts, etc.		• Refer to activity / phase specific mitigation measures above	

7 Conclusions

The investigation of the potential presence of wetland habitat and hydric soils along the alignment of a section of sewer pipeline that is proposed to be upgraded, revealed a number of areas of wetland habitat in relatively close proximity to the pipeline route. The alignment itself is unlikely to contain any hydric soils as it is located within the road reserve, directly adjacent to the road. An area of intact wetland habitat to the north-east of the alignment and a stream and associated riparian zone on the opposite ~~(~~western~~)~~ side of the road are located in the vicinity of, but not immediately adjacent to the sewer upgrade alignment. However an area of residual hydric soils was discovered in a narrow band immediately adjacent to the alignment. This area of hydric soils is located in an area between the road and railway servitudes, but has been extensively transformed through ~~the~~ historical actions and earthworks associated with the construction of the road and railway servitudes, as well as by the presence of a fuel pipeline in the intervening area. Due to the degree of physical transformation of this area, it displays very few characteristics and functions associated with a wetland, and although technically a wetland characterised by~~due to~~ the presence of the hydric soils, it has effectively ceased to function at all as a wetland. The more intact area of wetland habitat to the north-east and the stream and associated riparian corridor located to the west of the road however, are more intact and much more sensitive to ~~(~~construction phase~~)~~ impacts. A number of mitigation measures have been specified in order to prevent further disturbance and pollution of the area of residual hydric soils, and importantly to prevent the construction footprint from encroaching into the riparian corridor to the west.

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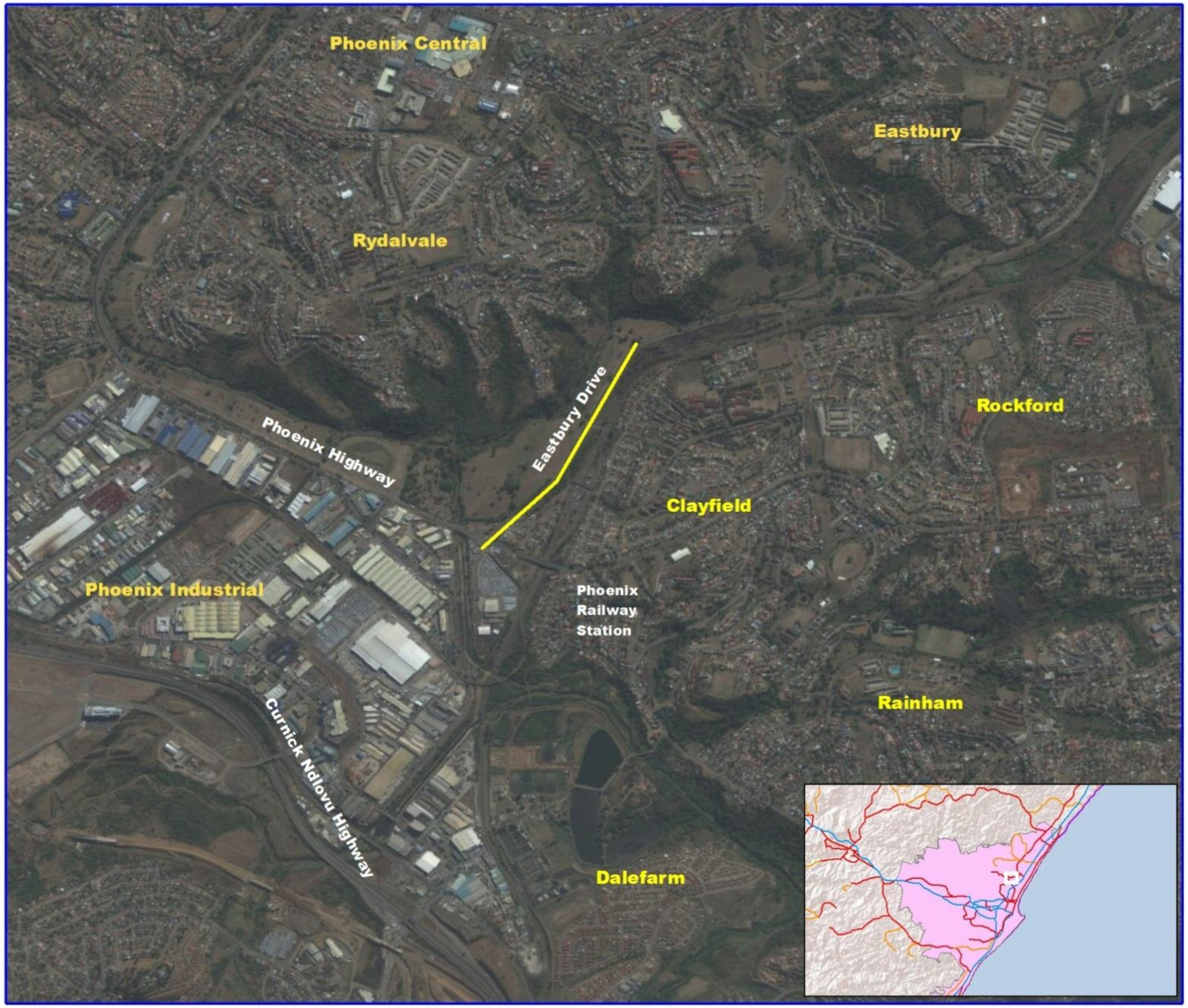
APPENDIX A: MAPS



PROPOSED UPGRADE TO THE EASTBURY TRUNK SEWER LINE

WETLAND DELINEATION ASSESSMENT

Locality

N

Legend

Sewer Section to be upgraded

0 250 500 1 000 Meters

Scale

1:15 000

Data Sources:
ESRI
Muncipal Demarcation Board

Date: 10 June 2014
Created by: Paul da Cruz
RHDHV Ref: T01.DUR.000343

Coordinate System: Custom
Datum: WGS 1984
Units: Degree

Tel: +27 (0) 11 798 6425
Fax: +27 (0) 11 798 6010
www.rhdhv.com

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PROPOSED UPGRADE TO THE EASTBURY TRUNK SEWER LINE

WETLAND DELINEATION ASSESSMENT

Occurrence of Wetlands and Hydric Soils

N

Legend

Sewer Section to be upgraded

Hydric Soils & Wetland Habitat

Type

- Wetland
- Wetland / Riparian
- Transformed - Residual Hydric Soils
- 30m buffer

Scale
0 25 50 100 Meters
1:3 500

Data Sources:
ESRI
Muncipal Demarcation Board

Date: 10 June 2014
Created by: Paul da Cruz
RHDHV Ref: T01.DUR.000343

Coordinate System: Custom
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APPENDIX B: IMPACT RATING MATRIX SCORING SYSTEM

The potential environmental impacts associated with the project will be evaluated according to its nature, extent, duration, intensity, probability and significance of the impacts, whereby:

Environmental Criteria	Description
Nature	A brief written statement of the environmental aspect being impacted upon by a particular action or activity
Extent	The area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment phase of a project in terms of further defining the determined significance or intensity of an impact. For example, high at a local scale, but low at a regional scale
Duration	Indicates what the lifetime of the impact will be
Intensity	Describes whether an impact is destructive or benign
Probability	Describes the likelihood of an impact actually occurring
Cumulative	In relation to an activity, means the impact of an activity that in itself may not be significant but may become significant when added to the existing and potential impacts eventuating from similar or diverse activities or undertakings in the area

CRITERIA	DESCRIPTION			
EXTENT	**National (4)** The whole of South Africa	**Regional (3)** Provincial and parts of neighbouring provinces	**Local (2)** Within a radius of 2 km of the construction site	**Site (1)** Within the construction site
DURATION	**Permanent (4)** Mitigation either by man or natural process will not occur in such a way or in such a time span that the impact can be considered transient	**Long-term (3)** The impact will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter. The only class of impact which will be non-transitory	**Medium-term (2)** The impact will last for the period of the construction phase, where after it will be entirely negated	**Short-term (1)** The impact will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase
INTENSITY	**Very High (4)** Natural, cultural and social functions and processes are altered to extent that they permanently cease	**High (3)** Natural, cultural and social functions and processes are altered to extent that they temporarily cease	**Moderate (2)** Affected environment is altered, but natural, cultural and social functions and processes continue albeit in a modified way	**Low (1)** Impact affects the environment in such a way that natural, cultural and social functions and processes are not affected
PROBABILTY OF OCCURANCE	**Definite (4)** Impact will certainly occur	**Highly Probable (3)** Most likely that the impact will occur	**Possible (2)** The impact may occur	**Improbable (1)** Likelihood of the impact materialising is very low

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